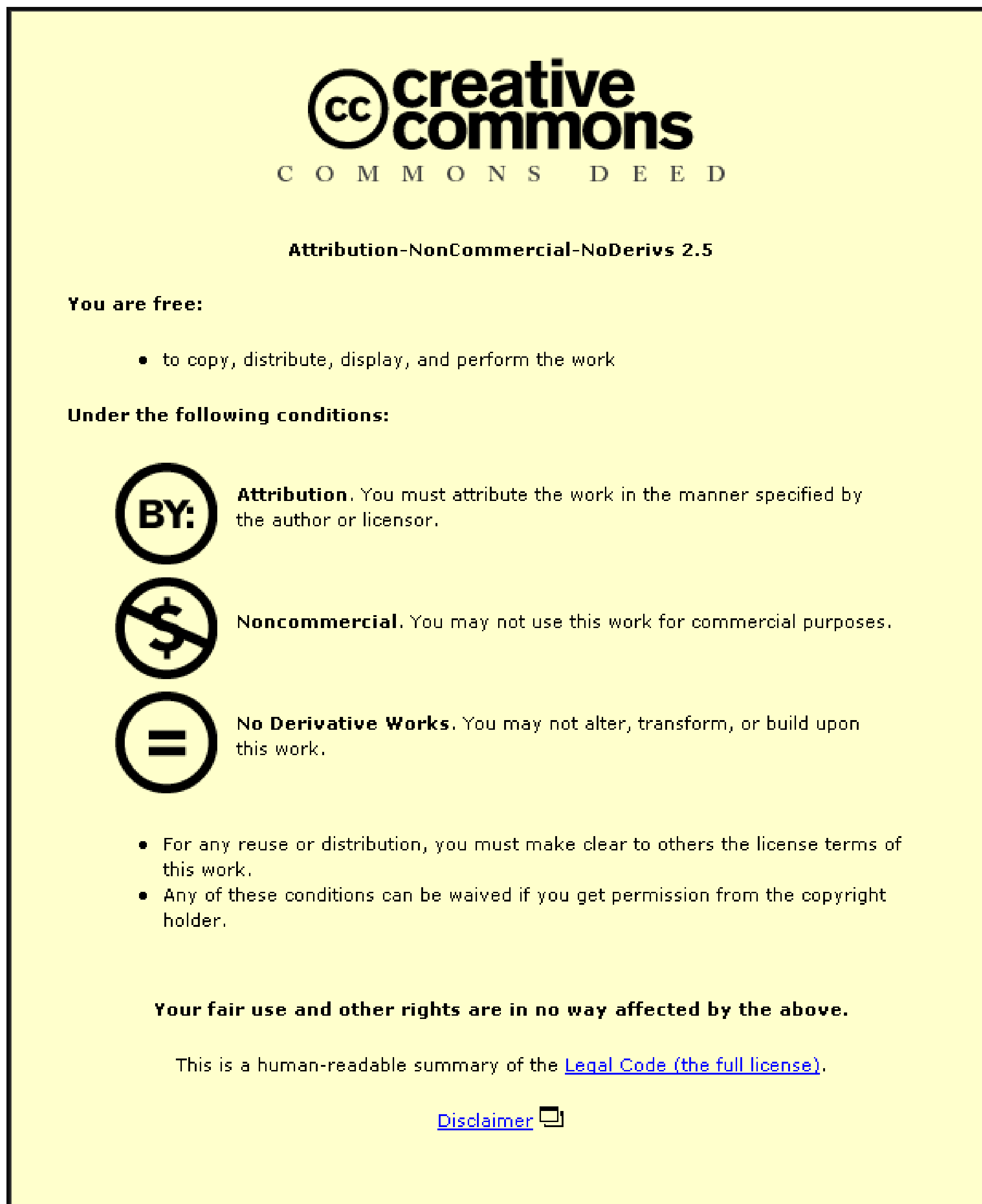


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Maternal Daily Activity in Low Risk Pregnancy: A Longitudinal Study

by

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A Doctoral Thesis

**Submitted in partial fulfilment of the requirements
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ABSTRACT

A review of the scientific literature revealed a lack of information regarding the integrated daily activity levels of low-risk pregnant women in contemporary Western society. A prospective, longitudinal study was therefore undertaken to (i) assess the impact of low-risk pregnancy on the daily activity levels of healthy, British primigravid women and (ii) examine the relationship between total maternal daily activity level and pregnancy outcome. The best combination of methods to measure daily activity levels during pregnancy was considered to be a subjective self-report measure used in conjunction with an objective ambulatory activity monitor. These methods were developed and were demonstrated to be both reliable and valid in non-pregnant women. However, the study identified some unique problems in using activity monitors in pregnant women. These problems emanated both from women's reluctance to wear an activity monitor when pregnant and from a need to measure extremely low levels of activity in late gestation.

Both data from the ambulatory monitor and the new activity questionnaire demonstrated a overall decrease in mean maternal daily activity levels between 25 & 38 weeks gestation ($n=51$; $p<0.01$). This decline masked different maternal responses in different activity domains. The mean occupational activity ratios of women working full-time declined steadily between 16 & 34 weeks gestation ($n=25$, $p<0.01$). Women's working hours and the more flexible elements of their work were reduced whilst the frequency of work breaks increased. Between 25 & 38 weeks gestation, mean recreational activity ratios also declined ($n=50$, $p<0.05$). Participation in structured sports and exercise ceased and increasing amounts of time were spent within the home. In contrast, mean overall domestic activity ratios were maintained. Between 16 & 38 weeks gestation mean nocturnal activity ratios increased steadily ($n=47$; $p=0.01$). To maintain waking activity during pregnancy, women actively engaged in a number of different balancing strategies. These strategies comprised monitoring, prioritising, pacing and forward planning.

Despite the changes that occurred in maternal activity behaviour, one of the strongest and most consistent predictors of maternal activity behaviour during pregnancy was that of maternal activity behaviour prior to pregnancy. Occupational activity levels pre-pregnancy were independently associated with maternal daily activity levels at 12, 16 & 25 weeks gestation ($p=0.004-0.020$). Self-efficacy was the only significant predictor of the change in maternal daily activity levels between 25 & 38 weeks gestation ($p=0.013$). The women who reduced their activity the most were likely to be those individuals who had more difficulty in overcoming perceived barriers to physical activity participation. Five main barriers to physical activity were identified: (i) the physical symptoms of pregnancy (ii) the effect of outside influences (iii) a lack of motivation (iv) a low maternal body image and (v) a lack of time and/or appropriate facilities.

Findings suggested that maternal daily activity may impact significantly on pregnancy outcome. Higher maternal daily activity at 16 weeks gestation was independently associated with a lower incidence of emergency caesarean section ($p<0.05$). Higher maternal daily activity at 38 weeks gestation was independently associated with a higher incidence of an induction of labour ($p<0.05$). Total daily activity at 25 & 34 weeks gestation was independently and negatively associated with infant birthweight ($p<0.05$).

KEYWORDS: ACTIVITY, MEASUREMENT, PREGNANCY, LONGITUDINAL, DETERMINANTS, OUTCOME

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LIST OF ASSOCIATED PUBLICATIONS & CONFERENCE PRESENTATIONS

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- **Clarke, P.,** Gross, H., Rousham, E., Halligan, A. & Bosio, P. 'Maternal daily activity levels during pregnancy: a longitudinal study.' 29th British Congress of Obstetrics and Gynaecology, Birmingham 2001.
- **Clarke, P.,** Gross, H., Rousham, E., Halligan, A. & Bosio, P. 'Nocturnal activity levels during pregnancy: a longitudinal study.' 29th British Congress of Obstetrics and Gynaecology, Birmingham 2001.
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- Gross, H., **Clarke, P.,** Rousham, E. & Halligan, A. 'Activity levels in pregnancy.' British Psychological Society Annual Conference, Winchester, 2000. [Abstract published as Gross, H., Clarke, P. & Rousham, E. 'Psychological wellbeing and activity levels during pregnancy.' *Proceedings of the British Psychological Society*, 8(2):31].
- **Clarke, P.,** Gross, H., Rousham, E. & Halligan, A. 'Relating activity levels to psychological health and pregnancy outcome: advice to pregnant women.' 2nd International Interdisciplinary Conference on Women and Health, Edinburgh, 1999.

INTRODUCTION

“Mothers are now programmed to believe that everything they do affects the welfare of their children- for better and for worse. Plenty of chat and the right stimulus as babies will make them more intelligent in later life; cruel words or neglect may land them in therapy or turn them into criminal delinquents. Smoking and alcohol are well known health risk factors for babies. A deficiency in folic acid in the first few weeks of a fetus’s life can cause neural damage and even spina bifida and so on.....”

(Kate Figes, The Guardian, September 26, 2000)

A critical characteristic of the experience of pregnant women today is their status as recipients of professional advice, instruction and health education. Although often the concern is genuine and the recommendations justifiable, the subliminal message that women receive when pregnant is that they must forever “be careful”. Indeed, as Clapp (1998) observes, a philosophy of risk-avoidance has firmly established itself as a central theme in the preventative aspects of contemporary obstetrical care.

The first definitive support for such concern emanated from the discovery that diethylstilbestrol (D.E.S) treatment for bleeding in early pregnancy was associated with a higher incidence of reproductive tract malformations in children, an effect which subsequently increased the risk of reproductive difficulty and cancer in their later lives (Clapp, 1998). In turn, reports confirmed that the ingestion of a commonly prescribed sedative, thalidomide, was responsible for a variety of defects in heart and limb development, a finding that was later superseded by the dangers of smoking, alcohol consumption and nutritive deficiencies. Recent work has even suggested that a slight imbalance in the diet of a pregnant woman may predispose her child to a life of cardiovascular disease (Koumentaki et al., 2000; Ghosh et al. 2000).

It must be acknowledged however, that the attention that is paid to women’s behaviour during pregnancy is not entirely a modern phenomenon. In Medieval Europe mothers

were believed to affect the appearance of their offspring simply by what they gazed at during conception and, in the 19th Century, 'unnatural' sexual intercourse, frights and cravings were all independently thought to cause markings, tumours or deformities in the fetus (Markens et al., 1997). Today, the biological underpinnings of the process are more clearly understood but a combination of social and medical developments may nonetheless still be serving to govern the experience of pregnancy for most (Scott & Niven, 1996).

Within contemporary industrialised societies, a widespread surveillance of pregnancy and childbirth now exists and a series of pharmacological and technological advances have led to the development of numerous obstetrical interventions (Scott & Niven, 1996). These advantageous developments have led to distinct changes, both in the frequency with which pregnancy is experienced and in its rate of successful outcome (Oakley, 1993; Loudon, 1992). Unfortunately however, they have also been accompanied by a more controversial change in attitudes towards prenatal care. Within a culture where the medical profession is assuming increasing responsibility for concepts of health (Oakley, 1984), views of pregnancy as a natural event have declined (Sherr, 1995; Scott & Niven, 1996). The growth and acceptance of technological intervention has served to perpetuate a model in which pregnancy is often viewed as problematic (Oakley, 1993; Scott & Niven, 1996) with the result that women's own perceptions of pregnancy are often overlooked (Graham & Oakley, 1986).

The Paradigm of Motherhood

According to Oakley (1981), "*the single most difficult aspect of motherhood today is that other people are always telling mothers what they ought to do.*" Feminist authors have previously examined the notion that a pregnant woman is not only perceived as an individual in express need of medical care and protection, but also as a person who must be guided or disciplined into the correct modes of behaviour (Oakley, 1981; 1993). All women are expected to ensure that they are healthy and 'ready' for pregnancy (Woollett & Phoenix, 1991) and those who do not conform in this way are socially construed as

being selfish and unconcerned about the health of their child (Lewis et al., 1995).

Consequently, maternal responsibilities are having to be assumed well in advance of birth, and for some may even begin as early as the pre-pregnancy period (Cefalo & Moos, 1988). Indeed, as Markens et al., (1997) state, the prevailing message that the majority of women receive when pregnant is that,

“what they do, and even to a greater extent what they consume, can directly affect the fetus growing inside them.”

(Markens et al., 1997, pp.351)

The Perceived Inappropriateness of Maternal Physical Activity

From a physical activity perspective especially, it has become customary to be solicitous towards the processes of human reproduction. The vast majority of books dealing with pregnancy and childbirth express the view that pregnancy is a time for moderation and the most common pattern of advice across cultures tends to demand some lightening of physical work. Previously, both lay and medical discourses have professed that certain types of physical activity should be renounced during pregnancy (Artal & Buckenmeyer, 1995) and even the public presence of pregnant women may sometimes be considered unacceptable. Indeed, as Unger and Crawford (1996) allude,

“Pregnant women (at least those that are white and middle class) are thought to be delicate, incapable of working and frail. Until quite recently pregnant women were expected to remain secluded in the home and they may still be forced to leave paid work.”

(Unger & Crawford, 1996, pp.405)

During pregnancy then, it can seem that a woman must become entirely altruistic and self-sacrificing. From friends and family to remarks made by complete strangers, pregnant women may instantly, if not consistently, be reminded to conduct themselves in a manner befitting their current condition (Markens et al., 1997). The underlying

dilemma here is that, as they enter their reproductive lifecycles, many women may already be experiencing a substantial level of physical exertion.

Women's Participation in Sports and Exercise

Today, both men and women are existing in a society that is actively promoting participation in recreational activities (Phillips et al., 1996). Evidence highlighting the importance of physical exercise is now stronger than ever and the benefits of physical activity to health are a constant source of public interest (Report of the Royal College of Physicians, 1991). To date, regular exercise has been shown to be associated with a reduced risk of heart disease and may also provide protective benefits for diseases such as non-insulin dependent diabetes mellitus, obesity and cancer (Marcus et. al, 1996). Exercise has also been shown to offer a wide range of psychological benefits including short- and long-term improvements in anxiety, depression and self-esteem (Pappas et al., 1990; Raglin, 1990). It is therefore not surprising to find that over the past two decades, physical health fitness has become increasingly more important in lives of women of childbearing age (McMurray, et al., 1993, Clapp, 1998).

Despite data from several developed countries indicating that between 15 and 40% of adults remain sedentary (Stephens & Craig, 1990; Allied Dunbar National Fitness Survey, 1992; Puska et al., 1993), current evidence suggests that many young women are making regular and sometimes quite vigorous commitments to exercise (McMurray et al., 1993). The gap between male and female activity rates is narrowing generally and according to the General Household Survey (1993-94) nearly three fifths of all women were undertaking some sort of sport, game or other physical activity in the four weeks prior to interview (Whitmarsh, 1995). More significantly, a growing number of supervised fitness programs are publicly targeting both pregnant and postpartum women and the popularity of exercise programmes among females generally has led many to assume that a large proportion of pregnant and lactating women may actually want to exercise quite regularly (Dewey & McCrory, 1994). Of note is the fact that this desire for

fitness has also coincided with a time when the social climate for women has changed more generally.

The Role of Women in Contemporary Western Society

During the last three decades, the social climate for women has changed considerably (Twenge, 1997). In a national survey of first year American college students, it was found that the statement, *'The activities of married women are best confined to home and family.'* attracted decreasing support (Higher Education Research Institute, 1993). Findings from the British Social Attitudes Survey (BSA) have also confirmed that support for traditional gender roles is declining (Newman & Smith, 1997).

A fundamental change in the structure of the labour market over the last few years has been an increasing participation of women. Indeed, according to Morris (1990) around three-quarters of potentially poor households are moved out of poverty by a woman's earnings. In 1996, women represented a third of all those working full time and 82% of those working part time (DfEE, 1997). The number of women who were self employed increased slightly over the period between 1991 and 1996 and the number and proportion of women working more than 40 hours a week also grew (DfEE, 1997). Notably, it has been mothers with children under five that have experienced the greatest increase in labour market participation over the last decade, the economic activity rate of women with a youngest dependent child aged 0-4 rising from 40% in Spring 1986 to 54% by Spring 1996 (DfEE, 1997).

Nevertheless, several authors have revealed that the move of women into the workforce has not yet been accompanied by the male population assuming equal responsibility for domestic chores. Evidence emanating from within the home reveals that established gender roles often still exist. In the National Child Development Study (1991) for instance, two thirds of full time working mothers said they were also responsible for cooking and cleaning and four fifths for laundry (Ferri, 1993). This continuing inequality

in the division of housework, even when women are working full-time, has further been observed in many other studies (e.g. Warde & Hetherington, 1993; Brannen, 1994).

Relevant to this issue is the fact that there exists a diversity and fluidity of contexts in which conception, birth and the raising of children may be taking place (Ferri & Smith, 1996). Arising as a consequence of a more general shift in family structure over the last generation, the traditional stereotype of a family has declined. Cohabiting couples have become much more common and there has been a substantial growth in lone parent families, particularly those in which the responsibilities of the household are left with the mother (OPEC, 1996; Newman & Smith, 1997). Thus, as Oakley (1993) summarises,

'The mother of the 1990s is more likely than her own mother to have children later and without being married or, if married, to experience a change in her family circumstances precipitating her into lone motherhood. She is also more likely to have relatives to care for as well as her own children. She is also considerably more likely to have paid employment of her own.'

(Oakley, 1993, pp.142)

In summary therefore, although much behavioural advice may seem to advocate rest and relaxation during pregnancy, it must be acknowledged that a woman waiting to give birth may be functioning amidst a number of social roles and obligations (Durham, 1998). A pregnant woman may, for example, also be a worker, a wife or a daughter responsible for elderly parents. Beyond all of these roles women are also individuals (Oakley, 1993). Thus, to equate a mother's physical activity pattern purely with the responsibility she may feel towards her unborn infant may ultimately be too simplistic. Indeed, if we were to do just this, we would still, as Oakley (1993) states,

'... be left with the problem of the fissure between the actuality of female experience and its dominant ideological expression.'

(Op Cit, pp.30).

The Research Aims

The identification of a potential mismatch between idealistic views of motherhood and prevailing social trends points clearly to the timeliness of new research to examine the extent and level of maternal daily activity in contemporary Western society. It is hoped that the acquisition of new baseline data will represent the first step towards formulating appropriate and realistic health advice for pregnant women, their families and their health-care providers. Such information is essential if future standards of antenatal care are to be improved. The specific aims of the work are:

- (i) To develop an appropriate methodology for the assessment of maternal physical activity during pregnancy.
- (ii) To examine the extent to which low-risk pregnancy may impact on the physical activity levels of healthy British women.
- (iii) To explore the association between maternal daily activity and the attendant physical, psychological and social changes that occur during pregnancy.
- (iv) To assess the extent of the relationship between maternal daily activity level and pregnancy outcome.
- (v) To consider the implications of these findings for antenatal health promotion and prenatal care.

The Structure of the Thesis

To assist in the reading of this document, the structure of the thesis is shown in Figure 1.1. Chapters 1 and 2 are dedicated to reviewing the current literature available on physical activity and pregnancy. Chapter 1 discusses the physiological, metabolic and skeletal stresses of pregnancy and examines the association between maternal physical activity

level and adverse pregnancy outcome. Chapter 2 places pregnancy and physical activity in a psychosocial context and focuses on the influences on, and consequences of, physical activity from a maternal perspective.

Chapters 3 and 4 address methodological issues. Chapter 3 examines the range of methods available by which to measure physical activity. It describes the development of a subjective semi-structured interview and an objective monitoring technique and also reports on a series of preliminary studies designed to assess the feasibility of these measures. Chapter 4 describes the methodology used in the main phase of data collection. Details are given about ethical considerations, sample recruitment and the final measurement procedure.

Chapters 5 through to 10 present the results of the main study. In Chapter 5 the characteristics of the sample are discussed. Chapter 6 presents a profile of the longitudinal daily activity patterns of the sample and considers issues relating to the measurement of daily activity during pregnancy. Chapter 7 focuses solely on the topic of occupational activity whilst Chapter 8 examines maternal responses to domestic, recreational and nocturnal activity. In Chapter 9, explanations for the longitudinal trends in maternal activity levels are offered and in Chapter 10 the extent of the relationship between daily activity level and fetal outcome is explored.

Chapter 11 re-examines the objectives of the research in relation to the findings described above. Contributions to current knowledge are considered and paths for future research are discussed.

Summary

Traditional expectations of pregnant women have rarely taken account of the wider social, structural and economic contexts in which women of the 21st century often exist. As a consequence, important information regarding maternal physical activity during pregnancy is lacking. This thesis will document the range of daily activity levels

exhibited by a cohort of women as they progress through low-risk pregnancy and examine the determinants and effects of the behaviour that is observed. However, before this can be achieved it is necessary to consider the physiological experience of pregnancy and establish the effects of physical activity on maternal and fetal health.

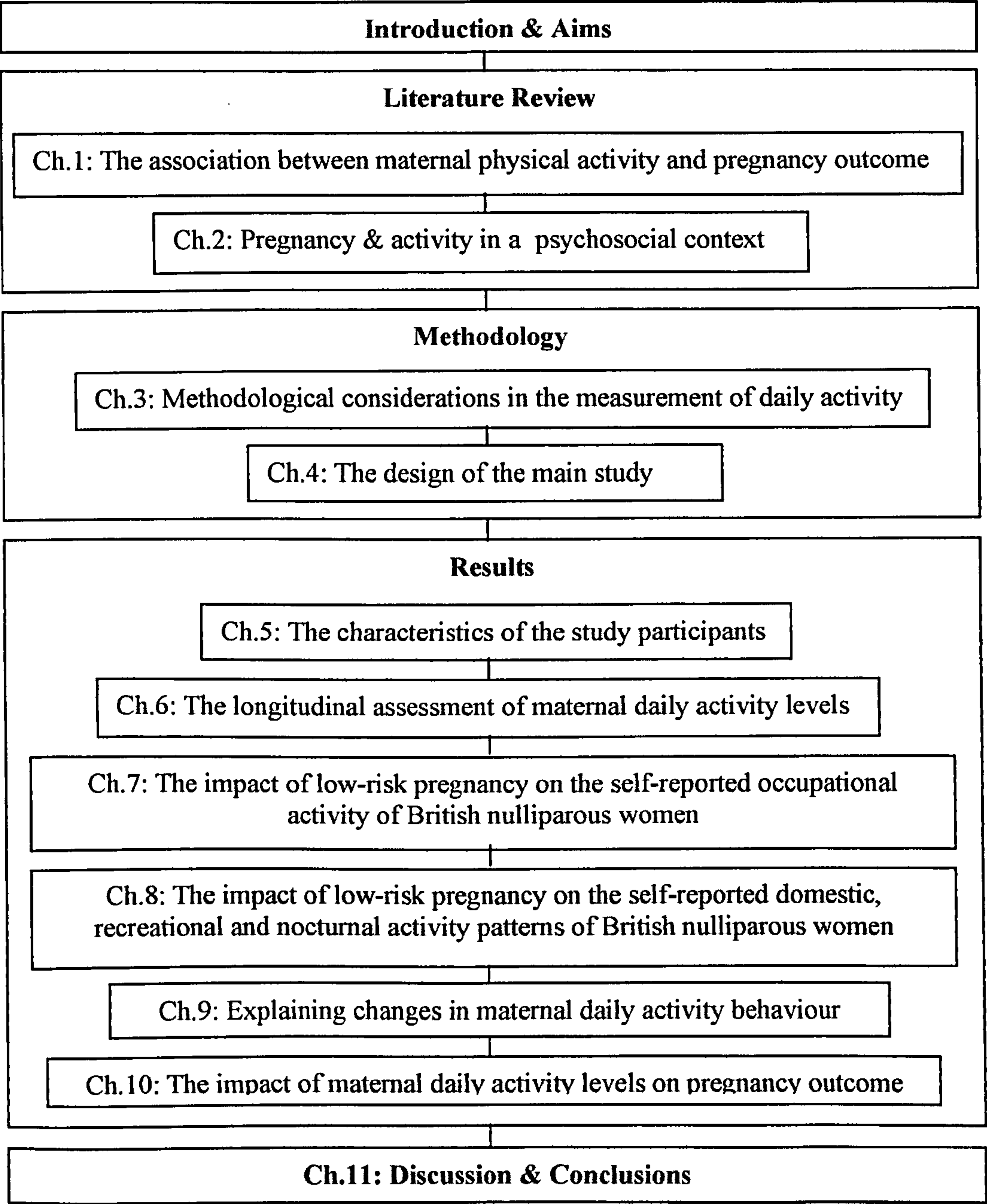


Figure I.1: The structure of the thesis

CHAPTER ONE

The Association Between Maternal Physical Activity and Pregnancy Outcome

1.1 Introduction

This chapter explores the extent to which physical activity may impact on pregnancy outcome and examines whether or not the traditional consensus of discouraging physical activity can be scientifically supported. Artal & Gardin (1986) take the position that, throughout history, recommendations for physical activity in pregnancy have typically been based more on social and cultural expectations than they have on any definitive evidence. Nonetheless, a large corpus of literature has accumulated in testimony to the fact that there may once have been a genuine theoretical basis for reducing exertion and it is this work that is detailed here.

In structure the chapter is divided into two main parts. *Part One* (Sections 1.2 - 1.4) discusses the appropriateness of physical activity during pregnancy and reviews the potential effects that it can exert on both fetal and maternal health. Previous studies dealing with the effects of physical activity on gestational outcome appear to have taken one of two main forms. Much has been physiologically orientated in nature and, as such, has concerned itself primarily with the biological pathways and compensatory mechanisms through which physical exertion may be conceived to exert an effect. The remainder has approached the topic purely from a clinical perspective and sought to associate various parameters of fetal health with either volitional exercise or occupational exertion. For clarity above all else, the review of literature in Part One is divided on a similar basis.

By reviewing the principal limitations of existing work, *Part Two* of the chapter (Sections 1.5 – 1.6) builds upon the information presented in Part One. In particular, attention is focussed on three distinct methodological limitations. These limitations concern (i) the

traditional methods by which data has been collected, (ii) the type and amount of activity that has been assessed and (iii) the sample populations that have been considered.

PART ONE

1.2 Physiological Responses to Physical Activity in Pregnancy

It is clearly the case that, as Sternfeld (1997) indicates,

“Pregnancy stresses the body more than any other physiological event in a healthy woman’s life and requires considerable cardiovascular, metabolic, hormonal, respiratory and musculo-skeletal adaptations.”

(Sternfeld, 1997, pp.34)

The literature on these different adaptations is extensive and several good reviews currently exist (e.g. Bell & O’Neill, 1994; McMurray et al., 1993). Consequently, the aim of this section is not to provide the reader with an exhaustive review, but rather to report on the most fundamental adaptations of pregnancy and their specific interactions with physical activity. The subsequent pages are thus organised into five brief sections that represent not only the main systems of the human body but also the principal areas of concern. The orientation of prior research means that these initial discussions focus primarily upon the physiological responses initiated by structured exercise, rather than more generic daily activity.

1.2.1 The Cardiovascular System

During the reproductive process, the human circulatory system alters dramatically. At an early stage, the outer cells of the fertilised egg release hormonal signals that initiate relaxation and reduce responsiveness in the muscle cells of the blood vessels (Duvekot et al., 1993). This rapidly increases both the elasticity and volume of the vascular network and as a result arterial blood pressure falls. For the pregnant woman this response may

manifest in many of the unpleasant symptoms of pregnancy including dizziness, nausea and waves of sudden fatigue. However, once the body senses that arterial blood pressure has dropped hormones are released from the heart and adrenal gland. These stimulate the body to retain salt and water and as a consequence, the volume of plasma in the vascular system begins to expand. This improves arterial pressure and blood flow to the organs. Eventually, the chamber volume and stroke volume of the heart expand by an average of 15-20% and both blood volume and cardiac output increase by approximately 40% (Capeless & Clapp, 1989). The overall effect is that:

“... a relatively high-resistance, average-volume, normal-flow rate circulatory system is converted into a low-resistance, high-volume, high-flow one needed to maintain the growth and development of the fetus within the body of the mother.”

(Clapp, 1998, pp.22)

As the vascular network expands, the most pronounced dilation occurs in the blood vessels supplying the skin, kidneys and reproductive tissues. In this way, a significant proportion of the additional blood available is directed towards these areas and blood flow here will increase between 2 and 20 fold (Clapp, 1998). Greater blood flow to the skin serves to improve a woman's ability to dissipate heat whilst the increased flow to the kidneys serves to improve the waste removal process. The increased volume of blood flowing to the reproductive tissues ensures an adequate delivery of oxygen and nutrients to both the placenta and the fetus.

In many ways, the circulatory adaptations induced by pregnancy appear to complement those produced by regular weight-bearing activity in the non-pregnant state. Many classic studies of the circulatory effects of regular exercise have demonstrated that vigorous training will increase blood volume, raise stroke volume and increase the maximum cardiac output that an individual can achieve. It will also increase the density and growth of blood vessels and improve an individual's ability to dissipate heat (Saltin & Rowell, 1980). Moreover, current research evidence suggests that when an adequate exercise regime is maintained during pregnancy, the results of the interaction between these two

sources of cardiovascular adaptation are at least additive (Clapp, 1998). The plasma volumes, red cell volumes and total blood volumes of women exercising regularly during pregnancy have all been found to be at least 10-15% higher than those of their sedentary counterparts (Pivarnik et al., 1994). Extra benefits for the prospective mother have also been postulated to include reduced heart rate and blood pressure, and possibly even decreased platelet aggregation (Simpson, 1993).

Despite these positive outcomes, there nonetheless remains some concern regarding the capabilities of the human cardiovascular system to meet the dual demands of exercise and pregnancy. The main rationale for considering physical stress as a risk factor for poor pregnancy outcome lies in the assumption that heavy physical effort during pregnancy may divert blood flow from the uterus and, by doing so, reduce oxygen and nutrient delivery to the fetus (Stein et al., 1986). Irrespective of its purpose, prolonged standing is known to result in decreased maternal plasma volume and cardiac output (Suonio et al., 1976) and any increase in skeletal muscle action will increase sympathetic vasomotor tone to the skeletal muscles. This then favours the redistribution of cardiac output away from the splanchnic organs and placenta and towards the working muscles (McMurray et al., 1993). Compounding this response further is the proposition that fetal oxygen requirements may increase with strenuous physical work, primarily as a consequence of concurrent increases in temperature and metabolic activity (Lotgering et al., 1985). If this is the case then any reduction in uterine blood flow initiated by physical exertion may ultimately be associated with a more severe fetal hypoxia than a similar reduction occurring at rest (Bell & O'Neill, 1994).

However, several mechanisms have been identified which may act to ensure that fetal oxygen consumption is not so readily compromised. There may for instance, be a marked rise in maternal haematocrit (Lotgering et al., 1983). This will subsequently decrease plasma volume and increase the oxygen carrying capacity of the blood. In addition, a redistribution of blood flow may favour the placenta over the myometrium (Rauramo & Forss, 1988) and finally, there seems to be an inverse relationship between blood flow and oxygen extraction such that as flow decreases, the arterio-venous oxygen difference

of the blood increases (Clapp, 1980). In summary therefore, the cardiovascular adaptations that occur during pregnancy appear sufficient to maintain adequate blood flow and oxygen delivery to both the exercising muscles and the developing fetus. From this perspective at least, it seems that physical activity in pregnancy need not be discouraged.

1.2.2 The Respiratory System

In addition to influencing the cardiovascular system, pregnancy also impacts upon several aspects of lung function. Its main effect is to augment the delivery of oxygen to both maternal and fetal tissue (Clapp, 1998). At rest, elevated levels of progesterone increase the depth of each breath by enhancing the sensitivity of the respiratory centre to carbon dioxide. This in turn improves the efficiency of oxygen uptake from the lung and the elimination of carbon dioxide from the blood. A beneficial elevation and widening of the rib cage also occurs (Clapp, 1998). This adaptation serves to maintain maximum breathing capacity at or above pre-conception levels (DeSwiet 1991; Lotering et al., 1991; Artal et al., 1995).

For these reasons stated above, exercise during pregnancy will rarely compromise lung function in healthy individuals. Indeed, because of the pregnancy-induced increase in ventilation, gas transfer at the tissue level should actually improve (Pivarnik et al., 1993). Peak ventilation and absolute maximal aerobic capacity are maintained during the reproductive process and it is probable that that a combination of pregnancy and formal exercise training can actually improve maximal aerobic capacity by 5 to 10% (Clapp & Capeless, 1991; DeSwiet, 1991; Lotering et al., 1991).

In addition to the changes that occur in lung function, the placenta develops within the uterus. This organ is structurally designed to maximise the efficiency of gas transfer between mother and baby. Blood flow around the placenta is high and the vessel arrangement is such that it is able to maintain gas transfer even in instances where the rate of maternal blood flow falls by as much as 50% (Clapp, 1998). Theoretically, it is

possible that any subtle disruption to the mechanisms of the placenta could restrict oxygen availability to the fetus. Nonetheless, in the majority of cases, the interactive effects of physical exercise and pregnancy appear to be protective (Clapp, 1998). Regular exercise during pregnancy has been shown to initiate faster placental growth in early to mid gestation (Clapp & Rizk, 1992) and physical training is also believed to improve the functional efficiency of the organ at any given rate of uterine blood flow (Jackson et al., 1995). Contrary to popular opinion therefore, physical activity during pregnancy is unlikely to disrupt the transfer of gases between mother and baby.

1.2.3. The Metabolic and Hormonal Systems

From a metabolic perspective, pregnancy has long been known to increase insulin resistance in maternal fat and muscle. In mid and late pregnancy, this change increases the amount of fat and decreases the amount of carbohydrate that is used to meet maternal energy requirements. As carbohydrate is the major source of fetal energy, this adaptation ensures that an adequate nutrient supply is maintained for fetal and placental growth (Ryan et al., 1985). In addition, pregnancy alters the rate of nutrient absorption from the intestine. This effect, combined with a suppression of the hormonal responses that serve to release stored sugars from the liver (Clapp, 1998), will often initiate an acute drop in maternal blood sugar levels if an individual has not eaten for several hours. Overnight fasting alone may be sufficient to initiate a state of accelerated starvation (Zaidise et al., 1986).

In some respects the metabolic changes that are induced by pregnancy mimic those initiated by regular exercise. Like pregnancy, regular exercise training increases the use of fat as an energy source and maintains blood glucose levels at normal levels for a longer time than would normally occur in non-exercising individuals (Gollnick, 1985; Coggan et al., 1990). Unlike pregnancy however, regular exercise reduces insulin resistance. A primary concern about activity in pregnancy therefore, is whether or not the carbohydrate needs of both the fetus and exercising muscles can be met without compromise. The suppression of glucose from the liver during pregnancy coupled with

the increased insulin sensitivity that regular exercise produces is likely to decrease the amount of glucose available for the fetus. Although one study has shown the magnitude of this change to be lower in pregnant than in non-pregnant women (Artal Mittelmark, 1991), the majority of studies have indeed found maternal exercise, and especially that which occurs in later pregnancy, to have significant hypoglycaemic effects (Sternfeld, 1997). For the most part however, a pregnant woman can overcome such problems simply by ensuring an adequate and regular intake of food (Clapp, 1998).

Elsewhere, many authors have considered the possibility that catecholamines may mediate an adverse effect of physical activity on pregnancy outcome, not least because adrenaline and noradrenaline are known to be released during exercise in both the pregnant and non pregnant state (Rauramo et al., 1982). Given that noradrenaline is also a potent uterine stimulant (Artal & Wiswell, 1986), any form of vigorous physical activity could theoretically stimulate contractions and result in premature delivery. Nonetheless, the available physiological evidence suggests that, although maternal catecholamines do indeed increase with exercise, fetal levels tend to remain relatively stable (Lotgering et al., 1985). Certainly, Bell & O'Neill (1994) conclude that, whilst increases in the frequency of uterine contractions have been observed during vigorous physical activity, the changes that occur are often minimal. No association between normal daily activity and uterine contraction frequency has been found (Dickinson et al., 1997), and it has thus been suggested that a mechanism may exist to counteract the stimulatory effect of maternal noradrenaline and protect against excessive uterine activity (Sternfeld, 1997). It therefore seems unlikely maternal catecholamines can be held responsible for an association between physical exercise and adverse pregnancy outcome.

1.2.4 The Thermoregulatory System

The penultimate mechanism that is often postulated to be inductive of a poor pregnancy outcome is that of hyperthermia, not least because severe hyperthermia has been previously associated with teratogenic effects and in particular neural tube defects (Edwards, 1986). Given that the primary determinant of fetal temperature appears to be

that of maternal temperature (Lotgering et al., 1984), maternal overheating during physical activity could fundamentally pose a serious threat to the unborn infant.

The process of human reproduction is undeniably a growth process and as such creates its own source of thermal stress that must be dissipated. In the non-pregnant state oestrogen is known to enhance the capacity for both heat storage and loss (Tankersley et al., 1992). It is therefore probable that the same hormone is responsible for many of the changes occurring in temperature regulation during pregnancy (Clapp, 1998). In the initial stages of pregnancy resting core temperature is reduced (Clapp, 1991). A marked increase in blood flow to the skin then increases the rate of heat loss into the surrounding air, the threshold for sweating is lowered and heat loss through exhalation increases in proportion to increased ventilation. Subsequently, a progressively greater body mass begins to buffer any escalation in heat production by increasing the amount of tissue available for storage (Clapp, 1998).

Any participation in physical activity will inevitably generate heat over and above that produced by pregnancy alone. This accepted, it has long been documented that regular sustained exercise will alter the thermoregulatory response to heat stress (Roberts et al., 1977) and when training does occur during pregnancy the thermal adaptations of both processes, like those of the cardiovascular system, appear to be of additive benefit.

Because of the difficulties involved, fetal temperature has not been studied directly in humans (Sternfeld, 1997). Nonetheless, Jarski & Trippet (1990) suggest that, whilst prolonged exercise can increase maternal core temperature and thus fetal temperature, an increased blood volume in pregnancy may ultimately help to transfer heat away from the unborn child. Observations of relatively moderate changes in maternal temperature with exercise in the pregnant do indeed suggest that an enhanced thermo-regulatory system may offer some protection (Clapp et al., 1987). Thus, unless activity is intense, prolonged or conducted under extremely humid conditions, the risk of physical exertion inducing a significant increase in body temperature remains extremely low, (Clapp, 1998). Indeed,

“the issue of the baby’s temperature rising too high during exercise may be a non issue for all but the competitive athlete.”

(Clapp, 1998, pp.36)

1.2.5 The Musculo-Skeletal System

When consideration is directed away from fetal health and towards issues of maternal safety, a potential interaction between physical activity and musculo-skeletal injury arises. Both the anatomical and physiological changes that accompany pregnancy have been implicated in increasing this risk (Heckman & Sassard, 1994; Sternfeld, 1997).

Early in pregnancy, an increased secretion of relaxin causes a softening of the fibrocartilage within the hips and lumbosacral spine of the pelvic area. Many surmise this ligamentous laxity to be present throughout all peripheral joints (Clapp, 1998) yet the evidence to support such a notion has only ever been provided in specific circumstances (Calganeri et al., 1982; Schauburger et al., 1996, Clapp, 1998). Under ordinary conditions, the ligamentous changes resulting from pregnancy do not seem to impair joint function or increase the risk of maternal injury (Karzel and Friedman, 1991; Schauburger et al., 1996; Clapp, 1998).

In addition to the above, a change in size and orientation of the uterus during pregnancy will inevitably increase lordosis, placing greater stress on the lower back and progressively altering an individual’s centre of gravity (Ellis et al., 1985). Nonetheless, the only common musculo-skeletal complaint that appears to be associated with such changes is that of lower back pain (Ostgaard et al., 1994).

Similarly, in the latter stages of pregnancy, oedema may limit the range of motion in the extremities and cause nerve compression in the hands whilst the additional weight gain associated with pregnancy will typically exert stress on the peripheral joints and place restrictions upon general mobility. This accepted, studies investing the effects of exercise during pregnancy have reported no instances of musculo-skeletal injury to date

(Sternfeld, 1997). Despite clinical data suggesting that some injuries may result from exercising in pregnancy, the incidence with which these events occur remains an unknown entity and the long-term implications for maternal and fetal health should, in effect, be nothing more than minimal (Sternfeld, 1997).

1.2.6 Summary: Physiological Responses to Physical Activity in Pregnancy

The medical and safety issues regarding physical activity in pregnancy have long been based upon the concern that certain aspects of cardiovascular, metabolic, thermal and mechanical stress could act to threaten outcome. This review suggests that this may not necessarily be the case. For each of these potential problems, specific complementary or compensatory mechanisms appear to exist. These ensure that fetal and maternal health is not so readily compromised and, as a consequence, the anticipated effects of combining physical activity and pregnancy rarely emerge. The next section considers studies that have examined the relationship between physical activity and pregnancy outcome from a clinical perspective.

1.3 The Impact of Voluntary Exercise on Pregnancy Outcome

Almost two decades ago the American College of Obstetricians and Gynaecologists published contraindications to, and guidelines for, exercise in pregnancy. This text detailed the theoretical risks that could be posed to both mother and fetus and recommended that active women stringently limit their exercise during pregnancy (ACOG, 1985). Since then however, the amount of work dedicated to investigating the effects of physical activity in pregnancy has escalated and the focus of research has broadened. Much interest has been prompted by a growing number of already active women who demand definitive answers regarding the appropriateness of their behaviour in pregnancy (Clapp, 1998). Thus, whilst physiological studies have documented the pathways through which physical stress may be perceived to exert an effect, clinical investigations have concentrated directly on the strength of association between activity participation and pregnancy outcome. Dependent variables that have been considered in

this context include parameters of fetal growth, length of gestation and type of delivery as well as various measures of maternal wellbeing. The following sections describe the current extent of this knowledge.

1.3.1 The Effect of Exercise on Fetal Growth and Development

In discussing the effects of voluntary exercise on fetal growth and development, it is first necessary to define the conventional meaning of an adverse pregnancy outcome. The primary measure in this context is that of low birthweight (LBW). Low birthweight refers to infants weighing 2500g or less and may be caused either by preterm delivery (PTD) or by intrauterine growth retardation (IUGR). The average length of gestation is 40 weeks, but infants delivered before 37 weeks are considered preterm (Gabbe et al., 1991). IUGR, which is also known as small for gestational age (SGA), is often defined as a birth weight in the lower 10th percentile of the norms for that gestational age (Kramer, 1991).

In one of the earliest epidemiological studies of recreational activities, Clapp and Dickstein (1984) observed an adverse pregnancy outcome among women continuing vigorous exercising late into gestation. Comparisons were made between pregnant women who maintained their exercise until late into the third trimester and those who either reduced their activity or remained sedentary. Women who continued to exercise at an intensity greater than 50% of the age predicted maximum heart rate for 30 minutes or more three times a week were found to exhibit significantly less gestational weight gain and a shorter gestational length. The same women also demonstrated a higher incidence of SGA babies and a mean birthweight 500g less than either women who were sedentary, or women who had ceased exercising prior to the 28th week of gestation. In a similar manner, Clapp and Capeless (1990) later reported that babies born to women who continued to exercise at or above 50% of their pre-pregnancy level were found to weigh an average of 310g less than those who did not. These authors documented that approximately 70% of the observed variance in infant birthweight could be directly attributed to differences in infant body fat.

Many other studies have investigated the effects of a variety of maximal and sub-maximal exercises on pregnancy outcome and much literature examining the relationship between physical activity, birthweight and gestational age has amassed as a result. However, in contrast to the two studies cited above, most of this work has served to cast serious doubt upon many of the old myths surrounding exercise in pregnancy (Clapp, 1998). In a large survey of women screened for α -fetoprotein, for example, vigorous physical activity was not associated with either increased rates of low birthweight or increased rates of fetal/neonatal death (Rose et al., 1991). Other studies have reported that physical stress arising from recreational exercise activity does not increase the incidence of either small for gestational age infants or premature labour; and may even decrease the incidence of both (Berkowitz et al., 1983; Klebanoff et al., 1990; Rabkin et al., 1990). Furthermore, several different case studies have focussed on athletes who have delivered normal birthweight infants despite running regularly throughout their pregnancies (Korcok, 1981; Cohen et al., 1989).

Similar findings have also arisen from laboratory-based exercise intervention studies. Pomerance et al. (1974) found no significant correlation between birthweight and a fitness score obtained on a sub-maximal cycle ergometer test in 54 women in late pregnancy. Similarly, Erkkola (1976) found physical work capacity determined by a symptom-limited cycle ergometer test to be unassociated with mean birthweight in 149 women. Two further studies have likewise failed to find any significant relationships between fitness and birthweight (Dibblee & Graham, 1983) or fitness and gestational age (Wong & McKenzie, 1987).

Whilst the results of such research may ultimately be criticised for their small sample sizes and possession of a statistical power insufficient in magnitude to detect a true association, the execution of larger studies has only served to substantiate their findings. Hall & Kaufmann (1987) recruited 845 pregnant women, each given the option of participating in an individually prescribed prenatal exercise program. The supervised program consisted of 45 minutes of strengthening exercise and between 1.7 and 3.3 km of cycle ergometry performed at 85% of maximum heart rate 3 days a week. Fetal heart

rates were monitored throughout the exercise sessions and no abnormalities were observed. Participants were later categorised on the basis of the total number of exercise sessions they completed during their pregnancy. No significant effect on gestational age or birthweight was reported. Rather, a trend for birthweight to be higher in the exercise group was observed. Moreover, higher amounts of exercise were revealed to be associated with a reduced incidence of Caesarean section, higher infant Apgar scores (a composite rating of colour, breathing, heart rate, movements and reflexes normally assigned 1 and 5 minutes after birth) and shorter hospitalisation. In this instance therefore, higher levels of physical activity actually appeared to be of benefit.

Another study that employed a rigorous experimental design was that of Kulpa et al. (1987). One hundred and forty one women were followed prospectively, stratified by parity and randomly assigned to a control or exercise group. All were given a prescription of 15 to 20 minutes of aerobic exercise (swimming, aerobics, jogging, cross-country skiing, cycling or racquetball) to be performed at 75% of maximum heart rate. The control group was required to complete the regimen less than once a week. Although the precise number of sessions performed by the exercising group was not formally regulated, the two did not differ significantly in terms of mode of delivery, gestational age, birthweight, infant Apgar scores or incidence of obstetric complications. Of significance, however, may be the observation that only 85 of the original 141 subjects were retained in the study. 26 women were disqualified because of obstetric complications, 20 dropped out, 2 became non-compliant and 8 spontaneously aborted.

In interpreting any such findings, it seems that the precise nature and intensity of the activity that is assessed may also demand attention. In 1990, for example, a study by Durak et al. evaluated the likelihood of uterine activity occurring in the third trimester of pregnancy whilst various types of exercise equipment were being used. The proportion of sessions during which subjects experienced contractions was zero when using an upper body ergometer or recumbent cycle, 10% when using a rowing machine, 40% when on a treadmill and 50% with a cycle ergometer. This led the authors to conclude that some forms of exercise may potentially be more harmful than others. Significantly, many

studies have focused solely on the impact of aerobic exercise and, as yet, very little consideration has been given to the effects of resistance training. For the most part however, the evidence linking physical exercise with a greater incidence of adverse birth outcomes is not very strong.

1.3.2 The Association Between Physical Exercise and Pregnancy Loss

Unlike infant birth weight and gestational age at delivery, the relationship between physical activity and spontaneous abortion has received very little scientific attention. Exercise in the peri-conceptual period and in the first few weeks of pregnancy has traditionally been considered to increase the risk of early pregnancy loss by stimulating uterine activity (Revelli et al., 1992). However, Clapp (1989) tested 119 women for the beta sub-unit of human chorionic gonadotrophin hormone within 2 days of a missed menses. The researcher later documented that miscarriage occurred in 17% of runners, 18% of aerobic dancers and 25% of controls. Such results therefore suggest that women who undertake these types of aerobic exercise early in pregnancy may not put themselves at any increased risk of such an adverse outcome. Reports from retrospective questionnaire studies of pregnant runners also confirm that running does not increase the rate of spontaneous miscarriage in early pregnancy (Jarrett and Spellacy 1984; Cohen et al., 1989). Thus, although more research may be required to substantiate these findings, current evidence for the association between physical exercise and pregnancy loss is weak.

1.3.3 The Influence of Exercise on Length of Labour and Type of Delivery

In contrast to the small number of studies investigating early pregnancy loss, much research has investigated the effect of exercise on the processes of labour and delivery. In one well designed study, Clapp (1990) found that exercise throughout pregnancy correlated strongly with a shorter duration of active labour (223 vs. 302 mins). Much earlier, Erkkola (1976) had also reported that, amongst those who delivered vaginally, fitter women spent significantly less time in labour. In addition, Pomerance et al. (1974)

discovered a large negative correlation to exist between maternal fitness and length of labour in multiparous, but not primiparous, women.

Further evidence suggests that exercise during pregnancy may have an impact on the type of the delivery that is experienced although as yet, the direction of this association is not clear. Hall and Kaufmann (1987) reported an inverse relationship between the amount of exercise undertaken during pregnancy and the proportion of caesarean deliveries that were performed. Their findings showed the frequency of caesarean section to range from 6.7% in the high exercise group to 28.1% in the sedentary group, a result that was consistent with a low frequency of caesarean and forceps deliveries reported in a previous survey of elite Hungarian athletes (Erdelyi, 1962). Such a trend nonetheless opposes the greater likelihood of caesarean delivery observed in a cohort of runners (Dale et.al., 1982).

Other studies into the effects of exercise on pregnancy outcome have focussed on the development ratings of perceived exertion during labour (Rice & Fort, 1991) and perceptions of labour pain (Varassi et al., 1989). The findings from these studies are summarised overleaf, alongside additional studies examining the impact of exercise on fetal growth and development (Table 1.1). The cumulative result of this research provides little indication of a negative relationship between higher levels of physical activity and adverse pregnancy outcome. Most studies demonstrate neutral if not favourable associations between maternal fitness and length or type of delivery.

1.3.4 The Effect of Exercise on Maternal Wellbeing

Compared with the number of studies that have investigated pregnancy from a fetal perspective, the literature dealing with a potential association between exercise and maternal wellbeing is less extensive. Nonetheless, several studies report significant findings in terms of maternal physiological, physical and psychological health.

TEXT BOUND INTO THE SPINE

Table 1.1: Further Studies of Exercise and Pregnancy Outcome

¹ Findings compare more active individuals with less active individuals

Reference	Sample/Study design	Exercise level studied	Outcomes investigated	Main findings ¹
Zaharieva (1972)	27 Olympic athletes; 59 masters athletes; 64 first grade athletes	Intensity/Frequency of pre-pregnancy training	Birthweight; pregnancy complications; delivery & length of labour	Fewer complications of pregnancy; less tearing
Marcoux, Brisson & Fabia (1989)	172 cases of pre-eclampsia; 254 cases of gestational hypertension; 505 controls	Energy expended in recreational activities before 20 weeks gestation	Pre-eclampsia, gestational hypertension	Decreased risk of pre-eclampsia, decreased risk of gestational hypertension
Botkin & Driscoll (1991)	19 exercising women; 25 non-exercising women	Frequency/duration of exercise	Birthweight; gestational age; length of labour; Apgar scores	Shorter stage 2 labour
Lokey, Tran & Wells (1991)	Meta-analysis of 18 studies	Exercise vs. no exercise	Maternal weight gain; birthweight; gestational age; length of labour; Apgar scores	No significant difference
Rice & Fort (1991)	12 active women, 11 sedentary women	Walking or swimming 3 or more times/week for 30 mins or more duration	Rating of perceived exertion in labour; birthweight; Apgar scores; gestational age	Higher 1 min Apgar scores; lower perceived exertion
Hatch, Shu & McLean (1993)	462 prenatal patients from 2 communities	Energy expended (kcal/week)	Birthweight	Increased birthweight
Misra, Strobino, Stashinko, Nagey & Nanda (1998)	Women scheduled for delivery at the University of Maryland Medical Systems	60 days or more of leisure time exercise in the first & second trimesters of pregnancy	Prematurity	Decreased risk of prematurity
Kardel & Kase (1998)	42 athletes	High or medium intensity exercise throughout pregnancy	Onset & length of labour; birthweight; Apgar scores	Earlier onset of labour for women who gave birth to girls

1.3.4.1 Maternal Physiological Health

As discussed in section 1.2, physical exercise may be of direct physiological benefit to a pregnant woman. Of particular interest in this respect are the interactive effects of pregnancy and exercise on maximal oxygen consumption ($\text{VO}_{2\text{max}}$). Investigations of trained women who continue to exercise during pregnancy suggest that they may increase or at least maintain their aerobic capacity (Sternfeld, 1997). Support for such a view has been provided both by competitive athletes who anecdotally report improved performance following delivery (Sady & Carpenter, 1989) and by case studies of recreational athletes who have maintained pre-pregnancy fitness levels throughout their pregnancies (Hutchinson, 1981; Ruhling et al., 1981). In one laboratory study of well-conditioned women, $\text{VO}_{2\text{max}}$ measured by treadmill exercise was found to be significantly higher between 12-24 weeks postpartum and 36-44 weeks postpartum than it was prior to participants becoming pregnant. In comparison, $\text{VO}_{2\text{max}}$ remained essentially unchanged in a group of trained women who did not experience pregnancy (Clapp and Capeless, 1991).

Because of the weight gain that accompanies pregnancy, the energy cost of all weight bearing activity is increased (Lotgering et al., 1984). Sternfeld (1997) suggests that this increase in weight, even in the absence of exercise, could ultimately improve both absolute and relative $\text{VO}_{2\text{max}}$. However, if exercise is reduced during pregnancy, the effect may no longer be evident, particularly among trained women for whom the stimulus of pregnancy may be less than their habitual exercise routine (Sternfeld, 1997). Given this possibility, a combination of regular exercise and pregnancy may indeed assist in maintaining or even improving $\text{VO}_{2\text{max}}$.

In one recent study of previously sedentary women other significant effects were also demonstrated. These included a decreased sub-maximal respiratory exchange ratio and an increased work-rate at the onset of lactate accumulation (Wolfe et al., 1990). Rather than being a risk factor therefore, physical exercise during pregnancy may once again have a positive outcome.

1.3.4.2 Maternal Physical Health

In addition to physiological benefits, physical activity during pregnancy has also been linked with the promotion of good maternal posture, prevention of excess maternal weight gain, facilitation of labour and the prevention of lower back pain (Dewey & McCrory, 1994). It has also been associated with a reduced risk of developing gestational diabetes, particularly among obese women (Dye et al., 1997).

A small corpus of literature has also considered the potential impact of exercise on maternal perceptions of physical and psychological symptoms. Women who exercise during pregnancy typically report fewer pregnancy-associated symptoms than those who are sedentary (Wallace et al., 1986; Hall and Kaufmann, 1987; Sternfeld et al, 1995). This reduction in physical symptoms has been observed for a number of complaints including nausea, fatigue, leg cramps, round ligament pain and lower back pain (Dewey & McCrory, 1994; Sternfeld, 1997). Sternfeld et al. (1995) employed an observational approach and followed 398 women throughout pregnancy. Not only did this observational study result in the discovery of an inverse, trimester-specific association between exercise and perceived symptoms but also in a temporal relationship. Since an increase in reported symptoms was preceded by a decrease in exercise, the authors subsequently used this finding to suggest that women were not exercising because they were feeling better but were, instead, feeling better because they were exercising.

1.3.4.3 Maternal Psychological Health

In terms of psychological benefits, additional evidence has accumulated to suggest that formal exercise participation may once again be beneficial for the pregnant woman. Sibley et al. (1981) for example, studied the effects of swimming activity during the second trimester. In this instance, no measurable improvement in fitness could be detected but an increased sense of wellbeing, improved appetite and a more restful sleep pattern were nonetheless observed. Volitional exercise during pregnancy has subsequently been linked to improved body image (Dewey & McCrory, 1994), a higher

level of self-esteem (Wallace et al., 1986) and reductions in depression (Derosis & Pellegrino, 1982).

In summary therefore, physical exercise during pregnancy may be associated with numerous positive outcomes from a maternal psychological perspective. Whilst the precise origins of this effect are unclear, Sternfeld (1997) postulates that the biological mechanisms responsible could include the hormonal and metabolic adaptations associated with improved cardiovascular functioning, an alteration in catecholamine release and response, or an increase in endogenous opiates over and above that which occurs with pregnancy alone. The issue of the relationship between physical activity and maternal psychological wellbeing is discussed in greater detail in Chapter 2 (Section 2.5).

1.3.5 Summary: The Impact of Voluntary Exercise on Pregnancy Outcome.

Previously, there has been much speculation about the adverse effects of exercise on pregnancy outcome. Of note however, is the fact that the scientific literature dealing with this issue does not support such concern. A very small number of studies have found birthweight, gestational length and gestational weight gain to be reduced among women who continue vigorous exercise during pregnancy compared to those who are sedentary but the majority of available evidence only demonstrates neutral, if not favourable, associations. There is no indication of a negative relationship with length of labour or type of delivery and, in terms of the discomforts of pregnancy, there may even be a beneficial effect. On this basis, it is not surprising to find that in 1994, the American College of Obstetricians and Gynaecologists revised and relaxed their earlier guidelines for exercise in pregnancy. Today,

“Women with normal pregnancies should be able to engage in exercise, with almost no restriction, without compromising either fetal growth or development or complicating the progress of pregnancy, labour or delivery.”

(ACOG, 1994)

Sternfeld (1997) takes the slightly more cautious position that women should not be encouraged to exercise in pregnancy, but that they may do so if they wish.

1.4 The Impact of Occupation on Pregnancy Outcome

The studies summarised above focus primarily on the effects of relatively short exercise sessions undertaken several times a week yet there is growing concern that the prolonged maintenance of a high level of physical activity may be more likely to affect fetal health. As a consequence, considerable research effort has been directed towards the impact of strenuous occupational exertion on pregnancy outcome. This work has examined the issue primarily, though not solely, in relation to the risks of preterm delivery (PTD) and low infant birthweight (LBW).

When outcome is defined specifically in terms of PTD and LBW, both studies which support and refute an association with employment exist. Woo (1997) suggests that part of the reason results remain equivocal is that the measures that have been used to quantify physical activity in the workplace vary significantly between studies. Previous research has chosen to investigate employment *per se*, contrasting occupational sectors, specific work-related activities and composite measures of occupational fatigue. These different methodologies have produced very different results.

1.4.1 Studies Investigating Employment *Per Se*

Early studies investigating the effects of occupational activity on pregnancy outcome typically compared the birth outcomes of employed women with those of non-employed women. Unfortunately, the findings from these studies were of limited value, not least because the two groups of women were likely to have differed from one another in a variety of ways. Not only may the research have been affected by '*the healthy worker effect*'; created when subjects of poorer condition are forced to remove themselves from the economic workforce, but numerous other interactions may also have been ignored. Indeed, recent studies have shown that employed women are more likely to be white,

married, more highly educated, higher in family income, more involved in prenatal care and more likely to be covered by medical insurance (U.S. Bureau of the Census, 1990; Savitz et al., 1990; Moss & Carver 1993). Thus, any study which isolates a component of maternal activity without acknowledging the full context in which it is occurring, will inevitably be at risk of losing statistical power. Simpson (1993) effectively highlights some of the principal difficulties involved in comparing groups of employed with non-employed women:

'an individual who is stressed financially may find it necessary to hold an unattractive job in addition to onerous home responsibilities. Job obligations further decrease the time available for domestic responsibilities increasing psychosocial stress and leading to such deleterious factors as smoking, drinking and fatigue.... Simply correlating presence or absence of a job with perinatal outcome is thus highly simplistic.'

(Simpson, 1993, pp.1236)

1.4.2 Studies Relying on Simple Occupational Classifications

In other studies the threat of selection bias from using non-workers as the basis for comparison has been controlled for by restricting consideration to workers in a variety of occupations (Stein et al., 1986). Often however, the categorisation of occupational activity has often been based solely on job title (e.g. Naeye & Peters, 1982; Zuckermann et al., 1986; Teitelman et al., 1990), a methodological approach which may in itself lead to an over- or under-estimation of effect.

The most simple classification systems have compared manual workers with non-manual workers. As table 1.2 shows, the cumulative result of this work has suggested that women in manual jobs may experience poorer birth outcomes than women in non-manual jobs. However, it remains unclear whether these findings can be attributed directly to differences in the physical activity requirements of the jobs or are instead caused by other factors such as differences in income (Woo, 1997). As can be seen from table 1.2, three previous studies that have reported significant relationships between job type and

pregnancy outcome did not adjust for potential confounding variables. Furthermore, a fourth study undertaken by Saurel-Cubizolles et al. (1991) found that women in partly skilled or unskilled occupations continued to exhibit higher rates of preterm birth than their professional or skilled counterparts, even when differences in occupational activity (e.g sitting and lifting) were taken into account. These findings suggest that differences in occupational type may represent more than just differences in physical work conditions, thereby making it an unsatisfactory measure of occupational activity (Woo, 1997).

In some circumstances, potential confounding influences can be reduced. Miller et al. (1989) for example chose to compare the birth outcomes of a group of physicians (a physically demanding job that is not usually held by women of lower economic status) with a group of non-physicians. The results of this research showed that after adjusting for a number of factors, physicians experienced higher rates of PTD and LBW than did non-physicians. This result was subsequently confirmed by Klebanoff et al. (1990) who demonstrated a higher rate of PTD and SGA infants among physicians as compared to physicians' wives. Unfortunately however, the confidence intervals of the ratios quoted in both studies incorporated the value 1. These studies thus provide little evidence of an association between job type and fetal outcome, particularly given that two further studies have reported physicians to experience greater birthweights and longer gestational lengths compared to national averages (Schwarz, 1985; Phelan, 1988).

1.4.3 Studies Examining Specific Aspects of the Occupational Workload

1.4.3.1 Measures of Work Duration

In addition to considering whether or not a woman is employed, several studies have addressed the question of weekly work duration. Mamellet et al. (1984), for example, reported on a study of 3437 women giving birth between 1977 and 1978 in the French towns of Hagenau and Lyon. Of this initial sample, 1928 women were found to be employed outside the home. At the time of delivery detailed histories were taken on the occupations of these women and on their circumstances of work, household activity and

Table 1.2: Studies Examining the Effect of Occupational Classification on Birth Outcome (adapted from Woo, 1997)

Reference	Occupational Classification	Association with Rate of Preterm Delivery	Association with Rate of Low Birthweight	Adjusted Confounding Variables
Hickey, Cliver & Mulvihill (1995)	Technical/sales/administrative vs. service	NS	-	-
Sanjose, Roman & Beral (1991)	Manual vs. non-manual	Manual higher than non-manual (5.6% vs. 4.6%)	Manual higher than non-manual (6.65 vs. 4.6%) SGA(i): manual higher than non-manual (6.3% vs. 4.6%)	-
Saurel-Cubizolles, Subtil & Kaminski (1991)	Professional/skilled (ref) vs. partly skilled/unskilled	OR = 2.6 (1.1-6.1)	-	Age, eth, grav, pPTD
Launer, Villar, Kestler & De Onis (1990)	Office (ref) vs. manual	OR = 1.11 (0.77-1.62)	SGA (ii): OR = 1.32 (1.12-1.56) SGA/PT: OR = 2.56 (1.10-5.96)	Age, inc, ht, pbw
Ahlborg (1989)	Nine groups: Office workers (ref), teachers, nursing occupations, sales & service, cleaners, waitresses & cooks, industrial & agricultural workers.	-	Cleaners, waitresses & cooks found to have higher birthweights. B = 76.1 (8.3-143.8)	Age, p-s-a, ed, smk, alc, caf, par, sex, ga
Hartikainen-Sorri & Sorri (1989)	Self employed/upper-level/lower level vs. manual	OR = 0.9 (0.6-1.6)	-	p-s-a, p-i-a, p-p-d, SES, ms, UTI, hyp, smk, IUGR, malf
McDonald,McDoanld & Armstrong (1988)	Six groups: Managerial, health, clerical, sales, services, manufacture	O/E = 1.14 (p<0.05) for service group	NS	Age, grav, pp-s-a, eth, ht, ed, smk, alc, SES, pPTD

Table 1.2 Continued:

Reference	Occupational Classification	Association with Rate of Preterm Delivery	Association with Rate of Low Birthweight	Adjusted Confounding Variables
Saurel-Cubizolles & Kaminski (1987)	Service/production/shop workers vs. professional/administrative/ clerical	Service workers higher than professional (6.6% vs. 3.7%)	NS	-
Saurel-Cubizolles, Kaminski & Llado-Arkipoﬀ (1985)	Four groups: Nurses, auxiliaries, ancillary staﬀ, other	Ancillary staﬀ higher than other groups (16% vs. 5-8%) (NS after adjusting for place of birth)	Ancillary staﬀ higher than other groups (11% vs. 2-6%)	SES, par, age, bth
Mamelle, Laumon & Lazar (1984)	Executives/teachers/office workers/skilled workers (ref) vs. shop staﬀ/medico-social staﬀ/unskilled workers/cleaning staﬀ	RR = 2.3(1.6-3.5)	-	-

SGA(i) = small for gestational age (birthweight in the lower 5th percentile of babies at that gestational age)

SGA(ii) = small for gestational age (birthweight in the lower 10th percentile of babies at that gestational age)

SGA/Pt = in the lower 10th percentile and less than 37 weeks gestation

RR = risk ratio, OR = odds ratio, O/E = observed to expected ratio, B= unstandardised regression coefficient, NS = not significant

age = maternal age, eth = ethnicity, inc = income, ed = education, SES = socio-economic status, ms = marital status, ht = height, bth = maternal place of birth
smk = smoking, alc = alcohol, caf = caffeine, grav = gravidity, par = parity, ga = gestational age, sex= infant sex, malf = foetal malformation
pPTD = previous preterm delivery, pbw = previous birthweight, p-s-a = previous spontaneous abortion, p-i-a = previous induced abortion
p-p-d= previous perinatal death, UTI = urinary infections during pregnancy, hyp = hypertension during pregnancy, IUGR = intrauterine growth retardation,

leisure. Preliminary analyses of the data revealed that women working more than 40 hours per week were at a significantly higher risk of PTD than those working less than this amount. A similar result was later documented by McDonald et al. (1988) who found women working more than 46 hours a week to be at increased risk of both PTD and LBW.

However, despite these positive associations, few other studies have demonstrated such an effect. In his retrospective study of female physicians, Klebanoff et al. (1990) only found a difference between those women who worked more than 100 hours per week during residency and those who did not. Several other studies have been unable to demonstrate any significant associations between working hours and either PTD or LBW (Saurel-Cubizolles et al., 1985; 1987; 1991; Rabkin, 1990; Hickey, 1995). Thus the evidence linking long work hours to greater incidence of adverse birth outcome is not strong. Variation in the activities and experiences associated with different job types is likely to have contributed to the inconsistency of the findings.

1.4.3.2 Broad Measures of Occupational Activity Level

As research into the possible risk factors associated with maternal employment has become more focussed, different types of physical activity in the workplace have been investigated. Many studies have evaluated the effects of a general level of occupational activity, although this in itself has been quantified in a number of different ways. The simplest method has been to estimate physical activity levels from job titles. This method does not rely on self-reported behaviour and is therefore not subject to recall bias in retrospective studies. Peoples-Sheps et al. (1991) used information from the dictionary of occupational titles to categorise jobs as sedentary, light, medium heavy or very heavy. In this instance, no significant associations with either PTD or LBW were observed. In contrast, Homer et al. (1990) employed a job characteristics scoring system to assign job titles to either a high physical exertion or low physical exertion group. After controlling

for potential confounding variables, high physical exertion was found to be a significant risk factor for PTD, LBW and PTD/LBW¹.

In a separate study, Teitelman et al. (1990) assessed 1206 women by categorising their jobs as either active, standing or sedentary. Although in this instance no increased risk of low birthweight was observed, work that necessitated mostly standing was, in comparison to active work, associated with a relatively higher risk of preterm delivery. However, two subsequent uses of the same classification system, failed to obtain the same results (Klebanoff et al., 1990; Hickey et al., 1995).

These apparently conflicting findings may be explained by the fact that, in estimating physical activity from job titles, there is always the potential for misclassification simply because the range of physical activities involved in any one job can vary greatly. For this reason, many researchers have chosen to base their measures of general occupational activity on self-report. The measures that have been used range from work activities classified as sedentary or non-sedentary (e.g Murphy, 1984) to activities quantified in terms of increasing amounts of heavy work (e.g Rose, 1991). Mamellet et al. (1984) for example, defined high physical exertion in the workplace in terms of physical effort and load carrying. Having controlled for several confounding factors, high physical exertion was found to be significantly associated with PTD. Once again however this relationship was not replicated in two further studies that utilised the same method (Mamellet & Munoz, 1987; Hickey et al., 1995).

Overall, studies that have quantified general levels of activity within the workplace have done little to indicate a relationship between occupational physical activity and fetal health. Woo (1997) argues that the primary shortcomings of such measures is that they utilise single items that are extremely broad. The amount of physical effort that is considered high will invariably depend upon the experiences of the individual. Thus, it is difficult to ascertain whether the absence of a statistically significant association between these single item measures reflects the lack of a true relationship or is instead simply an

¹ PTD/LBW refers to infants who are categorised as both preterm and low birthweight

artefact of an insensitive measure. This possibility highlights the need for more detailed approaches to the study of maternal activity.

1.4.3.3 The Effect of Posture

Several studies have speculated that the specific effects induced by prolonged standing may be more pertinent in increasing the risk of an adverse pregnancy outcome than any event initiated by a more general level of physical exertion. Physiologically, this is due to the potent combination of venous pooling, decreased blood pressure and decreased uterine blood flow that can accompany such activity (Schneider et al., 1984).

To date, the quantification of occupational standing has taken one of three main forms. Much has been classified by job title, using posture as part of the classification scheme. However, for the reasons noted in the previous section, this method has yielded mixed results. A second popular method of measuring standing has been to classify occupations according to responses given during an interview or in a questionnaire whilst the third has been to rely directly on self-reported measures. The self-report measures seem to be the most specific of the three methods especially if they are measured prospectively and give respondents a specific frame of reference, such as the number of hours spent standing per day (Woo, 1997).

Using this approach, Naeye & Peters (1982) were among the first to report a statistically significant association between fetal growth and standing at work. This result was later confirmed by Launer et al. (1990) and more recently, Fortier et al. (1995) have documented similar findings. More than 6 hours of standing per day and more than 5 hours of standing and/or walking per day have also been reported to increase the risk of prematurity (Henriksen et al., 1995; Luke et al., 1995).

It must be noted however that, in regard to this topic, the literature has not always reported consistent findings. For example, Berkowitz et al. (1983) failed to cite either standing or moving around on the job as significant risk factors for premature delivery

and McDonald et al. (1988) found that working in a standing position during the third trimester was neither associated with infant birthweight nor length of gestation. Together, these studies suggest that PTD may be associated with standing but only at extreme levels.

1.4.3.4 The Impact of Lifting & Carrying

Elsewhere, fetal growth has reportedly been affected less by positions of prolonged standing and more by tasks of heavy lifting or carrying. To date, studies have examined lifting in terms of its presence or absence, the amount of weight lifted and/or the frequency with which lifting takes place.

Nurminen et al. (1989) investigated both lifting and standing and found that whilst standing was associated with a non-significant reduction in fetal growth, heavy physical lifting in the third trimester significantly increased the risk of delivering an SGA infant. Two further studies document a greater risk of PTD in women who lift extreme amounts, 15 times a day (McDonald et al., 1988) or 12kg or more over 50 times a week (Ahlborg et al., 1989).

Other studies have demonstrated non-significant associations with the same activity. Henriksen et al. (1995), for example, document that heavy lifting does not increase the risk of preterm birth whilst Mamelle et al. (1984) also report a non-significant effect of load carrying on pregnancy outcome. In some instances, findings have even been opposite to what may be logically expected. Berkowitz et al. (1983) for instance, report a trend for the mothers of premature infants to lift less than a control group. Consequently, the results of research into the effects of heavy lifting and carrying remain equivocal.

1.4.4 Studies Examining Composite Measures of Occupational Exertion

In addition to examining individual activities several studies have also looked at the combined effects of different activities. Among the most convincing proponents of

decreasing the physical exertion associated with employment during pregnancy are those of Mamelle et al. (1984). These researchers constructed an occupational index and all employed women were assigned a fatigue score of between 0 and 5. The scale, later considered to be validated by Mamelle and Munoz (1987), was an amalgam of scores compounded from a variety of physical, psychological and environmental factors. The factors that were assessed included (i) *posture (working in a standing position more than three hours a day)*, (ii) *use of an industrial machine (working on a conveyor belt or machine with strenuous effort or vibration)*, (iii) *physical exertion (working with continuous or periodical physical effort or carrying a load of more than 10kg)*; (iv) *mental stress (routine work or tasks requiring little attention)* and (v) *environmental conditions (noise level, cold temperature, very wet atmosphere and manipulation of chemical substances)*.

After corrections for certain confounding variables (smoking notably not one of them) the prematurity rate was found to be 8.3% in women with the highest fatigue scores, such as unskilled staff and shop keepers, and 2.7% in those with the lowest. This latter group typically included more skilled workers, executive or office staff and teachers (Simpson 1993). Moreover, the fraction of preterm births that were found to be attributable to occupational fatigue totalled 21% compared to only 8% that could be explained by a mother having had a prior preterm delivery. Mamelle et al. also noted that women deemed at risk on the basis of a previous medical history displayed a further increase when an occupational burden was imposed. Two additional studies have since replicated the association between the above fatigue score and PTD (Mamelle & Munoz, 1987; McDonald et al., 1988) although a recent prospective design failed to demonstrate the same relationship (Hickey et al., 1995). Of note however is the fact that this prospective study only sampled women at risk for having an SGA infant. The higher risk nature of this group could ultimately have obscured the effect of occupational fatigue.

Elsewhere, other composite measures of occupational stress have certainly been documented as risk factors for adverse pregnancy outcomes. Tuntiseranee et al. (1998) recently assessed the effects of occupational activity in Southern Thailand. Although, in

this instance, no association between long working hours and prematurity could be found, the risk of delivering an SGA infant was seen to vary with working conditions. Women working more than 50 hours a week, squatting at work and commuting more than 1 hour a day during pregnancy were specifically identified as being at risk. In contrast however, Zuckerman et al. (1986) interviewed 1690 low income mothers at Boston City hospital between 1977 and 1979 and, having accounted for potential confounding variables, observed neither a significant relationship between employment and neonatal weight nor between employment and head circumference.

Other studies examining the relationship between composite measures of occupational exertion and fetal health are summarised in table 1.3. Based on reports of an ordinary workday Nurminen et al. (1989) tested an 'activity score' in which a mean physical workload was calculated by weighting major and minor occupational activities by the proportion of work time spent on each. Results indicated that women who engaged in work with a moderate or high mean physical load were more likely to have an SGA infant than women who engaged in sedentary work. Similarly, women whose most strenuous level of work was high were more likely to have an SGA infant than women whose most strenuous level of work was light. Of note is the fact that these findings remained significant even after adjusting for several confounding variables.

Earlier Saurel-Cubizolles et al. (1985) had examined the effects of a number of different physical work conditions. The activities examined by this author were long periods of standing, carrying heavy loads and heavy cleaning tasks. Women who experienced two or three of these work conditions were found to exhibit higher rates of PTD, but not higher rates of LBW, than women who experienced less than two of these conditions.

Subsequently, Saurel-Cubizolles et al. (1987) examined four other working conditions (see table 1.3) and found a higher rate of PTD and LBW among women faced with three or more of these tasks. However in this instance, the difference in PTD became non-significant after controlling for occupational type. A third study examined the combined effects of three occupational activities but in this instance no significant differences in the rates of PTD between the groups could be found. Woo (1997) attributes the inconsistency

Table 1.3: Studies Examining the Effect of Composite Measures of Occupational Exertion on Birth Outcome (adapted from Woo, 1997)

Reference	Composite Activity Measure	Association with Rate of Preterm Delivery	Association with Rate of Low Birthweight	Adjusted Confounding Variables
Saurel-Cubizolles, Subtil & Kaminski (1991)	Combination of working conditions: standing, other arduous position, lifting heavy weights	NS	-	Age, eth, ed, grav, pPTD
Launer, Villar, Kestler & De Onis (1990)	Activity score: type (office, manual); position (sitting, standing, walking); physical intensity (sedentary, moderate intense); no. hrs worked. Score divided into minimum, low moderate, high groups	NS +ve linear trend	SGA: lowest rate for low activity group, highest rate for high activity group SGA/PTD: sig. +ve linear trend	-
Nurminen, Lusa, Ilmarinen & Kurppa (1989)	a) Mean physical load: sedentary (ref) standing, work with walking, work with moderate physical load b) Short-term physical load: light (ref), moderate, high	-	a) SGA: RR for moderate group = 2.4 (1.3-4.6) b) SGA: RR for high group = 1.8 (1.1-2.9)	Age, par, p-p-o, ppwt, alc, smk
Saurel-Cubizolles, & Kaminski (1987)	Combination of working conditions: standing, carrying heavy loads, assembly line work, considerable physical effort	0 conditions = 4.0% 1-2 conditions = 5.1% 3-4 conditions = 8.2%	0 conditions = 4.5% 1-2 conditions = 3.2% 3-4 conditions = 8.5%	For PTD: NS after adjusting for occupation For LBW: par, smk, PTD, occupation
Saurel-Cubizolles, Kaminski, Llado-Arkipoff (1985)	Combination of working conditions: heavy cleaning tasks, carrying heavy loads, standing	0-1 conditions = 6% 2-3 conditions = 21%	0-1 conditions = 5% 2-3 conditions = 8% (NS)	SES, par, age, bth

SGA/PTD = in the lower 10th percentile and less than 37 weeks gestation RR = risk ratio, NS = not significant

age = maternal age, eth = ethnicity, ed = education, SES = socio-economic status, bth = maternal place of birth, smk = smoking, alc = alcohol, grav = gravidity, par = parity, pPTD = previous preterm delivery, p-p-o = previous pregnancy outcomes, ppwt = pre-pregnancy weight, PTD

in these findings to measurement error associated with the individual items included in the composite variables, suggesting that even when combined tasks are assessed, the constituent activities must be accurately quantified.

Recently, Koemeester et al. (1995) adopted a lengthy and much more rigorous approach towards assessing physically strenuous work. In this study, qualified nurses were asked to describe the tasks involved in their regular job, the physical activities involved in these tasks and their exposure to alternative occupational stressors. Besides their physical workload nurses were asked for data on age, smoking, drinking, alcohol, parity, number of sporting activities, number of working hours, work schedule, pressures on time and amount of freedom in the workplace. The first questionnaire was completed at 15 weeks gestation. At 20 weeks an interview also enquired about the ergonomic details and daily frequency of their physical activities. A total of 116 women took part. Koemeester et al. eventually reported a significant relationship between the duration of high physical workload per day and gestational age at delivery in a group of women who had otherwise experienced totally normal pregnancies. No single physical factor was found to be responsible for the adverse effects, however, and the authors recommended that all subsequent studies should include information about the sort and degree of physical workload that subjects perform. Ultimately, these detailed measures of maternal activity most accurately reflect the amount of physical strain that women experience and often exhibit an association with birth outcome.

1.4.5 Summary: The Impact of Occupation on Pregnancy Outcome

This section has explored the potential impact of maternal paid employment on the outcome of pregnancy. Whilst a substantial body of literature testifies to the fact that occupational activity has long been perceived as a risk factor for reduced fetal health, very few associations between total occupational activity level and either preterm birth or low birthweight have been found. This observation remains true whether activity is categorised by occupational sector, job title or general levels of physical exertion.

The most plausible relations between paid employment and adverse pregnancy outcome appear to involve positions of prolonged standing, long working hours and heavy lifting. However, studies that make broad assessments of these tasks or isolate their effects from other activities are of little clinical value. Any proposal that endorses pregnancy leave for all pregnant women on the basis of such research evidence may thus be premature (Simpson, 1993). In order to fully investigate the relationship between maternal employment and pregnancy outcome, composite measures of maternal occupational activity may be required. These measures exhibit a tendency to be associated with birth outcome variables and highlight the need for further studies to investigate the influence of a combination of activities.

PART TWO

1.5 The Limitations of Existing Knowledge.

Until now this chapter has been dedicated to reviewing what is known of the potential risks and benefits of maintaining specific components of physical activity during pregnancy. In doing so, it has demonstrated that prevailing standards of care have often been based on little more than speculation or the selective interpretation of scientific research. Most studies pertaining to physical exercise in gestation suggest that recreational activity may be safe for healthy, well-nourished pregnant women. In cases where the effects of maternal employment have been considered, results are more equivocal.

However, by their very nature these two components of activity reflect quite different entities and, as such, can contribute little to the type of antenatal advice required by more sedentary pregnant women. This section reviews the limitations of current knowledge. Particular attention is given to the type and amount of activity that has been assessed, the sample populations that have been considered and the usual manner by which data has been collected. A more detailed review of the issues of physical activity measurement is the focus of Chapter 3.

1.5.1 The Temporal Organisation of Data Collection

There are a number of limitations shared by many of the studies that have been reviewed. The first of these relates to a basic concern of retrospective research designs (e.g. Zuckermann et al., 1986; McDonald et al., 1988; Hartikainen-Sorri et al, 1989; Rice and Fort, 1991). Whilst these studies are generally associated with lower costs and less practical difficulties, they remain hampered by problems of memory and recall bias. Simpson (1993) illustrates this point well:

'Potential deleterious events are naturally recollected more easily by those with adverse perinatal outcome (recall bias) to say nothing of the inability to recall events occurring months or even years later (memory bias).'

(Simpson, 1993, pp.1236)

Affleck et al. (1991) report that whenever women experience an adverse birth outcome there is always tendency to find an explanation for the event. In a study of 114 families of preterm infants, these authors found physical strain to be among the top four most frequently cited categories as a major or minor cause of PTD following pregnancy complications, psychological stress and chance. The potential for recall bias to occur in a retrospective study of physical activity and pregnancy outcome is therefore extremely high.

A further disadvantage of retrospective studies is that they are limited in specifying exactly when during pregnancy the reported events occurred (e.g McDonald et al., 1988; Sanjose et al., 1991). This is important given the fact that physical exertion may have differential effects depending upon the stage of pregnancy at which it is undertaken. Strenuous activities performed later in pregnancy, for instance, may have more important implications for intrauterine growth retardation than activities performed earlier in pregnancy because the fetus gains the most weight during the third trimester (Williams et al., 1982). Likewise, strenuous activities performed earlier in pregnancy may be related to spontaneous abortions whereas strenuous activities performed later in pregnancy may be

related to premature delivery (Dewey & McCrory, 1994; Brett et al., 1997). However, in studies where the time frame is not specified, it is difficult to know whether a respondent is considering her behaviour in early, mid or later pregnancy, or even whether she is taking some form of mental average (Woo, 1997). Prospective studies can at least ensure that the whole sample is responding at a similar time and considering exactly the same time frame.

Unfortunately, even where previous studies have adopted a prospective design, few studies have taken measures longitudinally. A substantial proportion of the literature dealing with the effects of physical activity on pregnancy outcome continues to detail studies of cross-sectional design (e.g. Pomerance et al., 1974; Berkowitz et al., 1983; Zuckerman et al., 1986; Teitelmann et al., 1990). Since these assessments only seek to obtain one measure of physical activity from each individual involved, their ability to characterise behaviour during a process that is by its very nature, dynamic and developmental, must be questioned. By assessing behaviour at one point in time or even by considering physical activity over a period of time and reducing it to a single measure, much of what distinguishes one phase of pregnancy from another may be ignored. Not only can it be difficult to establish how much observed behaviour patterns may differ from early routines, for example but it also remains impossible to identify women who curtail their activities at different stages prior to birth. Only by observing the same outcome measure at multiple time points (e.g Rabkin et al., 1990) can studies provide a true account of events as they unfold over time.

1.5.2. Issues of Daily Lifestyle

As yet, the specific components of physical activity that may be physiologically harmful to the fetus do not appear to have been clearly identified. (Barnes et al., 1991) but if deleterious effects do exist, it does not seem unreasonable to assume that they may ultimately be elicited by a number of circumstances other than those that have been investigated previously.

The review of literature presented in Section 1.4 served to demonstrate that an accurate assessment of the relationship between employment-related activity and pregnancy outcome may rely upon the quantification of a combination of occupational tasks. However, the workplace is not the only context in which strenuous activities may exist. For example, domestic responsibility can incorporate a substantial physical stress component (Stein et al., 1986), and current trends suggest that many women perform such tasks outside of formal working hours. The performance of household chores has been shown to be an important component of the daily activity spectrum of women (Ainsworth et al., 1993) and it has recently been suggested that pregnancy should be considered with respect to all the responsibilities that women face throughout the day (Woo, 1997). As yet however, very little research has examined perinatal outcome in relation to a woman's role inside the home and even less frequently has the size of a woman's household or the availability of household help been considered (Berkowitz et al., 1983; Launer et al., 1990).

One exception is that of Tafari et al. (1980) who studied the effects of hard physical labour on 130 pregnancies in Addis Ababa, Ethiopia. The mean birthweight of infants born to women with physically strenuous occupations and to housewives without assistance in heavy household tasks was found to be 200g less than that of infants born to sedentary workers and housewives with domestic help. In this study however, the hard and light workers may have differed significantly in terms of their socio-economic status (Rabkin et al., 1990). Moreover, both groups were considered to be severely undernourished, consuming only 1540 and 1641 kcal per day respectively. For this reason, the findings cannot automatically be applied to pregnant women in the developed world.

A study undertaken by Launer et al. (1990) is one of few to specifically evaluate the effects of both employment and non-employment related physical activities in Western women. In this instance, odds ratios were adjusted for household income, maternal height, age, and the birthweight of previous children. The authors documented that, compared to women with less children, women who had three or more children and

received no household help were at increased risk of delivering an SGA infant. Neither having three or more children nor having household help was associated with PTD although interestingly, rates of SGA/PTD were found to be higher in those receiving help compared to those not receiving help. Launer et al. explained this result in terms of the fact that the women who benefited from family help had higher rates of morbidity than their counterparts. Thus, it was likely that the women with poorer health needed to request more family help and also that their health status affected their birth outcomes.

According to Woo (1997) higher SGA rates among women with many children may be due to the physically strenuous activities associated with caring for young children. These activities may strain a mother's resources and thus her subsequent ability to nourish the fetus. This possibility accepted, the relationship between more general household work and pregnancy outcome has not been demonstrated so conclusively. Although Launer et al (1990) demonstrated a significant association with housework, other studies have failed to replicate these findings. Recently, Schramm et al. (1996) examined the relationships between pregnancy outcome and exercise, employment and other daily activities during pregnancy in a large sample of American women. No significant association between adverse pregnancy outcome and daily activity was reported. Likewise, Rabkin et al. (1990) prospectively investigated the relationship between total physical activity and gestational age adjusted birthweight in a sample of women from London. Measurements were repeated at three different points during gestation but no associations between gestational age-adjusted birthweight and either paid work or housework could be found.

However, findings from other studies suggest that the impact of performing household chores may ultimately depend upon the population concerned. Misra (1998), for example, documents that the fundamental activities of daily living can almost double the risk of preterm birth amongst low-income women. Out of all domestic and social activities, climbing stairs and walking may be particularly implicated in increasing risk. Moreover, Hickey et al. (1995) report that carrying loads may be associated with an elevated risk of prematurity in white women, whilst strenuous home-based chores may heighten risk in

black women. However, it must be acknowledged that the differences observed in this study may simply have been the artefact of multiple comparisons (Woo, 1997).

For the most part, the measurements used in existing studies of household work suffer from the same methodological limitations as do studies of occupational exertion, that is that they have been too broad (Woo, 1997). Most researchers have explored the amount of time spent on housework but have rarely considered whether this time is spent on light or physically demanding activities. Similarly, studies have examined the effect of having other children in the home yet have never taken the age of these children into account. This latter factor will invariably affect the nature of the caring activities that a woman performs. There thus remains much room for methodological improvement in this area.

1.5.3 The Characteristics of the Sample Populations

The sample populations on which previous studies of physical activity in pregnancy have been carried out are wide ranging yet, just as few studies have examined the effect of habitual lifestyle activity, few can be considered to be representative of a general pregnant population. Indeed, due to the strenuous working conditions involved the vast majority of research investigating the relationship between occupational activity and pregnancy outcome has been conducted on medical or military personnel. Ramirez et al. (1990) for example, examined the relationship between occupational activity and the risk of preterm birth solely among US Army active duty primigravidas. As a consequence, the activity measure selected in this instance was not a measure of the physical activity performed during pregnancy but rather a quantification of the maximum upper body strength required by different military specialities under combat conditions. Similarly specialist occupations have been used in other studies (Table 1.4).

A study by Rose et al. (1991) did not attempt to evaluate physical activity in the work place but instead sought information on the overall level of physical activity undertaken by a large cohort of women enrolling for maternal serum α -fetoprotein (MSAFP) screening. In this instance, women were asked to rate their activity level as vigorous or

Table 1.4: Studies Evaluating Adverse Pregnancy Outcomes Among Medical & Military Personnel.

Reference	Outcomes investigated	Population compared
MEDICAL		
Axelsson, Rylander & Molin (1989)	Miscarriage, LBW	Nurses, nurses' assistants, nurses' aides, midwives, laboratory technicians & x-ray technicians
Luke, Mamelle & Keith (1995)	Prematurity	Nurses
Miller, Katz & Cefalo (1989)	Prematurity, LBW, PIH/P-ecl	Physicians & non-physicians
Katz, Jenkins, Haley & Bowes (1991)	Urinary catecholamines	Physicians & Nurses
Graunebaum, Minkoff & Blake (1987)	Prematurity, LBW, SGA/IUGR	Obstetricians pregnant before, during and after residency
Klebanoff, Shiono & Rhoads (1990)	Prematurity, LBW, SGA/IUGR, PIH/P-ecl, Bleeding	Female Physicians & wives of male physicians
MILITARY		
Magann & Nolan (1991)	Prematurity, IUGR, PIH/P-ecl	Active duty marines & wives of active duty personnel
Fox, Harris & Brekken (1977)	Prematurity, LBW, PIH/P-ecl	Active duty & non-active duty females
Hauth, Gilstrap & Brekken (1983)	LBW	Active duty & non-active duty females

LBW: Low Birthweight, SGA/IUGR: Small for gestational age/Intrauterine growth retardation, PIH/P-ecl: Pregnancy-induced hypertension/Pre-eclampsia

non-vigorous. No significant differences were observed between the groups either in rates of low birthweight, or fetal or neonatal death. Because of the nature of the population selected however, all women were placed under the care of a physician from the start of the study. They were therefore unlikely to represent a normal, healthy population in which medical surveillance occurs less frequently.

Previously, Klebanoff et al. (1990a) had investigated the effects of both employment and non-employment activity in an alternative clinical cohort. In this instance, subjects were recruited from a Vaginal Infections and Prematurity (VIP) study, the primary objective of which was to investigate the association between preterm birth and the genital tract carriage of various micro-organisms. Once again therefore, these women were of a high-

risk nature, an important characteristic that may ultimately have obscured the potentially subtle effects of physical activity on preterm birth. Other studies have included elite athletes (Erdeyli, 1962; Zaharieva, 1972; Kardel & Kase 1998), recreational runners (Dale et al., 1982; Jarrett & Spellacy, 1983; Clapp, 1989) and aerobic dancers (Clapp, 1989). Unfortunately however, few studies appear to be community-based and as a consequence the behaviours of low-risk populations have gone unstudied.

1.6 Chapter Conclusions

This chapter has considered the extent to which patterns of maternal physical activity may impact on pregnancy outcome. Studies investigating the physiological responses to activity in pregnancy provide little evidence to suggest that maternal exertion will adversely affect fetal wellbeing. The majority of clinical studies also demonstrate neutral, if not favourable, relationships between physical exercise and pregnancy outcome. Only in instances where composite measures of occupational activity have been studied have results been more controversial.

Unfortunately however, the majority of existing literature has documented the effects of isolated components of activity in specific populations. Very few studies have focussed on the impact of integrated levels of physical activity and rarely has the behaviour of healthy, low-risk pregnant women been taken into account. Thus, whilst previous research may go some way to increasing our understanding of the health consequences of certain physical activities in pregnancy, it is as yet, unable to inform us of the effects of more general lifestyle routines. In order to address this issue fully, future studies must satisfy three important criteria:

- (i) They must obtain an accurate and composite measure of all forms of physical activity that pregnant women undertake.
- (ii) They must take account of longitudinal variation in maternal activity levels.
- (iii) They must avoid data being influenced by the effects of memory and recall biases.

By satisfying these criteria, a clearer picture of the effects of daily activity on pregnancy outcome will be obtained. The present study will thus attempt to incorporate these recommendations in its methodology (Chapters 3 and 4). First however, the context of pregnancy as a social, cultural and psychological event is considered.

CHAPTER TWO

Pregnancy and Physical Activity in a Psychosocial Context

2.1 Introduction

Understanding more about the relationship between maternal daily activity and birth outcome is a pre-requisite to formulating appropriate clinical guidelines and providing effective antenatal care. However, the ultimate success of this care may not only depend upon its relevance to fetal health but also upon its understanding of the wider psychosocial context in which pregnancy occurs.

As Artal & Gardin (1986) point out many recommendations for physical activity in pregnancy reflect social and cultural expectations of the maternal role. These expectations rarely take account of the social, structural and economic contexts in which human reproduction occurs. Indeed, the introduction to this work has already served to demonstrate that a woman waiting to give birth may be functioning amongst a number of social roles. She may also have needs and desires that have nothing in common with the reproductive function (Deutsch, 1947). The full extent to which individuals can, or will, change their physical behaviour during pregnancy therefore remains unclear. This chapter considers the psychosocial experience of pregnancy and examines the range of factors that may impact on maternal behaviour during this time.

2.2 Pregnancy as a Transitional Process

'Pregnancy has been variously viewed by psychologists as a time of crisis brought about by emotional, psychological and social stress and reflecting the identity crisis of becoming a mother (Bribring, 1959); a period of fulfilment and calm in which a woman's deepest yearnings for motherhood and female achievement are met (Deutsch, 1947); or as a transitional phase in life akin to adolescence which marks the physical, social and

psychological transition from non-motherhood to motherhood (Breen, 1975; Wolkind & Zajicek, 1981).'

(Scott & Niven, 1996, pp.45)

To date, pregnancy has been considered in a number of different ways. In part, these differing opinions have reflected a change in societal attitudes towards the female role. Traditionally women were assumed to have a biological inclination to become mothers and conditioned to feel that pregnancy should bring inevitable fulfilment. Only more recently have real female experiences been explored (Zajicek, 1981).

From this work, it is clear that pregnancy is not simply a biological process. The transition to motherhood, like the transition to any new social situation, will also involve some degree of psychological change (Zajicek, 1981; Unger & Crawford, 1996). In addition to the physical changes that occur in body size and shape, a woman's relationships with her friends and family will inevitably be affected. Similarly, the private bond between herself and her partner will be re-evaluated, firstly to make space for another person and secondly, to cope with the changing orientation of the couple as individuals (Zajicek, 1981). In turn, an established social position must be relinquished, as must existing occupational interests and often an active career. These changes may have important consequences, both for a woman's physical activity level and for her psychological health.

2.3 Maternal Psychological Wellbeing During Pregnancy

Previous studies that have examined the psychology of pregnancy have typically taken one of two main forms. Much has focussed purely on the emotional experience of the process whilst the remainder has attempted to provide explanations for the feelings that are observed. Both represent important and extensive fields of research and for this reason, the following section has been divided accordingly.

2.3.1 *The Emotional Changes of Pregnancy*

Despite inaugural studies of working class women detecting feelings of resentment and fear to be associated with pregnancy (Hall & Mohr, 1933; Hurst & Strousse, 1938; Thompson, 1942) no such emotions were incorporated into theoretical models until almost three decades later (Caplan, 1960; Coblner, 1965; Zajicek, 1981). However, following a gradual change in the social position of women, researchers have begun to report that a heightened emotional state is often apparent. Depression, anxiety and irritability are all commonly reported (Klein et al., 1950; Bibring, 1959; Loesch & Greenburg, 1962; Jarrachi-Zadek et al., 1969) and, in some cases, have even been thought to denote a healthy manifestation of working through the transition to parenthood (Grossman et al., 1980). More recently, similar stresses have been identified in men whose partners are pregnant with raised levels of anxiety (Condon, 1987; Santos Perez et al., 1998), irritability (Condon, 1987) and depression (Condon, 1987; Deater-Deckard et al., 1998) all being detected in prospective fathers.

According to Unger & Crawford (1996), the proportion of women who experience decreased emotional wellbeing at some time during pregnancy and early motherhood is probably a majority. Nonetheless, empirical findings tend to support the notion that pregnancy is a time of more mixed reaction. Nash (1973) interviewed 100 primiparous women and discovered that, although 22% were upset and 15% ambivalent, more than three fifths (63%) were pleased about their pregnancies. Similarly, Green (1990) reported on a large and broadly representative group of English women early in gestation and found that, whilst 46% were anxious, 74% could be considered happy.

In two other studies, Elliot et al. (1983) and Condon (1987) both discovered that, during pregnancy, emotional wellbeing actually increased in some women yet in others episodes of depression and anxiety commensurate with psychiatric disorders could be detected. A high rate of psychiatric disturbance has also been reported elsewhere (Nilsson & Almgren, 1970; Benson et al., 1987; Mercer & Ferketich, 1988). Such serious illnesses are not thought to be common amongst prospective mothers however and Hendrick et al.

(1998) postulate that among pregnant women, major depression levels tend to be equivalent to those of non-pregnant women. It is estimated that, whilst 80% of women may experience some mood fluctuations in either the antepartum or postpartum period, only 10-20% may meet DSM-IV criteria for major depression and 0.1-0.2% will show signs of psychosis (Steiner, 1998). Indeed, as Spirito *et al.* (1992) emphasise, "*there have been a number of studies which have looked at women at various points in pregnancy and found levels of depression and anxiety are within normal limits.*" One particular example is that of O'Hara *et al.* (1990), who found no difference in rates of minor and major depression between samples of pregnant and non-pregnant individuals. This accepted, expectant mothers still reported more depressive symptoms and experienced less satisfactory social adjustment during later pregnancy than did the non-pregnant controls.

It has previously been suggested that once quickening has served to verify a baby's existence, the negative reactions experienced at the beginning of pregnancy often dissolve (Caplan, 1960). Certainly, it appears much rarer for women to express outright rejection of the pregnancy after this time (Coblner, 1965). Several authors have reported that maternal anxiety is at its lowest in mid-gestation and, as a consequence, the second and early third trimesters are traditionally assumed to be the times of least upset (Zajicek, 1981). Nevertheless, other longitudinal studies aimed at documenting the stability of mood over time have revealed conflicting findings. For example, work undertaken on both diabetic and non-diabetic populations has shown mood state to remain relatively stable throughout pregnancy (Spirito *et al.*, 1992).

Wolkind and Zajicek (1981) suggest that the psychological reactions of any one individual may vary. In their study 70% of married women reacted positively to the realisation that they were pregnant and 72% reacted positively after seven months. In addition only a small minority were experiencing major physical or psychological problems at the second interview. Of particular significance however, was the observation that those individuals who reported positive reactions early in pregnancy were not always the same women who did so later. Such findings have thus led Hendrick

et al. (1998) to conclude that the course of depression during pregnancy needs further exploration.

2.3.2 Factors Influencing Psychological Wellbeing in Pregnancy

Previous research has inevitably attempted to discover why some women adjust well to the experiences of pregnancy and others do not. Many studies have investigated the strength of association between depressive symptoms and hormonal status (Nott et al., 1976; Ballinger et al., 1982; Feksi et al., 1984; Gard et al., 1986). Others have studied postpartum depression in relation to previous depressive episodes (Whiffen, 1988; Kennerley & Gath, 1989; Gotlib et al., 1991; O'Hara et al., 1991; Anderson et al., 1994) and pre-menstrual mood changes (Sugawara et al., 1997). Elsewhere different factors have been explored. These are discussed below.

2.3.2.1 Sociodemographic Circumstances

The impact of a woman's sociodemographic circumstances on her psychological reaction to pregnancy has been well examined. Interestingly, Anderson et al. (1994) found no correlation between mood and demographic characteristics of women either in pregnancy or after 8 weeks postpartum. Similar results have been reported by O'Hara (1986) and Watson et al. (1984). However, the majority of evidence does indeed suggest that younger women may be at increased risk of depression (Wolkind and Zajicek, 1981, Gotlib et al., 1989, DaCosta et al., 1999). Piyasil (1998) for example, discovered a significantly higher prevalence rate of depression in teenage mothers (23%) as compared to adult mothers (11.9%), and Scott & Niven (1996) suggest that declining sources of employment and income may be expected to produce particular difficulties for these individuals.

A lack of material resources is an increasingly common feature of the life of many women with children in the United Kingdom (Glendinning & Millar, 1985). The last two decades have witnessed many changes in universal maternity rights, often with the result

of increasing economic vulnerability for pregnant women (Brannen & Moss, 1988; Scott & Niven, 1996). Until very recently, the outcome of these changes has been an increased reliance on household earnings and a corresponding increase in the number of women working until late into the third trimester (Scott & Niven, 1996).

Other studies also support the notion that psychosocial stress may be a specific aspect of morbidity among disadvantaged people. El Khoury et al. (1999) found depression during pregnancy to be inversely related to economic and educational levels and Bergant et al. (1998) found risk factors for the development of an early postpartal depressive disorder to include higher trait anxiety and lower social status. Similarly, in a study of an inner London population depressive symptoms during pregnancy were associated with having no educational qualifications, being unmarried, unemployed, and being in a second or subsequent pregnancy (Bolton et al., 1998). These reasons withstanding, other studies suggest that the changes initiated by pregnancy are likely to be more multifaceted (Anderson et al., 1994).

2.3.2.2 Expectations of the Course of Pregnancy

Irrespective of an individual's sociodemographic circumstances, the health status of the fetus and the expected course of pregnancy will inevitably also be of concern. High levels of antenatal anxiety have been correlated with previous obstetric abnormality (Crandon, 1979) and with prior miscarriage (Kumar & Robson, 1978). The symptoms of physical discomfort that affect all women are one of the most frequently reported stressors of pregnancy (Coutts, 1998) and in other studies, the pain associated with childbirth has been shown to be foremost in some women's minds (Norr et al., 1977; Anderson et al., 1994; Sjogren, 1997).

2.3.2.3 The Social Status of Parenting

As well as concerns regarding fetal health, specific aspects of the parenting experience

may also become more salient. Nicholson (1988) emphasises that many individuals will feel some familial, cultural and or societal pressure to look forward to childcare and if their feelings contradict this pressure dysphoria may result. Other studies have also indicated that women with depression or depressive symptoms often report feeling inadequate or doubtful about being a mother (Barnett & Parkey, 1986; Oloff & Aboud, 1991); have more negative attitudes towards care-taking (Kumar & Robson, 1984; Fleming et al., 1988; Gotlib et al., 1991); experience more stressors related to childcare (O'Hara et al., 1991) and have less prior experience with children (Fleming et al., 1988). Anderson et al. (1994) report similar findings. In their study two broad categories of factors were found to be associated with maternal mood. The first included attitudes towards parenting. Specifically, positive attitudes towards care-taking activities, a perceived ability to handle such activities and a high desire to seek information on childcare were associated with more positive moods during pregnancy and the early postpartum period. Views of oneself as a fun mother were also associated with more positive moods at the postpartum interval.

2.3.2.4 A Change in Body Image

The second category to emerge in Anderson et al's (1994) study included factors relating to perceptions of pain tolerance and maternal body image. Given that prevailing cultural stereotypes emphasise the value of a slender form (Bordo, 1990), it is not surprising to find that many individuals feel ambivalent towards the physical changes that accompany pregnancy (Ussher, 1989). The majority of women in industrialised societies enter their reproductive lifecycles immersed in issues of weight control (Bartky, 1988). Rarely however, is this a shape that a healthy pregnant woman can achieve (Anderson et al., 1994).

In one early study of emotional wellbeing, Zajicek (1979) documented that only a small minority of women reacted positively to their new figure and many voiced a desire to return to their non-pregnant body shape as soon as possible. Weight retention in the postpartum period has been associated with disappointment, surprise, symptoms of eating

disorders, reduced self-esteem and depressive symptoms one year following birth (Stein & Fairburn, 1996; Jenkin & Tiggemann, 1997; Walker, 1997). Other work has confirmed that negative attitudes towards one's body are common during pregnancy particularly in the third trimester (McConnell & Datson, 1961; Harris 1979; Leifer, 1980; Strang & Sullivan, 1985; Mercer, 1986).

Moreover, the association between body image and mood may be self-perpetuating. Certainly, Anderson et al. (1994) observe that whilst negative attitudes towards ones body may cause dysphoria, psychological distress may in turn heighten a woman's dissatisfaction with her appearance. Relevant to this notion are findings that indicate that psychological distress may be related to more negative perceptions about ones' health (Tessler & Mechanic, 1978) and the fact that high levels of anxiety in primiparous women have been found to result in a negative perceptual bias regarding their experiences (Barnett & Parkey, 1986). Dislike for one's body has also been observed in people who are clinically depressed (Fisher, 1985).

This withstanding, some studies have shown pregnancy to have a positive effect on body image. Clark & Ogden (1999) studied the current health behaviours, eating behaviour and weight concerns of 50 primigravidas and 50 non-pregnant nulliparous women. In this instance, pregnant women reported eating more, showed lower levels of dietary restraint, were less dissatisfied with their body shape and showed higher eating self-efficacy than did non-pregnant women. Likewise, Baker et al. (1999) examined changes in eating attitudes during the reproductive process and found weight and shape satisfaction to be higher in pregnancy than at 4 months postpartum.

Unger & Crawford (1996) posit that, for some women, pregnancy may represent a period during which they feel temporarily free from cultural demands to be slim. Thus, the weight and shape changes that accompany pregnancy may be distressing for some individuals yet liberating for others. During a recent investigation into the continuity and change in women's weight orientations, pre-pregnancy attitudes towards bodyweight emerged as the primary influence on women's pregnancy and postpartum feelings

(Devine et al., 2000). Elsewhere, past history of dieting for weight loss has been associated with episodes of overeating in pregnancy, dissatisfaction with shape changes and plans to diet following childbirth (Fairburn & Welch, 1990).

2.3.2.5 A Lack of Autonomy and the Loss of an Established Role

The emergence of body image as an influential factor in the development of maternal mood suggests that other aspects of the pregnancy experience may also impact on maternal psychosocial wellbeing. One particular factor that has repeatedly been shown to affect women during the transition to motherhood relates to a perceived lack of autonomy and the loss of an established role.

Within Western society, the first pregnancy invariably possesses the greatest symbolic value (Zajicek, 1981). As a consequence of its occurrence, women are temporarily brought into the home and an important distinction between the sexes is made (Rossi, 1968; Cohen, 1973). In one recent study of the characteristics of women with antenatal and postpartum depression, Steinberg & Bellavence (1999) documented that dyadic discord was accentuated by traditional sex role expectations. Much earlier, Wolkind & Zajicek (1981) had asked women if pregnancy had placed any restrictions upon their lives and, if so, whether or not they objected to them. Half of their sample maintained their lives had been restricted by pregnancy and one quarter objected to the restrictions that had been imposed. In particular, the women were ambivalent about giving up work. Only 28% were happy to be excluded from the active workforce, 41% had some misgivings and 31% definitely resented the idea. As explanation for their findings, the authors documented that many were fearful of losing contact with a world in which they previously played an important part. Fallowfield (1990) believes that a great deal of personal gratification can be obtained through the social recognition and the social interactions provided at and by work.

Undoubtedly, by causing disruption to a woman's career, pregnancy can both reduce an individual's sense of control over her life and lower her perceived sense of self-worth

(Gleve 1987). Compounding this effect further however is the fact that, within the context of the community, a pregnant woman will rarely be seen as an autonomous individual. Drawing from their own experiences, Unger and Crawford (1996) illustrate this point well,

“It seemed as if everything that had gone before – education, work, individual life history - was now to be put aside for the all-encompassing identity and job of Mother.”

(Unger & Crawford, 1996, pp.407)

Kitzinger & Perkins (1993) similarly observe that the maternal role often lacks measurable reward, particular in terms of financial remuneration. Even mothers who successfully negotiate the transition to motherhood may still forego a sense of achievement. Whether or not this event is viewed positively will essentially depend upon the woman herself, her self-esteem and her attitudes towards the maternal role. Each has her own perceptions of the situation and her own social sphere in which she exists. Thus, if a woman values her past life and finds she has to relinquish it, conflict may occur. Alternatively, if she is an individual who faces the future with a strong sense of personal control, she may cope with a new identity and find different tasks that satisfy her (Zajicek, 1981). In effect, pregnancy can be regarded as a time of potential loss and gain and, according to Breen (1975), women who are at least influenced by the ‘mystique’ of motherhood will often adjust the best.

2.3.3 Summary: Maternal Psychological Wellbeing During Pregnancy

This section has explored the manner by which ‘normal’ low-risk pregnancy may impact on maternal psychological health. Whilst women have traditionally been assumed to have a biological inclination to become mothers, a large corpus of literature demonstrates that pregnancy may be a time of more mixed reaction.

To date, the origins of negative affect during pregnancy have variously been investigated in terms of biological, psychological and social factors. Salient influences that have been

considered include hormonal status, sociodemographic circumstances, the expected course of pregnancy and the future course of parenting. Other important factors that have been identified include the impact of maternal body image, a loss of achievement and the loss of an established role. Depending upon the attitude and personality of the woman concerned, adverse effects may occur as an established social position is relinquished and autonomy as an individual is lost. Of interest to the present study is whether or not the emotional reactions that occur in response to these factors are sufficient to influence maternal physical activity during pregnancy. This possibility is considered further in section 2.5.

2.4 Factors That May Moderate Psychological Wellbeing in Pregnancy

In discussing those factors that may influence psychological wellbeing during pregnancy, the previous section alluded to the fact that the magnitude of their effect may rely upon the way in which individuals perceive and deal with the reproductive experience.

Ultimately, if it can be shown that a woman's psychological health will influence her physical activity behaviour, then any factors that moderate this wellbeing may also exert an effect. This observation necessitates some consideration of the different ways by which pregnant women may mediate the cognitive appraisal of stress and cope with the effects it creates. Factors that have consistently been studied with respect to this issue include maternal personality, perceived levels of social support and participation in negative health behaviours.

2.4.1 Maternal Personality Factors

From the cognitive perspective, one element that may be particularly important in coping with the emotional shifts of pregnancy is that of maternal personality (Miller & Lloyd, 1991; Younger 1991). Within this context, Reading (1983) claims that particularly influential variables may include maternal trait anxiety and attitudes towards the maternal role. Other studies also emphasise the benefits of constructive thinking (Epstein & Meier,

1989; Epstein & Katz, 1992; Park et al., 1997). However, a much more frequently investigated variable appears to be that of maternal self-esteem.

Within the general population, there is substantial support for the notion that self-esteem is an important determinant of affective state and many links have been established between this variable and depression (Brown et al., 1990). Recently, Terry et al. (1996) investigated depressive symptomology during pregnancy. These authors documented that in addition to family support, an individual's self-esteem appeared to be a particularly useful coping resource. Data were collected in the last trimester of pregnancy and at approximately 4 weeks and 4 months postpartum. Compared to other women, individuals who displayed high levels of self-esteem during pregnancy were less likely to be suffering from depressive symptomology four months after delivery. In interpreting these results, the authors concluded that the women who possessed the highest levels of self-esteem were likely to withstand the type of stressors that would otherwise threaten their sense of self-worth.

Previously, Wolkind & Zajicek (1981) had obtained an overall measure of self-image on 56 married and single women. On this occasion individuals were asked to describe both current self and their ideal self, with the discrepancy between the two rating scales being indicative of self-esteem. Mean scores during pregnancy did not differ from mean scores taken postpartum and correlations between the two were highly significant. Nonetheless, when women were compared in terms of their reactions to pregnancy, it was found that low self-esteem was associated with depression during pregnancy, uncontrollable diet changes, prolonged sickness and no desire to be pregnant. In addition, women who demonstrated low self-esteem during pregnancy were significantly more likely to be depressed, have marital problems and difficulties coping with the child during the first 14 months of motherhood. The authors concluded that, in contrast to body image, self-esteem may not be so susceptible to the transition of pregnancy. It may however still be related to a woman's ability to cope with the process and to the experiences that she has.

Chan (1977) posits that individuals with high self-esteem are likely to have a past history of coping with stress and therefore be more likely to be confident in their ability to manage stressful situations. Dimitrovsky et al. (1998) recently studied the relationship between maternal and general self-acceptance and pre- and postpartum affective experience in 49 married primiparous Israeli women. At both stages of pregnancy women tended to rate themselves significantly higher in terms of maternal self-acceptance than general self-acceptance. Women rated higher in general self-acceptance were once again reported to be less depressed and displayed less negative affect than their counterparts. Measures of an individual's self-esteem may thus be important in distinguishing between those women who will adapt well to pregnancy and those women who will not.

2.4.2 Social Support

Like self-esteem, the perceived availability of social support has long been recognised as a prominent coping resource. Throughout the life span of an individual its presence has been shown to buffer stress and during pregnancy, it has been reported to substantially reduce anxiety, enhance self-confidence and protect against antenatal and postnatal depression. Baker & Taylor (1997) specifically propose that social support may constitute a causal link between deprivation and health such that those with lowered socio-economic status may have poorer health because their lack of social support increases their vulnerability to physical and psychological morbidity. As part of the Avon Longitudinal Study of Pregnancy and Childhood (ALSPAC), these authors assessed 9208 pregnant women for depressive symptoms. Data were collected by self-completion questionnaire at eight weeks pre and postpartum. Responses on an eight-item social support questionnaire tapped different aspects of perceived support and, at each point, results showed significant associations between maternal deprivation and depression, and depression and low social support. Moreover, levels of social support changed as a consequence of the transition to motherhood and the extent and direction of this change was consistently associated with the presence or absence of depression.

Ultimately, the many different sources of support that are available to an individual can be represented as a social network. Within this network, one source of support that can impact substantially on maternal wellbeing is that of the partner. Chapman et al. (1997) recently examined the extent to which men's underestimation of the stress reported by their pregnant female partners influenced women's psychological distress and the sense that they were not supported. Women who reported a greater number of stressful life events suffered from increased depression if their partners did not report them as encountering these events. However, if their partners reported them as encountering a high number of stressful events, the otherwise negative impact of stress was buffered. A partner's stress report had no appreciable effect when women reported a low number of stressful events. Elsewhere, dissatisfaction with the marital relationship or rejection of the pregnancy by a male partner has also been linked with poor maternal adjustment and negative mood, both during pregnancy and in the early postpartum period (Pitt, 1968; Paykel et al., 1980; O'Hara et al., 1982; 1983; Elliot et al., 1983; Kumar & Robson, 1984; O' Hara, 1986; Anderson et al., 1994).

According to Wheatley (1998) primary sources of psychosocial support during pregnancy may not only include partners, close relatives and good friends but might also extend to include health professionals such as general practitioners, midwives and obstetricians. A number of studies have certainly examined the extent to which professional caregivers may also be able to buffer the effects of psychosocial stress. Oakley et al.(1990) for example, compared the effects of a supportive antenatal intervention with a standard programme of obstetrical care. The antenatal intervention consisted of 24-hour contact telephone numbers and a series of home visits during which midwives offered a listening service and provided practical advice and information when asked. Compared to the control group, significantly fewer of the women in the intervention group expressed concern regarding the outcome of their pregnancies. This accepted, neither Oakley et al. (1990) nor Olds et al. (1986) could demonstrate that a supportive intervention significantly influenced levels of maternal depression. For the most part however, the perceived availability of social support is accepted as an effective coping resource and may have a substantial impact on a woman's experience of pregnancy.

2.4.3 Negative Health Behaviours

In instances where the psychological symptoms of stress occur, an individual's propensity to engage in negative health behaviour will often increase. Smoking in particular has been reported to compensate for poor material conditions and for low levels of emotional and practical support (Graham, 1987, Oakley, 1989). Indeed, as Oakley (1993) states:

"... while smoking may be considered a risk to the fetus, it is very often a mechanism by means of which the mother acts out her responsibility to that child, to her other children, and to everyone for whom she cares, as smoking helps her to cope and to claim some authentic activity and personal space in an otherwise crowded and impossible life."

(Oakley, 1993, pp.136)

Further work has only served to confirm the occurrence of this pattern despite the fact that mothers are aware of its impact on their own and their child's health (Oakley, 1989). Previously, Newton & Hunt (1984) have demonstrated that both smoking and reduced clinic attendance are more likely among mothers suffering severe stress and more recently, Pritchard & Teo Mfphm (1994) have found smoking in pregnant women to be associated with household strain.

Weinmann (1981) argues that some stress-reducing strategies are chosen simply because they can immediately reduce the symptoms of negative affect. However, by coping in this way, many women may be adopting strategies that will cause irrevocable harm elsewhere. Excessive alcohol consumption is known to cause severe birth defects (Jones et al., 1973) and some reports have even shown that there are identifiable cognitive and behavioural deficits in children born to "social drinkers" (Streissguth et al., 1990). Likewise, maternal smoking has long been associated with increases in infant mortality and morbidity (Cnattingus et al., 1988; Kleinman et al., 1988). Wilcox (1993) delineates that pregnant women who continue to smoke more than 10 cigarettes a day will deliver on average, infants that weigh 200g less than those of non-smokers. Other evidence

suggests that maternal smoking may also affect children's subsequent physical (Goldstein, 1971) and mental development (Olds et al., 1994).

Such findings clearly demonstrate the extent to which maternal psychological wellbeing may impact on individual patterns of behaviour. By resorting to smoking, drinking or substance abuse, feelings of anxiety, tension and depression may all be temporarily relieved. Unfortunately however, these individualistic coping strategies may also serve to threaten fetal health and heighten the risk of an adverse pregnancy outcome.

2.4.4 Summary: Factors That May Moderate Psychological Wellbeing in Pregnancy

This section has demonstrated that pregnant women may contend with the stresses of the reproductive experience in a variety of ways. An individual's cognitive appraisal of stress may be mediated both by internal personality factors and by the external environment in which pregnancy occurs. Specific factors that have been addressed in this context include a high level of self-esteem, a perceived availability of social support and/or an increased reliance on negative health behaviours. As yet, the literature has been unable to clarify which of these moderating factors may be the most salient for any one individual. Nevertheless, what is apparent is that maternal psychological health during pregnancy may be influenced by a large number of interacting factors. Ultimately, if it can be shown that psychological health is related to maternal activity behaviour then these factors may be important influences on women's daily activity routines. The next section thus considers the potential association between an individual's level of physical activity and her psychosocial wellbeing.

2.5 The Association between Psychological Health and Physical Activity

The relationship between physical activity and psychological wellbeing is discussed in the following pages. Unfortunately, the national focus of most pregnancy-orientated research to date has been the reduction of infant mortality (Maloni, 1996). Most clinical studies have therefore assessed the consequences of maternal physical activity in terms of

fetal health, with very few measures of maternal satisfaction or psychological health being recorded. Elsewhere, psychosocial studies have documented both the normal and psychiatric experiences of pregnancy but rarely in the context of women's daily activity patterns. The end result is that comparatively little is known about the degree of interdependency that might exist between the two. The vast majority of evidence that is available emanates from research conducted within the general population. Within this context, researchers have considered both the effects of structured exercise and the impact of more generic lifestyle behaviour. The cumulative result of this work is that physical activity and psychological health appear to be related to one another in a bi-directional manner.

2.5.1 The Psychological Benefits of Exercise: Evidence from the General Population

“Physical activity is positively associated with good mental health.... when mental health is defined as positive mood, general wellbeing and relatively infrequent symptoms of anxiety and depression”

(Stephens, 1988, pp.41)

There is considerable evidence from the general population to suggest that physical activity is a means by which both physiological and psychological stress may be relieved (Steptoe, 1992). In 1984, the US National Institute of Mental Health formulated several consensus statements suggesting that physical fitness was positively associated with mental health and that exercise was negatively associated with symptoms of anxiety and depression (Morgan & Goldston, 1987). Since this time, several reviews of physical activity and mental health have been published and conclusions have almost always been positive (North et al., 1990). A meta-analysis of the anxiety reducing effects of exercise concluded that exercise has a small to moderate effect on both state and trait anxiety (Pertuzzello et al., 1991) and this has since been confirmed by Long & van Stavel's (1995) meta-analysis of exercise training studies. Other meta-analyses have been reported on the effects of exercise on depression, self-concept and self-esteem, cognitive

functioning, stress reactivity, personality and mood. The results from these studies are summarised in table 2.1.

Table 2.1: Effect Sizes from Meta-analytic Reviews of Exercise and Mental Health (Biddle, 1997).

Study	Outcome Variable	Activity Measure	Mean Effect Size
Long & van Stavel (1995)	Anxiety: i) within group (pre-post)	Aerobic fitness training	0.45
	ii) contrast group		0.36
Thomas et al (1994)	Cognitive functioning	Exercise	Range: -0.09 – 0.48
Petruzello et al (1991)	Anxiety: i) state	Exercise	0.24
	ii) trait		0.34
	iii) psychophysiological indicators		0.56
McDonald & Hogdon (1991)	Anxiety: i) state	Aerobic fitness training	0.28
	ii) trait		0.25
	Depression		0.97
	Mood		Range: -0.18 – 1.12
	Personality & adjustment		0.33
	Self-concept		0.56
North et al (1990)	Depression	Exercise	0.53
Crews & Landers (1987)	Stress reactivity	Aerobic fitness	0.48
Gruber (1986)	Self-esteem	Directed play & PE in children	0.41

(Positive mean effect sizes indicate positive psychological effects for exercise/fitness)

Evidence that links physical activity to psychological wellbeing in the general population ultimately comes from a number of different sources. At the anecdotal level, those who exercise regularly often comment that they feel better, have more energy and require less sleep (Bruess & Richardson, 1995). Elsewhere, regular exercise has been reported to reduce fatigue, reduce hostility, result in less hypochondria and improve self-concept (Brill & Cooper, 1993; Sacks, 1993). Comparisons drawn between the mood profiles of elite athletes or college sport players and the mood profiles of sedentary groups have also identified characteristically lower scores on scales of tension-anxiety, depression and confusion, as well as greater mental vigour amongst the physically active (Morgan & Pollock, 1977; Gondola & Tuckman, 1982). Analogous psychological benefits have also been observed at the epidemiological level. Farmer et al. (1988) document for example,

that symptoms of depression correlate cross-sectionally with a lack of recreational activity in American adults.

It must be acknowledged however, that some findings in this field may remain hampered by potential confounding variables. People do not choose to exercise at random and there may thus be underlying differences between active and inactive people that are themselves responsible for differences in mental health (Steptoe, 1992). This possibility is endorsed by the fact that personality differences have previously been found between fit and unfit people (Hogan, 1989). Such findings raise the possibility that cross-sectional comparisons of active and sedentary individuals can at best provide only weak support for the beneficial effects of exercise. The preferred alternative therefore, is to consider findings from longitudinal studies.

2.5.1.1. Longitudinal Studies of Exercise

Many longitudinal studies of the effects of exercise training on psychological wellbeing have been published. To date, trials have been carried out on a wide range of target populations including students, volunteers from the general adult population, elderly groups, people with psychiatric or medical disorders and members of specific groups such as the military and police. Virtually no researchers have shown aerobic exercise to have a deleterious effect on psychological health (Steptoe, 1992) and wherever exercise has been compared with control conditions, the vast majority of studies have demonstrated greater psychological improvements in the active group (e.g. Veale & Le Fevre, 1988; Blumenthal et al., 1989; Moses et al., 1989; Norris et al., 1990). These differences have been observed not only in anxiety and depression but also in measures of perceived coping abilities, self-efficacy and general indicators of mental health (Steptoe, 1992).

However, even in these studies there are additional methodological issues that must be taken into account. One salient consideration is the fact that comparisons between exercise and no treatment groups can never distinguish entirely between genuine

responses and alternative influences on emotional health. The maintenance of a physical training programme is after all, a complex phenomenon that may in itself have a non-specific yet beneficial effect (Steptoe, 1992).

Three specific problems that have confounded much research in this area concern the attention that is paid to active individuals, their expectations of the training programme's effects and their ongoing progression through a structured activity. All of these factors may combine to exert a positive effect on psychological wellbeing. Indeed, one set of treatments for clinical depression is largely based upon the principle of progressively engaging patients in constructive and rewarding activities (Lewinsohn & Hoberman, 1982). As Steptoe (1992) observes it is therefore possible that a group-based treatment which involved acquiring a sedentary skill could lead to improvements in mental health commensurate to those produced by more vigorous physical activities.

To overcome such problems, several studies have compared physical activity with active control conditions. Both McCann & Holmes (1984) and Roth & Holmes (1987) randomly assigned mildly depressed students to either aerobic exercise, relaxation training or no treatment conditions. Blumenthal et al. (1989) compared the effects of aerobic exercise with those of yoga whilst a supportive study group was employed by Fasting & Gronningsaeter (1986) in their long-term investigation of the unemployed. All of these studies reported that aerobic exercise produced a greater mood change than their respective control conditions. In conclusion therefore, it appears that physical exercise can indeed exert a positive effect on psychological wellbeing, over and above that which may be attributed to other factors.

2.5.2 The Benefits of Routine Activity: Evidence from the General Population

In contrast to the vast literature pertaining to physical exercise, comparatively little research has investigated the extent to which more inherent lifestyle activities may also contribute to an individual's emotional wellbeing. Morris & Hardman (1997) claim, for instance that although the pleasurable, therapeutic, psychological and social dimensions

of walking are evident, they have rarely been studied within the context of an occupational or domestic routine.

Because general mobility enables individuals to meet even the most fundamental of daily tasks, levels of habitual activity (as distinct from levels of formal exercise participation) are often presumed to play a particularly important role in promoting the wellbeing of the elderly (Shephard & Montelpare, 1988). It does not therefore seem unreasonable to consider that daily activity may also play an important role in fulfilling the needs of other populations.

Irrespective of age or health for example, Maloni (1996) recognises that many physical tasks allow independent living. According to Fallowfield (1990) dependency on others for the necessities of life can, for many people, cause a fundamental role loss with a concomitant loss of self-esteem. Any change in circumstance that prevents such activities from being performed is thus likely to increase psychological stress and precipitate a change in emotional wellbeing, particularly if sources of practical and/or emotional support are lacking. Durnin (1992) however, emphasises that psychological benefit may not always accrue from physical activity that has been forced upon an individual because of the nature of their situation. Obligatory activities may themselves incorporate a substantial stress component and it may therefore be hypothesised that many of the psychological advantages of maintaining an active lifestyle are likely to be confined primarily to volitional pursuits.

This accepted, Ehlers et al. (1988) argue that a disruption of any regular, social activity may trigger the onset of depression. These authors presented a hypothesis based upon a concept of '*social zeitgebers*', that is personal relationships, social demands or tasks that serve to entrain biological rhythms. Within this hypothesis, a chain of events was envisioned by which instability of social rhythms may lead to instability in specific biological rhythms. This instability then initiates a change in somatic symptoms, which if not mediated by protective factors at the individual level, will develop into a major depressive episode. In this way, the increased somatic symptoms that precede depression

can be considered a normal social and psychobiological response to a disruption in social rhythms. The extent of rhythm instability is ultimately thought to be a function of the strength of a particular relationship, task or demand to act as a 'social zeitgeber'.

The concept that social factors may synchronise circadian rhythms is not new (Wever, 1985). Hofer (1984) examined the role of relationships as psycho-biological regulators and established that, when an individual lives with a marital partner, they will typically synchronise their rhythms to those of their partner. Meal times, sleeping times and times of activity and rest thus represent compromises between two people's natural rhythms. If a partner is lost, not only is there emotional pain, but there is also the loss of a primary social zeitgeber. The loss of a job is also potentially associated with the loss of a potent zeitgeber (Ehlers et al., 1988).

In summary therefore, it appears that, in the general population at least, the maintenance of an active lifestyle may have a number of distinct advantages. Physical exercise participation may impact directly on a diverse range of psychological outcomes. In addition, more general lifestyle activities may facilitate independent living, increase social interaction and provide access to much-needed resources. Moreover, the maintenance of a daily routine may also serve to maintain social cues and protect against the disruption of certain biological rhythms. Many of these effects occur independent of age and gender and are therefore also likely to extend to pregnant women.

2.5.3 Direct Evidence from Pregnant Populations

Given that the main focus of the present study is on pregnancy, it is important to review the limited number of studies that have directly considered the association between pregnant women's psychological wellbeing and physical activity behaviour. Just as an extensive literature has developed to link exercise with affective changes in the general population, some similar work has been replicated with regard to volitional exercise in pregnancy (Sibley et al., 1981; Wallace & Engstrom, 1987). As discussed in Chapter 1 (Section 1.3.4.3), physically active pregnant women may benefit from an improved body

image, a higher level of self-esteem and a reduction in depressive symptoms (Derosis & Pellegrino, 1982; Wallace et al., 1986; Dewey & McCrory, 1994). In addition, exercise conditioning has been reported to reduce pain perception during labour (Varassi et al., 1989).

Elsewhere, the impact of more habitual lifestyle activity has also been considered. Within this context it may be assumed that the positive effects observed in the general population will invariably extend to include women during pregnancy and evidence certainly exists to support such a notion. Curtis (1986) for example studied 30 high-risk pregnant women, 15 of whom had been confined to bed rest and 15 who had not. The women who were prescribed bed rest displayed significantly higher levels of anxiety, depression, increased somatic complaints and emotional and intellectual lability than did their more active counterparts.

It may be argued that the psychological distress that was observed in the above study will have arisen more from participants' perceptions of a threatened pregnancy than from any restriction of their physical activity. However, Mackey & Coster-Schultz (1992) studied 20 high-risk women involved a programme of activity restriction at home, all of whom reported feelings of isolation, boredom, confinement and depression. In this particular case it was emphasised that stress not only resulted from worrying about the progress of pregnancy and the possibility of preterm birth but also from restricting activity when individuals felt physically well.

In attempting to explain anxiety among women whose preterm labour is stabilised, Monahan and DeJoseph (1991) suggest that activity restriction may be a more salient factor than pregnancy risk because there is a negative correlation between anxiety and bed rest but not between anxiety and length of gestation. More recent studies have shown total activity restriction to be associated with feelings of anxiety and hostility (Maloni et al., 1993), and alterations in mood and energy (Timm & Henderson, 1994). One important explanation for this finding is that home based activity restriction will inevitably manifest in some loss of control (Monahan & DeJoseph, 1991). Durham

(1998) examined the behavioural responses of individuals involved in the home management of preterm labour and found that demands from relationships, households and careers often competed with the prescription of bed rest. In such situations, many women resorted to cheating strategies that, to some extent, allowed them to manage both their activity restriction and the broader aspects of their daily life.

Evidently, pregnant women of a low risk status will not experience total activity restriction, but they may still find that their daily routine is variously affected by somatic complaints, lower energy levels and an increasing body mass (McMurray et al., 1993). In addition, the concerns of the women themselves, or the reactions of others, may deter them from engaging in certain activities and discourage public outings (Unger & Crawford, 1996). It is therefore both possible and probable that, if daily activity is not maintained, typical sources of stress relief such as social companionship, entertainment and physical recreation may all decrease. This loss of activity may in turn negatively affect maternal psychological health. Certainly, Anderson et al. (1994) found that one particular construct that correlated with mood during pregnancy and the postpartum was that of social boredom. Women with more depressive moods were more inclined to wish they could socialise more and claimed that their lives lacked variety. Earlier studies by Affonso & Arizmendi (1986) and Nicholson (1988) also reported women with depressive moods to experience feelings of isolation and decreased time for social activities during the early postpartum period.

During pregnancy then, as during any other stage of the lifecycle, the maintenance of daily activity may have several psychological gains. These gains include a sense of independence, a perceived sense of control over daily events and an opportunity for social interaction, which in turn may provide access to a variety of personal and social resources. In discussing these advantages however, it must also be acknowledged that not every individual will derive the same level of satisfaction from the same activity, nor will they be equally as reluctant to relinquish the same pursuits. As Artal (1991) delineates, pregnancy may in some instances, be a means by which to avoid other important life tasks that a woman is afraid to confront. Alternatively, it may simply represent a period

during which certain cultural expectations are removed and sedentary behaviour is legitimised. As documented in section 2.3.2.4, some authors have considered the notion that pregnancy may temporarily relieve women of their concerns regarding diet and weight control (Unger & Crawford, 1996). As yet however, no similar studies have been conducted with regard to the effect of pregnancy on physical activity. Further research is therefore required to investigate this issue.

2.5.4 The Impact of Mood on Physical Activity

In discussing the various psychological benefits that may accrue from physical activity, one must also acknowledge the fact that an individual's emotional health can itself impact on daily functioning. Correlational research suggests that individuals who experience high levels of stress often show a greater tendency to perform behaviours that increase their chance of becoming ill or injured. In particular it has been suggested that stress may result in an increase in the consumption of alcohol, cigarettes and coffee and a reduction in the amount of exercise taken. Recently, Stetson et al. (1997) asked a group of women exercisers to keep track of their stressful life events, levels of perceived stress and levels of exercise participation over a period of 8 weeks. Both the number of stressful events and perceived levels of stress in a week were found to be associated with less physical activity and more missed exercise sessions. The women reported that the stressful events were usually minor but they led to more time pressure to complete their usual tasks and this restricted their time for physical activity.

Other psychological affects can have similar consequences. Depression for example, is known to reduce daily activity and an alteration in motor activity is an observable clinical phenomena of depressed patients (Lemke et al., 1997; 1998; Lemke, 1999). Conversely, positive states of mental health may motivate physical activity involvement (Dishman et al., 1985). The association that exists between mood and physical activity must therefore be considered a bi-directional relationship.

2.5.5 Summary: The Association Between Psychological Health and Physical Activity

Within the general population, a substantial body of literature testifies to the fact that physical activity has long been associated with positive affect. Some similar work has also been replicated with regard to pregnancy. Structured exercise in particular has been credited with numerous psychological gains. These gains include an improvement in body image, an increased level of self-esteem and a reduction in depressive symptoms. Likewise, the maintenance of habitual lifestyle activity may also have its advantages. Daily activity has previously been postulated to facilitate independent living, foster a sense of control over events and encourage social interaction. All of these factors have the capacity to influence the appraisal of stress and maintain an acceptable level of emotional wellbeing.

Just as physical activity can impact on psychological health however, psychological health can also impact on physical activity. Thus, given the range of variables that may influence maternal psychological wellbeing, it is evident that a woman's physical behaviour during pregnancy may be affected by number of different factors. Any study that investigates the determinants of maternal activity must therefore account for some, if not all, of these variables.

2.6 Other Potential Influences on Maternal Daily Activity Levels

The previous sections of this chapter have served to identify some of the factors that, through their association with maternal psychological wellbeing, may influence women's physical activity patterns during pregnancy. There may however, be other factors that could impact directly on maternal daily activity levels and these also demand attention.

2.6.1 The Nature of Previous Research

To date, a substantial amount of research has investigated the determinants of physical activity within the general population. Unfortunately most of this work has focussed on

the general category of vigorous physical exercise and as such, can do little to facilitate our understanding of more ubiquitous activities performed by pregnant women as part of their daily routine. In the absence of more suitable evidence however, this work provides a valuable insight into the range of factors that may impact on women's activity pursuits during the reproductive process.

Previously, a wide range of theoretical models have been used to help researchers identify the important factors involved in determining human behaviour. The most notable among these are summarised in table 2.2. Some of the older theoretical models, such as the Health Belief Model (Rosenstock, 1966) and the Theory of Planned Behaviour (Ajzen, 1985) are almost entirely psychological in their content. These models assume that individuals make rational decisions regarding the costs and benefits of performing a chosen behaviour. Within this context, a woman's attitudes towards physical activity are considered one of the most salient determinants of her participation. More recent theories however, highlight the importance of a broad range of personal, social and environmental factors.

Unfortunately, none of the theoretical models that currently exist can explain all the complexities of physical activity behaviour. This is because the performance of exercise is frequently under the control of more immediate situational factors such as the availability of time or the proximity of facilities. For this reason, previous studies of the determinants of physical activity behaviour have not always been based on well-known theories. Indeed, some investigators hypothesise that new variables, or even combinations of variables from multiple theories, may be most effective in explaining exercise participation. Much research has thus attempted to discriminate between active and inactive individuals on a wide range of sociodemographic, biological and psychological factors. Within these studies, no single variable has been found to explain the majority of adult physical activity. However, certain variables have received consistent support for an association, both with physical exercise and with physical activity more generally. It is therefore possible that these variables may also influence maternal physical activity during pregnancy.

Table 2.2: A Summary of the Theories and Models used in Physical Activity Research

THEORY/MODEL	INFLUENTIAL COMPONENTS
Health Belief Model (Rosenstock, 1966)	<ul style="list-style-type: none">• General health values• Perceived susceptibility to health threat• Perceived severity of health threat• Perceived effectiveness of action against health threat• Perceived cost/benefit of action
Theory of Reasoned Action (Fishbein & Azjen, 1975)	<ul style="list-style-type: none">• Perceived outcome of action• Perceived benefits of outcome• Behavioural intention• Subjective norms• Motivation to comply with norms
Theory of Planned Behaviour (Ajzen, 1985)	<ul style="list-style-type: none">• Perceived outcome of action• Perceived benefits of outcome• Perceived behavioural control• Behavioural intention• Subjective norms• Motivation to comply with norms
Transtheoretical Model (Prochaska &DiClemente, 1982)	<ul style="list-style-type: none">• Stage of change• Perceived cost/benefit of action
Social Cognitive Theory (Bandura, 1986)	<ul style="list-style-type: none">• Outcome expectations• Behavioural capability• Self-efficacy• Observational learning• Reinforcement
Ecological Models (e.g Sallis & Owen 1997)	<ul style="list-style-type: none">• Multiple personal, institutional & community factors.

2.6.2 Sociodemographic Influences

Current research evidence indicates that, within the developed world, patterns of physical activity can differ substantially by age, sex, education and income (Ford et al., 1991). King et al. (1992) reported on a study that evaluated the factors that predicted leisure-time activity in adults. In this instance the typical profile of an active individual was described as being comparatively younger, better educated, more affluent and more likely to be male. Similar variations have been reported elsewhere. The U.S. Surgeon General’s

report on physical activity and health (U.S. DHHS, 1996), gives an account of the demographics of physical inactivity from recent population studies. Women are more likely to be inactive than men, levels of vigorous physical activity tend to decrease with increasing age and the prevalence of inactivity is found to increase with lower levels of education and income. It must be acknowledged however that whilst less affluent and less educated individuals may be more sedentary in their leisure time they may ultimately perform a significantly higher level of physical activity at work. Thus, whilst a significant relationship undoubtedly exists between physical activity and sociodemographic circumstances, it is less likely that the same relationship will hold for more generic levels of lifestyle activity. As a consequence, the full impact of sociodemographic circumstances on maternal daily activity during pregnancy remains unclear.

2.6.3 Physical Discriminators

Irrespective of an individual's sociodemographic circumstances, physical activity will, to some extent, always be dependent on health. Several studies have therefore sought to discriminate between active and inactive people solely on the basis of their physical attributes. Prior to 1988, most research conducted within the general population demonstrated that overweight people were less likely to participate in exercise programs than those who were not overweight (Dishman & Sallis, 1994). Explanations for this finding not only included the fact that exercise may be harder for overweight individuals to perform but also the possibility that leaner people, who typically have more active lifestyles prior to exercising, may be more capable of incorporating physical activities into their routine (Dishman, 1982). However, more recent studies have been consistent in finding no association between obesity and physical activity (Dishman & Sallis, 1994). The full impact of an individual's health status on their physical activity level thus remains equivocal.

Even when consideration is given directly to pregnancy, the strength of association between physical activity and physical health is hard to establish. During pregnancy weight gain is likely to be more rapid than at any other stage of the lifecycle and there

will inevitably be other artefacts, such as joint laxity or generalised fatigue, that may decrease a woman's ability to exercise (McMurray et al., 1993). It is thus often assumed that pregnant women will voluntarily choose to economise their energy expenditure by limiting certain activities. Previous studies have indeed demonstrated a tendency for pregnant women to reduce their levels of physical exercise as pregnancy progresses. Clapp et al. (1987), for example, studied both running and walking and noted a decline in the spontaneous level of exercise as pregnancy progressed. Women running at 74% of aerobic capacity prior to conception reduced their exercise intensity to 57% by 20 weeks of gestation and further to 47% by the 32nd week. However, when other more obligatory forms of activity are considered, the actual extent to which such economising will be possible may be limited by financial or domestic constraints. Further research is therefore required to establish the nature and strength of association between the physical experience of pregnancy and women's activity patterns during this time.

2.6.4 Personality

In addition to being influenced by physical wellbeing, an individual's activity level may also be determined by specific aspects of their personality. Although debate currently continues over the exact number of factors that best characterise personality, a review of the relevant literature discloses strong support for two very clearly marked and important dimensions. These two factors, named '*extraversion-introversion*' and '*neuroticism*', are believed to contribute more to a description of personality than any other set of factors outside the cognitive field (Eysenck, 1975). In effect, the typical extravert is,

'sociable, likes parties, has many friends, needs to have people to talk to and does not like reading or studying by herself. She craves excitement, takes chances and generally likes change.'

(Eysenck & Eysenck, 1975, pp.9).

By contrast, the typical introvert is,

'a quiet retiring sort of person, fond of books rather than people, reserved and distant'

except to intimate friends. She does not like excitement, takes matters of everyday life with proper seriousness and likes a well-ordered mode of life'

(Op Cit, pp.9).

From these definitions, it is evident that personality traits may impact directly on an individual's pattern of daily activity. Certainly, Halverson et al. (1994) document that activity is both a theoretical and empirical facet of extroversion and Tryon & Williams (1996) claim that adult personality is broadly relevant to physical activity measurement. Any study that investigates the determinants of physical activity should therefore always consider this influence.

2.6.5 Individual Attitudes & Intentions

Another factor that may potentially influence a woman's participation in physical activity is her attitude. The notion that personal attitudes towards physical activity and exercise may influence the adoption of an active or sedentary lifestyle certainly has intuitive appeal. People who come from families where exercise is practised (Sallis et al., 1988), who have positive attitudes towards physical activity (Kendzierski, 1990) and who believe that people should take responsibility for their own health are more likely to get involved in exercise programs than are people who do not (Dishman, 1982). Nonetheless, individual attitudes towards physical activity do not appear to predict participation in the long-term. Indeed, those who have a positive attitude toward exercise and health are just as likely to drop-out of structured exercise programs as those who do possess such attitudes (Dishman, 1982).

One specific motivation for participating in physical exercise may be the belief that it is enjoyable and provides social contact. Anecdotally, many people claim that they do not engage in physical activity simply because they do not enjoy it. In one early study, Riddle (1980) documented a tendency for non-joggers to believe that exercise required too much time and too much discipline. Compared to joggers, they also reported a lower belief in the positive effects of jogging and a lower belief in the extent to which significant others

valued this activity. Sallis et al. (1989) also found that a measure of agreement with the statement '*lack of enjoyment from exercise*' was moderately and inversely correlated with exercise frequency.

This accepted Azjen's (1985) Theory of Planned Behaviour, argues that intention rather than attitude is likely to be the primary determinant of behaviour. In a review of 12 studies of physical activity, Godin (1994) reported that the correlation coefficient between an individual's intention to exercise and their actual level of exercise participation ranged from 0.19 to 0.82, with a mean of 0.55. The magnitude of these correlations undoubtedly provides support for Azjen's theory. However, there are circumstances when good intentions do not always predict the right behaviour. Godin et al. (1993) for instance, found that although attitudes, habits and perceived behavioural control predicted the intention to exercise there was no association between any of these variables and the subsequent performance of physical exercise. It is therefore unclear whether a woman's attitudes towards physical activity in pregnancy, or even her intentions towards physical activity, will be related to her actual behaviour during this time.

2.6.6 Health Locus of Control

Despite the ambiguities described above, it is generally assumed that individuals will be more likely to gather health information and perform a range of health promoting behaviours if they believe that they control their own health (Strickland 1978; Wallston & Wallston 1981). The vast majority of research in this area has centred on Wallston's, (1978) multidimensional health locus of control (MHLC) scale. This construct measures generalised expectancy beliefs with respect to health along three dimensions. The internal belief scale assesses the extent to which people believe that different health events are a consequence of their own actions and thereby under personal control. In contrast, the external scale assesses the extent to which individuals believe that health is determined by chance. Finally, the powerful others scale measures the extent to which different health events are perceived to be under the control of other people. This latter scale is

only believed to be predictive of health behaviours recommended by a health professional.

Previous studies have examined the health locus of control construct in relation to alcohol consumption and smoking habits (Calnan, 1989; Norman, 1990; Dean, 1991), breast self examination (Smith et al., 1990; Nemeck, 1990) and weight loss (Schifter & Ajzen, 1985). Other studies have focussed specifically on the relationship between HLC beliefs and participation in physical activity. Slenker et al., (1985) compared the beliefs of joggers and non-joggers and found joggers to possess more internal health beliefs. Elsewhere, internal HLC beliefs have also been linked to attendance at work site fitness programmes (O'Connell & Price, 1982) and to participation in a range of physical activities high in caloric expenditure (Carlson & Petti, 1989). However, a number of other studies document much weaker relationships (Calnan, 1989; Norman, 1990; Rabinowitz et al., 1992). Some authors thus believe that more specific expectancies such as self-confidence or self-efficacy may be of greater predictive value (Bandura, 1986; Biddle & Mutrie, 1991). The concept of self-efficacy is discussed in greater detail in section 2.6.7.

Following the publication of Wallston's MHLC scale, Labs & Wurtele (1986) developed the fetal health locus of control scale (FHLC) specifically to study the health-related behaviour of pregnant women. This scale addresses the issue of whom the pregnant mother believes is responsible for the normality and health of the child to be. The internal (I) sub-scale measures the extent to which the mother believes that she is responsible for the health of the fetus. The powerful others (P) sub-scale measures the extent to which she believes that medical professionals are responsible for the health of the fetus and the chance (C) sub-scale assesses the extent to which the mother believes chance will determine her baby's health.

In the initial validation study Labs & Wurtele (1986) used the scale to predict the performance of health related behaviour during pregnancy and found that high internal sub-scale scores were associated with positive maternal health behaviours during

pregnancy. Internals on the scale were both less likely to be smokers and less likely to consume caffeine. They were also more likely to display strong intentions to attend childbirth classes and to learn techniques to control pain during labour and delivery. More recently, Walker et al. (1999) investigated psychosocial and demographic factors related to health behaviours in the first trimester of pregnancy. In this study, a self-care inventory gathered data relating to women's dietary habits, levels of substance abuse, recklessness, hygiene-related practices and rest and exercise behaviours. Higher scores on the internal dimension of the FHLC were once again related to more positive health behaviours. It is therefore highly possible that scores on the FHLC scale will show a significant association with maternal daily activity levels.

2.6.7 Self-Efficacy

As stated previously, self-efficacy may also be related to levels of physical activity participation. Self-efficacy effectively represents the summary of a person's processing of many kinds of information about a behaviour and constitutes the degree to which an individual believes they can successfully execute that behaviour. It thus remains distinct from outcome expectations, or an individual's belief that the performance of a behaviour will produce a specific outcome.

Within the context of physical exercise, the vast majority of research has shown self efficacy to be a strong predictor of adult participation in physical activity even in the presence of other factors such as gender and exercise history (Marcus et al. 1994; McAuley et al., 1994). This relationship has been observed both in cross-sectional (Sallis et al. 1989) and prospective studies (Sallis et al., 1992). However, Biddle & Mutrie (1991) point out that little is known about the way in which self-efficacy may impact on different physical activity settings outside of structured exercise participation. Within the physical activity field self-efficacy is a person's confidence in his or her ability to do specific physical activities in specific circumstances. Thus, the more specific the measure the more highly it should be related to physical activity outcome. Nonetheless, an

investigation of the relationship between self-efficacy and more general lifestyle activities may necessitate that a more generalised measure be taken.

2.6.8 Barriers to Participation

Ultimately, the adoption of physical exercise may be influenced by an individual's perceptions of the number of barriers preventing their participation. In a 2-year study of the determinants of exercise for example, both the number of baseline barriers and the change in these barriers were found to be related to months of exercise participation (Sallis et al., 1992). In this instance it was not clear whether the proffered lists referred to true reasons or to convenient excuses but irrespective of whether ratings represent objective or subjective reality, there always remains a strong and consistent relationship between these barriers and participation in physical exercise.

Recently, Calfas (1994) factor analysed a scale of 18 potential barriers in a group of university students and alumni. Four main factors were revealed. These factors consisted of inconvenience, worries, competing demands and aversiveness of activity. In an earlier study Steinhardt & Dishman (1989) had identified four major barriers relating to a lack of time, required effort, excessive obstacles and limiting health. However, whilst these results support the type of barriers identified in other descriptive epidemiological surveys (Canada Fitness Survey, 1983; ADNFS, 1992), the precise nature of the barriers that an individual identifies will invariably depend upon their own circumstances, their gender and their age. In a sample of women who were interested in starting exercise, for example, lack of time was cited as the primary barrier, with reasons for lack of time including work and school, childcare, and household duties (Johnson et al., 1990). It is unlikely that the same perceptions would be held by men. Other barriers endorsed by the women were a lack of money, a lack of facilities, the lack of a partner and a feeling that exercise was boring. As yet no similar work has focussed directly on the number or nature of barriers perceived by pregnant women but the ubiquity of these variables undoubtedly makes them important to study.

2.6.9 Social Norms

When identifying barriers to physical activity participation, social circumstances and perceived social norms may be considered as extremely important influences (Allison et al., 1999). Wherever exercise is made more convenient, or is tied to one's social system, adherence is likely to be higher (Wilhelmson, 1975). It is therefore not surprising to find that both in cross-sectional and prospective studies, social support from friends and families is consistently related to physical activity behaviour (Dishman & Sallis, 1994).

During pregnancy, current cultural expectations may impact on an individual's normative beliefs and encourage a reduction in maternal physical activity levels. However, whether or not these beliefs are actually sufficient to alter a pregnant woman's behaviour is not yet clear. It has previously been established for example, that the point of greatest disagreement between mothers and health professionals lies in the notion espoused by mothers and not by doctors that pregnancy and childbirth are not inherent illnesses but episodes of health (Oakley, 1993). This is not to say that many women's experiences of pregnancy do not have characteristics in common with illness, for several studies have shown this to be the case (Sadler, 1992). Rather, it is that the context of the two events remains distinctly different. Thus, whilst a doctor may view an individual's progress as an isolated patient episode, abstracted from the rest of life's experiences (Oakely, 1993; Scott & Niven, 1996), a woman considers pregnancy and childbirth to be dynamic processes carrying numerous implications for other aspects of her existence. Such a notion may thus limit the extent to which women will be prepared to reduce their physical activities during pregnancy. Further research is needed before the influence of social norms on maternal behaviour patterns can be stated definitively.

2.7 Chapter Conclusions

This chapter has considered the psychosocial experience of pregnancy and identified some of the factors that may impact upon maternal behaviour at this time. Current research evidence suggests that a combination of sociodemographic, biological and

psychological variables may ultimately influence the physical activity levels of individuals. However, despite a widespread awareness of these relationships within the general population, the precise determinants of activity in pregnancy remain unknown. This observation serves to highlight a general lack of information regarding the integrated daily activity levels of low-risk pregnant women in contemporary Western society. Akin to work undertaken on leisure based activities of non-pregnant females (Kay, 1995), the majority of evidence that is available is fragmented and second hand, culled from studies that are primarily concerned with other topics. Hence, a comprehensive review of the literature may currently hint at the range of activities performed by pregnant women but as yet it is able to tell us little about the pattern, the stability or even the determinants of any one routine.

Ultimately, it may be argued that an accurate conceptualisation of maternal activity behaviour during pregnancy is not necessary, providing that the association between activity behaviour and pregnancy outcome is firmly established. However, until the time we know more about the range of everyday activities that such women undertake, we cannot pretend to know what types of behaviours may be deemed 'normal', nor how instruction to alter ones physical activity may be interpreted. In order to be effective, future standards of antenatal care must rest on a fundamental and accurate understanding of women's behaviour during pregnancy. It is therefore considered a research priority to document maternal activity patterns during pregnancy and to identify the primary factors influencing this behaviour. The present study aims to address this issue by asking the following questions:

- (i) How does pregnancy impact on the daily activity levels of healthy, British nulliparous women?
- (ii) What are the determinants of maternal daily activity behavior in low-risk pregnancy?
- (iii) What are the perceived benefits and barriers to physical activity in pregnancy?

- (iv) Is there a relationship between total maternal daily activity level and pregnancy outcome?

To answer these questions, an appropriate methodology for assessing maternal daily activity levels during pregnancy needs to be established.

CHAPTER THREE

Methodological Considerations in the Measurement of Daily Activity

3.1 Introduction

From the review of literature in Chapter One it was decided that the current study should obtain an accurate and composite measure of all forms of physical activity that pregnant women undertake. However, before physical activity can accurately be measured, it needs to be defined (Hensley et al., 1993). Traditionally, the term physical activity has been used to refer solely to the effects of occupational exertion or volitional exercise. As has already been demonstrated however, '*daily activity*' is not always synonymous with these interpretations of physical activity. Indeed, according to Booth (2000), the different aspects of daily life in which physical activity may take place not only include recreational pursuits and occupational demands but may also extend to include gardening and yardwork, household chores and moving from place to place. This chapter thus considers the range of physical activities that the present study should address and determines how this activity can most accurately be measured.

3.2 The Range of Activities That Need to be Measured

Perhaps it is precisely because physical activity has so many dimensions and influences that previous studies have chosen to concentrate on the separate effects of employment and exercise, for these admittedly are the two components that reflect the most prominent secular trends of our time. However, as a consequence of extracting these activities from the wider context of daily lifestyle, little is known about the pattern or effects of work performed elsewhere. The preferred trend is for conventional measures to leave much of women's work undocumented and, by doing so, severely underestimate a subject's participation in physical activity (Barnes et al., 1991). The idiosyncrasy of this approach is clearly reflected in the words of Magann et al. (1996) who state that,

“To assess the effects of daily activity on pregnancy outcome employment energy expended must be added to daily activity and should include domestic work in the home, leisure ventures and athletic activity.”

(Magann et al., 1996, pp.182)

Thus, in investigating integrated daily activity several different domains of physical activity must be considered. In addition, it is recognised that periods of maternal *inactivity* may also contribute to levels of 24-hour energy expenditure, albeit a small amount. Thus, any measurement of daily activity during pregnancy must not only assess levels of occupational, domestic and recreational activity but also consider women's resting behaviour and nocturnal activity. Ultimately, if questions are not asked about all these types of activity, true daily activity will not be measured and vital information may be lost. For example, as pregnancy progresses an individual may cease to be active at work or in sport yet may increase her contribution to the running of the home. Similarly, she may become more restless at night but start to nap during daylight hours. Considering one component without the other would therefore be unwise.

3.2.1 The Dimensions of Physical Activity That Must be Addressed

A second important consideration is the differential nature of the activity information that must be measured. Caspersen (1989) states that physical activity is a multi-dimensional behaviour that cannot easily be condensed into a unitary measure. Likewise, Washburn et al. (2000) believe that frequency, intensity, duration and mode of activity are all necessary to provide an accurate picture of physical activity behaviour.

Past measures of pregnant populations have intended to assess various combinations of posture (Koemeester et al., 1995); activity over a specific duration, intensity or frequency (Klebanoff et al., 1990; Clapp & Capeless, 1990) and total energy expenditure (Magann et al., 1996). This range, in conjunction with the literature reviewed in Chapter 1, reveals how the precise physical activity stimuli that may cause adverse effects on pregnancy outcome have not yet been definitively identified. Because of this, the measure used in

the current study needs to address multiple dimensions of physical activity. At the very least these measures must include:

- An assessment of the frequency, duration and intensity of maternal activity participation
- An assessment of maternal posture
- An estimation of daily energy expenditure
- An estimation of occupational, domestic, recreational and nocturnal energy expenditure

Together, these measures should provide a more detailed and comprehensive profile of activity behaviour over the course of pregnancy.

From a more practical perspective, the chosen tool must also be capable of being administered on a repeated measure basis, for without such a capability the possibility of longitudinal variations in maternal activity levels cannot be explored. According to Avons et al. (1988) the main challenge in epidemiological research is to accurately measure the low levels of activity displayed by the most inactive Western women. The chosen method must therefore not only be sensitive to large shifts in maternal physical activity behaviour but must also be able to detect the much smaller changes that may occur in more sedentary women. Having established the above criteria it becomes possible to identify the most suitable measurement technique.

3.3 Methods of Measuring Daily Physical Activity

Daily activity is, in essence, a composite measure of all components of physical activity occurring within a 24-hour time period. Thus, to appreciate the range of methods by which daily activity can be assessed, the variety of ways in which physical activity can be measured must also be acknowledged. Unfortunately, Avons et al. (1988) claim that the accurate measurement of physical activity within the community is fraught with difficulty. It is therefore not surprising to find that as many as 30 to 40 different

procedures for assessing physical activity have previously been proposed (Hensley et al., 1993), often with high initial expectations that have not always been met (Norgan, 1992).

The principal methods that have been used to study physical activity are summarised in Table 3.1 and can be seen to range from observational through physiological and mechanical, to self-report. Conventional techniques for the assessment of activity levels include actometry and pedometry, accelerometry, heart rate monitoring and diary records. The following sections discuss these methods and consider their applicability to the current study.

Table 3.1: Methods of Assessing the Habitual Physical Activity levels of Populations

General Type	Examples	Techniques
• Observational		
• Physiological ⇒	Caloric intake Oxygen consumption ⇒⇒	Douglas bag method Doubly labelled water technique
• Mechanical ⇒	Heart rate Pedometers Actometers Electronic Motion Sensors	
• Self report ⇒	Diary annotation Questionnaire assessment ⇒	Self administered Interviewer administered

3.3.1 *Observational Assessment*

An individual’s participation in physical activity is influenced by many different environmental factors including his or her location, the presence or absence of others and the range of facilities available. Observational assessment can provide detailed, objective information on all of these variables without placing the burden of response on the subject. Consequently, it is often considered a valuable method of documenting patterns of behaviour over time (Baranowski et al, 1987).

Observational assessment has proved particularly useful in quantifying and classifying children’s activity patterns, not least because it overcomes some of the difficulties

associated with recall ability in young subjects (Melanson & Freedson, 1996). One example of its use in an adult population however, is that of Benefice et al. (1996), who adopted observational methods in order to measure the physical activity patterns of Senegalese women over a complete seasonal cycle. In this instance, activity levels of both pregnant and non-pregnant women were monitored by direct observation for a total of 12 hours a day. The observations were maintained for three consecutive days on the first visit and two consecutive days on all subsequent visits. Female surveyors were specifically trained to observe subjects on a minute-by-minute basis and record the appropriate code for the intensity of the activity they performed. In addition, the reason for specific tasks and the location of the activity being undertaken were recorded at 15-minute intervals.

To be most accurate, the sampling interval employed should be sensitive to brief periods of activity and not exclude short bursts of physical behaviour (Melanson & Freedson, 1996). Technological advances facilitate this procedure by enabling complex observational codes to be entered, stored and analysed by portable computer (McKenzie & Carlson, 1989). Nonetheless, certain disadvantages are also associated with such techniques (McKenzie, 1991). Firstly, the events that are studied must be observable and amenable to pre-specified coding procedures and are therefore usually limited to events that are seen or heard. Secondly, observers must be present in the environment in which the activity occurs and as a result can initiate reactive behaviour.

To ensure that recorded data provides the best representation of a true activity pattern, observers must be trained to reduce subject reactivity and be objective in their own judgement. The provision of training programmes however, like the preparation of coding conventions, is often costly and time consuming. Observational assessment ultimately requires a good deal of diligence on the part of the researcher (Cale, 1993) and as a result, is rarely considered appropriate for a population study.

3.3.2 Physiological Assessment

3.3.2.1 Caloric Intake

If an individual can be assumed to be in approximate energy balance, then one of the simplest, cheapest and most traditional methods of quantifying physical activity is to determine energy intake. A variety of methods may be employed to accomplish this task although one of the most common necessitates a subject to recollect what has been eaten over 24 hours. Cale (1993) acknowledges that this 'recall method' is the most practical but also reports that problems may be encountered. Often, the accuracy of data obtained from food records is affected by the subject's ability to recall and describe the amount of food consumed. Acheson et al. (1980) for example, reveal that depending on the type of questionnaire used, dietary recall can result in an underestimation of caloric intake of 21 - 33%. By comparison, reliance on a subject to weigh their food and estimate caloric content from food tables can result in an underestimation of approximately 7% (Acheson et al., 1980).

Further problems arise in the primary assumption that energy consumption and expenditure are in equilibrium. According to Garrow (1974) this assumption is only correct if energy intake is measured over at least 5 days and any changes in growing body mass are taken into account. Given however, that pregnancy is not only a time when body mass will increase, but also a time when nausea can decrease food intake, the error involved in approximating energy expenditure from caloric intake is likely to be high.

3.3.2.2 Oxygen Consumption

An alternative method of determining the energy costs of various activities is through the direct quantification of oxygen consumption. This, in turn, can be achieved either by whole body calorimetry (Dauncey & James, 1979), the 'Douglas bag' method (Croonen & Binkhorst, 1974) or the more innovative 'doubly labelled water' method (Prentice et al., 1984).

The traditional approach to measuring energy expenditure requires a subject to wear a mask or nose clip and to breathe, via a mouthpiece, into a Douglas bag. This technique utilises an open circuit respiratory system in which the volume of expired gas is measured and a sample analysed for its oxygen and carbon dioxide content. Such an approach has been shown to accurately calculate energy expenditure to within a range of -2 to $+4\%$ (Croonen & Binkhorst, 1974). Unfortunately, the necessity of wearing a facemask can interfere considerably with daily activity and this restricts the applicability of the technique in the field setting (Cale, 1993). To overcome such difficulties, Durnin & Passmore (1967) suggest that oxygen consumption can simply be measured for a few characteristic activities. An activity diary can then be kept and daily energy expenditure predicted from these data. The disadvantage here however, is that the accuracy of the data then relies upon the recall ability and co-operation of the subjects (Acheson et al., 1980).

More recently, total daily energy expenditure has been quantified by means of the doubly labelled water (DLW) technique. Originally developed by Lifson et al. (1955) the rationale for this approach arises from the use of oxygen in energy metabolism and the elimination of carbon dioxide as the product of aerobic respiration. Success necessitates that an individual simultaneously consumes a quantity of two stable isotopes of water (H_2^{18}O and $^2\text{H}_2\text{O}$). Within several hours the isotopes dilute in the body and their subsequent disappearance rates are monitored by isotope ratio mass spectrometry (Davies, 1992). The disappearance rate of $^2\text{H}_2\text{O}$ reflects water output whilst that of H_2^{18}O reflects both water output and carbon dioxide production. Thus, by measuring the concentrations of labelled hydrogen and oxygen in the urine and the concentration of oxygen and carbon dioxide in the expired air, oxygen consumption and integral energy expenditure can be calculated for a specific time period (Klein et al., 1984).

The advantages of the technique are that it is reported to be very accurate, simple and non-invasive (Seale et al., 1990). Schoeller (1983) highlights the possible sources of error with the technique based on the results of measurements in 17 subjects between the ages of 8 and 34 years. A theoretical coefficient of variation in energy expenditure was calculated and was found to be between just 4 and 8%. Similarly, Schoeller & Van

Santen (1982) report a non-significant over-estimation (2.1%) compared with dietary intake over 13 days.

Evidence suggests that DLW estimates are most accurate if monitoring is carried out over a 6 to 14 day period (Schoeller et al., 1986). However, the technique does not discriminate between different activity patterns nor permit evaluation of exercise intensity (Melanson & Freedson, 1996). It also displays high running costs and requires considerable expertise. Consequently, its operation is often restricted to use in controlled clinical energy balance studies or related research settings (Hensley et al., 1993, Norgan, 1992).

3.3.2.3 Heart Rate

Of all the physiological variables, heart rate is probably one of the easiest to register with least interference to the subject. This method has thus become a popular means of measuring physical activity.

Different techniques may be used to record heart rate, including telemetry, tape recorders and solid state recorders. All are based on the accepted principle that heart rate is linearly related to energy expenditure. Montoye (1975) documents that, when work is carefully controlled, oxygen consumption (VO_2) and heart rate are closely related and their relationship is linear over most of the range that measurements are taken. Moreover, Ceesay et al. (1989) report that the satisfactory predictive power and low cost of the method make it suitable for many field and epidemiological studies.

It must be noted however, that the resting heart rate, the slope of the heart rate response and the maximum heart rate may vary from one subject to another. Also, at any given workload, a subject may display day to day variation in heart rate (Clapp, 1998). A variety of exogenous factors can influence the measured variable and make the interpretation of continuous heart rates problematic. High ambient temperature, humidity and emotional state have all been shown to raise heart rate despite oxygen consumption remaining constant (Payne et al., 1971; Anderson et al., 1981). Compounding this

problem further however, is the knowledge that heart rate responses will be influenced by the muscle groups that are employed in the activity and the type of contraction that occurs. For instance, even though the energy cost of two activities may remain the same, heart rates are typically greater when physical work is performed solely with the upper limbs than when the upper and lower limbs are used in tandem (Payne et al., 1971; Anderson et al., 1981). Similarly, isometric (static) exercise has been shown to raise heart rate above that expected on the basis of the work load undertaken (Hansen & Maggio, 1960).

An additional issue surrounding the utility of heart rate measures is the length of the monitoring that is required to characterise habitual physical activity. In adults especially, low heart rates are generally observed during normal everyday activities and Dauncey & James (1979) demonstrate that the accuracy of the heart rate measure is particularly poor over this lower range. As a consequence Durant et al. (1993) report that just over 4 days of recording are necessary to achieve a reliability of 0.80. Such concerns have led researchers away from translating heart rate responses into continuous energy expenditure equivalents (Cale, 1993). This accepted, Wareham & Rennie (1998) suggest that the technique may be of value in moderately sized epidemiological studies, or as a validation tool for questionnaires.

Kalkwarf et al. (1989) studied the accuracy of heart rate monitoring for measuring energy expenditure in 12 free-living adult women. Estimates of energy expenditure were calculated from heart rate monitoring by use of four different prediction equations. Energy intake adjusted for changes in body energy stores was used as reference and heart rate monitoring was found to overestimate group energy expenditure by 2 to 9%. However, errors in estimating individual energy expenditure were reported to range from -53 to 67%. More recently, Li, et al. (1993) evaluated the prediction of energy expenditure from minute-by-minute heart rate recordings in 40 female workers. Results revealed that the relationship between energy expenditure and heart rate varied greatly both between and within subjects. The authors concluded that to have the best estimates of individual energy expenditure, individual calibration curves must be used. Moreover,

these curves should be generated on more than one occasion and the calibration procedure should include a wide range of different physical activities.

It should be acknowledged however, that heart rate may be a particularly unreliable measure of physical exertion in childbearing women (Clapp, 1998). During early pregnancy, relaxation of the arteries and veins elevates both resting and exercising heart rates. As gestation proceeds, blood volume expands to fill the dilated vessels and, in turn, the amount of blood pumped by the heart each beat increases. As a consequence, exercise heart rates will gradually decline. Because cardiac output is rising however, resting heart rate will not fall. In the later stages of pregnancy, the combined effects of regular exercise and pregnancy serve to expand blood volume further, which then increases the amount of blood pumped with each beat and removes the need for a corresponding increase in heart rate during strenuous activity. Thus, as Clapp (1998) concludes, the exercise heart rate can only have value if it is continuously monitored, interpreted in the context of pregnancy and compared with other measures that reflect exercise intensity and physiological effect.

3.3.3 Mechanical Assessment

Most daily activities involve some element of physical activity which can in turn involve movement of the body, the trunk or the extremities. Several devices have thus been developed to obtain objective estimations of such movements over certain periods of time. The simplest devices for recording activity in this way can be categorised as either (i) mechanical or (ii) electrical motion sensors.

3.3.3.1 Mechanical Motion Sensors

The most common example of a mechanical counter is that of the pedometer (Lauter, 1926). Worn at the ankle or the waist, this unit effectively consists of a lever arm balanced by a delicate spring. With each step the impact of the foot striking the surface causes the lever arm to move vertically (Gayle et al., 1977). This movement is then

passed through a gear assembly and registered in a counting mechanism (Meijer et al., 1991).

Despite the fact that pedometers are simple to operate and cause little inconvenience to the subject, Montoye and Taylor (1984) report that commercially available brands should not be used in physical activity research. Hensley et al. (1993) also document that pedometers are not a recommended method of quantifying the amount of physical activity performed. Certainly, several studies have shown their reliability and validity to be poor (Saris & Binkhorst, 1977; Kemper & Verschur, 1977; Montoye & Taylor, 1984). The same pedometers have been shown to give different results when worn by different individuals (Gayle et al. 1977; Washburn et al., 1980) and to give varying readings depending on which side of the body the instruments are worn. This latter problem arises from the fact that an individual's walking gait rarely allows both feet to touch the ground with equal impact. Saris (1985) also notes that instruments can vary considerably due to variations in spring tension. The pedometer may be calibrated for stride length in order to convert steps into distance travelled (Stunkard, 1960) but has been shown to under- and over-estimate journey length at slower and faster speeds of movement respectively (Saris and Binkhorst; 1977; Washburn et al., 1980). A further disadvantage is that the pedometer does not reflect the intensity of movement (Meijer et al., 1991) and therefore differences in energy expenditure cannot be accurately assessed (Saris & Binkhorst, 1977). Moreover, because their operation remains dependent on a surface impact, such instruments are inappropriate for skiing, bicycling, isometric exercise and arm activities.

The actometer proposed by Schulman & Reisman (1959) provides a preferable alternative to the pedometer. Resembling a modified wristwatch in which the escape mechanism has been removed, this instrument is again worn on the wrist or ankle. Movement of the appropriate limb causes a rotor to turn which is then transferred to the hands of the watch (Meijer et al., 1991). The advantage of this unit is that it records both movement and intensity of the movement. The stronger the movement the faster the rotor will turn. Activity can subsequently be interpreted from the resulting time displayed on the instrument's face.

The actometer measures accelerations and decelerations in one plane and shows a fairly good correlation with energy expenditure under a variety of circumstances (Saris & Binkhorst, 1977; Avons, 1984, Avons et al., 1988). Researchers have employed actometers as indices of mobility and used their output to discriminate between the physical activity patterns of different individuals and different groups (Laporte et al., 1979; 1982). However, despite a good test-retest reproducibility (Schulmann & Reisman, 1959), the actometer shows very large inter-instrument variability which makes individual calibration essential (Meijer et al., 1991).

3.3.3.2 Early Electronic Motion Sensors

The first descriptions of electronic accelerometers date from the early 1970s (Morris 1973; Colburn et al., 1976). Their evolution is the logical consequence of the development of integrated circuits and the manufacture of devices small enough to be socially acceptable (Meijer et al., 1991).

One such example is the large-scale integrated motor activity monitor (LSI). Slightly larger than a wristwatch, this self-contained instrument can be worn on the arm, leg or hip (Foster et al., 1978). To register physical activity it relies upon a mercury switch sensitive to a 10-degree tilt in a single axis, the accuracy of which is thought to be comparable to that of the pedometer. (Meijer et al., 1991). Test-retest coefficients of 0.44 - 0.98 for a mercury switch on the wrist and of 0.1-0.85 for a switch on the waist have been previously reported in four subjects performing standardised activities (Montoye et al., 1983). Nonetheless, Montoye and Taylor (1984) identify at least two advantages compared with the pedometer. Firstly, because the counter operates on tilt rather than on impact, it may be applicable to a greater number of activities. Secondly, because mechanical springs are not employed, the standardisation of the different instruments should be improved. This accepted, correlations between self reported activity and LSI recordings are rarely more than modest (Patterson et al., 1993). Moreover, the cost of the device still prohibits its use in many research communities.

A second type of electronic movement counter is that of the uniaxial accelerometer. Although different types of sensor have been proposed (Morris 1973; Wong et al., 1981; Meijer et al., 1989), all make use of piezo-electrical ceramics, the characteristic property of which is that they evoke a charge when deformed in a given direction. The magnitude of the resulting voltage is directly related to the extension of the deformation (Meijer et al., 1989).

A large amount of empirical evidence shows a linear relationship between the integral of body acceleration and energy expenditure or oxygen uptake (Ismail et al., 1971; Bhattacharya et al., 1980). High correlation coefficients have been reported between accelerometer readings and energy expenditure as measured by indirect calorimetry under a variety of circumstances (Wong et al., 1981; Schutz et al., 1988; Meijer et al., 1989). In children, Janz (1994) demonstrated validity correlation coefficients between accelerometry and heart rate telemetry to range from 0.50-0.74.

3.3.3.3 Modern Electronic Motion Sensors

The development of the uniaxial accelerometer resulted in the design of the commercially available Caltrac (Muscle Dynamics Inc., Torrance, CA). This instrument is popular in physical activity research, not least because it is cheaper than many other devices and relatively easy to use. The Caltrac monitor is traditionally worn on the non-dominant hip and displays an approximate caloric expenditure based upon an individual's basal metabolic rate and total activity energy expenditure. Basal metabolic rate is estimated from the participant's height, weight, gender and age whilst energy expenditure from physical activity is measured by vertical acceleration (Cale, 1993). Hensley et al. (1993) suggest that the use of the Caltrac may be an affective tool for monitoring energy expenditure over several days. Nonetheless, most evaluations have been performed in the laboratory and do not provide information about the validity and usefulness of the instrument in free-living subjects (Bouten et al., 1996). Williams et al. (1989) report a minimal relationship between this instrument and established self report measures and claim its reliability to be poor. As with other motion sensors, the Caltrac does not

quantify energy expenditure in activities where the acceleration of the body is limited nor does not account for the added energy cost of running uphill or climbing stairs (Hensley et al., 1993).

Further advances in technology have resulted in the development of three-dimensional accelerometers specifically designed for physical activity research (Melanson & Freedson, 1996). Some utilise a triaxial design with individual sensors or switches for each axis whilst others rely on a single plate that deforms in response to movement in any direction but does not differentiate movement in each axis (Meijer et al., 1989; 1991). Comparisons with indirect calorimetry display significant relationships between accelerometer output and energy expenditure for physical activity during sedentary and walking activities ($r=0.95$) (Bouten et al., 1994a) as well as during a one day period of standardised activity in a respiration chamber ($r=0.89$) (Bouten et al., 1994b).

3.3.3.4 *The Possible Effects of Wearing an Activity Monitor*

According to Sadeh et al. (1995),

“The unique feature of actigraphy that differentiates it from early technologies is the ability to attach the device to the wrist or ankle of an individual for prolonged periods of time and provide continuous activity data with little interference or few limitations imposed on the subject.”

(Sadeh et al., 1995, pp.289)

Recent technological advances undoubtedly offer new methods for monitoring physical behaviour beyond the simple record keeping systems used previously. There is concern however that such procedures may themselves heighten behavioural awareness and influence daily activity patterns.

Behavioural monitoring refers to recording and paying attention to one's own behaviour (Cardinal, 1997). This in turn raises awareness of the behaviour and may also serve to

reinforce behaviour change. Certainly, Weber & Wertheim (1989) found that those who monitored their own exercise behaviour had significantly higher fitness centre attendance compared to those who did not. In contrast, Oldridge & Jones (1983) report that a combination of written agreement and behavioural monitoring did not increase the program attendance of a group of cardiac rehabilitation patients.

Zarnow (1995) used a Caltrac accelerometer to monitor her own physical activity behaviour over the course of one week and noticed an increase in both the quantity and intensity of exercise. It must be acknowledged however that, unlike many other accelerometers the Caltrac provides a continuous feedback of estimated energy expenditure on a liquid crystal display (Laporte et al., 1985). Cardinal (1997) examined the effect of providing such information to 23 females aged between 23 and 54 years. The ethnicity of participants varied such that 66% were Caucasian, 30% were African-American and 4% were Asian American. Individuals were randomly assigned to either an experimental or control group. The experimental group attended a one-hour educational program on the importance of physical activity and wore a Caltrac accelerometer for 14 days. Those in the control group also attended the educational program. The two groups did not differ in terms of age or ethnicity and behavioural monitoring was found to have no aggregate effect on either the participants' physical activity or on the psychosocial determinants of their exercise behaviour.

Crews (1993) suggests that the extent to which such physical activity monitoring affects behaviour may ultimately be related to individual differences and/or varying degrees of participant motivation. Nonetheless, Melanson & Freedson (1996) claim that, because they can easily be placed on a belt or in a pocket, motion sensors should be considered the least reactive of all physical activity assessment techniques. Certainly, Van Hilten et al. (1993a) evaluated inter-night and intra-subject variability in healthy subjects and revealed no significant first night, age or sex effect. Such findings tend to negate the view that adaptation to activity monitoring is required.

3.3.3.5 The Possible Effects of External Influences

One problem that may be more salient with regards the use of activity monitors may be the fact that all units are susceptible to external vibrations (Sadeh, 1994). Patterson et al. (1993) attempted to assess the effects of external vibration artefact during daily activity monitoring. Eight adult subjects, seven of who were female, were recruited to drive a pre-determined course that included residential, business district and freeway driving conditions. Vehicle and/or road surface vibration was found to have a large effect on the recording and analysis of actual physical activity. The percentage of actigraph readings that could be attributed to the actual driving ranged from 10 to 55%. As a direct result of this study, Patterson et al. (1993) maintain that when subjects drive vehicles of different makes, models, years and mechanical condition, any correction for vehicle driving artefact must be ultimately be done on a case by case basis. The larger the sample the less feasible this approach will be.

More recently however, Bouten et. al (1996) have demonstrated that vibrations due to transportation do not influence the original relationship between actigraph output and bodily activity. Ultimately, the effects of external vibrations are only believed to be of serious consequence when activities such as truck driving or heavy machine operation comprise an exceptionally large proportion of an individual's daily routine. Otherwise, as long as the limitations of activity monitors are acknowledged, a combination of ambulatory assessment and self report can be highly effectively in analysing human activity within its naturalistic context (Patterson et al., 1993).

3.3.4 Self-Report Assessment

As an alternative to mechanical measures, the quantification of physical activity often involves elements of self-report. To date, self-report instruments for physical activity assessment have traditionally been used in three main areas of investigation. These include epidemiological surveys, investigations into behaviour change and correlational studies (Baranowski, 1988). Epidemiologists have frequently utilised self-report

measures to study the relationships between physical activity and cardiovascular disease (Powell et al., 1987) or mental health (Brown & Lawton, 1986). By comparison, behavioural scientists have employed self-report measures as the dependent measure when testing methods for increasing physical activity (Dishman, 1982; Baranowski et al., 1984). Others have used similar forms in an attempt to identify exactly who does exercise, who does not and why (Sallis et al., 1986).

The three most common types of self-report measures that are used for quantifying physical activity levels include concurrent or end of the day diaries, retrospective reports on self-completed forms and retrospective interviewer-conducted forms. Each varies in the specificity with which mode, duration, intensity and frequency of activity are assessed (Cale, 1993). They also vary in the time period covered and in the nature of the resulting data. Data can effectively be reported as ratings, activity scores with arbitrary units, time, calories expended, or other summary scores.

3.3.4.1 Diaries

The diary method is a useful tool for measuring physical activity and has been used in a number of studies, although it is not appropriate for use with all populations. The technique requires a high level of co-operation from subjects (Montoye & Taylor, 1984) and Hensley et al. (1993) fear that because recording activity is so time consuming, the method itself may interfere with normal daily activity. These authors claim that if a subject is asked to record all physical activity over a 48 hour period, the individual may be inclined to do less physical activity than normal simply because it is easier to record less data. Edholm (1966) recommends that, in keeping a diary, a prepared form and a simple code are useful. The code must be designed for the particular group of subjects under study and should encompass all the activities in which they are likely to engage. It has previously been found that approximately fifteen code letters can adequately cover the habitual activities of most individuals (Cale, 1993).

The detailed monitoring of activity minute by minute throughout the day is often undertaken in conjunction with measurements of the energy cost of typical activities. Van Raaij et al. (1990) adopted this approach to study the energy cost of physical activity throughout pregnancy and the first year postpartum in 25 Dutch women with sedentary lifestyles. Five measurement points occurred throughout pregnancy and four during the first six months postpartum. A final measurement was taken at 1 year postpartum. At each point, BMR was measured by indirect, open-circuit calorimetry. Common household tasks were categorised as quiet sitting, sitting, standing or walking activities and the energy cost of at least one task from each category was measured in every subject. The study participants subsequently kept detailed physical activity diaries for 5 consecutive days. Activity record cards covered a 24-hour period and had been divided into small squares each equivalent to one minute. Daily activities were divided into seven categories according to work posture and constituent movements. Each time a woman engaged in a new activity, the code letter for the appropriate category was written in the corresponding time square. Activities of less than 1-minute duration were not recorded. Eventually, a physical activity index (PAI) was calculated from the activity pattern data and activity costs.

Unfortunately, a study such as that described above can demand much of both the investigator and the volunteer under study. Moreover, when the diary method is used to collect information over a relatively short period of time, the long-term pattern of habitual activity may not be measured. Anderson et al. (1978) suggest that if diaries are to be useful, they must be kept for at least several days. Entries must be made on weekends and weekdays and sampling should, wherever possible, take account of seasonal variations.

3.3.4.2 Self-Completion and Interviewer-Conducted Questionnaires

According to Paffenbarger et al. (1993) the instrument of choice for physical activity surveys is the questionnaire. Many refinements in the design and layout of questionnaires have been achieved and recent attention has centred on aspects of standardisation and

independent validation of the best available examples (Paffenbarger et al., 1993).

Baranowski (1988) acknowledges that retrospective reports are convenient to administer, comparatively cost effective, unobtrusive and non-reactive. Furthermore, they may cover details of activity for the previous days, weeks, months or even years and can be used to measure a variety of physical activity variables over time. Questionnaires are an extremely versatile measure of assessment and may assess the duration, intensity and frequency of an activity, the location and social environment in which it occurs and even the self-generated reasons for participation or non-participation. They can also be used to provide evidence of associations between physical activity, physiological fitness and health status. Not all are interchangeable however and as Baranowski (1988) documents, individual instruments must be crafted to meet the perceived needs and strengths of the particular research problem.

A primary disadvantage of the self-report measure is that it may not sample all types of physical activity behaviour and, as such, may misclassify activity habits (Cale, 1993). Sallis (1991) remarks that actual observable behaviour is not directly assessed by self-report. Rather the suggestion is that the data reflects decayed memories of physical activity that have been filtered through perceptions and biases and tainted by social desirability or misunderstanding of instructions. According to Hensley et al. (1993) the accuracy of the instrument may ultimately depend on the respondent's level of education, age, gender, type of physical activity surveyed and time involved. The reliability and validity of self-report measures are reviewed in more detail in Section 3.5.

3.3.5 Summary: Methods of Measuring Daily Physical Activity

In the previous sections the different techniques by which daily activity can be assessed have been reviewed. Each method has been shown to have its own advantages and limitations. The doubly labelled water technique can be considered a highly accurate technique for assessing total daily activity yet, in many instances, remains too costly to be considered practical. Heart rate monitors and motion sensors appear to be the most objective alternatives although the former can be influenced by extraneous variables and

are not believed to be appropriate for use in pregnant populations. Activity monitors, diaries, observational methods and self-report measures all possess the ability to distinguish between different activity patterns but both diaries and observational assessment are hindered by potential reactivity. As a consequence, self-report measures are often regarded as the instrument of choice. Ultimately, whatever approach is taken, some degree of objectivity, reactivity, cost, validity or reliability has to be compromised.

3.4 The Selected Method

When consideration was given to the range of physical activity measures in existence and to the research resources available, it was felt that many of the aims of the current study could be achieved through a self-report measure. Indeed, as Sallis (1991) believes, *“it is reasonable to ask subjects to report their own physical activity because they have experienced it and many physical activities are salient events that even children are likely to remember to some extent.”*

Self-reports have been used in a range of ages and measures can be adapted to fit the needs of a particular population or research question (Sallis & Saelens, 2000). This accepted, a particularly pertinent problem with self reported data is the finite amount of information that can be gathered in this way (Baranowski, 1988). Several factors, such as the human cognitive process, the concentration and attention spans of the target population, and a need to keep mental workload at a level whereby participant interest and compliance can be maintained, all restrict the quantity and quality of data that can be obtained. Moreover, it cannot always be assumed that respondents will wish to answer correctly. A given individual may consciously or subconsciously want to deny personal involvement in certain daily activities for instance, if only because they believe that this will place them in a better position or that it is what the researcher wants to know.

Social desirability refers to the tendency of an individual to convey an image in keeping with social norms and to avoid criticism in a ‘testing’ situation (Hebert et al., 1995). The response bias that can result from social desirability can significantly obscure or distort

the measurement of the variable of interest. This effect could be particularly pertinent given the nature and context of the current research problem. For example, pregnant women have previously been shown to upward bias their estimates of total energy intake in a manner consistent with antenatal dietary advice (Hebert et al., 1995). It is therefore possible that these individuals would also downward bias their reports of physical activity behaviour so as to conform with current cultural expectations. Thus, it was concluded that the attainment of an accurate picture of women's daily activity patterns during pregnancy would necessitate a two tier investigative approach.

The best combination of methods to achieve the research objectives was considered to be a subjective self-report measure used in conjunction with an objective measure of daily activity. This objective measure would need to be capable of assessing free-living activity over a prolonged period of time, in a relatively large number of pregnant women. An ambulatory activity monitor was therefore identified as the most suitable technique.

3.5 The Characteristics of the Activity Monitor.

As emphasised in section 3.3.3 several studies have used uniaxial motion sensors to assess physical activity. These first generation accelerometers however do not have the capability to collect and store data by time and are therefore incapable of determining patterns of daily activity within a field setting. Triaxial accelerometers have some advantages over uniaxial monitors (Welk & Corbin 1995) but their larger size decreases participant compliance and acceptability (Nichols et al., 2000).

The activity monitor chosen for use in the current study was the "*Actiwatch AW2*" (Cambridge Neurotechnology Ltd.). This unit represents a new generation of compact and lightweight devices for measuring activity. It measures 27 x 26 x 9mm in size, is only 16g in mass and has the potential for a more complete assessment of physical activity patterns. Each actiwatch contains an omni-directional sensor able to detect motion in all directions. This sensor assesses daily body movement by integrating the degree and speed of movement occurring within a given period, or epoch. The actiwatch

has a variable epoch length of between 0.25-15.0 minutes. The resultant activity count is stored within an internal memory. At a 1-minute epoch the unit has a maximum recording capacity of 5.6 days.

Actigraphs are calibrated on production such that given exactly the same situation (person, placement, activity, position) they should give identical readings and record with an inaccuracy of less than 5% (N.Oakley, Cambridge Neurotechnology Ltd, personal communication, 1998). However, to obtain the most reproducible results a standardised Actiwatch mounting and positioning protocol had to be developed.

3.5.1 The Site of Attachment

According to Tryon (1991), body sites can be differentially active and the movement of one is never perfectly correlated with the movement of any other. As a result, there is no consensus regarding the preferred placement of actigraphs upon the human body.

McPartland et al. (1975) claim that the activity of the dominant arm typically reflects greater involvement in daily tasks and that, as a consequence, the non-dominant arm should be considered a closer approximation to total body movement. This accepted, Van Hilten et al. (1993b) examined diurnal and nocturnal motor activity in 20 healthy subjects and, when the two wrists were compared, found no significant differences between them.

Previously, Webster et al. (1982) had studied recordings taken from each wrist, one ankle and the forehead of nine subjects completing 22 overnight assessments. Results revealed that the activity monitors detected most activity when located on the wrists and that a slight, yet non-significant difference existed between the dominant and non-dominant arms. In contrast, Sadeh (1994) compared the differential effects of mounting an activity monitor on different sides of the body and reported the mean activity level of the dominant wrist to be significantly higher than that of its non-dominant counterpart.

Undoubtedly, many studies that have focussed on daily patterns of activity have chosen to use the wrist as the principal site of attachment (e.g. Renfrew et al., 1987; Brown et al.,

1990) but this location invariably introduces error from isolated upper limb movements. Patterson et al. (1993) suggest, that sedentary activities requiring higher than normal wrist movement can produced actigraph readings comparable to those of physical tasks. Similarly, Sadeh (1994) emphasises that the wrist is often placed over the chest or stomach during sleep and as such, can record movement induced by the breathing pattern of the body. To obtain a more accurate assessment of daily activities it has been advocated that monitors should be worn on multiple body locations such as the arm and the waist or the arm and the thigh (Patterson et al., 1993). In normal practice however only one accelerometer is used and anything more than this may cause discomfort or inconvenience (Westerkerp, 1999).

Van Hilten et al. (1993) evaluated the relationship between daily patterns of truncal motor activity and wrist activity. A significant difference between the wrist and the waist recording was demonstrated with the wrists recording higher activity levels than the trunk. Furthermore, both dominant and non dominant wrist recordings showed a gradual but significant decline across the diurnal period whilst truncal activity declined promptly in the evening. The authors concluded that it would be inaccurate to regard wrist motor activity as representative of an invariable percentage of truncal motor activity since the relationship between the two varied across the day.

From a theoretical point of view it seems that the sensor should ideally be placed on the trunk since this position represents most body mass and may best reflect whole body movements (Meijer et al., 1991). Moreover, such attachment locates the monitor close to the body's centre of gravity and allows accelerations to be measured with a high reproducibility (*Op cit*, 1991). In pregnancy however, an enlarged lower abdomen and greater waist-hip ratio may hamper this approach and reduce subject compliance. Fetal movements and respiratory artefacts may also be reflected in the measure.

Thus, for the purposes of this project, the ankle was selected as the preferred recording site. Such a decision reflected the assumptions that larger movements of the body will have the greatest influence on daily activity level and that the overall impact of smaller

limb movements (fidgeting) will be negligible. Certainly, Sadeh et al. (1995) suggests that ankle placement could conceivably overcome some of the artefacts associated with wrist actigraphy and may more appropriately reflect gross movements in wakefulness. Ultimately, it is believed that recordings taken from the lower limb will distinguish adequately between large movements, postural shifts and periods of inactivity and activity without causing significant discomfort to subjects

3.5.2 Preliminary Study (1): Focus Group on the Proposed Use of an Activity Monitor

This section reports on a study that was undertaken in order to investigate the feasibility of the proposed activity monitoring technique. Previous studies have demonstrated the value of activity monitors in the assessment of daily activity (see section 3.3.3) but few of these have been conducted within the context of pregnancy. The one exception is that of Shinkoda et al. (1999) who recently used wrist actigraphy to study changes in the sleep-wake cycle of 4 women in late pregnancy and at 3 months postpartum. The limited knowledge in this area thus necessitated a flexible and exploratory method for conducting a preliminary examination of the relevant issues. For this reason, a focus group discussion was chosen as the most appropriate method. Focus groups involve bringing people together to conduct a form of collective interview. The method allows researchers to interact directly with respondents and provides an opportunity to obtain large and rich amounts of data (Stewart & Shamdasani, 1990). The primary objectives of the current work were (i) to explore women's interest in the research, (ii) to examine their attitudes towards the use of activity monitors and (iii) to provide preliminary information in preparation for the main study (Chapter 4).

3.5.2.1 Sample

Women were recruited to the pilot study via advertisements in the local press and in a Leicestershire National Childbirth Trust (NCT) magazine. All pregnant women were invited to take part. Interested individuals received a parent information sheet and those who agreed to participate were contacted by telephone to arrange a mutually convenient

meeting time. 10 women were recruited, 5 of who were in the early stages of pregnancy (10-16 weeks gestation) and 5 of whom were in the later stages of pregnancy (32-36 weeks gestation). Participants' ages ranged from 24.1 - 37.4 years with a mean of 27.8 years (S.D 3.9 years). All women were volunteers and were not paid for their involvement in the discussion.

3.5.2.2 Study Design

The focus group discussion took place at a local community centre. The discussion lasted approximately 45 minutes in total with a short coffee break half way through. A schedule was prepared in advance in order to guide discussions. The moderator's role was to introduce items on the discussion schedule. There was no fixed order to the scheduled items and the moderator could encourage discussion of the items that arose naturally without prompting during conversation. A second observer recorded the discussion.

3.5.2.3 Results

Two main issues arose from the focus group study. These issues concerned (i) the acceptability of the activity monitoring technique and (ii) the need for certain accompanying materials. Both of these issues are discussed below.

3.5.2.3.1 The Acceptability of the Activity Monitoring Technique

The daily routines of the participants varied according to women's stage of pregnancy and working status. This variation in routine was found to influence individual opinions regarding the proposed method of activity assessment. Some participants expressed concern regarding the use of the monitor at work. This was primarily due to the fact that a few women in the early stages of gestation had not yet informed their employer of their pregnancy. For the most part however, there was considerable interest in the use of the activity monitor and it was felt that, where necessary, steps could be taken to disguise its use.

A variety of different strategies for overcoming the problems of the activity monitor were discussed. These strategies varied according to the nature of the job and its associated dress code. The most common strategy that was proposed was to wear a sock or trousers over the monitor. Where this was not possible, women felt that they would like to provide an alternative explanation for the monitor's use.

3.5.2.3.2 The Need for Certain Accompanying Materials

The desire to provide alternative explanations for the use of the activity monitor in early pregnancy highlighted the need for a detailed parent information sheet (Appendix 4). Women felt that this sheet should not only include instructions for use but should also provide several other scenarios in which activity monitors could be used. Ultimately, it was believed that this would assist women in providing a suitable explanation for the activity monitor and increase its acceptability of use in public settings.

In addition, the possibility of using an activity diary alongside the monitor was discussed. Initially it was thought that the use of such a form may aid interpretation of the data recorded by the activity monitor. However, the vast majority of women expressed concern regarding the use of a diary. Common problems that were envisaged included the concern that the diary would be too distracting to use when at work or when out socialising, prohibitively large to use discretely, difficult to understand and difficult to maintain for a long period of time particularly in formal circumstances or on repeated occasions. Most participants preferred the concept of an activity monitor without the use of the diary. Consequently, in order to maintain participant compliance in the main study, it was decided that an activity diary should not be used. Rather interpretation of the monitor data would be achieved through direct comparison with responses given to a physical activity questionnaire.

3.6 A Review of Existing Physical Activity Questionnaires

According to Lamb & Brodie (1990) there are currently at least 38 available questionnaires by which physical activity can be quantified. These instruments have been

developed for a variety of research purposes and follow a number of different formats. Both simple and complex questionnaires have been developed, some self-administered and others interviewer-completed (Kriska & Caspersen, 1997). Single item questions may ask individuals whether the person surveyed is more active than others of their age or sex (National Centre for Health Statistics, 1985) whilst more complex questionnaires attempt to survey specific activities over a designated time frame. The different characteristics of some of the most popular adult forms are summarised in table 3.2. This collection is not inclusive of all questionnaires in the field however and other well-established measures also exist (see Ainsworth et al., 1994; Kriska & Caspersen 1997; Montoye et al., 1996).

Not only do the questionnaires described in table 3.2 vary in complexity but they also utilise a number of different procedures for scoring daily activity. Physical activity levels have previously been reported as ratings, activity scores with arbitrary units, and more commonly, as estimates of energy expenditure.

Davies (1992) emphasises that physical activity is only one component of total energy expenditure (TEE). By far the largest contribution to TEE is basal metabolic rate (BMR). The difference between BMR and TEE represents the combined energy cost of thermoregulation, dietary induced thermogenesis, the energy cost of growth and the energy expended in physical activity. The first two of these components are comparatively small and after the first two years of life the energy cost of growth has also diminished to a negligible amount (Davies, 1992). Thus, the difference between TEE and BMR in children, adolescents and adults is primarily due to the energy expended in physical activity. The ratio of TEE to BMR, or resting metabolic rate (RMR), is used frequently as an index of physical activity and is often known as the physical activity index (PAI) or physical activity level (PAL). It has previously been calculated that a non-active individual would have a PAL value of 1.5 x BMR whilst an active individual spending 2 hours walking on the level at an average pace, would have an overall PAL of 1.9 (Department of Health, 1991).

Basal metabolic rate can be measured with relative ease using indirect calorimetry but

Table 3.2: Principal Characteristics of Common Adult Physical Activity Reports.

Questionnaire	Primary reference	Activity Assessed	Time frame of Recall	Mode of Administration
Health Insurance Plan	Shapiro, Weinblatt, Frank & Sager (1965)	Occupational & Recreational	Usual activity	Self / Interviewer
British Civil Servants	Alderson & Yasin (1966)	Recreational	Past two days	Interviewer
Tecumseh	Montoye (1971)	Occupational	Past year	Self
Paffenbarger	Paffenbarger, Wing & Hyde (1978)	Recreational	Usual activity	Self
Minnesota	Taylor, Jacobs, Shucker, Knudsen, Leon & DeBacker (1978)	Recreational & Household	Past 12 months	Interviewer
Framingham Physical Activity Index	Kannel & Sorlie (1979)	Sleep, Rest, Occupational & Extracurricular	Typical 24 hour period	Interviewer
Baecke	Baecke, Burema & Fritjers (1982)	Occupational, Sporting and Non-sporting Activities	Usual activity	Self
Godin	Godin & Shephard (1985)	Recreational	Usual activity	Self
7-day Recall	Sallis, Haskell & Wood (1985)	Recreational & Occupational	Past 7 days	Interviewer
Aerobics Centre Longitudinal Study	Kohl, Blair, Paffenbarger, Macera & Kronenfeld (1988)	Recreational & Household	Past 3 months	Self
Cardia	Jacobs, Hahn, Haskell, Pirie & Sidney (1989)	Recreational, Occupational & household	Past year	Interviewer
Historical	Kriska, Knowler & Laporte (1990)	Recreational	Specific life periods	Interviewer
Modifiable	Kriska, Knowler & Laporte (1990)	Occupational & Recreational	Past year & past week	Interviewer

measurement of total energy expenditure in the field setting is difficult. Thus, the Tecumseh study (Montoye, 1971), the 7-Day Recall (Sallis et al., 1985) and the Minnesota leisure time study (Taylor et al., 1978) all rely on estimates of energy expenditure based on established energy costs. The costs used in these questionnaires are expressed as ratios of work metabolism to basal metabolism (WMR/RMR) and given the units of METS. The basis of the calculation is that resting or basal metabolism (1 MET) requires 3.5 ml of O₂ per kilogram of body weight per minute. This is equal to approximately 1 kcal per kilogram per hour (Kriska & Caspersen, 1997; Ainsworth et al., 1993). Activities requiring 3 METS will therefore expend 3kcal/kg/hr. This method eliminates the necessity of considering the subjects body weight and assumes that a task performed by a heavy individual will raise the metabolism to a similar proportion as the same task performed by a lighter individual (Cale, 1993). Reiff et al. (1967) claim that since most activities involve moving one's own body weight, errors in making this assumption are rarely serious.

Several established questionnaires use energy costs derived from the work of Passmore and Durnin (1955). When using the 7-day recall questionnaire however, Blair (1984) recommends that the energy costs of Katch & McArdle (1977) should be employed. Other tables of metabolic costs have been produced by Torun (1983) and Bouchard (1983) although the most comprehensive measure available remains the compendium published by Ainsworth et al. (1993). Based on the 'best representation' from published lists and selected unpublished data, this classification system has the advantage of grouping activities by purpose and providing flexibility in determining energy costs. Much of the data is derived from actual measurement of adult subjects by indirect calorimetry, but where data are not available the figures have been estimated from the energy costs of activities having similar movement patterns. By using such tables in conjunction with measurements of the type, frequency, duration and intensity of activity performed during a particular period, a researcher can ultimately analyse data at several levels (Figure 3.1).

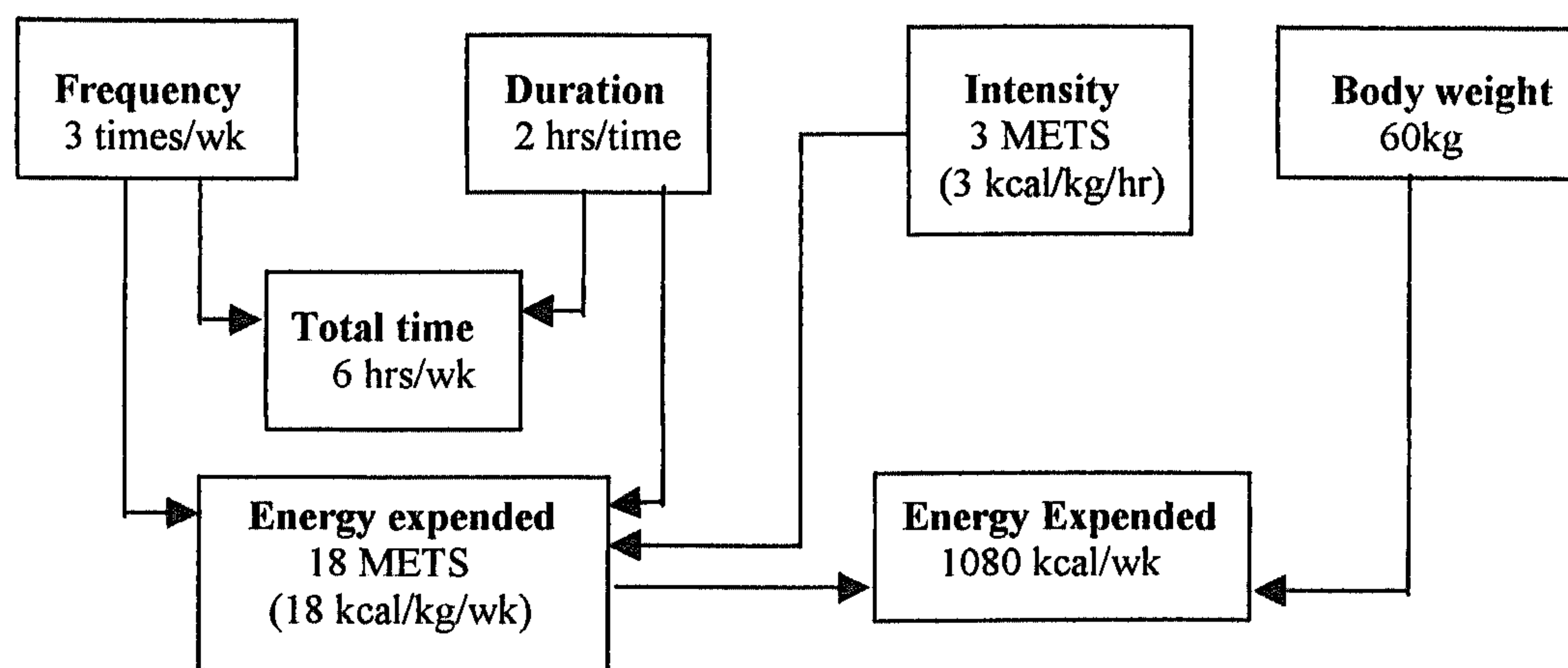


Figure 3.1: Computation of Summary Estimates of Physical Activity (Adapted from Kriska & Caspersen, 1997)

3.6.1 Limitations of Existing Self-Reports Measures of Physical Activity

The measures described in table 3.2 constitute popular examples of typical self-report adult physical activity measures. However, before employing any of these measures in the current study, their quality must be examined. There are several ways in which current self-report measures are limited for use in the present study. In particular, these concerns include (i) the reliability and validity of existing instruments and (ii) the general focus of their assessment.

3.6.1.1 The Reliability and Validity of Existing Self-Reports

Firstly, it must be acknowledged that existing measures of self-reported physical activity, and particularly those designed for use in pregnant populations, are often hampered by issues of reliability and validity. As Dishman & Steinhardt (1988) state, *“the minimal requirements of an instrument for the recall assessment of physical activity necessitate that it provide reliable and valid measurements, that its administration is feasible, and that it will not alter habitual physical activity patterns.”*

Nonetheless, Kriska & Caspersen (1997) state that the valid and appropriate measurement

of physical activity is a challenging task. Self-report instruments have been used extensively in the measurement of physical activity but many investigators have concerns about the accuracy of such measures (Baranowski, 1985; Powell et al. 1987). The reliability and validity of many self-report measures is reported to be poor (Lamb & Brodie, 1990) or unknown (Washburn & Montoye, 1986) and, as a result, data from physical activity self reports are often viewed with suspicion.

By definition, *reliability* represents the extent to which a measure can consistently provide the same results under the same circumstances. Conversely, *validity* assesses the degree to which an instrument measures what it is designed to measure (Kriska & Caspersen, 1997). Both of these parameters have traditionally been difficult to establish. There is no accepted criterion method for assessing physical activity (Baecke et al., 1982; Laporte et al., 1985; Melanson & Freedson, 1996) and therefore, the most appropriate way to assess reliability and validity is not yet known. Indeed, Hensley et al. (1993) remark that past methods of assessing physical activity have often been validated against criteria that are less than the “gold standard.” Popular objective tools include indirect calorimetry, movement counters and measures that estimate physical fitness such as heart rate monitoring or graded exercise testing (Kriska & Caspersen, 1997) but none of these are entirely error free. Baranowski (1988) suggests that observational methods provide one candidate for a gold standard but the extent to which an observer affects the level and the memory of activity performed has never been conclusively documented (Cale, 1993).

Similar problems are associated with the assessment of reliability. A test-retest procedure is traditionally the optimal method to examine instrument reliability (Lamb & Brodie, 1990) but, if the period of recall is more than 7 days and the subject is asked to recall activities from the same period as before, then such a result may be affected by memory. Alternatively, when a different 7-day period is assessed, the finding may be influenced by the stability of the subject’s physical activity behaviour. In acknowledging this problem, Jacobs et al. (1993) claim that a one-month re-administration of a questionnaire with a short time frame will measure both short-term behavioural stability and questionnaire

reliability. Moreover, this observation will apply increasingly more strongly the longer the interval between administrations.

The difficulties of reliability and validity assessment are further aggravated by the fact that the target populations to which the instruments have been applied often differ across studies. This makes it hard to compare coefficients and generalise published values (Baranowski, 1988; Cale, 1993). Nonetheless, Washburn & Montoye (1986) have published a summary for a selection of common self-report measures and Lamb & Brodie (1990) have provided a critical review of physical activity questionnaires in which validity and reliability, format and content, time to administer and mode of measurement are all included. More recently, Jacobs et al. (1993) have reported the findings of the SAFE study designed to evaluate the reliability and validity of ten frequently used activity surveys.

3.6.1.2 The Focus of Existing Self-Reports

In addition to issues of reliability and validity there are other problems which are just as difficult to rectify. Epidemiological research has traditionally been conducted on male populations and, as a consequence, questionnaire development has been orientated around the physical activity behaviour of men. Of significance however, is the fact that the physical activity patterns of men and women are known to differ, not least because men engage in more intense physical activity than women (US DHHS, 1996). Thus, many popular questionnaires may be insensitive to the differences in physical activity levels that occur amongst women.

Estimates from physical activity time and motion studies suggest that whilst women spend significantly less time in recreational and conditioning activities (Shaw, 1991; Ainsworth et al., 1999), large proportions of their day are taken up with occupational, household and family care activities. Indeed, Ainsworth (2000) documents how, in 1996, under the aegis of the Women's Health Initiative, 53 experts met for a two day meeting to discuss important issues related to measuring physical activity in female populations. The

range of activities identified as important in the lives of women included occupation; home chores and family care-giving; transportation; shopping; social, community or church involvement; personal (free) time and physical recreation activities.

Henderson et al. (1989) posit that for activities to be defined as leisure they must be in settings that include the elements of free choice, enjoyment, relaxation, personal involvement and self expression. Since it is doubtful whether many women will view household and family responsibilities as leisure experiences, simply asking women to complete a survey about their leisure time physical activity may be irrelevant. Rather, to provide better measures of women's habitual activity patterns, surveys need to be broad and inclusive of activities performed by these individuals in their everyday lives. Most prominent among previously ignored activities appear to be household tasks, walking, childcare and garden work.

Assessing the contexts in which people engage in physical activity is an undeniably important part of the content validity of a questionnaire. However, as discussed in Chapter 1, many studies of maternal activity in pregnancy do not account for physical effort in domestic work and therefore, even measures that have been developed specifically for this purpose may suffer from the weaknesses described above.

3.6.1.3 Pregnancy-Specific Measures

Given that previous studies have rarely examined the daily activity levels of pregnant women (see Chapter 1, section 1.5.2), it is not surprising to find that few self-report measures have been developed specifically for this purpose. However, one notable exception is that of Wildschut et al. (1993). These authors document the use of a short self-completion questionnaire for the assessment of habitual activity in pregnancy. The measure is designed to quantify occupational tasks, commuting behaviour, household activities and leisure pursuits, and includes questions that relate to both perceived physical and psychological burden. All of the information is collected by means of closed questions in which responses have been classified *a priori*. Wildschut et al. (1993) state

that the form was validated during its development by means of a structured in-depth interview.

More recently, Schramm et al. (1996) have used a postal survey to gather data on maternal employment and other daily activities. In this instance, one question is used to assess how frequently mothers engage in exercise activities before and during pregnancy. Examples are given of what was meant by vigorous activity and responses are coded as never, less than once a week, 1-2 times a week and 3 or more times a week. Women are also asked to describe the physical activity that they perform most often. Separate questions probe whether or not women are employed during pregnancy, the nature of the occupational tasks that they perform and the conditions of the environment in which they work. Other items gather data on activities such as stair-climbing, standing for 3 or more hours, engaging in strenuous household work and taking care of children. Similar approaches have been adopted by other researchers (e.g. Rabkin et al., 1990; Launer et al., 1990; Magann et al., 1996) and have been described previously (see Chapter 1, section 1.5.2). Rarely however do such self-report forms investigate daily activity at a level sufficient to detect temporal shifts in activity behaviour for example, nor do they provide an opportunity for respondents to offer self-generated explanations for any behavioural changes.

3.7 The Development of a Questionnaire For the Assessment of Daily Activity in Pregnancy

Once it had been established that maternal daily activity levels during low risk pregnancy could not be accurately assessed by existing self-report measures, it was necessary to design and develop a new measure. This measure would have an important role in the research, being a valuable data gathering tool that would obtain subjective information about women's daily activity patterns, experiences of pregnancy, attitudes and values.

3.7.1 Questionnaire Content

Given that the self-report measure was to be administered to more than one woman on more than one occasion, it was vital that the questions included within it had a specific purpose and order. Ultimately, by standardising the interview so that all respondents were asked the same questions in the same words and order, it was ensured that they were presented with the same stimuli and were responding to the same research instrument (Oppenheim, 1992). In total, the interview consisted of a maximum of 39 pages and took approximately 45 minutes to complete (see Appendix 2). To enhance recall the forms were divided into nine different sections organised roughly into different segments of the day (Baranowski, 1988). Within each section the foci of individual interview questions were developed from previous measures, from themes emanating from the literature and from pilot testing (see section 3.8).

3.7.1.1 Background Information

Section A of the questionnaire provided an explanation for the interview and asked for background information. This information included data relating to maternal age and current participation in health-related behaviours. Questions asked women to provide a self-reported measure of their smoking behaviour, level of alcohol consumption and drug use, dietary habits and attendance at parentcraft classes. The time-scale for these questions always referred to the last seven days prior to interview.

3.7.1.2 Occupational Activity

Sections B, C and D dealt with physical activity in paid employment, in a second job and during study. In accordance with the recommendations of Moser & Kalton (1971) a series of simple questions was employed to gather information on these broad and complex topics. Individuals were asked explicitly about their hours of work, the frequency and length of breaks they had taken, their mode of transport to and from work and the number of flights of stairs they had climbed in the workplace. Activities on the job were separated

into sitting, standing, walking, lifting, carrying and driving and individuals were required to estimate the proportion of the working day they had spent in each. Additional enquiries were made about exposure to occupational hazards and usual working posture. If an unsatisfactory response to a question was obtained, set probes were allowed (see questionnaire, appendix 2).

The time span for investigating levels of physical activity in previous studies has varied from two days to one year. On this occasion, women were always questioned about their activity in the last seven days prior to interview. Surveys with short time frames are known to have an advantage over those with longer time frames in that estimates of activity participation are less vulnerable to recall bias and more practical to validate (Kriska & Caspersen, 1997). They are also less likely to reflect an individual's 'usual' behaviour (Kriska & Caspersen, 1997) and are therefore more suited to studying variation in activity levels over time. Nonetheless, the inability to distinguish pregnancy-induced effects from exogenous influences on daily activity remained a concern for this research. Hence, wherever possible, an effort was made to minimise this problem by giving subjects the opportunity to provide reasons for their reported behaviour.

3.7.1.3 Domestic Activity

The next section examined domestic activity behaviour. The format for investigating daily household activity was derived from the Allied Dunbar Fitness Survey (1992). This study was chosen because it includes questions relevant to domestic tasks without incorporating pre-defined thresholds into the questions. Unfortunately, given the nature of the information that was required in this section, it was often necessary to ask respondents to recall varying lengths of activity in terms of minutes of participation. The difficulty of doing this accurately has been acknowledged by Baranowski (1988). Attempts were therefore made to make the task easier for respondents. The choice of questions separated their behaviour into specific events and then asked how frequently and for how long they performed each one. Respondents were asked explicitly about the

different amounts of time that they spent in light and heavy housework, light and heavy gardening and DIY.

The categorisation of domestic tasks into different intensities of activity also possessed other advantages. Booth (2000) warns that the extent to which chores are mechanised will have a great impact on the amount of effort or energy they require. For example, lawn mowing may be done with a ride on mower, a power mower that is pushed or an unpowered mower. To account for these discrepancies, specific examples of the types of activities included within the different intensity groups were given to respondents on prompt cards (Appendix 3).

Other questions within the household section probed participants' involvement in the care of dependants. This behaviour was separated into lifting & carrying activities, walking & pushing activities and other physical pursuits, such as playing games. The final question of the section probed the amount of stair-climbing activity performed at home.

3.7.1.4 Recreational Activity

In section F, leisure time activity was assessed. This included both formal exercise participation and social interaction although, to maintain continuity with preceding questions, recreational activity within the home environment was detailed first. Five closed questions asked specifically about the proportion of time that a subject had spent watching television, reading, performing sitting and standing activities and walking around the home. It was predicted that a large majority of women might spend significant amounts of their leisure time in such pursuits and that often this participation would be fragmented into many short episodes. As a consequence, participants were not asked to estimate the duration of these activities in minutes or hours but only in terms of their relative proportions (Q. 147-151, Appendix 2). Actual lengths of participation were then obtained by subtraction during the analytical process.

The questions investigating sport and physical exercise behaviour began by probing patterns of walking, cycling and running behaviour. Walking in particular is a frequent activity for which recall tends to be poor (Allied Dunbar National Fitness Survey, 1992). Activity profiles were therefore built up in a stepwise process by asking about walks of different and pre-specified length. Adopting the approach taken by the ADNFS, walks of two miles or more were defined as a continuous walk that would usually take at least 40 minutes to complete whilst walks of 1-2 miles were defined as taking between 20 and 30 minutes. Estimates of walking intensity were subsequently derived from a validated question (Kohl et al., 1988) located in a later section (Q.231, section H).

Thereafter, more structured sporting activities were investigated. This information was gathered through open questions concerning the frequency of times played in the last week together with mean of participation each time. These questions stressed that respondents should only consider playing time and not include the time they spent changing or resting. Estimates of the intensity of effort were derived from specific activities listed in tables (Q. 174, 175 & 178), an approach that has been adopted previously (Paffenbarger et al. 1993).

The last part of section F presented subjects with a checklist of social activities. It was hoped that the measurement of daily activity rather than physical activity would encourage even the most sedentary of people to participate in the study.

3.7.1.5 Nocturnal Activity

Section G probed maternal sleeping patterns, daytime resting patterns and sexual activity behaviour. Twenty four questions asked about nocturnal sleeping, some of which had sub-sections. For sleep duration, questions were asked about a subject's usual time of going to bed, of going to sleep, of waking up and of rising. For sleep interruption, questions were designed to measure the number of episodes of waking and the activity engaged in during this time. Eight further questions were included to identify patterns of daytime napping and resting whilst sexual activity in the seven days prior to interview

was investigated by means of only two questions. Based upon the recommendations of Sinclair (1990), these questions were kept brief and were posed in a relatively relaxed manner. To encourage accurate responses, each participant was also given the option of recording their answers on a separate, self-administered form. The interview concluded with a selection of open-ended questions designed to collect general sociodemographic information and individual comments.

3.7.2 Format of Administration

There are, in effect, three major survey methods of administering a self report measure: postal questionnaire, personal interview, and telephone survey (Frankfort-Nachmias & Nachmias, 1992). The advantages of postal questionnaires are that they are low cost, avoid interviewer biasing errors, can be anonymous and provide good accessibility to respondents. Postal questionnaires also provide an opportunity for respondents to consider their responses fully. The disadvantages of this technique are the potentially low response rates and the inability to query or probe responses. The advantages of conducting interview surveys, by telephone or in person, are that they are flexible and allow the interviewer to clarify questions and probe responses (Frankfort-Nachmias & Nachmias, 1992). Interviews also offer greater control over the sequence of questions and usually have high response rates. The main disadvantages of these survey methods are the lack of anonymity and risk of interviewer bias in responses. Interviews may also be more expensive than postal surveys.

Despite these limitations, both the length and detail of the new questionnaire necessitated an interview-administered format. Ultimately it was hoped that presence of a researcher would not only enable answers to be clarified, but would also help to sustain response rates and subject motivation. Baranowski (1988) explains that while self-completed forms are more efficient from the point of view of the researcher's resources, some have found an interviewer is necessary to conduct probing and to maintain attention over a long period of time. Of further significance is the fact that the questionnaire was to be administered by one interviewer and as such did not necessitate interviewer training.

3.7.3 Translating Women's Responses into Meaningful Data

To calculate energy expenditure in the current study a scoring system similar to those which have been used in the Tecumseh study (Montoye, 1971), the 7-Day Recall (Sallis et al., 1985) and the Minnesota leisure time study (Taylor et al., 1978) was adopted (see section 3.5.1). This system, which provides an estimate of daily activity in terms of METS, provides a suitable means by which to compare individuals over time since variation arising from an increase in body weight will not alter the relative ranking of activities. The compendium of energy costs compiled by Ainsworth et al. (1993) was chosen for use in the present study.

However in discussing this scoring procedure, it must be acknowledged that such a technique does have its limitations. Although using published values to quantify an individual's physical activity level is a convenient method of interpreting responses, both Taylor et al. (1978) and Kriska & Caspersen (1997) acknowledge that the researcher makes several assumptions when employing intensity codes to establish estimates of energy expenditure. Firstly, a MET value provided in a list is assumed to be representative of the manner in which an individual undertakes a given activity yet individual variation in the vigour and pace of performing activities can have a marked effect on actual energy expenditure. This has been controlled for in so far as the interview allows subjects to differentiate between varying intensities of activity. Nonetheless, it still remains inhibited by the fact that many of the established intensity codes were originally obtained in highly standardised, experimental situations, rather than free-living situations (Cale, 1993). Many have not been confirmed recently and the nature of some activities, such as housework, has changed. Further inaccuracies can arise if there is frequent change in the activity being measured since, with such alternation, the steady state values for energy expenditure as given by the tables may not actually be reached. Moreover, some activities do not have intensity codes and therefore estimations become necessary in categorising them. Indeed, Taylor et al. (1978) emphasise that researchers must exercise judgement in choosing intensity codes and aim for a reasonable representation of each activity as it is typically performed.

More importantly, it must be acknowledged that the use of basal to work metabolic rate for the calculations is not exact, since basal metabolism is not consistent at 1 kcal per minute. This issue is particularly relevant to a study of activity in pregnancy because metabolic efficiency is known to improve during this period (Clapp, 1998). However, whilst the use of a MET scoring system may not provide an accurate measure of energy expenditure, it nonetheless provides a suitable means by which to rank and score different activity behaviours. Thus, whilst a change in an individual's scores may not represent a true change in their level of energy expenditure, it will still provide direct evidence of a change in their behaviour patterns.

3.8 Preliminary Study (2): Piloting the Questionnaire

Once created, interview schedules have to be adapted to ensure that they work as intended (Oppenheim, 1992). The objectives of this work are firstly, to refine and revise the content of the interview and secondly, to identify questions that are ambiguous, leading or generally inappropriate (Mead, 1994).

3.8.1 Sample

Mothers were recruited to the preliminary study via antenatal clinics held at an East Midlands hospital during November 1998. All women were invited to participate providing they were pregnant with their first baby. Interested individuals received a parent information sheet and those who agreed to participate were contacted by telephone to arrange a mutually convenient meeting time. 20 women consented (mean (S.D.) age 25.9 (3.0) years; range 22.1-31.7 years) and were subsequently interviewed in their homes. The women were of varying stages of pregnancy (12-34 weeks gestation).

3.8.2 Results

The results of the first preliminary study were used to improve the acceptability of the interview in a number of ways. The revised version appears in Appendix 2 and was

described above. The interview was standardised to overcome difficulties that arose from questions being ambiguous, inappropriate or purposeless. Explanatory instructions were also added to some questions and the ordering of other questions was altered. Each of these issues is discussed in turn below.

3.8.2.1 Ambiguous Questions

In piloting the self-report measure, it was found that certain questions proved to be ambiguous or confusing for respondents to answer. An example of this was in the questions relating to working conditions. Different respondents appeared to have different views regarding the definition of “shift-work”. Some women who worked part-time wrongly regarded themselves as shift-workers whilst others assumed that shift-work always entailed working nights. In order to clarify this ambiguity, only respondents who worked different hours each week, on an organised rotating basis were classified as working shifts. A separate question was then added to distinguish between those women who worked during the day and those women who worked at night.

3.8.2.2 Questions with Inappropriate Response Categories

Just as some questions were ambiguous, others were difficult to answer because they had been assigned inappropriate response categories. One example of this was a question pertaining to the women’s reproductive history. Women were asked if their current pregnancy had been planned and a simple dichotomous “yes-no” response category was offered. For single women who had experienced an unplanned pregnancy the answer was clearly “no”. However, it was found that some married women who had planned to have children in the future, but who had not anticipated becoming pregnant when they did, could ultimately answer “yes” or “no”. In this instance, it was appropriate to adapt the response categories so that three possible answers could be offered: (a) yes, definitely, (b) partly (c) no, not at all.

3.8.2.3 Purposeless Questions

Piloting also revealed that the original self-report measure contained a few questions that had no specific purpose. For example one question asked women if they participated in athletics. When this question was originally designed it was intended to quantify women's participation in track running as opposed to street running or jogging. However, it was found that this distinction rarely had to be made as virtually all women who reported jogging used their local roads. Including this question extended the length of the interview unnecessarily and for this reason it was removed. As Booth (2000) delineates, the inclusion of items that are very likely to be irrelevant to respondents may reduce the face validity of an instrument and impact negatively on the data quality.

3.8.2.4 The Need for Explanatory Instructions

Although the modifications described above allowed some of the data to be gathered easily, other questions continued to require a more detailed explanation. This meant that specific explanatory instructions or prompts had to be added to the interview. The standardisation of these explanations enabled respondents to understand the meaning of each question yet also ensured that interviewer bias was kept to a minimum. The instructions were added to the interview in a different type-face so that the interviewer could easily distinguish between the questions and the prompts (McColl, 1994).

3.8.2.5 The Order of the Questions

During the pilot interviews it became obvious that some of the questions were located too early in the interview schedule. Questions relating to the individual's socio-demographic circumstances were initially placed at the beginning of the interview alongside questions pertaining to the women's reproductive history and health behaviours during pregnancy. These questions however, did not constitute an effective introduction to the interview and did little to establish rapport between the interviewer and interviewee. Consequently, these questions were moved to the end of the questionnaire and were preceded by a short

explanation regarding their relevance. Similarly, because several mothers were sensitive to questions that enquired about their patterns of sexual activity, these questions were also placed late in the interview schedule. In this way, participant motivation and compliance could be maintained.

3.8.3 Summary

According to Cannell & Kahn (1968) a good interview schedule should be based upon the formulation of questions that give “*maximum opportunity for complete and accurate communication of ideas between the researcher and respondent.*” The results of the pilot work demonstrate how this objective was achieved in the present study. What remains to be established however is the reliability and validity of this self-report measure and the activity monitor in assessing the daily activity levels of healthy British women.

3.9 Pilot Studies (3), (4) & (5): The Reliability and Validity of the Measures

To verify the accuracy of the proposed measures, three preliminary studies were undertaken. The objective of the first was to examine the relative validity of the new activity questionnaire and that of the second to determine its test-retest reliability. The objective of the third study was to assess the validity of the lower limb as a designated site of attachment for the actiwatch accelerometer².

3.9.1 Sample

All three studies were conducted on the same sample. Women were recruited to the studies in December 1998 via advertisements placed at the university and around the local area. All women of childbearing age were invited to participate, irrespective of their reproductive status. This was done for two reasons. Firstly, the accurate assessment of

² The reliability of the Actiwatch monitor was established by the manufacturers (Cambridge Neurotechnology Ltd) and maintained by their regular and ongoing calibration of the instruments.

questionnaire reliability necessitated the use of population that was not undergoing a significant life change at the time of measurement. Secondly, it was felt that if a non-pregnant population was considered, this would provide an accessible group against which the performance of the measures in a pregnant population could be compared (see Chapter 6).

20 healthy, non-pregnant female volunteers were recruited for participation. Two did not comply with the study protocol and were therefore excluded from all subsequent analyses. The mean age of the remaining participants was 29.8 (S.D. 6.3) years with a range of 21-40 years. All women were Caucasian and 94% were non-smokers. 10 women (56%) were employed, 4 (22%) were in full-time education and 4 (22%) were homemakers. 8 participants (44%) were employed full-time and 2 (11%) part-time. All working women were engaged in secretarial or other light intensity occupations.

3.9.2 Method

To determine the relative validity of the new activity questionnaire and also to evaluate the validity of the actiwatch placement site, two established physical activity measures were chosen as a reference method. These were (i) the modified version of the Baecke questionnaire (Pols et al., 1995) and (ii) a 3-day Physical activity record (Bouchard, 1983).

At entry into the study, each participant completed the modified version of the Baecke questionnaire. This questionnaire has previously been shown to be both valid and reliable in measuring the activity patterns of adult female populations (Pols et al., 1995). The modified version of the Baecke questionnaire produces a total daily activity index based upon a wide range of occupational, sporting and non-sporting leisure activities. The introduction to the questionnaire explained that the questions referred to physical activity during the past 12 months. In the manner of Pols et al. (1995), unemployed participants were instructed to consider household activities or studying as their work if this was their main form of daily activity.

Study participants then maintained a record of their daily activity using the 3-day Physical activity record (Bouchard, 1983). This record was chosen as the second validation instrument because it was considered to be an established, economical and simple way of obtaining information with regard to activity levels and energy expenditure. Moreover, it has been demonstrated that this measure is both valid and reliable in assessing the daily activity levels of adults (Bouchard, 1983).

Each participant was provided with a 3-day activity log divided into 15-minute segments (Bouchard, 1983). The three-day recording period was scheduled to include two working days and one non-working day. In accordance with the recommendations for its use, individuals were instructed to maintain their usual behaviour patterns and to record all activities performed as often as conditions would permit. Every 15-minute segment was later quantified in terms of energy cost on a nine-point scale ranging from 0.26kcal/kg/15min to 1.95 kcal/kg/15min (Bouchard, 1983) and summed to produced an estimate of total daily energy expenditure for each participant.

Over the same 72-hour period, spontaneous body movement was assessed by means of the “Actiwatch AW2” activity monitor. The characteristics of this monitor have been described previously (section 3.5). Each woman wore the actiwatch monitor facing outwards on her non-dominant ankle, attaching it directly above the ankle bone. Participants were instructed to start wearing the actigraph on the night preceding the first day of recording and to use it continuously until the morning following the last day of recording. The monitors were to be removed only briefly for bathing, showering and water sports. Each time the unit was removed and replaced, a marker button was depressed to indicate the time and duration that the monitor was not being worn. Data was subsequently downloaded to a computer and marked periods eliminated from the analyses.

To maximise the amount of time that could be left between participants recording their daily activities and recalling their behaviour, women were not contacted for three more days. On the fourth day, the new activity questionnaire was administered. Assessment

took place in the home environment and was organised so that the time frame of recall included the period in which activity monitoring had occurred. This interview was re-administered under similar conditions one month later.

3.9.3 Statistical Analyses

Visual inspection of the resulting scatterplots and calculation of Pearson Product Moment Correlation coefficients (PPMCs) assessed the relative validity of the new activity questionnaire. Mean 24-hour activity level derived from both the new activity questionnaire (first administration) and the activity monitor were compared with the total Baecke activity index and the mean 24-hour activity level derived from 3-day diary. In each instance, data were also entered into a regression analysis. In this way the extent of the relationship between each pair of measures could be established.

One-month test-retest reliability of the new questionnaire was estimated by means of a PPMC. Subsequently, subjects were classified in tertiles according to the mean 24-hour activity level derived from the two administrations of the questionnaire. Cohen’s kappa (percentage of agreement corrected for chance) and percentage of gross misclassification were then calculated.

3.9.4 Results

Mean 24-hour activity levels as assessed by each method are shown in Table 3.3. One subject failed to wear the activity monitor, nor did she complete the 3-day activity diary. No explanations for non-compliance were provided.

Table 3.3: A Comparison of the Measured Daily activity Indices.

Units of measurement		n	Daily Activity Level			
			Mean	S.D.	Max	Min
New questionnaire	METS	18	1.4	0.3	2.0	1.0
Actiwatch AW”	Activity counts/1-min epoch	17	277.0	114.5	527.2	101.7
Diary	Kcal/kg	17	38.0	4.9	52.0	29.6
Modified Baecke	Total activity index	18	7.4	1.4	10.0	4.9

3.9.4.1 Relative Validity of the New Questionnaire

A scatter plot of mean 24-hour activity levels estimated from the new questionnaire against total Baecke activity scores is displayed in figure 3.2. The Pearson's correlation coefficient between these two variables was found to be 0.73 ($p < 0.01$). Figure 3.3 shows a scatterplot of mean 24-hour activity level derived from the new questionnaire against that derived from the activity diary. The Pearson's correlation coefficient between these two variables was initially found to be 0.54 ($p < 0.05$). However, closer inspection of the data identified one score from the diary as an outlier (52.04kcal/kg). Exclusion of this subject reduced the correlation to 0.32 (NS).

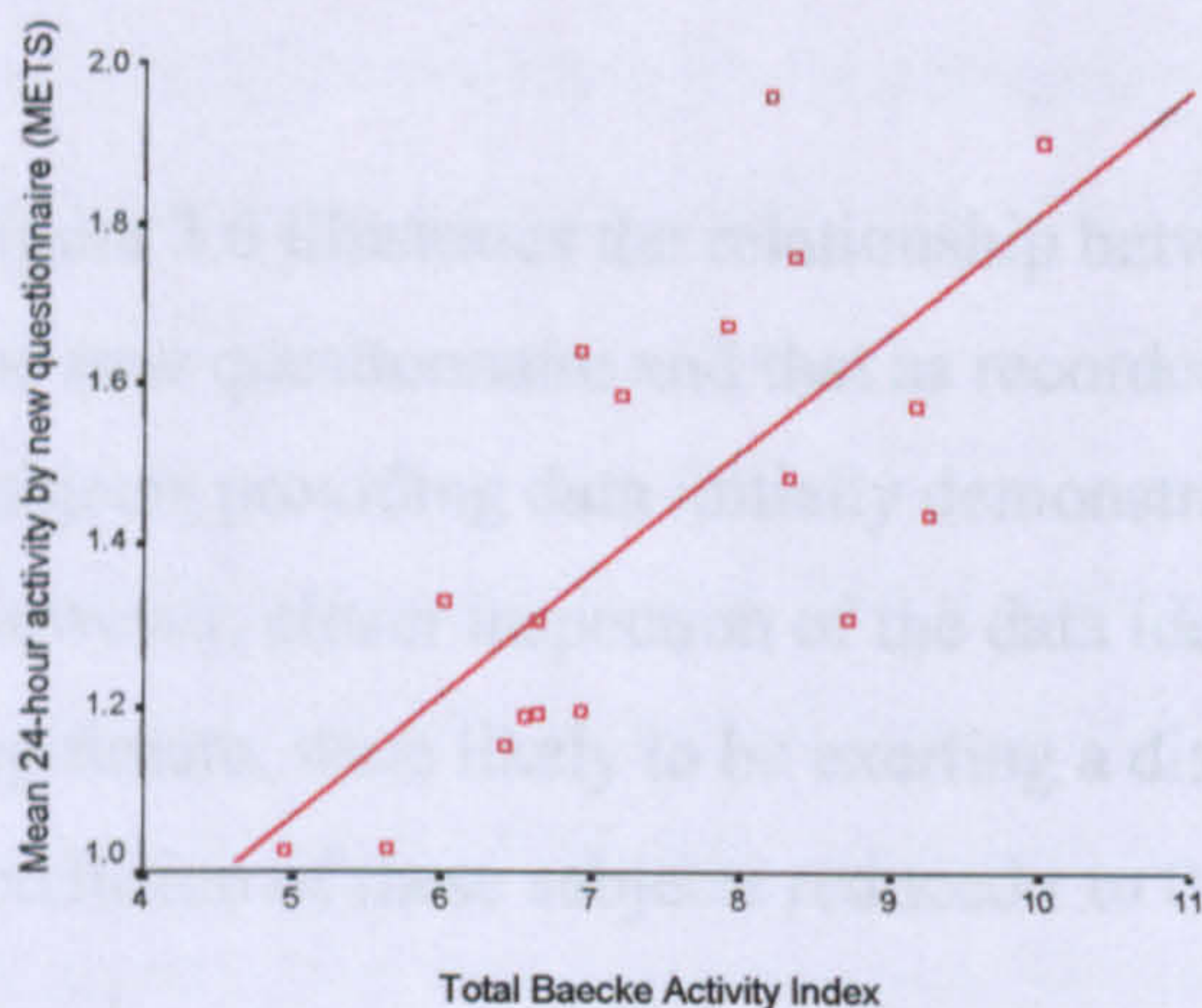


Figure 3.2: Regression of mean 24-hour activity Level from new questionnaire (1st administration) On total Baecke index ($n=18$; $R^2=0.53$, $SEE=0.20$ METS; $Y=0.15X + 0.32$)

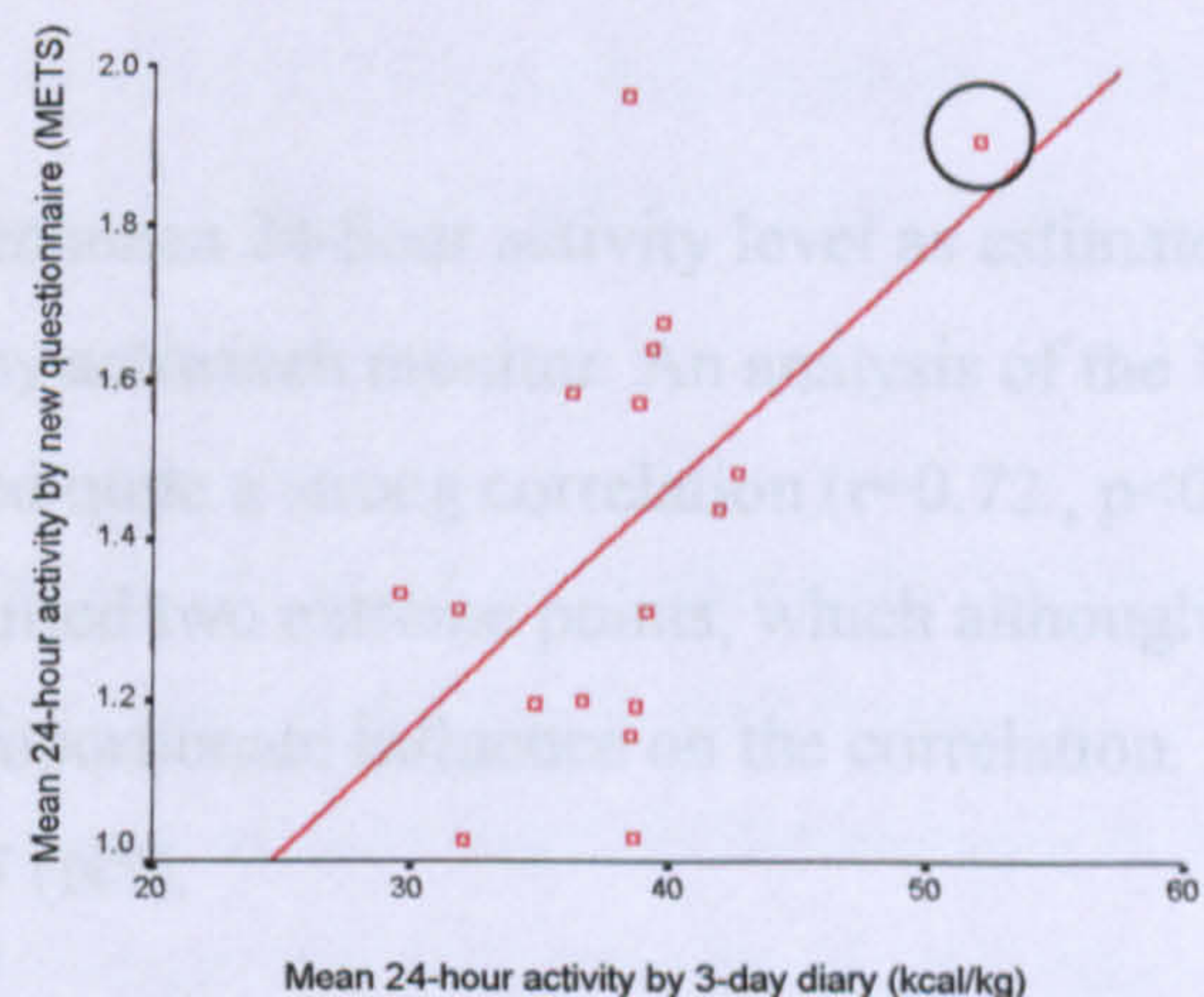


Figure 3.3: Regression of mean 24-hour activity level from new questionnaire (1st administration) on 3-day diary (outlier highlighted) ($n=17$; $R^2=0.29$, $SEE=0.24$ METS; $Y=0.03X + 0.26$).

3.9.4.2 Relative Validity of the "Actiwatch" Monitor

A scatter plot of mean 24-hour activity levels estimated from the actiwatch monitors against total Baecke activity scores is displayed in figure 3.4. The Pearson's correlation coefficient between these two variables was 0.66 ($p < 0.01$). Figure 3.5 shows a scatterplot of mean 24-hour activity level estimated from the actiwatch monitor against that estimated from the activity diary. The correlation coefficient between these variables was initially found to be 0.73 ($p < 0.01$). Exclusion of the outlier identified previously reduced the correlation to 0.59 ($p < 0.05$).

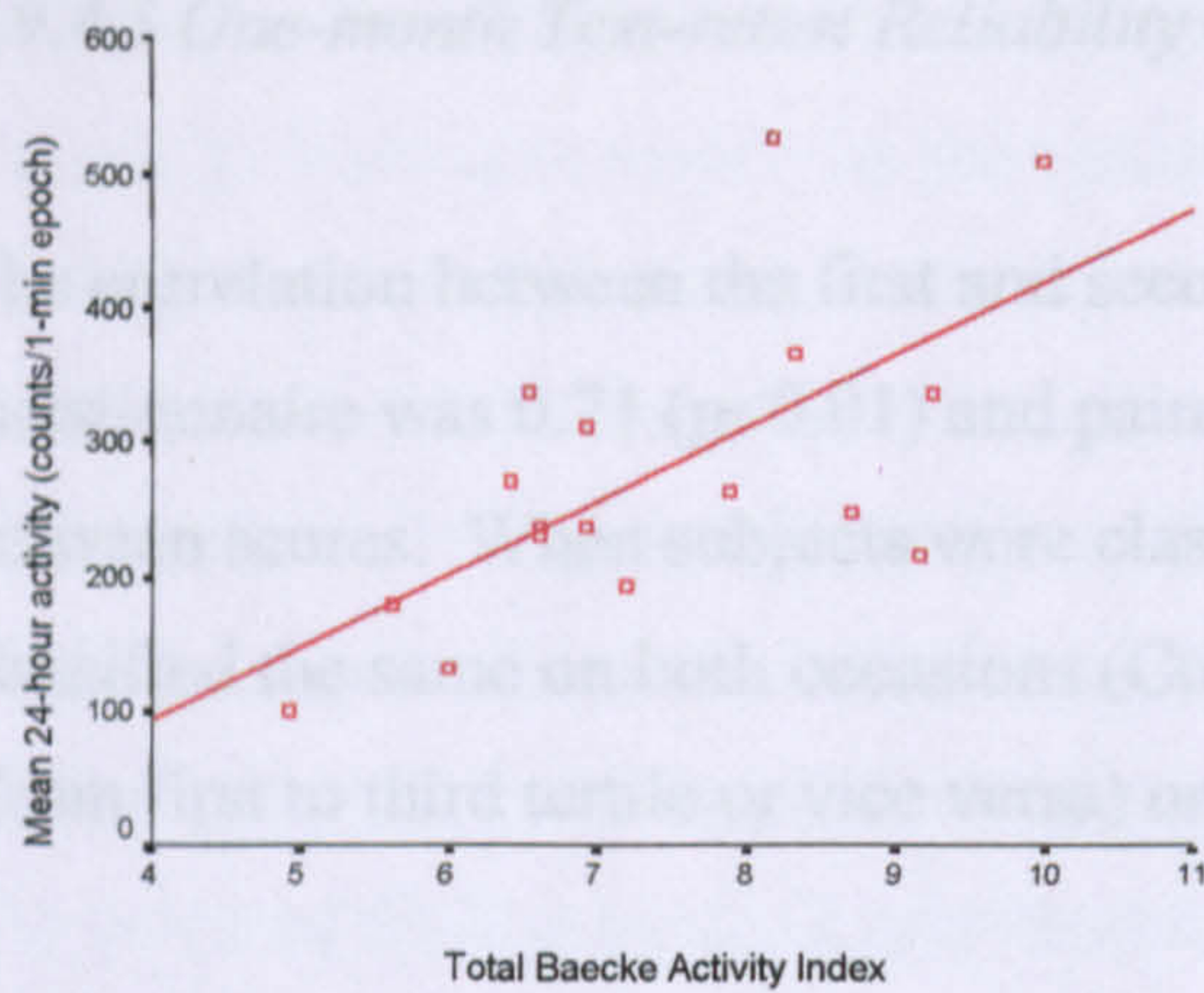


Figure 3.4: Regression of mean 24-hour activity level by actiwatch on total Baecke index ($n=17$; $R^2=0.43$, $SEE=89.17$ counts; $Y=53.80X-119.60$)

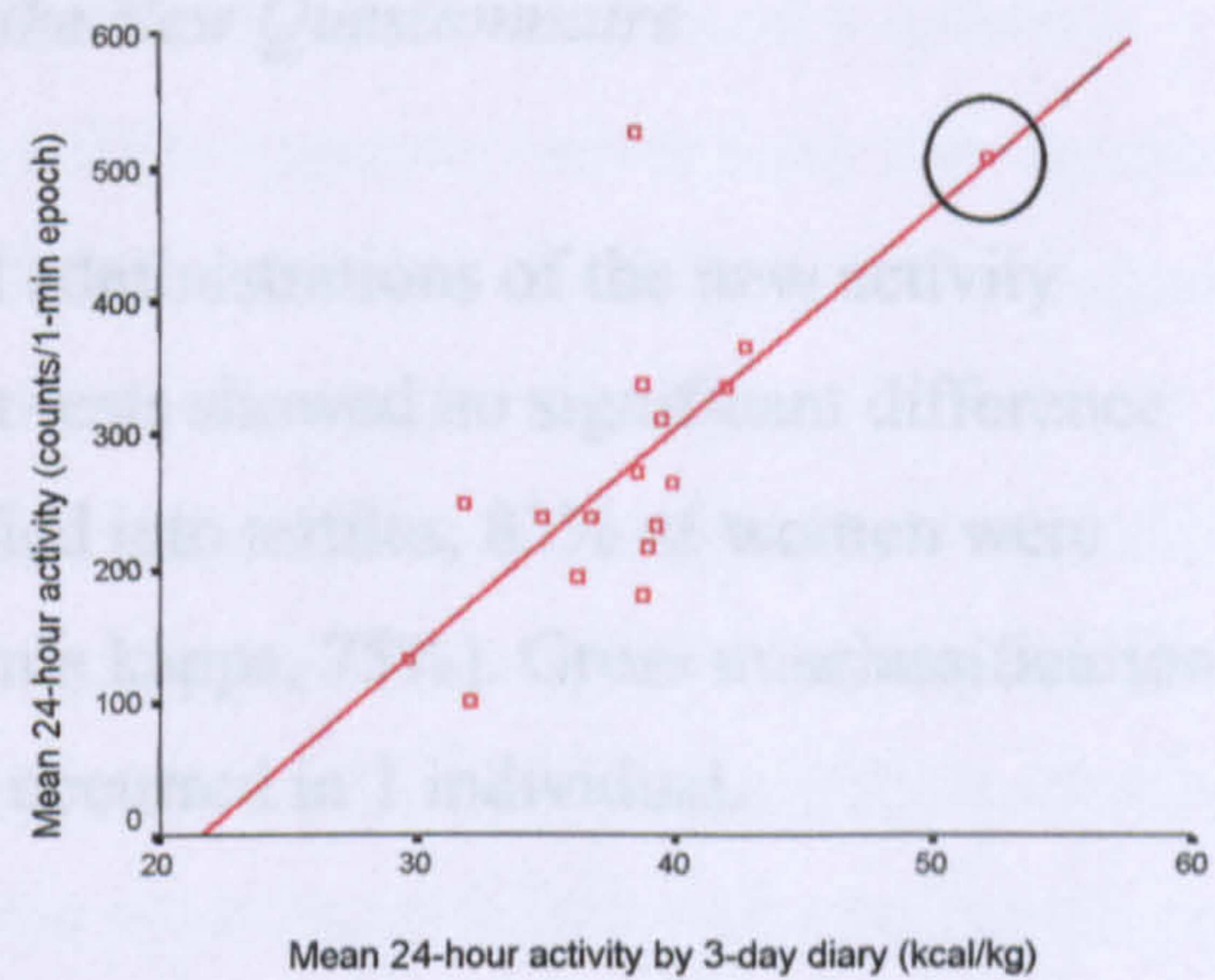


Figure 3.5: Regression of mean 24-hour activity level by actiwatch on 3-day diary (outlier highlighted) ($n=17$, $R^2=0.35$, $SEE=84.35$ counts; $Y=16.58X-356.41$)

Figure 3.6 illustrates the relationship between mean 24-hour activity level as estimated by the new questionnaire and that as recorded by actiwatch monitor. An analysis of the 17 subjects providing data initially demonstrated quite a strong correlation ($r=0.72$, $p<0.01$). However, closer inspection of the data identified two extreme points, which although legitimate, were likely to be exerting a disproportionate influence on the correlation. Exclusion of these subjects reduced r to 0.37 (NS).

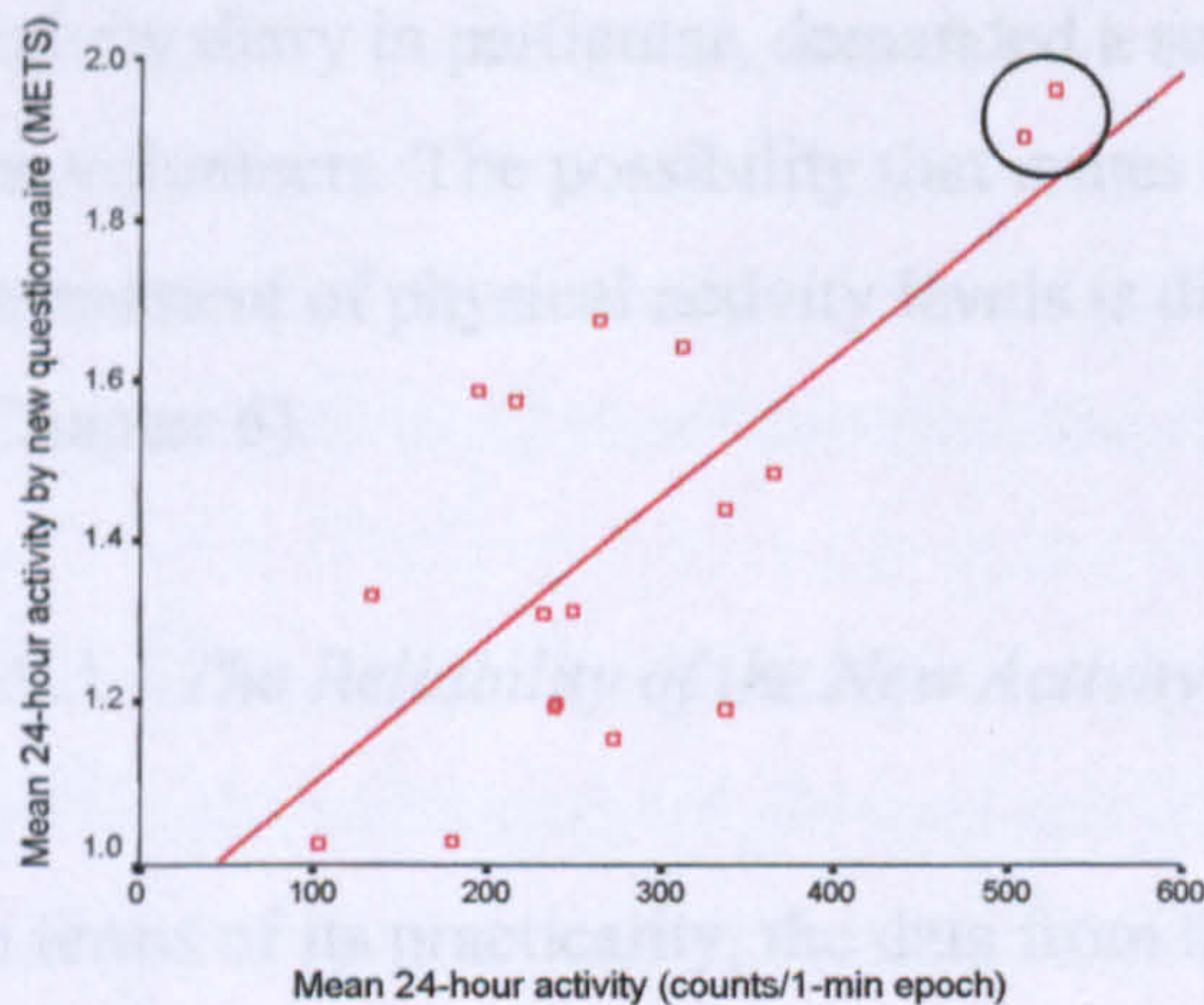


Figure 3.6: Regression of mean 24-hour activity Level by questionnaire (first administration) on actiwatch monitor (extreme values highlighted) ($n=17$; $R^2=0.52$, $SEE=0.20$ METS).

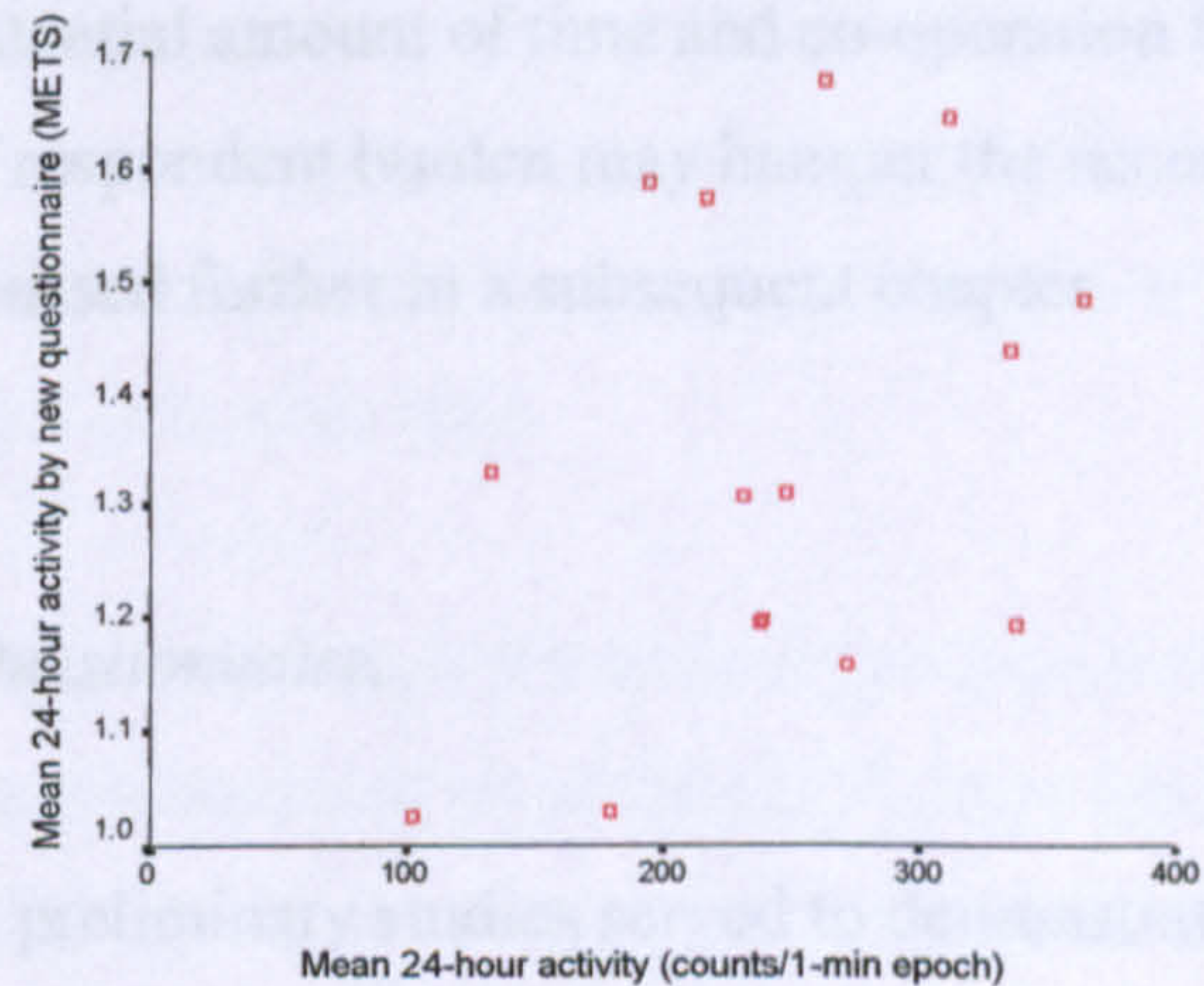


Figure 3.7 Scatterplot of mean 24-hour activity level by questionnaire (first administration) on actiwatch monitor (extreme values removed).

3.9.4.3 One-month Test-retest Reliability of the New Questionnaire

The correlation between the first and second administrations of the new activity questionnaire was 0.71 ($p < 0.01$) and paired t-tests showed no significant difference between scores. When subjects were classified into tertiles, 83% of women were classified the same on both occasions (Cohen's kappa, 75%). Gross misclassification (from first to third tertile or vice versa) only occurred in 1 individual.

3.9.5 Discussion

The above studies aimed to examine the relative validity of the new activity questionnaire and the Actiwatch monitor by comparing them with two established methods of assessing daily physical activity. It also evaluated the one month test-retest reliability of the new questionnaire.

Of all subjects approached, 85% responded positively to the study protocol. No reasons were given for the 2 cases of non- or incomplete participation although it can be hypothesised that both may have been caused by a marked disparity between participant motivation and participant burden. The study design, and the inclusion of the 3-day activity diary in particular, demanded a substantial amount of time and co-operation from the volunteers. The possibility that issues of respondent burden may hamper the accurate assessment of physical activity levels is discussed further in a subsequent chapter (Chapter 6).

3.9.5.1 The Reliability of the New Activity Questionnaire.

In terms of its practicality, the data from the preliminary studies served to demonstrate that the new activity questionnaire is both easily administered and reliable. Scores obtained from the second administration of the activity interview correlated significantly with those from the first ($r = 0.71$). Coolican (1994) suggests that for a measure to be deemed reliable, test-retest coefficients of 0.7 to 0.85 are desirable. On this basis, the new

activity questionnaire can be deemed to possess a favourable degree of short-term reliability. Further evidence for the accuracy of this measure comes from the repeated classification of participants into tertiles. Following a month test-retest, 83% of women were classified the same on both occasions and only one individual was grossly misclassified. Given that the study was assessing free living activity behaviour (a variable that has the potential to fluctuate) these findings suggest that the new activity measure will consistently and adequately distinguish between individuals with high, moderate and low levels of daily activity. It may therefore be considered suitable for use in both cross-sectional and longitudinal studies of physical activity participation.

3.9.5.2 The Validity of the New Activity Questionnaire

The findings of the validity studies demonstrated a varying level of agreement between the four different measures of physical activity that were examined. Overall however, the new activity questionnaire demonstrated an acceptable level of criterion validity.

The strongest correlation that was observed existed between the new activity questionnaire and the modified Baecke questionnaire (Pols et al., 1995) ($r=0.73$). This result was somewhat surprising given the marked difference in the time frame of recall between the two forms (the past 7 days versus the past 12 months). A much weaker relationship was found to exist between the new activity questionnaire and the 3-day activity record (Bouchard, 1983) ($r=0.32-0.54$) despite these both being measures of comparatively short time frame that are scored in similar ways.

Nevertheless, when compared to the correlation coefficients obtained in previous studies validating the accuracy of physical activity questionnaires, all of the coefficients reported in the current study can be seen to compare favourably. A review of the literature reveals that correlation coefficients between physical activity questionnaires and reference measures vary widely, not least because of differences in methods or study populations. Albanes et al. (1990) for example, validated the Minnesota Leisure Time Questionnaire against summary estimates from eight other questionnaires in a population of 21 men

aged between 28-55 years. On this particular occasion, correlation coefficients were reported to range between 0.13 and 0.49, with the correlation coefficient between the Minnesota questionnaire and the Baecke questionnaire being just 0.36. Previously, Cauley et al. (1987) had compared five subjective measures of physical activity in post menopausal women and found the majority of correlations to be between -0.20 and 0.30 (Pols et al., 1995). The correlation that exists between the new questionnaire and the modified Baecke questionnaire ($r=0.73$) used in the current study therefore appears to demonstrate a high degree of criterion validity. Indeed, any correlation coefficients that are greater than 0.70 are traditionally accepted as an acceptable level of scientific validity (Coolican, 1994).

The fact that the correlation between the new activity questionnaire and the 3-day activity recall was lower may be explained by the fact that a 3-day activity diary was not an optimal reference method for this population. Indeed, a preferable alternative would undoubtedly have been to validate the new approach directly against a physiological measure of physical activity. For several reasons however, such an approach was not possible. Participants were already being asked to test a new motion sensing system and were reluctant to wear additional heart-monitoring equipment. The need to assess physical activity in the field made the direct determination of oxygen consumption difficult and other methods of quantifying energy expenditure were deemed too costly or too time-consuming to employ. In such situations, Melanson & Freedson (1996) confirm that indirect validation is a common strategy.

3.9.5.3 The Validity of the Ambulatory Activity Monitor

With regard to the validity of the ambulatory activity monitor, associations between the Actiwatch AW2, the Baecke questionnaire and the 3-day activity diary were also moderately high ($r=0.59-0.73$). These findings suggest that the ankle is indeed a valid site of attachment for assessing the mean daily activity levels of adult women. A caveat to this however, was that the relationship between the actiwatch monitor and the new activity questionnaire appeared more questionable. When the scores of all participants

were considered the correlation coefficient for the whole sample was found to be comparatively high ($r=0.72$). Following the exclusion of two extreme values however, this relationship was noticeably weakened ($r=0.32$).

The lower correlation that was obtained in the second instance may be explained in part by a lower variation in mean daily activity levels recorded by the actiwatch monitor since the size of r is very much dependent upon the variability of the values measured (Guildford, 1956). However, it may also be explained by the fact that the two instruments are measuring two different dimensions of physical activity (see section 3.3).

Recently, Bouten et al. (1996) published a report on daily activity assessment in which the techniques of movement registration and doubly labelled water were compared. The use of movement registration for daily activity assessment was evaluated during a 7-day period in 30 free-living subjects. Body movement was registered with a triaxial accelerometer (over 1-minute intervals) and average output was correlated with against four different energy estimates. These comprised average daily metabolic rate (ADMR), determined with doubly labelled water; sleeping metabolic rate (SMR), determined in a respiration chamber; the absolute value of energy expenditure for physical activity (ADMR-SMR) per kilogram of body weight and overall physical activity level (PAL = ADMR/SMR). The highest correlation was reported to exist between average body movement and PAL ($r=0.58$). Given that the current study compared an activity monitor with a much cruder method of activity assessment (i.e self-report), it is not surprising that the observed correlations were lower.

In summary therefore, the results obtained from the current study should not be disregarded. The new activity measure consists of an objective measure augmented by a self-report assessment and provides an easy and effective way of monitoring short-term physical activity behaviour. Moreover, in non-pregnant women at least it has proved both a useful and reliable method of assessing daily activity under real life conditions.

3.10 Chapter Summary

This chapter began by reviewing literature on the methodology of monitoring physical activity. It outlined the procedures that were followed and the considerations that were made in selecting a measure of daily activity for the current study. It was acknowledged that the chosen instrument would need to elicit a wide range of information, be capable of being administered on a repeated measure basis and would need to be sensitive to any changes occurring in physical activity behaviour. On this basis, a two-tier methodology was selected. An ambulatory activity monitor was chosen to provide objective information on levels of daily movement whilst an interviewer-administered questionnaire was selected to investigate self-reported behaviour.

Unfortunately, existing physical activity questionnaires were found to be inappropriate for use in the current study. Many are hampered by problems of validity and reliability and few acknowledge the types of daily activity performed by healthy adult females. Thus, in order to investigate the impact of pregnancy on maternal daily activity levels, a new self-report measure was developed. The validity and reliability of both this new questionnaire and the ambulatory activity monitor were assessed. The findings from these preliminary studies have served to raise our confidence in using these two measures to study the daily activity patterns of low risk pregnant women. In the next chapter, the main study is described.

CHAPTER FOUR

The Design of the Main Study

4.1 Introduction

Once the method by which daily activity would be assessed had been established, data collection could commence. The aims of the main study were (i) to examine how the experience of low-risk pregnancy may impact on the daily activity levels of healthy, British nulliparous women (ii) to examine the attendant physical, psychological and social changes occurring during pregnancy and to consider their association with maternal daily activity behaviour and (iii) to consider the relationship between total maternal daily activity level and pregnancy outcome. The study was designed to overcome the methodological limitations of previous studies by prospectively assessing maternal daily activity levels on a longitudinal basis. In this chapter, details of the study design, measured variables and assessment techniques are discussed.

4.2 Methods

4.2.1 Sample Size

The power of the present study to detect long term changes in maternal activity was calculated after examining a previous study by Van Raaij et al. (1990). This study examined the energy cost of physical activity throughout pregnancy and the first year postpartum in Dutch women with sedentary lifestyles. Compared to their behaviour in early pregnancy, women in late pregnancy were found to spend 40 ± 70 minutes less on very light sitting activities, 30 ± 55 minutes more on light housework and 20 ± 80 minutes more on moderate housework. Using these figures as an approximation of the magnitude of change that may occur in the physical activity of British women, it was established that the current study would require sample sizes of $n=32$, 35 and 169

respectively³. Because of this wide range in sample size, consideration of the survey objectives and the available resources also helped to guide decisions regarding the number of participants that should be recruited.

Consultation with antenatal clinic co-ordinators regarding the number of nulliparous women attending booking appointments at the local hospital, and an estimation of the number of repeated home visits that could be conducted within the time-scale of the research project, suggested that a final sample size of 60 women would be achievable. Given that the research represented a cohort study of a new area, the primary intentions of which were to gather detailed information on the stability of daily activity and to establish baseline data on women's beliefs, behaviour and wellbeing, this figure was judged to be acceptable. Not least because of the time and expense involved, longitudinal studies typically tend to use comparatively fewer people than do cross-sectional comparisons (Coolican, 1994). The magnitude of the sample size nonetheless remains a salient issue when interpreting results, particularly when predicting birth outcome. Given that the aim of this work was not to influence antenatal care policies directly however, this latter issue remains less of a concern.

4.2.2 Sample Recruitment

Study participants were recruited from a population attending 'booking' visits at the antenatal clinic of an East Midlands hospital. To reduce sampling bias, it was necessary to recruit women with a variety of sociodemographic characteristics. In particular maternal age, socio-economic status and pre-pregnancy weight were all required to be wide ranging. To achieve this, a stratified sampling procedure was considered. However, from a practical perspective this approach was not possible. In order to ensure that a sufficient number of participants could be recruited within a limited time frame, the study needed to rely on voluntary participation.

³ Sample size was calculated assuming a power of 90% at the 95% confidence level.

This accepted, three specific criteria served to restrict women's participation in the study. Each participant had to be:

- nulliparous
- <14 weeks gestation & designated low-risk at entry into the study
- able to speak sufficient English to participate in face-to-face interviews

The reasons for selecting these criteria are discussed in detail below.

4.2.2.1 The Need for Nulliparous Women

Having reviewed current medical and cultural expectations of activity patterns during pregnancy (Unger & Crawford, 1996; Clapp, 1998), it was decided to investigate the influence of pregnancy on maternal activity solely by focusing on nulliparous women. In traversing the conceptual divide between non-motherhood and motherhood, this population is more inclined to perceive a change in their self-identity and social role than any other group. By implication therefore, if any degree of maternal-fetal conflict does exist in activity behaviour, it is most likely to be accentuated in women whose habitual activity patterns or expectations of pregnancy have not already been altered by a previous reproductive experience. Certainly, as discussed in Chapter 3, social circumstances appear to be an important influence on physical activity (Allison et al., 1999). The lifecycle stage of an individual has long been known to affect their activity patterns, both in the nature of the activities engaged in and the time available to be allocated to them (Chapin, 1974). Sternfeld et al. (1999) for example, document how having young children at home reduces the likelihood of women scoring highly on sports and exercise and active living indices yet increases their likelihood of high household and care-giving activity. In addition, Wolkind & Zajicek (1981) point out that not only might subsequent pregnancies be easier from a physical point of view but psychological stress and anxieties are also less common. It would therefore be extremely difficult to interpret the replies of a group of individuals if that group contained some women expecting their first baby and others their third.

4.2.2.2 The Need for Women to be Less Than 14 Weeks Gestation and Designated Low-Risk

The second criterion was set to enable a full longitudinal investigation of the daily activity behaviour of healthy pregnant women. Difficulties involved in recruiting women prior to pregnancy prevented any earlier contact with the participants. It was felt that if this approach was taken, sample size could be severely limited, the women participating would be unlikely to be representative of the pregnant population as a whole and the study would not be completed within the time span of a doctoral research project. It was therefore necessary to wait until women reported to their local doctor or hospital at which time they were already pregnant. Moreover, because the health status and gestational stage of each participant had to be confirmed, it was impossible to identify eligible participants prior to their booking visit and ultrasound scan at the local hospital. This visit typically occurred between 10 and 16 weeks of pregnancy.

4.2.2.3 The Need for Women to be Fluent in English

Fluency in English was a necessary criterion for participation in the study. This decision originated from the simple restriction of having no facilities or support for translation.

In summary therefore, the sampling frame comprised all healthy, English speaking women, expecting their first babies, designated as low risk at entry into the study and less than 14 weeks gestation at the time of recruitment. Sampling using these criteria controlled for certain confounding factors that may have affected the participants' daily activity patterns. Other factors were controlled for during data analysis (Chapters 5-10).

4.2.2.4 Concerns Regarding Voluntary Participation

A major concern of voluntary participation is that of participant bias. This effect is equivalent to the non-response biases frequently encountered in postal surveys (Jobber & Saunders, 1989). It occurs when survey results are affected by a difference between participants and non-participants, thereby threatening to limit the generalisability of the

results to the population from which the sample was selected. In order to reduce this problem, four steps were taken to maximise the range of people agreeing to participate:

- (i) All women meeting the aforementioned selection criteria were approached.
- (ii) The objectives of the study were explained to each eligible participant and it was stressed that the topic of interest was not structured physical activity but rather everyday lifestyle routine. This approach encouraged even the most sedentary of individuals to take part.
- (iii) All women were visited at home at a time convenient to them and participation did not entail any additional hospital visits (see below). The researcher undertook all travelling and, as a result, the final sample was not limited to women who had access to a means of transport.
- (iv) Pregnancy outcome measures were collected for a sample of women who did not take part in the study. These women attended the same antenatal clinic and met the same criteria for participation. They were matched to those participating in the longitudinal study on the basis of age (± 1 year); employment status (homemaker, part-time or full-time employee & working in a light or heavy intensity occupation); smoking status (non-smoker, non-smoker during pregnancy or smoker) and ethnicity.

4.2.3 Study Design

To avoid methodological problems encountered by previous studies of maternal activity and gestational outcome, the impact of pregnancy on the daily activity behaviour of nulliparous women in Britain was investigated using a prospective, longitudinal design. Participants enrolled in the study over a three-month period between January and March 1999. All women meeting the pre-specified inclusion criteria were approached with a parent information leaflet (Appendix 1). These leaflets were handed to women in the antenatal waiting room and the researcher was always available to answer any questions or concerns. Women agreeing to take part in the research project were issued with full details of the present study together with a letter for informed consent.

At the booking visit, date of conception was determined from routine ultrasound examinations performed on the day of enrolment. When performed during the first 18 weeks of gestation, ultrasound permits an extremely accurate assessment of gestational age. The fetal crown-rump length, a measurement from the top of the fetal head to its rump can define gestational ages between 6-12 weeks with an error of ± 3 days and can reduce the risk of women being identified as overdue from 8% to 2% (Gabbe et al, 1991).

The first phase of data collection corresponded with the booking visit. Information on pre-pregnancy lifestyle characteristics was collected by questionnaire (see section 4.3). Subsequent phases of data collection occurred throughout pregnancy and into the postpartum period. Pregnancy is a dynamic, developmental process and for this reason alone, it seemed unwise to presume that daily activity patterns would drift in a steady and uniform manner over its course. Thus, an approach had to be taken that would detect fluctuations in activity behaviour and account for any changes that may occur whilst moving through the three trimesters.

The assessment points that were selected coincided with the 12th week of pregnancy (unless women were recruited after this time), the 16th, 25th, 34th & 38th week of pregnancy and the 6-8th week postpartum. The first two visits at 12 and 16 weeks were scheduled to assess early pregnancy and spanned the main period during which women are most likely to suffer nausea or sickness. The third visit at 25 weeks corresponded with mid pregnancy, a time at which pregnancy has become established and women are traditionally assumed to 'bloom'. The final visits at 34 and 38 weeks of pregnancy were scheduled to span the period during when women were most likely to leave paid work and begin preparing for the approaching birth. All visits lasted approximately 45 minutes-1 hour. Their undertaking began in January 1999 and was complete by February 2000. The overall organisation of data collection is summarised in figure 4.1.

4.3 Measured Variables

In order to maintain a holistic view of women's experiences of pregnancy the current

study sought to assess a wide range of variables. These variables were chosen on the basis of theoretical interest and previous literature (see chapter 2 for a review). The measures were effectively divided into two different types. *Initial measures* comprised those factors that were unlikely to vary across the course of pregnancy and therefore only had to be measured once. *Repeated measures* were taken wherever the stability of variables was not known or where measurements were hypothesised to change.

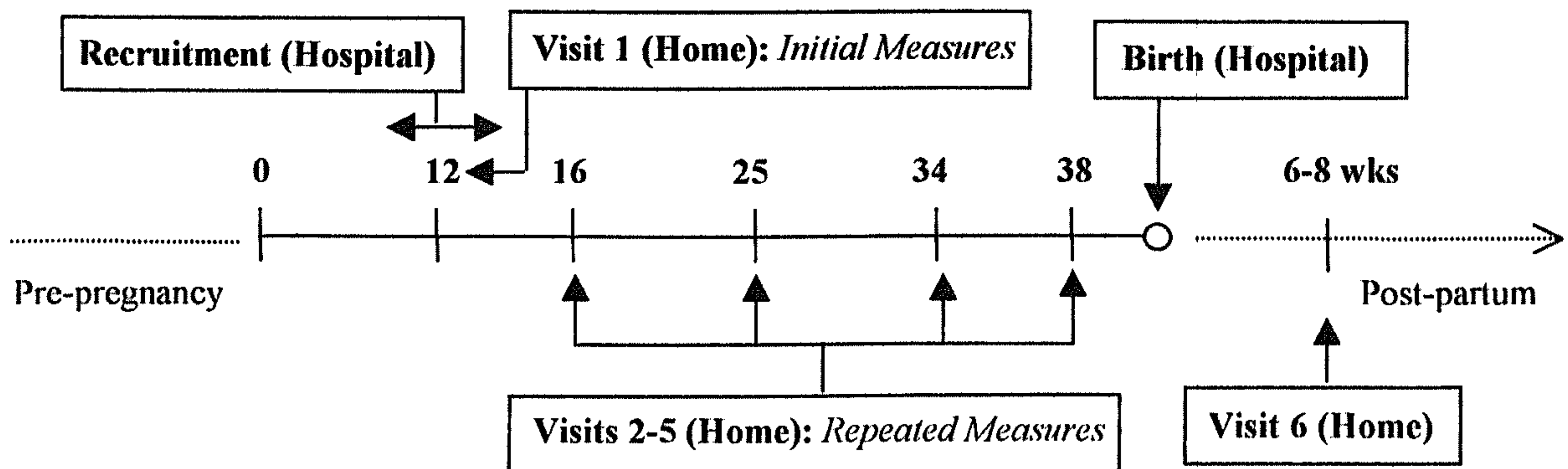


Figure 4.1: Organisation of Data Collection

4.3.1 Initial Measures

4.3.1.1 Sociodemographic Characteristics

The sociodemographic variables that were assessed comprised maternal age at the time of conception, marital status, ethnic group, educational level, socio-economic status and type of housing. The majority of these variables can be found within women's obstetric notes. However, the accuracy of the medical record as a repository of patient related data has previously been shown to be suspect (MacIntyre, 1978; Timmers, 1993; Kay & Purves, 1996; Harris et al., 1997). Indeed, data abstracted from medical records are often inaccurate, incomplete and unreliable (David, 1980; Van der Lei, 1991; Aaronson & Burman, 1994). Therefore, all sociodemographic variables were assessed from maternal self-report in the first instance and later checked against data held in hospital databases. Where discrepancies were found, the women's own responses were taken as an indication of their sociodemographic circumstances.

4.3.1.2 Anthropometric Variables

Initial anthropometric measurements of maternal height and pre-pregnancy body mass were taken at the time of the first interview. Maternal height was measured using the same measuring tape for each participant (Microtoise 04 11). Pre-pregnancy body mass was based on retrospective maternal self-report. Although this technique can at best provide only a crude measure of pre-pregnancy body weight, it is nonetheless believed to obtain a sufficiently accurate indication of pre-pregnant weight for most practical purposes (Harris, 1997). Reported and measured body weights are highly correlated ($r=0.86-0.99$) and only vary by an average of 1.1-2.4kg (Stunkard & Albaum, 1981; Palta et al., 1982; Stewart, 1982; Stevens-Simon et al., 1986; 1992) (see chapter 5 for a discussion of potential bias in this measure). All subsequent measures of maternal body mass were obtained through direct measurement at the time of each interview using a “Tanita” scale calibrated professionally to within 200g.

4.3.1.3 Pregnancy History

Pregnancy history was assessed by three questions relating to parity, previous pregnancy experience (ending in miscarriage or non-spontaneous abortion) and level of pregnancy planning. Responses to the first two questions were subsequently checked against the women’s obstetric notes and no discrepancies were found.

4.3.1.4 Personality

In the current study, personality was assessed by means of the Eysenck Personality Inventory (EPI). This form is a development of the Maudsley Personality Inventory (MPI) (Eysenck, 1959) and comprises two scales aimed at assessing dimensions of extraversion and neuroticism. Unlike the MPI, items in the EPI are carefully worded so as to make them understandable to subjects of lower educational levels (Eysenck & Eysenck, 1975). The EPI is also relatively short and simple and employs a yes-no dichotomy that eliminates the tendency for respondents to endorse a ‘don’t know’ response set.

In normal subjects, the EPI is accepted as a reliable method of assessing personality. Test-retest reliabilities of 0.94 and 0.84 over a nine-month and one-year period respectively have been found (Eysenck & Eysenck, 1975). Moreover, individuals who impress others as showing introverted or extroverted behaviour patterns, or who are judged to as be stable or unstable in their everyday behaviour, typically answer the EPI in the corresponding manner (Eysenck, 1962; Eysenck & Eysenck, 1963). Researchers have thus concluded the inventory's responses give a reasonably valid picture of the subject's behaviour patterns under normal conditions.

The EPI was used in preference to the newer Eysenck Personality Questionnaire (EPQ(R)) in order to allow participants' scores to be compared with those obtained in previous studies. Others researchers have successfully employed the EPI to study personality traits during pregnancy (e.g. Chapple & Furneaux, 1964; Meares et al., 1972). Kumar & Robson (1984) used the EPI to prospectively investigate the incidence of depressive disorders in a group of 119 first-time mothers. A comparison of scores taken approximately 12 months apart revealed that subjects' responses were highly correlated on all dimensions. This result reflects the stability of inventory scores over such an important life change.

4.3.1.5 Generalised Self-Efficacy

In order to assess the strength of an individual's belief in his or her own ability to respond to the novel experience of pregnancy and to deal with any obstacles and setbacks that it may bring, the current study employed the Generalised-Self-Efficacy Scale (GSES; Schwarzer, 1992). The GSES is a brief ten-item scale that has been translated from an original German version. It is self-administered and normally takes only 2-3 minutes to complete. Respondents are required to read each statement and indicate the extent to which they feel it applies to them. For each item there is a four choice response from not at all true (1) to exactly true (4). The scores of the ten items are summed to give a total score and the higher the score, the greater the individual's generalised sense of self-efficacy. The measure has been shown to possess high internal consistency and factor

analyses have confirmed that GSES assesses a unitary concept (Schwarzer, 1993). The concurrent validity of the scale has been established on the basis of appropriate correlations with other tests. Significant positive correlations have previously been found with self-esteem, internal control beliefs and optimism whilst negative correlations have been found with general anxiety, performance anxiety, shyness and pessimism (Schwarzer, 1993).

4.3.1.6 Health Value

The Health Value Index measures the value that individuals' place on absolute health (Lau et al., 1986). The scale comprises four items and asks respondents to rate the importance they place on health without placing the questions in any context or making comparisons with the value they would place on any other factor. The items comprise the phrases '*If you don't have your health you don't have anything*'; '*There are many things I care about more than my health*'; '*Good health is only of minor importance in a happy life*' and '*There is nothing more important than good health*'. Responses are measured using a 6 point Likert scale ranging from strongly agree (6) to strongly disagree (1). The second and third items are reversed coded and the sum of all four scores provides an overall measure of health value with scores ranging from 4 to 24. This short form did not increase the demands placed upon respondents to any noticeable degree.

4.3.1.7 Self-Reported Activity Beliefs & Physical Activity Enjoyment

At entry into the study, women were also asked to rate the importance of 10 different health behaviours in pregnancy on a 5 point Likert scale ranging from '*not at all important*' to '*very important*'. These statements assessed how much importance women attributed (i) getting a good night's sleep, (ii) rest and relaxation (iii) getting out and about (iv) regular exercise and (v) having an active lifestyle. The scale also assessed the importance women attributed to (i) not smoking, (ii) not drinking too much alcohol, (iii) avoiding worrying (iv) avoiding fatty foods and (v) avoiding getting overweight. This scale has been employed previously in order to investigate physical activity beliefs within

the general population (ADNFS, 1992). Participants within the current study were also asked whether they considered themselves more or less active than other pregnant women of their age and whether or not they generally enjoyed participating in physical activities.

4.3.1.8 Pre-Pregnancy Activity Levels

In order to classify women according to their habitual level of daily activity it was necessary to provide a more detailed assessment of women's physical activity patterns prior to pregnancy. In practice pre-pregnant measures of maternal activity are rarely available because many pregnancies are unplanned and mothers are not reporting this information routinely before they conceive. There was thus little alternative but to use a self-report of women's pre-pregnancy routines and daily activity behaviour. A series of short questions investigated women's working status and level of domestic responsibility.

In addition, the modified Baecke questionnaire (Pols et al., 1995) was used to provide a habitual daily activity index. This questionnaire produced a total daily activity index based upon the different occupational, sporting and non-sporting leisure activities that the women had engaged in during the 12 months prior to becoming pregnant. Women who had been employed or had attended school during this time were instructed to consider their domestic activities or study as their main form of daily activity and answer the Baecke questionnaire accordingly. As described previously (section 3.10.2), the modified Baecke questionnaire has been shown to be both valid and reliable in measuring the activity patterns of adult female populations (Pols et al., 1995).

4.3.1.9 Maternal Work Satisfaction

Because pregnant women can rarely be considered a homogenous group, study participants were also asked to complete an established Work Satisfaction Scale (Pattison & Moyse, 1995). The reason for the inclusion of this scale lay in the hypothesis that individuals would ultimately experience greater satisfaction with their daily workload if

their interests matched their role. A corresponding Home Satisfaction Scale for non-employed mothers was also included (Pattison & Moyse, 1995).

4.3.2. Repeated Measures

Throughout pregnancy, information was gathered on a wide range of behavioural and psychosocial variables. These included data relating to maternal daily activity levels, lifestyle changes and psychological wellbeing. Variables that were measured on more than one occasion are discussed in detail below.

4.3.2.1 Maternal Depression

Maternal depression was assessed using the Edinburgh Postnatal Depression Scale (EPDS) (Cox et al., 1987). This instrument is a screening tool for detecting postnatal depression which has also been used outside of the postnatal period (Thorpe, 1993). The EPDS has been shown to be both reliable and valid (Cox et al., 1987) and has been used extensively to investigate the prevalence and correlates of mood disturbances in pregnancy (e.g. Lane et al., 1997; DaSilva et al., 1998; Steinberg & Bellvance, 1999).

The 10-item EPDS scale is a short and simple measure that is usually completed without difficulty in less than five minutes. For each item, participants are required to underline one of four possible statements that most closely resembles how they have been feeling over the past week. Responses are scored from 1 to 4 and summed for all ten items. Subjects who score above a cut-off threshold of 12-13 are judged to be suffering from a depressive illness. When compared against established Research Diagnostic Criteria, the scale has been shown to have satisfactory levels of sensitivity and specificity (Cox et al., 1987).

4.3.2.2 Maternal Anxiety

Levels of maternal anxiety were measured using the State-Trait Anxiety Inventory

(STAI) (Spielberger et al., 1970). The STAI comprises two scales that enable both current levels of anxiety and underlying stable anxiety to be assessed. The State anxiety scale consists of twenty statements that ascertain how respondents feel *right now*. In contrast, the T-anxiety scale consists of 20 statements that measure how people *generally* feel. Each STAI item is given a weighted score of between 1 and 4 and total scores are obtained by summing the scores for each scale. The inventory is designed to be self-administering and has no time limits for completion.

Both the test-retest and internal reliability of the STAI are reported to be high (Spielberger et al., 1970; 1983) and extensive normative data is available for working female adults and college students. Scores on the S-scale have previously been found to be a sensitive indicator of transitory anxiety experienced during counselling, psychotherapy and behaviour modification programmes (Spielberger, 1983) and during unavoidable life stressors such as imminent surgery and job interviews (Spielberger, 1983). Moreover, the STAI is one of the most commonly used anxiety rating scales in pregnancy and the postnatal period (e.g DaCosta et al., 1999).

4.3.2.3 Maternal Adjustment

Whilst the State-Trait Anxiety Inventory and the Edinburgh Postnatal Depression Scale were both chosen to assess major constructs of maternal emotional wellbeing, neither of these questionnaires were specifically concerned with a woman's orientation towards her pregnancy. A third scale, the Maternal Adjustment & Maternal Attitudes questionnaire (Kumar et al., 1984) was therefore used to investigate women's attitudes towards pregnancy and motherhood. The questionnaire comprises five separate 12-item sub-scales concerning (i) maternal body image, (ii) somatic symptoms (iii) attitudes towards the pregnancy and baby (iv) the marital relationship and (v) sexual functioning during the past month. Only the first three sub-scales were employed in the current study. Quinton et al. (1976) have previously criticised self rating questionnaires aimed at assessing marital relationships and similar comments apply to self assessments of sexual functioning (Bentler & Abramson, 1981).

Every item on the MAMA questionnaire is answered on a 4-point scale and respondents are always required to make a decision in either the positive or negative direction. The rating scale is rotated at random to avoid a set response and both antenatal and postnatal versions are available. Kumar et al. (1984) have previously shown the form to be both reliable and valid when used on primiparous women.

4.3.2.4 Perceived Social Support

The Support in Pregnancy Questionnaire (SPQ) (McWilliams, 1994) was chosen to measure perceived levels of maternal support. This measure is a self-administered instrument which has previously been shown to have high predictive value (McWilliams, 1994). Within the questionnaire, four separate sub-scales are identified. These refer to (i) partner support, (ii) parental support, (iii) family/general support and (iv) self-support. Each sub-scale contains 28 short questions, which are answered on a seven-point response scale. The majority of questions are assigned a value from 1 (strongly agree) to 7 (strongly disagree) although one question is scored from 7 (strongly agree) to 1 (strongly disagree). A total score of 16 or above in each domain is taken to represent the cut-off value for women at risk of stress or anxiety due to an inadequacy of perceived social support.

4.3.2.5 Fetal Health Locus of Control

The Fetal Health Locus of Control Scale (FHLC) (Labs & Wurtele, 1986) was used to address the issue of who the women believed was responsible for the normality and health of their child. The FHLC measures the extent to which the mother believes that (i) she will determine the health of the fetus, (ii) the medical professional will determine the health of the fetus and (iii) chance will determine the health of the fetus. The validity of the scale has been demonstrated by Labs & Wurtele (1986) who have previously reported using the scale to predict levels of maternal smoking behaviour, caffeine consumption and intention to attend childbirth classes during pregnancy (see Chapter 2, section 2.6.7).

4.3.2.6 Maternal Health Behaviours

The extent to which study participants engaged in several different health behaviours was estimated via self-report. Women were asked to report their levels of smoking, alcohol consumption, caffeine consumption, drug use and attendance at parentcraft classes in the 7 days prior to each interview.

4.3.2.6.1 Smoking Behaviour

To account for differences in the accuracy with which smoking behaviour was reported, women were classified into one of the following categories: non-smoker, 1-10 cigarettes daily, 11-20 cigarettes daily or more than 20 cigarettes a day.

4.3.2.6.2 Alcohol Consumption

Alcohol consumption was assessed in two ways. Firstly, women were asked to describe themselves simply as a non-drinker, occasional drinker or regular drinker. Secondly, they were asked to recall the number and type of alcohol drinks that they had consumed in the seven days prior to interview. These responses were recorded and later converted into units of alcohol by the researcher.

4.3.2.6.3 Caffeine Consumption

Respondents were asked to indicate how many cups of coffee, tea and cola they consumed on a daily basis. These self-reported values were then converted into an estimate of daily caffeine consumption on the basis of values reported by Hatch & Bracken (1993). 'Real' coffee was assumed to contain 110mg of caffeine, instant coffee 65mg, tea 50mg and cola 40mg.

4.3.2.7 Daily Activity Behaviour

The final repeated measure was that of maternal daily activity levels. At each visit, maternal daily activity levels were assessed by two methods: (i) a self-reported, semi-structured activity questionnaire and (ii) an ambulatory activity monitor ("*Actiwatch*

AW2", Cambridge Neurotechnology Ltd). These methods were described in detail in Chapter 3 (see sections 3.5 and 3.7).

Women were instructed to wear the activity monitor for a continuous 72-hour period on each occasion. This recording period was always set to include the same three days of the week and was organised so as to comprise two working days and one non-working day⁴. The Actiwatch AW2 unit was delivered directly to the woman on the day preceding data collection and each participant was told to start wearing the monitor that same night. Each woman wore the actiwatch monitor facing outwards on her non-dominant ankle, attaching it directly above the anklebone. The monitors were to be worn continuously until the morning following the last day of recording and removed only briefly for bathing, showering and water sports. Each time the unit was removed and replaced, a marker button was to be depressed to indicate the time and duration that the monitor was not being worn. Data was subsequently downloaded to a computer and marked periods eliminated from the analyses.

Collection of the monitor coincided with the administration of the subjective activity questionnaire. This questionnaire had undergone extensive pilot testing (see Chapter 3, section 3.8) and was designed to give the maximum opportunity for a complete and accurate communication of views between the mother and the researcher. The same interviewer administered the questionnaire to all participants and assessment took place within the women's homes. To maintain subject compliance and prevent unnecessary travelling, individuals were always contacted by telephone the day before their interview. Due to the limited amount of time that was expected to be available to women in the early postpartum period, the activity questionnaire was not administered at the final visit. Instead, a summary sheet on which women recorded pre-specified activities (see appendix 5) was used in conjunction with the activity monitor. This sheet facilitated the interpretation of the monitor data in the absence of data from the questionnaire.

⁴ Where women were not employed, the days were chosen to correspond to the working patterns of their partner. It was hoped that this would account for any variation in family-orientated activities resulting from a partner being at home or at work.

4.3.3. Birth Outcome Measures

It was decided to investigate the influence of activity on pregnancy outcome using information contained within medical records not least because medical records provide a convenient and readily accessible source of obstetric information for large numbers of women. Not surprisingly researchers have used this rich source of information to conduct a wide variety of studies into reproductive health and maternity care (e.g Johnson et al., 1987; Hall et al., 1980).

From databases held at the hospital involved, data were gathered on selected delivery characteristics and neonatal health status. These data consisted of measures of gestational age at delivery, infant birthweight and Apgar scores, mode of labour onset, mode of delivery, form of infant feeding and length of hospital stay.

4.4 Ethical issues

The entire study was undertaken with the approval of Leicestershire Health Authority's Committee on the Ethics of Clinical Research Investigation. It was also in compliance with the Loughborough University Department of Human Sciences Ethics Guidelines. Responses were confidential and participants' anonymity was guaranteed. No names were indicated on the completed interviews and results of the research could not be traced to any individual respondent.

4.5 Compilation of Data

Quantitative data were screened for encoding errors and compiled using SPSS 9.0 (Statistical Package for the Social Sciences, Version 9.0). Open-ended responses from the activity interview were also entered into this program. These responses were coded as each different answer was encountered and subsequently collapsed into more general categories as required. Descriptive and inferential statistical analyses were conducted and are described where appropriate in the relevant results chapters (Chapters 5-10).

4.6 Chapter Summary

This chapter has described the main study design for the current research project. Data collection was divided into three separate phases. The first assessed personal factors considered to be stable characteristics of the study sample. Due to the method by which women were recruited, this initial phase was always completed between 12 and 14 weeks of pregnancy. The second and longest phase of data collection occurred throughout the reproductive process. During this period, more transitory measures of daily activity behaviour and maternal wellbeing were investigated. In this phase data collection took place on a repeated basis. The final phase of data collection took place at the time of birth. Indicators of fetal health status, labour and delivery were obtained from hospital databases. A summary of the full data collection process is given in figure 4.2. The results of the study are dealt with in the remaining chapters, starting with the details of the women who took part.

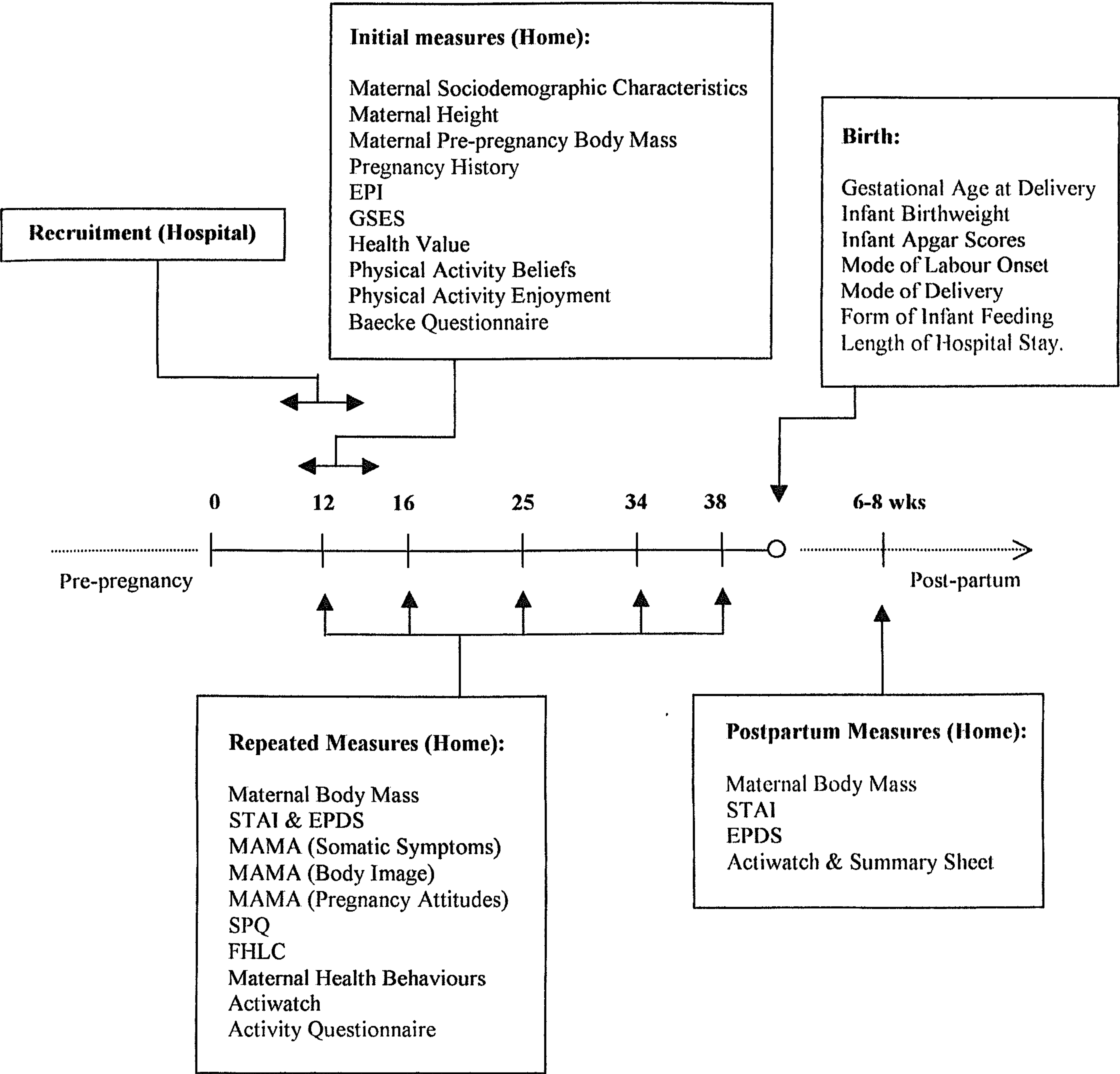


Figure 4.2: A Summary of Data Collection:

(EPI=Eysenck Personality Inventory, GSES=Generalised Self-Efficacy Scale, Baecke Questionnaire=Baecke index of Habitual Physical Activity, STAI=State-Trait Anxiety Scale, EPDS=Edinburgh Postnatal Depression Scale, MAMA=Maternal Attitudes & Maternal Adjustment, SPQ=Support in Pregnancy Questionnaire, FHLC=Fetal Health Locus of Control)

CHAPTER FIVE

The Characteristics of the Study Participants

5.1 Introduction

In the previous chapter, the materials and methods that were selected in order to study the daily activity patterns of nulliparous pregnant women were discussed. To this end, participant recruitment, the nature of the data collected and the organisation of the study protocol have all been addressed. However, before describing the daily activity patterns of the respondents, it is helpful to present details of the participants themselves, so that their activity behaviour may be considered in context. In this chapter, attention is therefore directed towards the characteristics of the study participants. Sample attrition is described and the background sociodemographic circumstances and individual characteristics of the women are reviewed. Also considered are data relating to the more transient experience of pregnancy. The longitudinal design of the research provided an opportunity to gather background data on the participant's reproductive histories, health behaviours, and physical and psychological wellbeing before and during pregnancy. Also examined were details of gestational weight gain, maternal mood and maternal attitude. As postulated in Chapter three, all of these factors may have the potential to affect women's daily activity behaviour during pregnancy.

5.2 Statistical Analyses

Data were analysed using the Statistical Package for the Social Sciences 9.0 (SPSS Inc., Chicago). All data are reported as mean (S.D.) or as percentages. Relationships between the background variables under test were assessed using independent sample t- tests for dichotomous variables, one way analyses of variance (ANOVAs) or Chi square tests for categorical variables and Pearson's correlation coefficients for continuous variables. All tests were two tailed.

5.3 The Sample

The sample was drawn from women who attended antenatal appointments at an East Midlands hospital between January 1st and 31st March 1999. A total of one hundred and twenty women were eligible for inclusion in the study, all of whom were approached and informed about the study. Of these, 74 agreed to participate. Ten withdrew prior to the first home visit and 64 began the study (table 5.1). After this, only a further 7 subjects were lost. This second phase of attrition occurred either because of problems relating to the pregnancy or because of unavoidable logistic difficulties. 57 individuals thus provided data for analysis.

Table 5.1: The Extent and Nature of Sample Attrition.

		n	% participation ^a
Total recruited (Jan-March 1999)		74	100 (62)
Initial Attrition:	Unavailable at first interview	5	
	Spontaneous abortion	3	
	Dissatisfaction with activity monitor	1	
	Unexplained withdrawal	1	
Total remaining		64	86 (53)
Subsequent Attrition:	Antepartum haemorrhage	1	
	Premature rupture of membranes	1	
	Unexplained complications	1	
	Transferred out of LRI catchment area	3	
	Possessed no fixed address	1	
Total remaining in data analyses		57	77 (48)

^aas a proportion of women recruited (% of all women approached).

All 57 women were followed throughout their pregnancies and 51 (89%) completed all five appointments scheduled between 16 weeks gestation and 6-8 weeks postpartum. At 38 weeks gestation, 2 women were unavailable for interview and 4 had already delivered their babies. 30 of the 57 individuals taking part (28 of those completing all five visits between 16 weeks gestation and 6-8 weeks postpartum) were recruited sufficiently early to provide supplementary data at 12 weeks gestation.

Comparisons drawn between the women who were recruited before 12 weeks of pregnancy and those recruited after revealed no significant differences in terms of sociodemographic, anthropometric or psychosocial variables. Data from the two samples were therefore combined for analysis. The following sections present information regarding these characteristics.

5.4 Initial Measures

5.4.1 Sociodemographic Characteristics

5.4.1.1 Maternal Age

The sociodemographic characteristics of the women included in the study are summarised in table 5.2. At the time of conception respondents ages ranged from 15.7 – 38.2 years with a mean age of 26.3 (S.D. 5.2) years. National trends suggest that the mean age of women at the birth of a child has gradually increased over the last ten years from 27.2 years in 1978 to 28.9 years in 1998 (OPCS, 1999). In this respect, the women surveyed were on average slightly younger than mothers in the general population. Indeed, at the time of conception half were aged between 25 and 34 years and 45% were under 25. This compares to approximately 60% and 25% nationally. It is acknowledged however, that national figures do not take account of birth order. Directly comparable figures for the mean age of first time mothers are not yet available.

5.4.1.2 Marital Status

The vast majority of women in the study (79%) reported living with a partner. 65% of the sample were married and 14% were co-habiting. Once again, these figures broadly reflect the national picture. In 1998, 62% of all live births were registered inside marriage and 23% were registered jointly by parents living at the same address.

5.4.1.3 Educational Attainment & Socio-Economic Status

Almost half of the women (44%) had been educated beyond the compulsory age of 16. The distribution of socio-economic status, according to the Registrar General's Classification of Occupations (1970), is given in table 5.2. Published information on social class distribution is available for nulliparous, married women only. Nationally, 44% of married women belong to social classes I & II, 12% to III (N), 24% to III (M) and 15% to social classes IV & V (OPCS, 1999). When corresponding figures were calculated for married women in the current study, a similar distribution was obtained. In this instance, 52% of married women were in social classes I & II, 9% in class III (N), 28% in class III (M) and 11% in social classes IV & V.

Table 5.2: Sociodemographic Characteristics of the Study Participants (n=57).

Characteristic	% (n)
Maternal age (years)	
<20	12 (7)
21-24	33 (19)
25-29	23 (14)
30-34	27 (15)
35-39	4 (2)
40+	-
Marital Status	
Married	65 (37)
Co-habiting	14 (8)
Single	21 (12)
Highest Level of Educational Attainment	
CSE 2-5 or below	13 (7)
CSE 1/GCSE	44 (25)
A-level, HND, Equivalent Qualification (Non-Degree)	25 (14)
Degree, Equivalent Professional Qualification	19 (11)
Current Socio-Economic Status ^a	
I or II	46 (26)
III (N)	28 (16)
III (M)	12 (7)
IV	12 (7)
Unclassified ^b	2 (1)

^a According to the Registrar General's Classification of Occupations (1970) ^b One respondent who had recently left school, was unemployed and lived away from home could not be classified.

5.4.2 Pregnancy History

Alongside general sociodemographic data, the first interview also considered participants' reproductive histories. As stated earlier, all participants were nulliparous. The majority (70%) had experienced no previous pregnancy. Less than one fifth (18%) had suffered a previous miscarriage and a smaller proportion (12%) had undergone a termination of pregnancy. 61% of participants reported that their current pregnancy had definitely been planned. 6 individuals (11%) said that it had been planned a little and over a quarter (28%) reported that their pregnancy had not been planned at all.

5.4.3 Individual Characteristics

5.4.3.1 Extroversion, Neuroticism & Generalised Self-Efficacy

At the first interview all respondents were asked to complete the Eysenck Personality Inventory (EPI) and the Generalised Self-Efficacy Scale (GSES). Only 51 respondents completed the latter measure satisfactorily. Six forms were found to be incomplete when analysis commenced. In terms of both extroversion and self-efficacy, the study sample was found to correspond closely to the mean scores of normative samples. Scores on the neuroticism scale were slightly although not markedly lower than those of published figures (table 5.3).

5.4.3.2 Health Value

The mean health value score for women in the study was 15.79 (S.D. 3.63). Although no official norms are available for this scale, a comparison can nonetheless be drawn between the mean score of the sample, a mean score obtained by 11-16 year old girls and the mean score of these girls' parents. The mean score for 11-16 year old girls has previously been reported to be 13.43 (S.D. 2.96) and that of their parents 16.22 (S.D. 2.93) (Lau et al, 1986). Thus, since the age range of the current sample fell between these two groups, the scores achieved by participants were once again considered typical of a wider population.

Table 5.3: Selected Personality Traits of the Sample as Compared to Published Norms.

Characteristic	Study Sample		Comparative Norms	
	n	Mean (S.D.)	Sample	Mean (S.D.)
Extroversion (EPI score)	57	12.35 (3.80)	Females: 16-19 yrs	3.31 (4.61)
			20-29 yrs	12.89 (4.70)
			30-39 yrs	11.97 (4.95)
Neuroticism (EPI score)	57	11.26 (4.61)	Females: 16-19 yrs	13.28 (5.22)
			20-29 yrs	12.87 (4.99)
			30-39 yrs	12.57 (5.28)
Generalised Self-Efficacy (GSES score)	51	29.94 (4.17)	German adults	29.28 (4.60)

5.5 Repeated Measures

5.5.1 Gestational Weight Gain

The first activity interview asked participants for a self-reported estimate of their body weight prior to becoming pregnant. Maternal height was also measured. Subsequent interviews incorporated a weight measurement of each woman at each stage of pregnancy. All data are shown in table 5.4.

Table 5.4: Anthropometric Measurements for the Study Sample

Characteristic	n	Mean (S.D)		
Pre-pregnancy body mass (kg) ^a	57	59.3 (11.9)		
Maternal height (m)	57	1.63 (0.07)		
Pre-pregnancy BMI (kg/m²) ^b	57	22.2 (3.5)		
	n	Mean (S.D.)	Mean (S.D) Weight Gain ^b	
Maternal Body Mass (kg):	12 wks	30 62.9 (11.8)	2.2	(2.9)
	16 wks	57 63.8 (12.2)	4.4	(3.5)
	25 wks	57 68.0 (12.2)	8.6	(3.4)
	34 wks	57 72.3 (13.0)	13.0	(4.3)
	38 wks	51 74.2 (13.6)	15.0	(4.7)

^a self-report ^b based on self-reported pre-pregnancy body mass

Using self-reported pre-pregnancy body weight as a baseline, mean weight gain for the sample at 38 weeks gestation was 15.0 (S.D. 4.7) kg. The total weight gain recommended in pregnancy for normal women is 11.3-15.9 kg (Gabbe et al. 1991) although individuals

may be counselled to expect to gain anything from 9.6 to 19.2 kg (Royal College of General Practitioners, 1998). Thus, whilst the mean weight gain for the sample may be considered somewhat high on the basis of current medical recommendations, it nonetheless remained well within the normal limits of weight gain that may be experienced during pregnancy. Indeed, for the majority of studies that use self reports of pre-pregnant weight followed by measurements of maternal body weight, an underreporting of pre-pregnant weights will tend to overestimate the amount of weight gained following pregnancy simply because self-reports of body weight tend to underestimate true body weight (Harris & Ellison, 1997).

5.5.2 Psychological Health

At the first interview women were questioned about their psychological health prior to pregnancy. 6 individuals reported suffering from a previous episode of stress or anxiety and 3 women from a previous episode of depression. No individuals were suffering psychological health problems at their entry into the study.

5.5.2.1 Maternal Depression

Throughout the study, the Edinburgh Postnatal Depression Scale (EPDS; Cox et al 1987) was used as a measure of depression. The mean EPDS score for the sample at each stage of pregnancy is displayed in table 5.5.

Table 5.5: Mean EPDS Scores for the Sample Across Pregnancy

Stage of gestation (weeks)	n	Mean (S.D) EPDS score	% (n) with depressive symptoms
12	30	9.1 (5.2)	27 (8)
16	57	7.5 (4.3)	7 (4)
25	57	7.2 (4.0)	7 (4)
34	57	7.7 (4.8)	18 (10)
38	51	7.6 (5.2)	10 (5)

The prevalence of depressive symptoms (EPDS scores greater than 13: Cox *et al*, 1987) was found to be highest at 12 weeks gestation (27%) and lowest at 16 and 25 weeks gestation (4%). Only three individuals had scores that indicated cause for concern on two or more occasions. Pairwise comparisons showed the mean EPDS scores at 12 weeks to be significantly higher than at 16 weeks ($t=3.10$, $df=27$, $p<0.01$), 25 weeks ($t=2.16$, $df=27$, $p<0.05$), and 38 pregnancy ($t=2.26$, $df=27$, $p<0.05$).

5.5.2.2 Maternal Anxiety

Maternal anxiety during pregnancy was measured by the State Trait Anxiety Inventory (Speilberger, 1970). Between 16 and 38 weeks gestation, mean state anxiety increased steadily. Pairwise comparisons with multistage Bonferroni correction showed mean levels of state anxiety to be significantly higher at 38 weeks than at 16 weeks of pregnancy ($t=-2.22$, $df=49$, $p<0.05$). At no stage of pregnancy however, was the sample considered to be highly anxious. Both mean state anxiety and mean trait anxiety were found to broadly reflect the mean scores obtained by a sample of adult working females during the development of the scale (table 5.6). Trait anxiety scores were not found to vary significantly over time and were therefore reduced to a mean value for each participant.

Table 5.6: Mean STAI Scores for the Sample Across Pregnancy

	Stage of gestation (weeks)	Sample		Comparative Norms ^a	
		n	Mean (S.D)	Mean	(S.D)
Trait Anxiety	Mean	57	37.67 (8.40)	36.15	(9.53)
State Anxiety	12	30	37.25 (9.63)	36.17	(10.96)
	16	57	32.39 (9.10)		
	25	57	34.09 (9.49)		
	34	57	35.37 (10.84)		
	38	51	36.21 (11.13)		

^a Adult working females aged 19-39

5.5.3 Maternal Adjustment

Throughout pregnancy, maternal adjustment was quantitatively evaluated by means of three separate sub-scales of the MAMA questionnaire (Kumar et al., 1984). Responses to each item were measured over a four-point range with lower scores denoting greater maternal adjustment and a more positive maternal attitude. Table 5.7 shows the distribution of the scores on each sub-scale across pregnancy.

Table 5.7: Mean MAMA Scores for the Sample Across Pregnancy

MAMA Sub-scale	Gestation (weeks)	n	Mean	(S.D.)
Maternal Attitude	12	30	24.34	(4.59)
	16	57	23.59	(4.72)
	25	57	22.71	(4.23)
	34	57	22.86	(4.54)
	38	51	23.54	(5.52)
	Mean Score	57	23.23	(4.25)
Body Image	12	30	28.03	(5.31)
	16	57	27.95	(4.99)
	25	57	27.54	(5.19)
	34	57	28.12	(5.11)
	38	51	27.50	(5.36)
	Mean Score	57	27.84	(4.25)
Somatic Symptoms	12	30	26.79	(4.13)
	16	57	26.58	(4.40)
	25	57	24.88	(4.28)
	34	57	26.26	(4.29)
	38	51	26.60	(4.20)

Since normative values for the MAMA scale are not available, it was not possible to assess the normality of the women’s scores. However, no significant differences in maternal attitude or body image were observed. On both these measures therefore, scores were reduced to a single mean value for each participant. In contrast, somatic symptoms varied significantly over the course of pregnancy. Pairwise comparisons with multistage Bonferroni correction showed the mean scores on the somatic symptom sub-scale of the MAMA scale at 25 weeks to be significantly lower than at 12 weeks of pregnancy ($t=3.44$, $df=27$, $p<0.05$). The difference between scores at 25 weeks and 38 weeks just missed significance at the $\alpha=0.05$ level ($p=0.06$).

Most common amongst frequently experienced somatic symptoms at 12 weeks gestation were lack of energy (90%), nausea or vomiting (38%), and dizziness (9%). Most common amongst frequently experienced somatic symptoms at 38 weeks were lack of energy (55%) and breathlessness (15%). However, many ‘pregnancy-related symptoms’ were conspicuous by their infrequency (e.g heartburn, swollen ankles and constipation) and even with the most common symptoms it was clear that not all women were affected.

5.5.4 Perceived Social Support

The Support in Pregnancy Questionnaire (SPQ; McWilliams, 1994) was used as a measure of perceived social support. Women in the current study were found to score slightly lower (and therefore perceive a slightly higher level of support) than a previous sample reported by McWilliams et al (2000) (table 5.8). Moreover perceived support was found to increase significantly throughout pregnancy such that they were significantly higher at 38 weeks than at 16 weeks gestation ($t=2.40$, $df=50$ $p<0.05$). These findings suggested that overall, women in the current study perceived a comparatively high level of support throughout their pregnancies.

Table 5.8: Mean SPQ Scores for the Sample Across Pregnancy

Study Sample			McWilliams (2000)	
Stage of gestation (weeks)	n	Mean (S.D)	Mean	(S.D)
12	30	57.90 (22.49)	63.62	(25.34) ^a
16	57	60.93 (26.85)		
25	57	56.61 (19.23)		
34	57	55.91 (17.09)		
38	51	53.69 (17.02)		

^a score obtained by 500 women across all trimesters of pregnancy.

5.5.5 Fetal Health Locus of Control

Finally, women completed the Fetal Health Locus of Control scale (Labs & Wurtele, 1986). From table 5.9 it can be seen that average FHLC-I sub-scale scores were by far the highest of the three FHLC sub-scales. Mean scores on the Chance and Powerful Others

sub-scales broadly reflected corresponding mean values obtained by Labs & Wurtele (1986) whilst mean scores on the internality scale were slightly lower than those expected on the basis of the original validation study. The variation in sub-sample scores across the five stages of pregnancy was found to be non-significant and values were therefore condensed into an overall mean score for each scale.

Table 5.9: Mean FHLC Scores for the Sample Across Pregnancy

FHLC sub-scale	Study Sample				Labs & Wurtele (1986)		
	Gestation (weeks)	n	Mean	(S.D.)	n	Mean	(S.D.)
Internal	12	30	37.97	(5.72)	63	46.84	(5.76)
	16	57	37.74	(7.09)			
	25	57	37.79	(6.71)			
	34	57	37.04	(7.11)			
	38	51	37.44	(6.88)			
	Mean	57	37.46	(6.05)			
Powerful Others	12	30	23.77	(10.16)	63	24.56	(10.44)
	16	57	20.96	(9.51)			
	25	57	20.91	(8.90)			
	34	57	20.17	(9.64)			
	38	51	22.06	(9.53)			
	Mean	57	21.14	(8.51)			
Chance	12	30	27.93	(10.83)	63	26.76	(10.24)
	16	57	29.14	(9.45)			
	25	57	28.63	(10.03)			
	34	57	27.63	(8.91)			
	38	51	28.24	(10.41)			
	Mean	57	28.72	(8.71)			

5.6 Interrelationships between Variables

5.6.1 Stable Measures

All initial measures and all stable repeated measures (i.e those that did not change significantly over the course of pregnancy) were entered into a correlation matrix (table 5.10). Figures in this table indicate strong correlations between a number of maternal

Table 5.10: Cross-Tabulated Associations Between Maternal Background Characteristics (Stable Measures) (Figures denote probability p-values)

Variable	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
01. Maternal Age	X	<0.1	<0.1	<0.1	.14	.08	.41	.10	.37	.28	.33	.19	.02	.51	.48
02. Marital Status		X	.33	.03	<0.1	.13	.28	.76	.28	.47	.21	.75	.30	.83	.48
03. Social Class			X	<0.1	.54	.14	.42	.02	.02	.28	.35	.62	.09	.20	.03
04. Education Level				X	.72	.14	.44	.06	.01	.62	.40	.93	.64	.02	.14
05. Degree Pregnancy Planned					X	.43	.68	.67	.45	.32	.81	.99	.37	.43	.06
06. Extroversion						X	.03	.56	.96	.65	.98	.46	.95	.08	.40
07. Neuroticism							X	<.01	.02	.94	.13	.59	.76	.48	.60
08. Generalised Self-Efficacy								X	.07	.35	.31	.09	.17	.86	.46
09. Health Value									X	.80	.48	.23	.92	.50	.72
10. Gestational Weight Gain										X	.58	.61	.98	.17	.13
11. Maternal Attitude											X	<.01	.17	.33	.37
12. Body Image												X	.02	.36	.51
13. FHLC-I													X	.48	<.01
14. FHLC-C														X	<.01
15. FHLC-P															X

Social Class = (i) IV & V (ii) III_m & III_n (iii) II & I; Educational level = (i) GCSE or below (ii) Above GCSE; Marital Status = (i) Single (ii) Married/cohabiting

Figures emboldened in blue denote significant positive relationships; Figures emboldened in red denote significant negative relationships

N.B. Lower maternal attitude and body image scores denote a more positive level of maternal adjustment

socio-demographic and psychosocial characteristics. Older women were significantly more likely to be married ($p<0.001$), of a higher social class ($p<0.001$), and a higher educational standard ($p=0.001$) than were younger women. Scores on the internal dimension of the FHLC scale demonstrated that older women were also significantly more likely to hold themselves responsible for the health of their baby ($p=0.016$). Social class was significantly associated with maternal self-efficacy and health value such that women of a higher social class were more likely to have a higher level of generalised self-efficacy ($p=0.015$) and place a higher value on their health ($p=0.019$). They were also significantly less likely to believe health professionals were responsible for the health of their baby ($p=0.025$). Similarly, women who had reached a higher educational standard were also likely to place a higher value on their health ($p=0.006$) and be significantly less likely to believe that the health of their baby would be determined by chance ($p=0.02$). A higher maternal body image was significantly associated with both higher scores on the internal dimension of the FHLC scale ($p=0.015$) and a more positive maternal attitude towards pregnancy and the baby ($p<0.01$).

5.6.2 Changing Variables

Further relationships were observed between measures of maternal psychological health and other aspects of the pregnancy experience. At each stage of pregnancy for example, higher EPDS scores were significantly associated with higher levels of maternal anxiety ($p<0.001$) and lower levels of perceived support ($p<0.006 - p=0.03$). With the exception of scores at 34 weeks of pregnancy, higher levels of maternal depression were also consistently associated with higher levels of reported somatic symptoms ($p<0.009 - p=0.01$). Higher maternal anxiety was significantly associated with higher levels of reported somatic symptoms at 12 weeks ($p=0.02$), 25 weeks ($p=0.007$) and 38 weeks of pregnancy ($p=0.008$) and with lower levels of perceived social support at 16 weeks ($p=0.04$) and 38 weeks of pregnancy ($p=0.03$). Table 5.11 highlights other significant relationships that existed between these variables and the more stable sociodemographic and psychosocial measures described in section 5.6.1

Table 5.11: Cross-Tabulated Associations Between Maternal Background Characteristics (Stable and Changing Variables) (Figures denote p-values)

Variable:	EPDS Scores										STAI Scores										MAMA Scores (Somatic Sub-scale)										SPQ Scores									
	Stage of gestation (weeks):																																							
	12	16	25	34	38	12	16	25	34	38	12	16	25	34	38	12	16	25	34	38	12	16	25	34	38	12	16	25	34	38	12	16	25	34	38					
01. Maternal Age	.52	.04	.10	.17	.40	.85	.05	.91	.24	.37	.30	.03	.12	.21	.25	.20	.62	.44	.56	.026																				
02. Marital Status	.34	.18	.35	.04	.03	.01	.37	.28	.11	.01	.26	.79	.62	.18	.40	.89	.57	.63	.63	.35																				
03. Social Class	.26	.01	.02	.03	.04	.22	.04	.77	.04	.09	.94	.75	.52	.09	.60	.64	.05	.37	.14	.59																				
04. Education Level	.09	.77	.49	.18	.15	.05	.28	.69	.33	.22	.89	.70	.63	.53	.75	.76	.71	.57	.66	.18																				
05. Degree Pregnancy Planned	.18	.71	.91	.79	.80	.12	.84	.79	.76	.79	.65	.75	.22	<.01	.15	.25	.26	.27	.20	.16																				
06. Extroversion	.28	.12	.18	.19	.08	.31	.44	.37	.51	.08	.91	.49	.76	.42	.83	.53	.38	.51	.60	.39																				
07. Neuroticism	.11	<.01	.33	.02	.14	.08	<.01	.24	.07	.06	.45	.62	.90	.36	.17	.68	.75	.69	.21	.56																				
08. Generalised Self-Efficacy	.44	<.01	.02	.02	.11	.50	.04	.10	.20	.12	.29	.74	.69	.88	.98	.15	.04	.03	.01	.14																				
09. Health Value	.32	.13	.23	.05	<.01	.24	.32	.88	.07	.08	.39	.74	.73	.12	.18	.12	.93	.51	.63	.20																				
10. Gestational Weight Gain	.59	.50	.39	.07	.57	.86	.94	.90	.99	.45	.90	.89	.65	.83	.15	.31	.47	.26	.66	.82																				
11. Maternal Attitude	.09	.81	<.01	<.01	<.01	<.01	.05	.08	<.01	<.01	.88	.86	.23	.24	.58	.08	.15	.03	<.01	<.01																				
12. Body Image	.70	.15	.46	.33	<.01	.14	.09	.99	.84	.01	.57	.95	.74	.38	.64	.31	.04	<.01	<.01	<.01																				
13. FHLC-I	.32	.33	.04	.92	.44	.18	.12	.22	.56	.99	.89	.55	.10	.51	.94	.85	.04	.32	.03	.50																				
14. FHLC-C	.03	.35	.40	.61	.98	.04	.93	.34	.80	.31	.06	.12	.54	.67	.84	.45	.52	.79	.51	.22																				
15. FHLC-P	.08	.84	.29	.02	.77	.02	.85	.19	.27	.57	.61	.58	.21	.09	.18	.35	.98	.85	.45	.94																				

Social Class = (i) IV & V (ii) III_m & III_ln (iii) II & I; Educational level = (i) GCSE or below (ii) Above GCSE; Marital Status = (i) Single (ii) Married/cohabiting

Figures emboldened in blue denote significant positive relationships; figures emboldened in red denote significant negative relationships

N.B. Lower maternal attitude, body image and somatic symptom scores denote a more positive level of maternal adjustment

Lower SPQ scores denote a higher level of perceived support.

5.7 Summary: Background Characteristics of the Study Participants

Analysis of the background characteristics of the sample revealed that the participants of the current study were typical of a wider pregnant population with respect to a number of different sociodemographic, anthropometric and psychosocial variables. Although mean maternal age was slightly lower than that of the national average, the age range of the sample spanned that of the main child bearing years. A slight bias towards higher social classes and higher levels of educational attainment was observed. This was believed to be an unavoidable consequence of the study's reliance on voluntary participation.

Associations between the main sociodemographic characteristics of the women confirmed that these variables were related to one another in a predictable manner. Indeed, a positive association between maternal age, educational level and social class is not unusual. Wilkie (1981) suggests that delayed motherhood is a recent strategy adopted by women interested in careers and especially those in higher education. Other studies have also confirmed that older mothers are more likely to have been in education longer and to have professional occupations than are younger mothers (e.g. Kern 1982, Berryman et al., 1995, Hemminki & Gissler, 1996).

Similarly, the women participating in the study did not appear unusual in terms of either their physical or psychological health status during pregnancy. The main variables that were found to change significantly over the course of pregnancy were levels of maternal depression, anxiety, somatic symptoms and perceived social support. In terms of physical wellbeing, there appeared to exist an optimal stage of pregnancy for the sample during which self-assessed somatic symptoms were at their lowest. This stage occurred at approximately 25 weeks gestation. The pattern of change that was observed in somatic symptoms thus reflected a traditional image of pregnancy in which physical complaints are stereotypically more common in the first and third trimester than they are in the second.

The percentage of women reporting depressive symptoms in the current study was highest at 12 weeks gestation and lowest at 16 and 25 weeks gestation whilst mean levels

of maternal anxiety were highest in late pregnancy. A similar pattern has again been observed in other studies (e.g Beck et al., 1980; Areskog et al., 1984). More recently, DaCosta et al. (1999) tracked hassles, pregnancy-specific stress and state anxiety in 161 low-risk pregnant women. Tracking commenced in the third month of pregnancy and continued at monthly intervals thereafter. The authors subsequently reported that, whilst hassles were found to be stable throughout pregnancy, women reported significantly higher pregnancy-specific stress in the first and third trimester. Compared to the first and second stages of pregnancy, state anxiety was significantly increased in the third.

In the present study, strong correlations existed between the psychosocial characteristics of the participants. The existence of these correlations, as well as correlations between sociodemographic and psychosocial variables, demonstrates the need for a number of potential confounding variables to be taken into account whenever relationships between maternal daily activity level and social, psychological and behavioural factors are assessed. The strength these potential relationships is examined further in Chapter 9.

5.8 Health Behaviours Before and During Pregnancy

In order to gain an insight into the type of factors that may affect maternal daily activity behaviour during pregnancy, the women's participation in other established health behaviours was considered. A series of questions in the activity questionnaire probed respondents' behaviour patterns regarding their attendance at parentcraft classes, alteration of smoking habits, alcohol consumption and caffeine intake.

5.8.1 Parentcraft Attendance

Nine participants (16%) expressed no intention to attend formal parentcraft classes during pregnancy. These intentions were related to social class ($\chi^2=9.59$; $df=4$; $p<0.05$) and to age. The mean age of the individuals who did not intend to be present at parentcraft classes was significantly lower than those who indicated they would attend ($t=-3.2$;

$df=55$; $p<0.01$). Intention to attend classes was not associated with any of the personality variables.

5.8.2 Smoking

At each visit, women were asked to indicate the number of cigarettes they were smoking each day, their usual caffeine intake and their weekly consumption of alcohol. In summarising their responses, it must be acknowledged that this information was self-reported and as such may be open to inaccuracy or bias towards current antenatal health advice.

Prior to becoming pregnant, 34 women (60%) reported that they were non-smokers. 23% smoked between 1 and 10 cigarettes a day, 12% between 11 and 20 cigarettes and 5% 21 or more. At 16 weeks of pregnancy, the percentage of non-smokers had increased to 76%, the percentage smoking between 1 and 10 cigarettes had reduced to 19% and the percentage smoking between 11 and 20 cigarettes was down to 5%. This distribution remained relatively stable throughout the rest of the pregnancy. Altogether, 8 individuals (35% of smokers) gave up smoking completely during pregnancy and a further 12 (52% of smokers) reported that they had cut down since becoming pregnant. No individual reported increasing their smoking level during pregnancy.

The Health Education Authority for England has conducted seven surveys between 1992 and 1997. Nationally, around 35% of women smoke during pregnancy, around one in ten gives up before becoming pregnant and one in six gives up during pregnancy (Owen et al., 1998). Whilst the figures from the current sample are slightly below these levels (24% were still smoking at 38 weeks gestation) they are nonetheless, in accordance with a previous sample recruited from the same antenatal clinic. Haslam (1999) examined maternal smoking behaviour in 254 pregnant women recruited from the same East Midlands hospital trust. In this instance, nearly a quarter of the sample (24%) were found to be smokers and 50% were never smokers. Moreover, the majority of current smokers

(83%) had reported that they had cut down since becoming pregnant. The smoking habits of the present sample were therefore not unusual.

5.8.3 Alcohol Consumption

In a similar manner, self-reported alcohol consumption also decreased. 18% of women described themselves as non-drinkers prior to pregnancy, 56% described themselves as occasional drinkers and 26% as regular drinkers. By 34 weeks gestation, 61% were non-drinkers, 37% were occasional drinkers and only 2% were regular drinkers. No individuals increased their consumption of alcohol. Current recommendations state that pregnant women should consume no more than 1-2 units of alcohol once or twice a week, that is, no more than a maximum of four units per week (Sensible Drinking, 1995). Only one individual exceeded this amount at 16 and 25 weeks gestation and only two exceeded it at 34 and 38 weeks gestation.

5.8.4 Caffeine Consumption

Respondents were asked to indicate how many cups of coffee, tea and cola they consumed each day. These self-reported values were later converted into an estimate of daily caffeine consumption on the basis of values reported by Hatch & Bracken (1993). Compared to a sample of pregnant women studied by Gross & Pattison (1995), women in the current study reported consuming slightly more caffeine on a daily basis prior to pregnancy (mean (S.D): 318 (208) mg/day vs. 216 (165) mg/day). Employing the scoring system used in the present study, this level of caffeine intake approximates to almost 5 cups of instant coffee per day. However, more than half the women (57%) who had consumed caffeine before pregnancy reported reducing their caffeine intake by 34 weeks gestation and a further 23% reported eliminating it from their diet completely. By 38 weeks gestation estimated mean daily caffeine consumption was 177 mg/day (S.D. 165 mg/day), the equivalent of approximately 2.5 cups of coffee per day.

5.8.5 Factors Influencing Health Behaviours During Pregnancy

To establish whether there were any associations between maternal health behaviours and sociodemographic or psychosocial characteristics, a series of one way ANOVAs and Chi-square analyses were conducted. Women were divided on the basis of (i) their smoking behaviour during pregnancy and (ii) their caffeine consumption. Because so few women reported drinking regularly during pregnancy, analyses were not conducted on this variable.

Maternal smoking behaviour during pregnancy was significantly associated with maternal age, body image and fetal health locus of control beliefs (table 5.12). Women who stopped smoking during pregnancy were significantly more likely to be older ($t=2.78$, $df=18$, $p=0.012$) and significantly more likely to hold themselves responsible for the health of their baby ($t=2.80$, $df=18$, $p=0.012$) than were women who only partially reduced their smoking levels. Both women who stopped smoking and women who reduced their smoking were significantly more likely to report a more negative body image in late pregnancy than were women who continued smoking at or above their pre-pregnancy level ($t=3.01$, $df=9$, $p=0.015$ & $t=3.82$, $df=13$, $p=0.002$ respectively). There was also a very strong trend for women who changed their smoking behaviour to be of a higher educational level than women who did not ($\chi^2=5.86$, $df=2$, $p=0.053$).

Maternal caffeine consumption during pregnancy was also significantly associated with fetal health locus of control beliefs (table 5.12). Women who eliminated caffeine from their diet were significantly more likely to score highly on the internal and powerful others sub-scales of the FHLC than were women who either reduced ($t=2.48$, $df=43$, $p=0.017$; $t=2.76$, $df=43$, $p=0.009$) or did not change their level of caffeine consumption ($t=3.48$, $df=22$, $p=0.002$; $t=2.54$, $df=22$, $p=0.018$). Whether or not similar associations exist between FHLC beliefs and maternal physical activity behaviour remains to be established. However before this can be investigated, it is first necessary to examine women's habitual patterns of physical activity prior to pregnancy.

Table 5.12: Associations Between Maternal Background Characteristics and Extent of Change in Self-reported Health Behaviours (Data presented as Mean (S.D.) or %)

	Smoking Status during pregnancy ^b			Caffeine Consumption during pregnancy ^b		
	Increased/Same	Decreased	Cut out	Increased/Same	Decreased	Cut out
	c n=3	n=12	n=8	n=11	n=32	n=13
Maternal Age (yrs)	21.26 (5.05)	21.32 (4.36)	27.28 (5.19)*	24.10 (5.90)	26.15 (5.10)	26.25 (5.23)
Marital Status:						
<i>Married/Cohabiting</i>	33	58	87	82	75	92
<i>Single</i>	66	42	13	18	25	8
Social Class:						
<i>I & II</i>	-	17	50	27	50	54
<i>III & IV</i>	66	50	50	45	44	31
<i>V</i>	33	33	-	27	6	15
Education Level:						
<i>GCSE or below</i>	100	92	50	55	66	31
<i>Above GCSE</i>	-	8	50 ^x	45	34	69
Pregnancy Planned:						
<i>Yes</i>	66	50	62	64	75	69
<i>No</i>	33	50	38	36	25	31
Extroversion	15.67 (3.21)	13.58 (3.40)	13.75 (3.33)	13.91 (2.66)	12.03 (3.94)	11.30 (3.73)
Neuroticism	14.33 (4.93)	11.33 (5.40)	8.00 (3.46)	10.36 (4.08)	11.69 (5.06)	10.69 (3.84)
Self-Efficacy	30.00 (3.00)	27.40 (4.99)	31.00 (3.83)	28.27 (5.22)	30.18 (3.74)	31.64 (3.26)
Health Value	15.67 (1.53)	14.83 (4.73)	14.50 (3.46)	14.73 (4.52)	16.06 (3.24)	15.54 (3.57)
Gest. Weight Gain	16.85 (1.91)	14.86 (4.55)	16.78 (6.39)	16.55 (3.65)	14.79 (5.32)	15.00 (2.94)
Maternal Attitude	21.95 (4.88)	24.14 (3.98)	21.02 (4.41)	24.48 (4.99)	23.10 (3.95)	22.72 (4.71)
Body Image	23.35 (2.08)	29.08 (2.37)	29.04 (2.97)**	28.40 (3.73)	27.68 (4.38)	27.76 (4.76)
FHLC-I	36.17 (5.78)	33.07 (5.41)	40.15 (5.76)*	33.62 (4.34)	36.93 (5.49)	41.64 (6.49)**
FHLC-C	28.90 (2.95)	29.05 (9.36)	28.23 (9.18)	28.77 (8.10)	28.67 (8.41)	28.87 (11.54)
FHLC-P	19.77 (8.94)	20.75 (7.42)	16.39 (7.08)	18.09 (8.52)	19.79 (7.71)	27.01 (8.57)*
EPDS^a	7.00 (6.56)	8.83 (4.53)	8.50 (4.87)	8.27 (4.94)	7.34 (4.74)	7.69 (5.20)
STAI ^a	38.67 (20.74)	37.08 (8.25)	38.13 (13.70)	39.82 (9.29)	33.38 (10.54)	36.08 (12.56)
MAMA Som Symp.^a	28.33 (4.16)	26.75 (4.29)	28.00 (3.55)	27.09 (4.28)	26.19 (4.00)	26.54 (4.45)
SPQ^a	53.00 (22.65)	62.08 (20.65)	53.14 (8.55)	56.73 (18.29)	54.77 (17.64)	57.69 (16.57)

^a at 34 weeks ^b at 34 weeks as compared to pre-pregnancy * p<0.05 ** p<0.01 by one-way ANOVA ^x p=0.053 by χ^2

5.9 Pre-Pregnancy Physical Activity Levels

Pre-pregnancy activity levels were measured by means of the modified Baecke Questionnaire of Habitual Physical Activity (Pols et al, 1995; see section 4.3.1.8). Total scores on this scale ranged from 4.7 to 11.2 with a mean activity score of 7.5 (S.D. 1.2). Mean values for the separate work, sport and leisure indices are displayed in table 5.13, alongside comparative values obtained in the original validation study of this questionnaire.

Table 5.13: Pre-Pregnancy Activity Levels as Assessed by Modified Baecke Questionnaire

Baecke Index	Study Sample			Pols Peeters et al (1995) ^a		
	n	Mean	(S.D.)	n	Mean	(S.D.)
Work	57	2.8	(0.7)	56	2.7	(0.5)
Sport	57	2.4	(0.6)	56	2.2	(0.6)
Leisure	57	2.4	(0.5)	56	2.7	(0.5)
Total	57	7.5	(1.2)	56	7.6	(1.1)

^a Scores obtained by women aged 20-70 years (April administration).

The mean total activity score of the study sample closely reflected that obtained previously. Compared to the values published by Pols et al. (1995), the study sample scored slightly higher on the sport index and slightly lower on the non-sporting leisure index. These differences are largely believed to be an artefact of the different age composition of the two populations. In the original validation study, 32% of the sample were aged 60 or over. Unlike younger women, these individuals are often inclined to show a reduced propensity for engaging in sporting activity (Allied Dunbar National Fitness Survey, 1992). Given also, that older women may be more likely to engage themselves in non-sporting pursuits such as gardening (Q.18), walking (Q.14) or walking for shopping (Q.16), the differences that are observed in the scores are of little concern.

5.9.1 Pre-Pregnancy Recreational Activity

Over three fifths of women participating in the current study (63%) reported engaging in some form of weekly sport or exercise activity outside the home before becoming

pregnant. Of this group, 28 women (49% of the total sample) reported regular participation in moderate intensity exercise (e.g swimming, aerobics/keep fit) and 8 women (14% of the sample) reported regularly participating in high intensity exercise (e.g running). These figures compare favourably to the results of the Allied Dunbar National Fitness Survey (1992) in which 66% of females were reported to participate in moderate to vigorous activity at least once a week.

Notably, enjoyment of physical activity did not appear to be an accurate predictor of physical activity participation in the current study. In total, 80% of the sample reported that they generally enjoyed physical activity before they became pregnant while 21% said that they did not. Over one third of those who reported enjoying physical activity (35%) did not report participating in any form of sport or exercise prior to becoming pregnant. Conversely, one half of those women who reported that they did not enjoy activity nonetheless reported regular participation in moderate intensity activities. There was however, strong evidence to suggest that the women who chose to participate in vigorous recreational pursuits enjoyed performing such activities (table 5.14).

Table 5.14: Proportion of women reporting physical activity enjoyment (%)

Reported physical activity enjoyment	Intensity of regular exercise participation		
	None	Moderate	Vigorous
High	71	79	100
Low	29	21	-

To establish whether there were other, more accurate predictors of women's habitual levels of physical activity participation, the study participants were compared in terms of a number of sociodemographic and psychosocial variables. Those who reported participating physical activities outside the home were more likely to have been educated to degree level ($\chi^2 = 5.70$, $df=2$, $p=0.05$) and more likely to be of social class 1 or 2 than 3 or 4 ($\chi^2 = 7.40$, $df=1$, $p<0.01$). There was also a significant positive association between scores on the Baecke sport index and maternal health value ($r=0.38$, $p<0.01$).

5.9.2 Pre-Pregnancy Occupational Activity

Prior to pregnancy, the majority of women (n=47) were in full time employment (mean (S.D.) number of hours worked per week = 39.2 (4.8), range 30.0–55.0). Only 3 individuals were working part-time (range 18.0 – 25.0 hours/week). 3 women were homemakers, 3 were unemployed and 1 was in full-time education. As Callender et al. (1997) observe, nulliparous women are more likely to be employed prior to and during pregnancy and more likely to be employed full time than are other mothers. The current sample was therefore not considered unusual in terms of its working status. The nature of the respondents' occupations are summarised in table 5.15.

Table 5.15: Respondents Occupations According to the Standard Occupational Classification System

Occupational Sector	Examples	n	% of sample	1988 PSI survey (%)
Managers & Administrators	Office Managers, Civil Servant Executives, Managers in Service Industries	5	10	7
Professionals	Health, Teaching, Financial Professionals	8	16	10
Associate professionals and technical	Scientific Technicians, Health Associates, Financial Associates	4	8	13
Clerical & Secretarial	Administrative Officers, Clerks, Receptionists	16	33	31
Personal & Protective Services	Childcare, Hairdressers, Catering	4	8	11
Sales	Representatives, Assistants, Check-out Operators	9	18	9
Other	Food, Drink, Textiles Operatives	4	7	17

The distribution of occupations in the current study were found to broadly reflect those of the 1988 PSI Maternity Rights Survey (McRae, 1991). Women performing professional jobs were slightly over represented (16% compared with 10%), as were those working in sales (18% compared to 9%). In contrast, women working in more miscellaneous jobs were under represented (7% compared to 17%). Such differences could ultimately be due

to a number of factors including the reliance of the current study on voluntary participation, variation in the sample sizes and differences in the occupational opportunities of different geographical areas with different industries and demographic characteristics.

5.9.2.1 Working Conditions

Despite variation in the participants' occupations, women's responses demonstrated that their working environments were predominantly safe and non-hazardous. When questioned about their working conditions, only 3 respondents reported that they were exposed to fumes or chemicals at their place of work. In addition, 38% of workers indicated that their workplace was never or not often noisy, 29 % believed it was sometimes noisy, 5% reported that it was noisy most of the time and 5% said that it was always so.

Levels of occupational satisfaction were also found to be quite high. The mean score on the work satisfaction scale was 44.69 (S.E. 0.75). Pattison & Moyse (1995) previously obtained a mean score of 40.79 (S.E. 1.20) for a sample of mothers whose interests matched their occupation and a mean score of 33.60 (S.E. 1.21) for a sample of women known to be occupationally unsuited. Only 6 individuals in the present study achieved a score of less than 40, the minimum being a score of 35. For the majority of these women therefore, occupational activity was likely to be perceived as intrinsically rewarding, despite the fact that a substantial percentage reported working comparatively long hours (see section 5.9.2.3 below).

5.9.2.3 Work Duration

Prior to pregnancy, almost half of the women who were employed full-time (45%) reported habitually working 40 hours or more per week. This finding was believed to reflect in part the nulliparous status of the study sample, since women without children may have less competing demands, a greater opportunity to work longer hours and/or a

higher level of career commitment. Table 5.16 compares the demographic and occupational characteristics of individuals who worked more than 40 hours with those who worked less than this amount. Compared to women working shorter hours a greater percentage of women working in excess of 40 hours a week were educated beyond the compulsory age of 16 (57% vs. 38%). A greater percentage were also managers, administrators or professionals (33% vs. 21%) whilst a smaller percentage were associate professionals (5% vs. 11%), clerical workers (29 vs. 34%) or workers in personal and protective services (5% vs. 10%).

Table 5.16: Selected Demographic and Occupational Characteristics of Respondents According to Hours Worked per Week.

	Hours worked per week	
	< 40	40+
n	29	21
Age (years)	25.8 (5.2)	26.7 (5.7)
Educational level		
CSE 2-5 or below	14	14
CSE 1/GCSE	48	29
A-level or equivalent	21	24
Degree or equivalent	17	33
Occupational sector		
Managers & administrators	7	14
Professionals	14	19
Associate professionals	11	5
Clerical	34	29
Personal & protective services	10	5
Sales	17	19
Other	7	10
Occupational Activity index	2.9 (0.6)	2.6 (0.7)
Sport Activity index	2.5 (0.7)	2.3 (0.7)
Leisure Activity index	2.5 (0.5)	2.3 (0.4)*
Total Activity Index	7.8 (1.1)	7.2 (1.2)*

Data are mean (S.D.) or percentages as appropriate *p<0.05

Reported work duration was found to have a significant effect on the amount of physical activity that women performed outside of the workplace. Women working more than 40 hours per week scored significantly lower in terms of their level of non-sporting recreational activity ($t=2.04$, $df=48$, $p<0.05$) and their total activity level ($t=2.02$, $df=48$,

$p<0.05$). However, despite these differences, women working more than 40 hours a week were not significantly more or less active at work than those working less than 40 hours a week. Work activity was therefore assumed to be less of a consequence of time spent at work and more a consequence of activity requirements of the job.

5.9.2.2 Working Activity

The mean occupational activity score on the modified Baecke questionnaire of habitual activity was 2.8 (S.D. 0.7). Table 5.17 shows the occupational characteristics of the women who scored above this mean value compared to those who scored the equivalent or below. Those with higher occupational activity levels included all those working in personal or protective services and all those working in miscellaneous occupations. This group also included most of those working in sales. Conversely those with occupational activity levels below the mean included the vast majority of managers and administrators and clerical and secretarial workers.

Table 5.17: Respondents Grouped According to Occupational Activity Level

	Baecke Occupational Activity Index		
	Total n	2.75 or lower	> 2.75
Occupational Sector			
Managers & Administrators	5	4	1
Professionals	8	4	4
Associate professionals and technical	4	2	2
Clerical & Secretarial	16	14	2
Personal & Protective Services	4	-	4
Sales	9	3	6
Other	4	-	4
Sport Activity index	57	2.42 (0.59)	2.37 (0.69)
Leisure Activity index	57	2.31 (0.50)	2.50 (0.42)
Total Activity index	57	6.97 (1.06)	8.28 (1.07)*

Data are mean (S.D.) or n as appropriate * $p<0.05$

Despite differing significantly in their work activity levels ($t=12.20$, $df=48$, $p<0.01$) the two groups did not vary significantly in either their sporting activity level, their non-sporting recreational level or their total non-occupational activity levels. They did however vary in terms of their total daily activity level ($t=3.85$, $df=48$, $p<0.01$).

5.10 Chapter Summary and Discussion

Analysis of the background characteristics of the sample revealed that the participants of the current study were broadly representative of a wider pregnant population with respect to a number of different sociodemographic, anthropometric and psychosocial variables. Compared to other pregnant women, they also displayed typical patterns of health behaviour. The extent to which smoking habits and caffeine consumption changed during pregnancy were both significantly associated with women's fetal health locus of control beliefs. Similar relationships have been documented previously (Labs & Wurtele, 1986; Walker et al., 1999; see section 2.6.6). This observation serves to raise confidence in the normality of the women's behaviour patterns.

An examination of the women's pre-pregnancy physical activity patterns further revealed that the study participants were typical of a wider adult female population, both in terms of their total daily activity level and their levels of sports and exercise participation. Several different factors were identified as potential determinants of the respondents' physical activity behaviour. The levels of sporting activity that women reporting participating in prior to pregnancy were significantly associated with their health value and their sociodemographic circumstances. The women's level of non-sporting recreational activity and their level of total daily activity were both influenced by weekly work duration. Total daily activity was also associated with levels of occupational activity, a factor that was primarily determined by job type.

The associations that were observed between physical exercise participation and women's educational level and social class reflected relationships that have previously been identified elsewhere. As discussed in Chapter three, demographic characteristics, and particularly those associated with education and income are consistent and powerful correlates of adult physical activity behaviour (e.g. Ford et al., 1991, King et al., 1992, US DHSS, 1996), not least because women of a higher social class and educational level are likely to have access to financial and/or practical resources that facilitate

participation. Such factors may therefore also have implications for women's physical activity behaviour during pregnancy, an issue that is addressed more fully in Chapter 9.

Nonetheless, an alternative explanation for the pre-pregnancy relationships observed in the current study may lie in the fact that participants' health value also increased with increasing levels of education and social class. Ultimately, it may be hypothesised that individuals who place a higher value on their health will be more likely to value different health-related behaviours. Riddle (1980) for example documents that joggers typically place a higher value on health than do non-joggers. Sallis & Hovell (1990) also report that a knowledge of health and exercise may predict the maintenance of moderate intensity activities more generally. The significant association that was observed between health value and reported physical activity level in the current study certainly suggests that this may be the case.

Further support for the notion that physical activity participation may partly be driven by a belief that health and fitness are important can also be found in the percentage of women in the current study who participated in moderate intensity exercise despite reporting they did not enjoy such activities. It must be acknowledged however, that this latter finding does not preclude the possibility that some women participated in physical sports and exercise purely because of the enjoyment they derived from doing so. Indeed, all respondents who reported participating in vigorous recreational pursuits reported that they enjoyed performing these activities.

This accepted, analysis of the participants working status further revealed that occupational activity may also impact on women's recreational activity levels. Interestingly work duration rather than work effort was found to influence the amount of physical activity performed in other areas of daily life. Similar observations have been made elsewhere. Wilbur et al (1999) for example, used modifications of the Minnesota leisure-time and Tecumseh occupational questionnaires to show that women maintained similar leisure time and household activity levels irrespective of their level of occupational activity. Estimates from published time and motion studies also suggest that

it is the amount of time that women spend in occupational, household and family activities, rather than the amount of effort, which limits their recreational activities. (Ainsworth et al, 1999). Indeed, Schor (1992) notes that the amount of time spent in housework and family care activities in the past 30 years has declined only 15% while the time spent in paid work has increased 27%. This inevitably results in a net decrease in the amount of time available for leisure pursuits.

Ultimately, long working hours may present both practical and motivational barriers to physical activity participation. For example, access to facilities may be reduced as may an individual's inclination to be active when free time is short. Of interest to current study is whether the same factors continue to determine women's physical activity patterns during pregnancy. This issue cannot be properly addressed until the full impact of pregnancy on maternal daily activity levels has been discussed.

CHAPTER SIX

The Longitudinal Assessment of Maternal Daily Activity Levels

6.1 Introduction

The previous chapter established that the women involved in the current research were broadly representative of a wider population of women in terms of their sociodemographic, psychosocial and behavioural characteristics prior to pregnancy. The present chapter examines the accuracy of the two methodological approaches that were chosen to assess maternal daily activity levels during pregnancy. An accurate measure of maternal daily activity is critically important if a baseline indication of women's behaviour patterns during such a unique life stage is to be obtained. An accurate assessment of daily activity is also required before the full impact of integrated physical activity levels on pregnancy outcome can be examined. In practice, accurate measurements of physical activity are difficult to achieve (Avons et al., 1988; see Chapter 3, section 3.3). Researchers and clinicians thus have to rely on the best possible estimates that are available for use.

It was against this background that the current study explored the use of two different techniques for estimating maternal daily activity levels in pregnancy. The following sections present physical activity data originating from (i) an ambulatory activity monitor and (ii) a newly developed activity questionnaire. The longitudinal trends displayed by both measurement techniques are compared and from this a general activity profile of nulliparous pregnant women is obtained. The relative merits of the two approaches are considered and their feasibility for use in pregnant populations is discussed.

6.2 Statistical Analyses

Data were analysed using the Statistical Package for the Social Sciences 9.0 (SPSS Inc., Chicago). All data are reported as mean (S.D.) or as percentages. Longitudinal changes in daily activity were assessed using repeated measures ANOVAs followed by pairwise comparisons with multistage Bonferroni adjustment. Relationships between the objective and subjective data were investigated using Pearson's correlation coefficients for continuous variables. All tests were two tailed.

6.3 Total Daily Activity as Assessed by Ambulatory Activity Monitor.

This section presents objective data originating from the use of the "*Actiwatch AW2*" activity monitor. Participant compliance is discussed and total maternal activity levels as measured by this method are examined.

6.2.1 Level of Participant Compliance

At each stage of pregnancy, all women participating in the study were asked to wear an ambulatory activity monitor. This monitor and the protocol for its use have been described previously (see chapter 4, section 4.3.2.7). Participants were informed that the monitor was to be worn continuously for 72 hours and only removed for bathing, showering or water-sports.

The extent to which participants complied with these instructions varied enormously, both between individuals and between different stages of gestation. At 12 and 16 weeks gestation the vast majority of women monitored their activity levels for a complete 72-hour period. By 25 and 34 weeks gestation however, the number of women providing a full set of data had markedly declined (table 6.1).

Table 6.1: Level of Actigraph Compliance at Different Stages of Low Risk Pregnancy.

		Gestation (weeks)				
		12	16	25	34	38
Total sample (n)		30	57	57	57	51
% (n) providing data for:						
	24 hours	3 (1)	5 (3)	11 (6)	7 (4)	-
	48 hours	3 (1)	12 (7)	19 (11)	18 (10)	-
	72 hours	90 (27)	81 (46)	63 (36)	47 (27)	60 (34)
% (n) providing at least 24 hours data		96 (29)	98 (56)	93 (53)	72 (41)	60 (34)

Overall, few individuals were able to maintain compliance with the study protocol over the entire course of their pregnancy. Of the 51 women who provided self-reported data between 16 and 38 weeks of pregnancy, only 5 (10%) consistently monitored their activity for a complete 72-hour period every time. A further 49% partially complied with instructions and wore an activity monitor for at least 24 hours on each occasion.

6.2.1.1 Possible Influences on Participant Compliance

The levels of compliance that were observed were significantly lower than those expected on the basis of a pilot study described in chapter 3. This pilot study monitored daily activity levels in non-pregnant women and found that 94% of respondents were willing to wear an ambulatory activity monitor over a period of 72 hours. The results of the current study therefore demand attention.

Two obvious ways in which the studies differed were in their design and in their sample characteristics. The pilot survey was not a longitudinal study and as such did not require measurements to be taken on more than one occasion. The lower level of compliance in the current study may therefore be considered an unfortunate consequence of a repeated measures design. This possibility is supported by the fact that compliance was found to decrease steadily as time progressed. Washburn et al. (2000) posit that respondent burden may be one of several factors that will limit the use of motion sensors. To discover that a study which relied on both voluntary participation and prolonged

commitment would encounter such problems is therefore not surprising. However, this does not discount the possibility that a difference between the two samples could also have affected behaviour. The fact that pregnant women consistently demonstrated lower levels of compliance than non-pregnant women certainly suggests that there may be a differential effect of reproductive status.

6.2.1.2 A Comparison of Compliant and Non-Compliant Participants

To explore the extent to which individual characteristics may have influenced participants' compliance with the activity monitors, a series of one way ANOVAs were performed. The sample was categorised according to the level of compliance demonstrated at 25 weeks of pregnancy⁵. Group 1 comprised those individuals who had worn the monitor for less than 48 hours ($n=10$). Group 2 comprised those individuals who had provided between 48 and 72 hours of data ($n=11$) and Group 3 comprised those individuals who had provided a complete 72-hour activity profile ($n=36$). Participants were compared on the basis of their sociodemographic circumstances, personality and selected pregnancy-related variables (*maternal attitude, body image, FHLC beliefs and reported somatic symptoms*).

Significant differences in health value ($F(2,54)=4.15, p<0.05$) and extroversion ($F(2,54)=3.10, p=0.05$) were observed. Post-hoc comparisons showed that women who complied the least placed significantly less value on their health than did those who complied either moderately ($t=-2.20, df=19, p<0.05$) or fully ($t=2.82, df=44, p<0.01$). They were also significantly more extroverted than those who had complied the most ($t=2.18, df=44, p<0.05$). The sample was also categorised according to the level of compliance demonstrated at 34 weeks of pregnancy. The same classification system was employed and a significant difference in extroversion once again observed ($F(2,54)=3.39, p=0.05$). Post-hoc comparisons confirmed that, like before, women who

⁵ 25 weeks corresponded to the first stage at which level of compliance was sufficiently varied to warrant analysis.

demonstrated the lowest levels of compliance were significantly more extroverted than women who had complied the most ($t=2.77$, $df=45$, $p<0.01$).

It seemed apparent therefore that the women who complied with the Actiwatch protocol differed from those who did not on a least two personality aspects. Significant associations between compliance, health value and extroversion suggests that the successful implementation of activity monitors during pregnancy may ultimately rely upon a trade-off between the importance that is attributed to the research and the perceived cost of monitoring physical activity in public. This issue is discussed in detail in Chapter 11 (section 11.2).

6.2.2 Maternal Daily Activity Levels as Assessed by Ambulatory Monitor

Notwithstanding the low levels of compliance that were observed, the vast majority of participants in the present study provided at least one complete 24-hour activity profile at each stage of gestation. From this, an estimation of women's mean daily activity level could be obtained. Mean daily activity level was calculated by dividing the total number of recorded activity counts by the duration for which the monitor was worn. Marked periods designated the times between which a monitor was not worn and these were removed prior to analysis. At 16 weeks of pregnancy, the mean duration for which a monitor was removed was 46.86 minutes/24-hour period (S.D. 22.14 minutes). There was no significant variation in this value across the course of pregnancy.

Table 6.2: Mean Daily Activity Levels as Assessed by Ambulatory Monitor.

Gestation (weeks)	n ^a	Total Daily Activity Level (Activity count/1-min epoch)	
		Mean	(S.D.)
12	29	172.96	(67.50)
16	56	186.73	(59.43)
25	53	182.21	(65.72)
34	41	164.15	(69.46)
38	34	157.35	(69.04)

^a sample comprises all women providing at least one complete 24-hour activity profile at each stage of pregnancy.

In women who provided more than one 24-hour activity profile, no significant differences between the mean daily activity levels of working and non-working days could be observed. Data were therefore combined for analysis and an overall mean value for each recording period obtained (table 6.2).

6.2.2.1 Longitudinal Trends in Monitored Daily Activity Levels

It is important to note that the descriptive statistics presented in table 6.1 were calculated according to the maximum number of participants providing data at each gestational stage. As a result, sample size varies across pregnancy. The changes that occur in daily activity level during low-risk pregnancy may be better illustrated by considering only those women who provided data at all designated measurement points. Figure 6.1 shows mean daily activity levels as a function of advancing pregnancy in the 30 women who wore an activity monitor for at least 24 hours on every occasion between 16 and 38 weeks of pregnancy. Mean daily activity levels can be seen to increase between 16 and 25 weeks and decrease steadily thereafter. A repeated measures analysis of variance with Greenhouse-Geisser correction detected a significant change in mean daily activity level across pregnancy ($F(2.36, 68.46)=4.46, p=0.01$). Mean daily activity level at 38 weeks was significantly lower than both that at 16 weeks ($t=-2.41, df=29, p<0.05$) and 25 weeks of pregnancy ($t=4.10, df=29, p<0.01$).

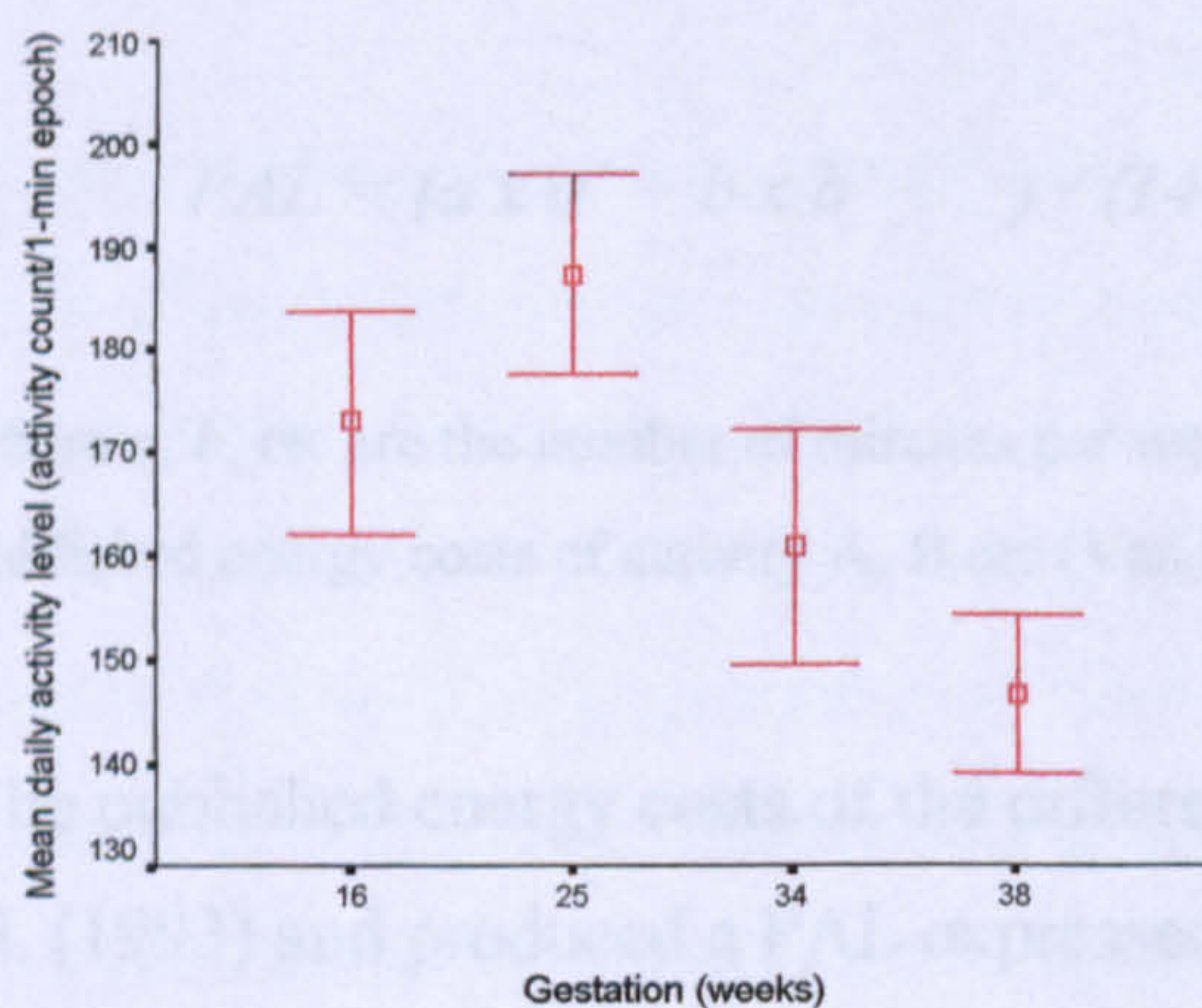


Figure 6.1: Mean daily activity levels (± 1 S.E.) As a function of advancing pregnancy (n=30)

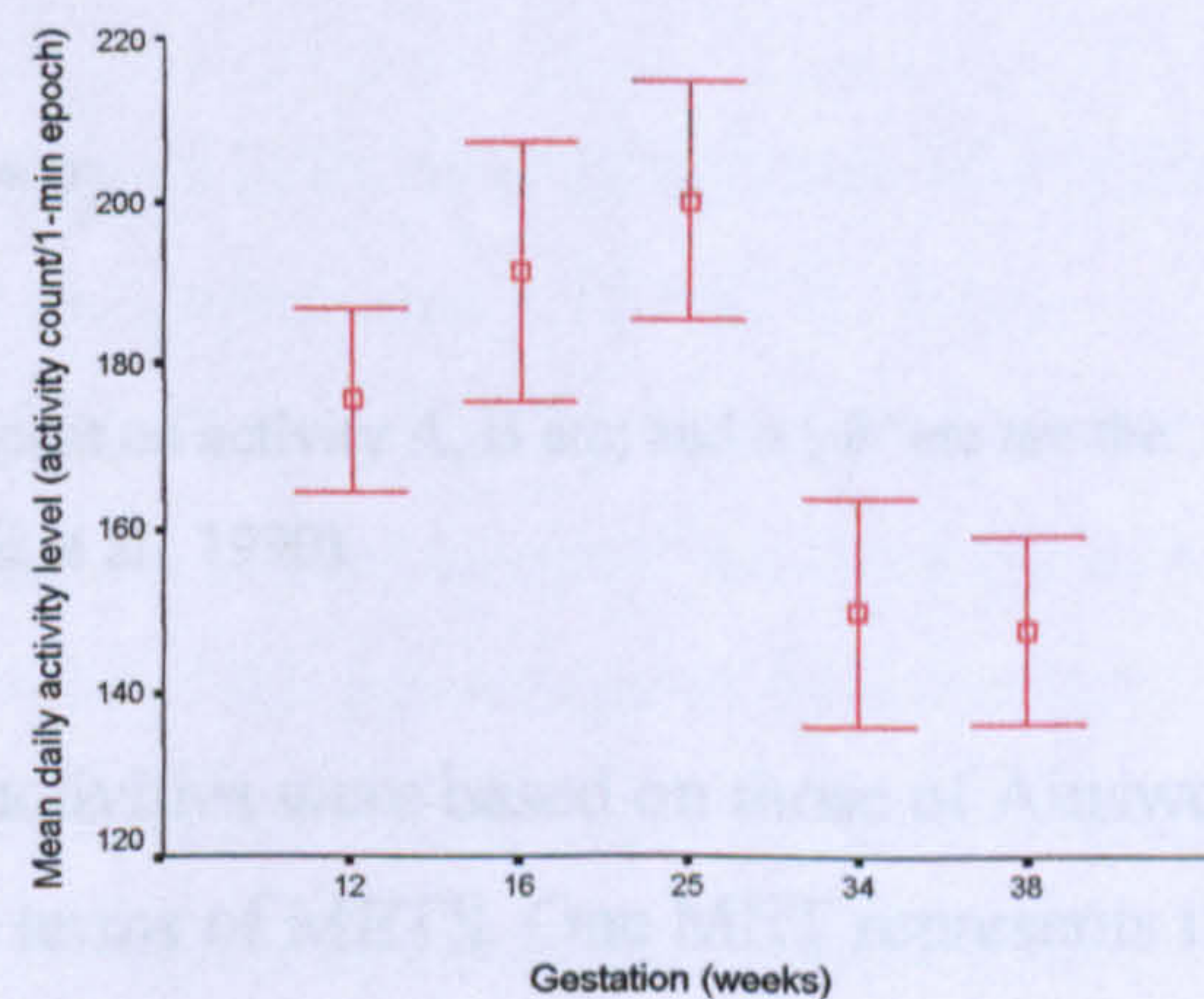


Figure 6.2: Mean daily activity levels (± 1 S.E.) as a function of advancing pregnancy (n=16)

Of the 30 subjects included in the first analysis, 16 also provided data at 12 weeks gestation (Figure 6.2). The pattern of change obtained by this sample can be considered similar although not identical to that described above. In this smaller sample a much sharper reduction in activity occurred between 25 and 34 weeks gestation. A repeated measures analysis of variance confirmed that mean daily activity level changed significantly across pregnancy ($F(4,60)=4.80, p<0.01$). Pairwise comparisons showed mean daily activity at 34 weeks to be significantly lower than both that at 16 weeks ($t=2.69, df=15, p<0.05$) and 25 weeks of pregnancy ($t=2.56, df=15, p<0.05$). Mean daily activity at 38 weeks was also significantly lower than that at 12 weeks ($t=2.42, df=15, p<0.05$), 16 weeks ($t=2.67, df=15, p<0.05$) and 25 weeks of pregnancy ($t=3.92, df=15, p<0.01$). Objective data obtained from the Actiwatch activity monitors thus provided evidence to suggest that the mean daily activity level of the study sample declined significantly in the latter half of pregnancy.

6.3 Maternal Daily Activity Levels as Assessed by Self-Report

The second method of assessing maternal daily activity levels was via a subjective questionnaire. This questionnaire was designed specifically to record the nature and duration of all forms of physical activity undertaken in the 7 days prior to interview (see chapter 3, section 3.7.1). From this information an estimate of daily physical activity level (PAL) could be calculated:

$$PAL = (a \times a' + b \times b' + \dots) / (1440 * 7)$$

where a, b , etc are the number of minutes per week spent on activity A, B etc; and a', b' etc are the published energy costs of activity A, B etc (Van Raaij et al., 1990).

The published energy costs of the different activities were based on those of Ainsworth et al. (1993) and produced a PAL expressed in terms of METS. One MET represents the resting metabolic rate of an individual (RMR) and is set at 3.5ml of oxygen consumed per kilogram body mass per minute, or approximately 1 kcal/kg/hr. The assumptions that

were incorporated into calculating activity level in this way have been discussed previously (section 3.7.3).

To assess overall trends in activity behaviour, the physical activity level (PAL) of each participant was calculated for each measurement period. Table 6.3 presents the descriptive statistics for this analysis.

Table 6.3: Daily Activity Levels as Assessed by Self-Report

Gestation (weeks)	n	Total Daily Activity Level (METS) ^a	
		Mean	(S.D.)
12	30	1.47	(0.21)
16	57	1.54	(0.18)
25	57	1.51	(0.26)
34	57	1.40	(0.20)
38	51	1.31	(0.14)

^a (1 MET = 1 x BMR)

The range of mean daily activity levels that were obtained across pregnancy reflected the impression given by pre-pregnancy data and suggested that, as a group, the women were predominantly sedentary. Mean PAL was highest at 16 weeks gestation (1.54 (S.D 0.18) METS) and lowest at 38 weeks gestation (1.31 (S.D. 0.14) METS). For comparison, the report of a joint FAO/WHO/UNU expert consultation recommends a daily energy intake of 1.56 x BMR for women with light activity patterns.

However, the sample was not entirely homogenous in its activity patterns. The highest level of daily activity that was obtained by a participant was 2.15 METS. It has previously been calculated that an active individual spending 2 hours carrying out activity at an intensity of 4 x BMR, e.g. walking on the level at an average pace, would have an overall PAL of 1.9 (Department of Health, 1991). This participant is therefore not following a sedentary lifestyle. Examination of the individual's activity profile revealed that, despite working full time as a staff nurse, regular episodes of swimming, cycling and running were reported. The duration of these activities averaged approximately one hour per day and all were reported to be performed at a vigorous intensity.

6.3.1 Longitudinal Trends in Self-Reported Daily Activity Levels

To assess longitudinal trends in the self-reported data, consideration was limited to those women who had completed the activity questionnaire at every stage of pregnancy.

Figure 6.3 shows mean self reported daily activity levels (± 1 S.E.) as a function of advancing pregnancy for the 51 subjects completing all four visits between 16 and 38 weeks gestation. Mean levels of physical activity decreased significantly during this period ($F(3,150) = 20.93$ $p < 0.01$). Mean daily activity level at 34 weeks gestation was 0.13 METS lower than at 16 weeks gestation ($t = 4.00$, $df = 50$, $p < 0.01$) and 0.11 METS lower than at 25 weeks gestation ($t = 2.93$, $df = 50$, $p = 0.01$). A further significant reduction of 0.09 METS occurred between 34 and 38 weeks gestation ($t = 3.81$, $df = 50$, $p < 0.01$).

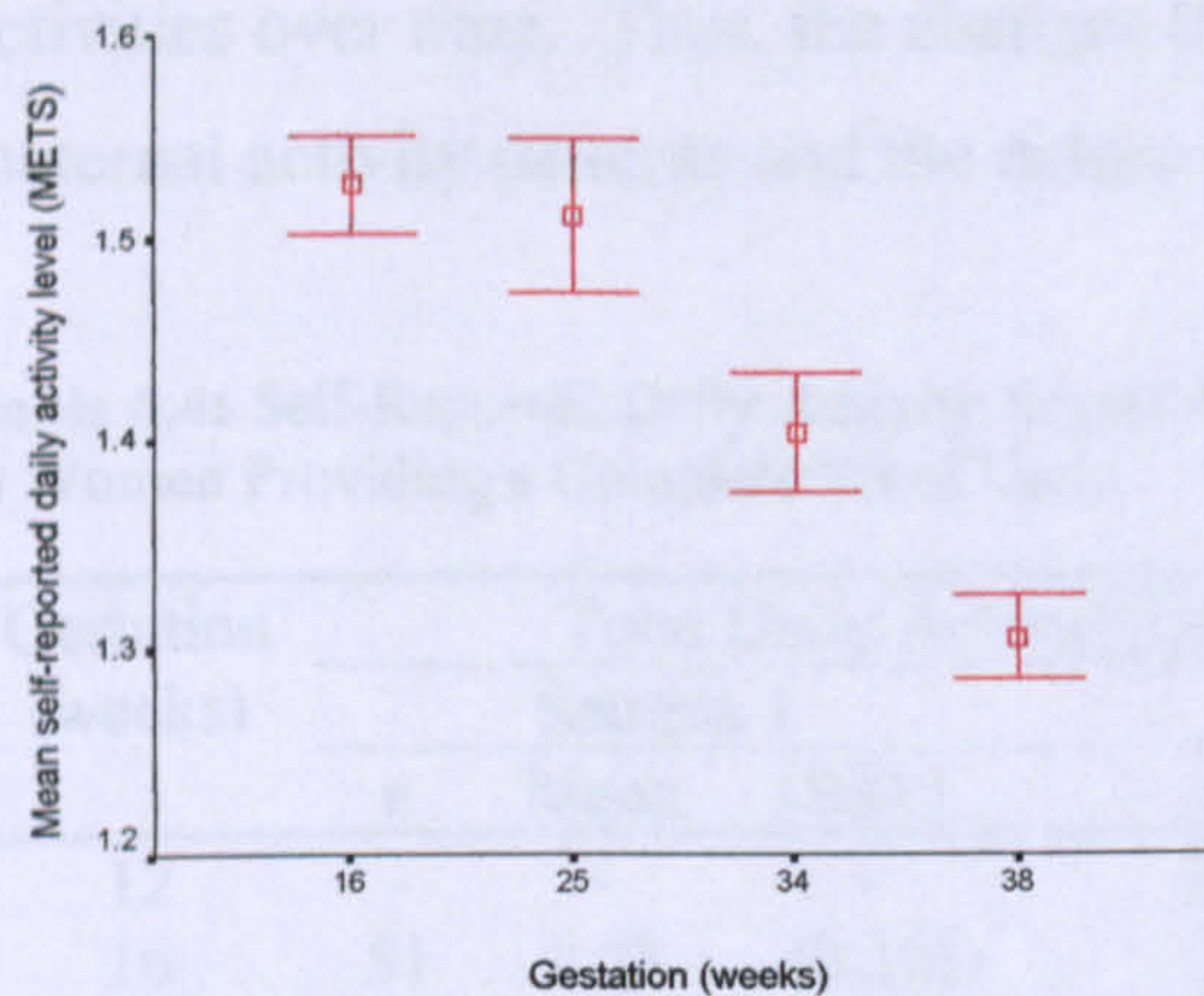


Figure 6.3: Mean self-reported daily activity level (± 1 S.E.) as a function of advancing pregnancy ($n=51$)

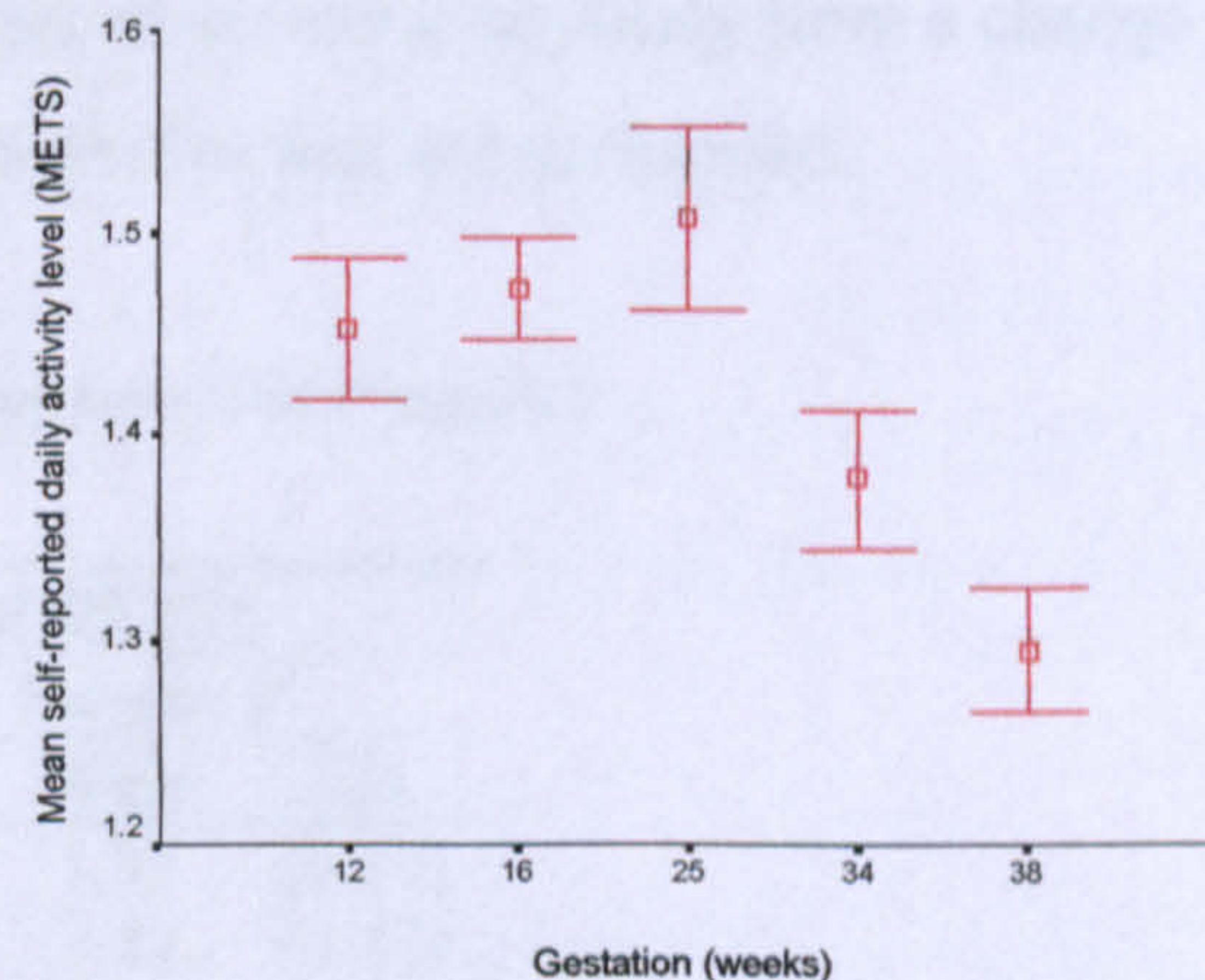


Figure 6.4: Mean self-reported daily activity level (± 1 S.E.) as a function of advancing pregnancy ($n=28$)

Of the 51 subjects included in the above analysis, 28 had also provided data at 12 weeks gestation (Figure 6.4). The pattern of change displayed by this sample can be considered similar although not identical to that described above. In this instance, mean daily activity level at 16 weeks of pregnancy was found to be slightly lower than that measured in the larger sample (1.47 METS vs. 1.53 METS), and levels of physical activity were found to increase between 12 and 25 weeks of pregnancy. However, despite these differences, an

overall decline in mean self-reported daily activity level was once again evident ($F(4,108) = 9.72, p < 0.01$). Mean daily activity level at 34 weeks of pregnancy was significantly lower than that at 16 weeks ($t=2.85, df=27, p < 0.05$) and 25 weeks of pregnancy ($t=3.08, df=27, p < 0.05$). Mean daily activity level at 38 weeks of pregnancy was significantly lower than that at 12 weeks ($t=3.60, df=27, p < 0.01$), 16 weeks ($t=6.01, df=27, p < 0.01$) and 25 weeks of pregnancy ($t=6.36, df=27, p < 0.01$).

6.3.2 Interpreting Changes in Self-Reported Activity Behaviour

In discussing the change that is observed in mean PAL across pregnancy it is pertinent to note that the energy calculations that were used in the current study assumed a constant basal metabolic rate and did not account for variation in the energy cost of physical activities over time. Thus, the changes that are observed arise solely from a change in maternal activity patterns and the nature of activities that are performed.

Table 6.4: Self-Reported Daily Activity Levels Across Low Risk Pregnancy in Women Providing a Complete Set of Data.

Gestation (weeks)	Total Daily Activity Level (METs)					
	Sample 1			Sample 2 ^a		
	n	Mean	(S.D.)	n	Mean	S.D.
12	-	-	-	28	1.45	(0.19)
16	51	1.53	(0.18)	28	1.47	(0.14)
25	51	1.51	(0.27)	28	1.51	(0.24)
34	51	1.40	(0.20)	28	1.38	(0.18)
38	51	1.31	(0.14)	28	1.29	(0.16)

^a Sample 2 constitutes a sub-group of sample 1.

Table 6.3 summarises the changes that occur in mean PAL across pregnancy for the two samples shown in figures 6.1 and 6.2. Between 16 and 38 weeks gestation, the mean PAL of the largest sample (n=51) was reduced by 14% (0.22 METs). For a healthy *non-pregnant* woman of constant body weight (60kg) such a reduction in physical activity would cause a decline in energy expenditure of approximately 316 kcal/day. This change, whilst *not* being indicative of a change in maternal energy requirements during pregnancy, provides some quantification of the extent to which women reported adapting their habitual activity patterns over time.

Previously, it was acknowledged that the changes that were detected in the self-reported data might have reflected cultural and personal ideologies as much as individual behaviour. However, given that the objective data described previously also exhibited a significant decline in mean daily activity levels, our confidence in these responses is raised.

6.4 The Influence of Habitual Activity Levels on Daily Activity During Pregnancy

The previous sections have served to demonstrate that pregnancy may have a significant impact on the daily activity levels of British nulliparous women. However, the trends that were presented referred solely to the mean curve for the sample and as such, cannot be assumed to reflect the pattern of change experienced by any one individual. It is possible, for example, that pregnancy may have a differential effect on women with different levels of baseline activity. This section thus examines whether the extent to which daily activity is altered in pregnancy depends directly upon the level of activity that women engage in pre-pregnancy. Other potential influences on maternal behaviour are discussed in Chapter 9.

The habitual activity behaviour of the study participants before pregnancy has been described previously (see Chapter 5, section 5.9). The Modified Baecke Questionnaire of Habitual Physical Activity (Pols et al., 1995) was used to estimate respondents physical activity in the 12 months prior to pregnancy and on the basis of these scores women were classified as either demonstrating a low, moderate or high level of habitual activity. Cut-off values for inclusion into the lower and middle groups were set at 7.2 and 7.9 respectively. These values corresponded to the 33rd and 66th percentile scores for the sample.

Figure 6.5 displays the change in mean daily activity levels between 16 and 38 weeks gestation for the three activity groups. In each case, an overall decline in mean daily activity level was observed. However, the magnitude of this decline varied such that

those women who had reported being the most active prior to pregnancy experienced the greatest reduction and those women who had been the least active experienced the least reduction. This resulted in the three groups being indistinguishable from one another in terms of their activity levels late in pregnancy. Whilst the two most active groups differed significantly from the least active group at 16 ($F(2,54) = 4.32$ $p < 0.05$) and 25 weeks gestation ($F(2,54) = 2.97$ $p = 0.05$) this effect was no longer evident by 38 weeks gestation.

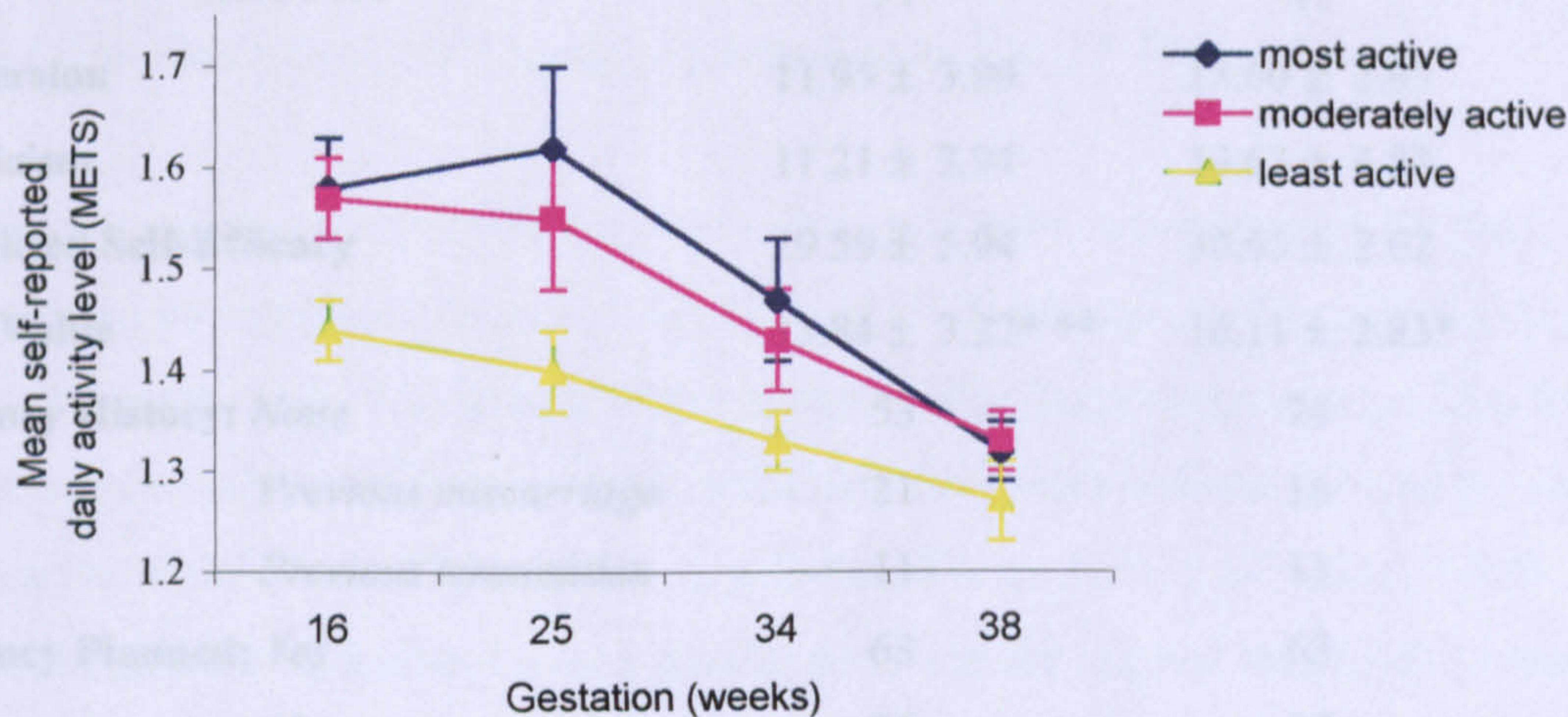


Figure 6.5: Mean (± 1 S.E.) Daily Activity Level Across Low Risk Pregnancy According to Habitual Activity Level ($n=51$)

The above findings thus provide some evidence of a normalising effect of pregnancy. Irrespective of habitual activity levels, maternal daily activity levels decline to a common baseline. One explanation for this effect is that women of different activity levels prior to pregnancy also experienced different levels of physical or psychological symptoms during pregnancy. However, as demonstrated in table 6.5, no significant differences in the pregnancy experiences of the samples could be observed. The only significant difference that existed between the three groups was in terms of maternal health value. As discussed in Chapter 5, women with higher levels of pre-pregnancy activity were found to place a significantly higher value on their health.

Table 6.5: Characteristics of the Sample According to Total Level of Daily Activity Pre-Pregnancy

Maternal characteristic	Pre-Pregnancy Activity Level (Baecke Total Activity Index)		
	<7.2	7.2 < 7.9	7.9+
Maternal Age (yrs)	25.94 ± 5.90	26.22 ± 4.44	26.80 ± 5.44
Marital Status: <i>Married/Cohabiting</i>	84	74	84
<i>Single</i>	16	26	16
Social Class: <i>I & II</i>	32	53	58
<i>III & below</i>	68	47	42
Educational Level: <i>GCSE or below</i>	69	53	42
<i>Above GCSE</i>	31	47	58
Extroversion	11.95 ± 3.99	13.00 ± 2.93	12.10 ± 4.45
Neuroticism	11.21 ± 3.94	10.63 ± 4.82	12.00 ± 5.08
Generalised Self-Efficacy	29.59 ± 5.94	30.65 ± 2.62	29.58 ± 3.37
Health Value	13.84 ± 3.27* **	16.11 ± 2.83*	17.42 ± 3.92**
Pregnancy History: <i>None</i>	53	74	68
<i>Previous miscarriage</i>	21	16	32
<i>Previous termination</i>	11	11	-
Pregnancy Planned: <i>Yes</i>	63	63	79
<i>No</i>	26	37	21
Maternal Attitude (MAMA)	23.47 ± 4.57	23.98 ± 3.79	22.26 ± 4.53
Body Image (MAMA)	28.17 ± 4.09	28.31 ± 4.87	27.04 ± 3.83
FHLC-I	37.28 ± 6.86	38.51 ± 5.80	36.60 ± 5.60
FHLC-C	26.32 ± 10.09	30.06 ± 8.22	29.77 ± 8.27
FHLC-P	21.25 ± 7.65	23.39 ± 8.69	18.78 ± 8.95
Depression Change (EPDS) ^a	-1.11 ± 5.02	-0.42 ± 5.20	1.14 ± 3.35
State Anxiety Change (STAI) ^a	-2.90 ± 6.24	-0.79 ± 9.69	-1.86 ± 5.57
Somatic Symptoms Change (MAMA) ^a	-2.42 ± 4.50	-1.79 ± 3.77	-0.35 ± 4.22
Social support Change (SPQ) ^a	4.05 ± 9.79	5.26 ± 11.23	3.00 ± 9.17
BMI Change (kg/m²) ^a	2.73 ± 1.12	2.06 ± 1.20	2.09 ± 1.05

^a change in scores between 25 and 38 weeks of pregnancy * p<0.05 ** p<0.01

N.B. Lower maternal attitude, body image, somatic symptoms & social support scores denote a more positive level of maternal adjustment

The fact that no other significant differences could be observed between the three groups suggests that the impact of pregnancy on maternal activity may ultimately depend less upon the experience of pregnancy *per se* and more upon the type of activity being performed. Different lifestyles and activity levels may ultimately present different opportunities for behavioural change. For example, individuals with a higher level of habitual activity may both perceive more need and have more scope to reduce their activity levels than may sedentary individuals who already perform only the minimal tasks of daily living.

6.4.1 The Opportunity to Change Activity Levels During Pregnancy

The notion that activity levels may only change if there is opportunity for them to do so is supported by previous literature. Van Raaij et al. (1990) used activity dairies to study the activity patterns of 18 sedentary Dutch women throughout pregnancy and the first year postpartum. Individuals were measured on five occasions between 10 and 34 weeks gestation and the mean PAL of the sample found to be 1.50 (S.D. 0.08) x BMR. When the mean PAL is calculated over a similar period in the current study (12-34 weeks gestation) a slightly lower level of activity is obtained (1.45 (S.D. 0.19) x BMR).

Whilst an influence of different methodological approaches cannot be discounted, the variation that is observed between these studies is most likely to reflect differences in the parity and pre-pregnancy lifestyle characteristics of the two samples. The sample in Van Raaij's (1990) study consisted entirely of women with one or more children and no paid employment. This is in direct contrast to the participants of the current study, all of whom were nulliparous and most of whom were employed at the start of pregnancy (see Chapter 5, section 5.9.2).

Given that the first pregnancy invariably brings employed women into the home (Zajicek, 1981), a much greater change in activity may be experienced by nulliparous women. Indeed, in the present study, whilst maternal reports of domestic activity remained almost unchanged, a decrease in maternal working activity was accompanied by a significant

increase in the duration of home-based recreational and resting activities that were reported (figure 6.6). It is therefore clear that both the nature of the activity being performed and the social context in which pregnancy occurs may be important influences on maternal daily activity patterns. This notion is considered further in Chapters 7-9.

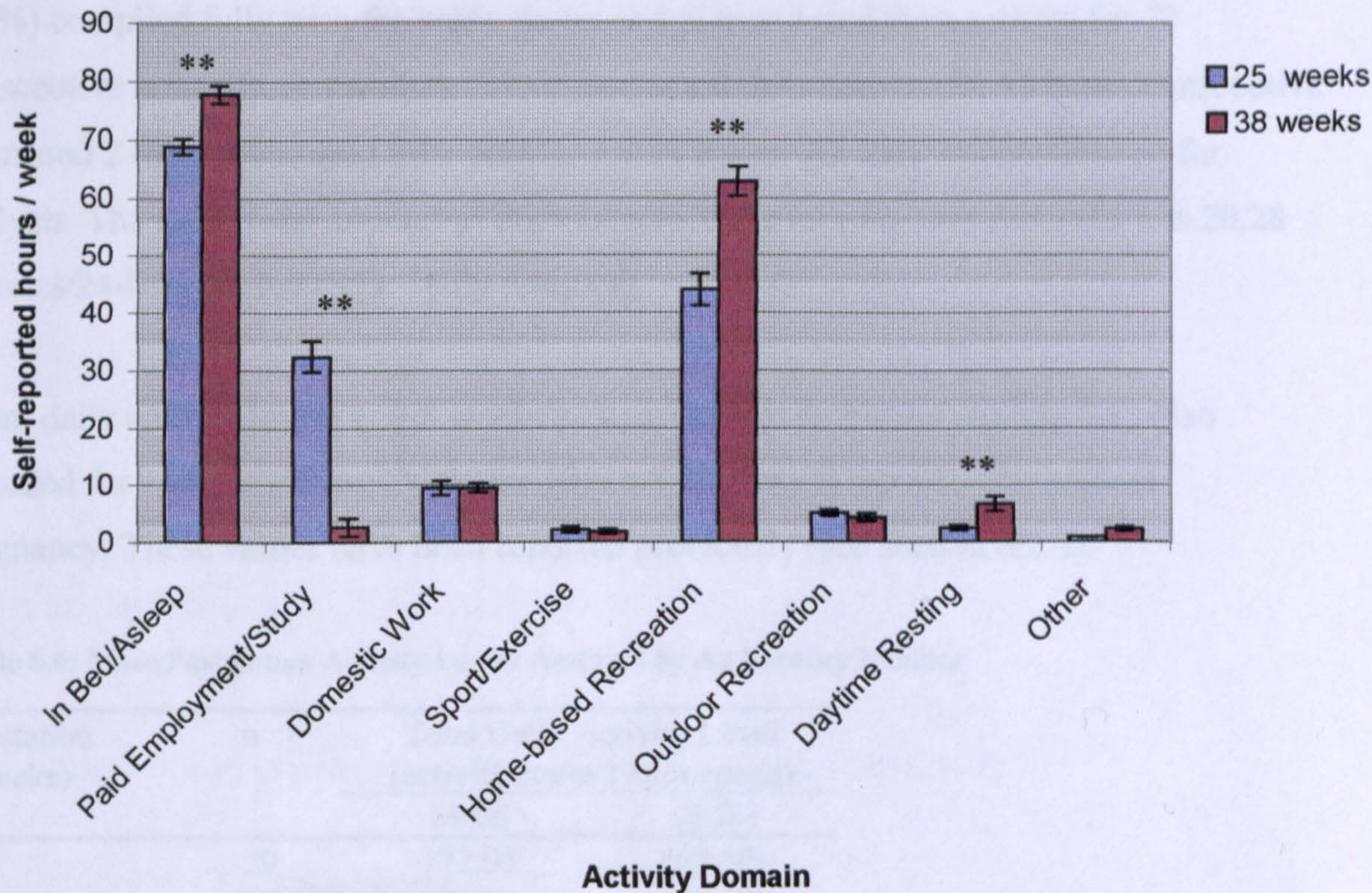


Figure 6.6: Self-reported duration of daily activities at 25 and 38 weeks gestation, **p<0.01

6.5 Maternal Daily Activity Levels in the Postpartum Period

Ultimately, any changes that occur in women’s behaviour during pregnancy should always be considered within the context of the possibility of long term development and change. Thus, to fully understand the impact of pregnancy on the daily activity levels of British nulliparous women, it is also necessary to consider the participants’ activity patterns during the postpartum period.

6.5.1. The Objective Assessment of Postpartum Activity Levels

33 women (65%) agreed to wear an activity monitor at 6-8 weeks postpartum. Compared to women who did not wear the activity monitor, these individuals were significantly older ($t=2.53$, $df=55$, $p<0.05$), more highly educated ($\chi^2=4.52$, $df=1$, $p<0.05$) and placed a higher value on their health ($t=2.47$, $df=55$, $p<0.01$). Twenty four of the 33 women (73%) complied fully with the study protocol and monitored their activity for 72 consecutive hours. Seven women (21%) monitored their activity for 48 hours consecutive hours and 2 (6%) monitored their activity for 24 hours. All data were combined for analysis. The mean total amount of time for which the monitor was removed was 20.28 minutes/24-hour period (S.D. 14.09 minutes).

Mean daily activity levels at 6-8 weeks postpartum are displayed in table 6.6. Also included for comparison are the mean daily activity levels recorded throughout pregnancy. These values have been reported previously (see section 6.2.2).

Table 6.6: Mean Postpartum Activity Levels Assessed by Ambulatory Monitor

Gestation (weeks)	n	Total Daily Activity Level (activity count/1-min epoch)	
		Mean	(S.D.)
12	29	172.96	(67.50)
16	56	186.73	(59.43)
25	53	182.21	(65.72)
34	41	164.15	(69.46)
38	34	157.35	(69.04)
6-8 pp	33	183.31	(60.68)

Of the 33 subjects who provided data at 6-8 weeks postpartum, 20 had also provided data at every visit between 16 and 38 weeks gestation. The pattern of change in activity levels displayed by this sample is shown in figure 6.7. A characteristic decline in mean daily activity levels during the second half of pregnancy is once again evident. However, the available evidence indicates that this decline is only a temporary one since at 6-8 weeks postpartum, mean daily activity levels are once again comparable to those recorded at 25 weeks gestation. A repeated measures analysis of variance confirmed that mean daily

activity level changed significantly across the five stages of pregnancy ($F(4, 76)=2.52$, $p<0.05$). Pairwise comparisons showed mean daily activity at 6-8 weeks postpartum to be significantly higher than at 38 weeks gestation ($t=3.02$, $df=19$, $p<0.05$). No significant differences between mean daily activity level postpartum and mean daily activity level at any earlier stage of pregnancy could be observed.

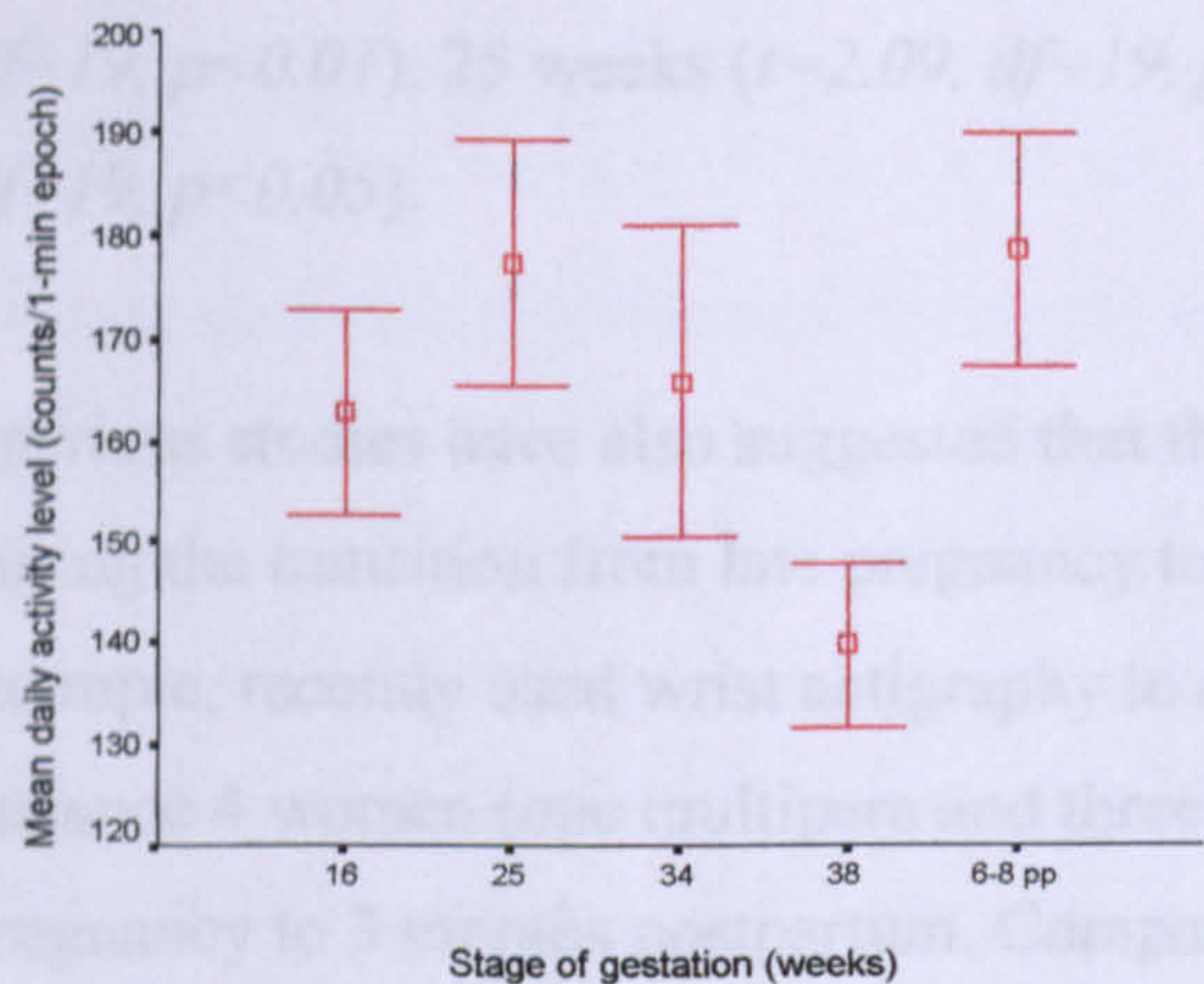


Figure 6.7: Mean daily activity levels (± 1 S.E.) as a function of advancing pregnancy ($n=20$)

6.5.2. Nocturnal & Diurnal Activity Levels in the Postpartum Period

To ascertain whether the increase in mean postpartum daily activity levels was a product of increased activity during the diurnal or nocturnal period, participants’ activity profiles were divided according to the times that they reported going to bed at night and getting up in the morning. Mean diurnal and nocturnal activity levels at 6-8 weeks postpartum are shown in table 6.7.

Table 6.7: Mean Diurnal and Nocturnal Activity Levels During Low Risk Pregnancy

Gestation (weeks)	n	Diurnal Activity Level (activity count/1-min epoch)		Nocturnal Activity Level (activity count/1-min epoch)	
		Mean	(S.D.)	Mean	(S.D.)
12	27	278.31	(116.27)	21.12	(11.00)
16	56	263.69	(106.05)	17.45	(11.06)
25	51	255.14	(121.98)	18.41	(12.61)
34	39	219.16	(109.03)	17.26	(9.82)
38	34	255.47	(114.39)	24.25	(13.02)
6-8 pp	33	283.07	(103.82)	29.78	(16.94)

Figure 6.8 shows mean nocturnal activity levels as a function of advancing pregnancy in the 20 individuals providing data at every visit between 16 weeks gestation and 6-8 weeks postpartum. A repeated measures analysis of variance with a Greenhouse Geisser correction revealed that mean nocturnal activity level changed significantly across pregnancy ($F(2.57, 48.74)=3.94, p<0.05$). Pairwise comparisons showed mean nocturnal activity at 6-8 weeks postpartum to be significantly higher than that at 16 weeks ($t=-3.21, df=19, p<0.01$), 25 weeks ($t=2.09, df=19, p<0.05$) and 34 weeks gestation ($t=-2.36, df=19, p<0.05$).

Previous studies have also suggested that the nocturnal activity of women will increase during the transition from late pregnancy to the puerperium. Shinkoda et al. (1999) for example, recently used wrist actigraphy to demonstrate a comparable trend. In this instance 4 women (one multipara and three primigravidae), were studied from late pregnancy to 3 months postpartum. Compared to measures taken during the latter stages of pregnancy, an irregularity of the sleep-wake cycle with an increased number of awakenings was notable 1 month after delivery. Subsequently, the number of awakenings tended to decrease. These authors concluded that the findings were indicative of an association between the neonatal feeding cycle and the maternal sleep-wake cycle. Additional analyses of the nocturnal sleep patterns demonstrated by women in the present study are presented in Chapter 8.

6.6 Comparison of Monitor Data with Self-Reported Data

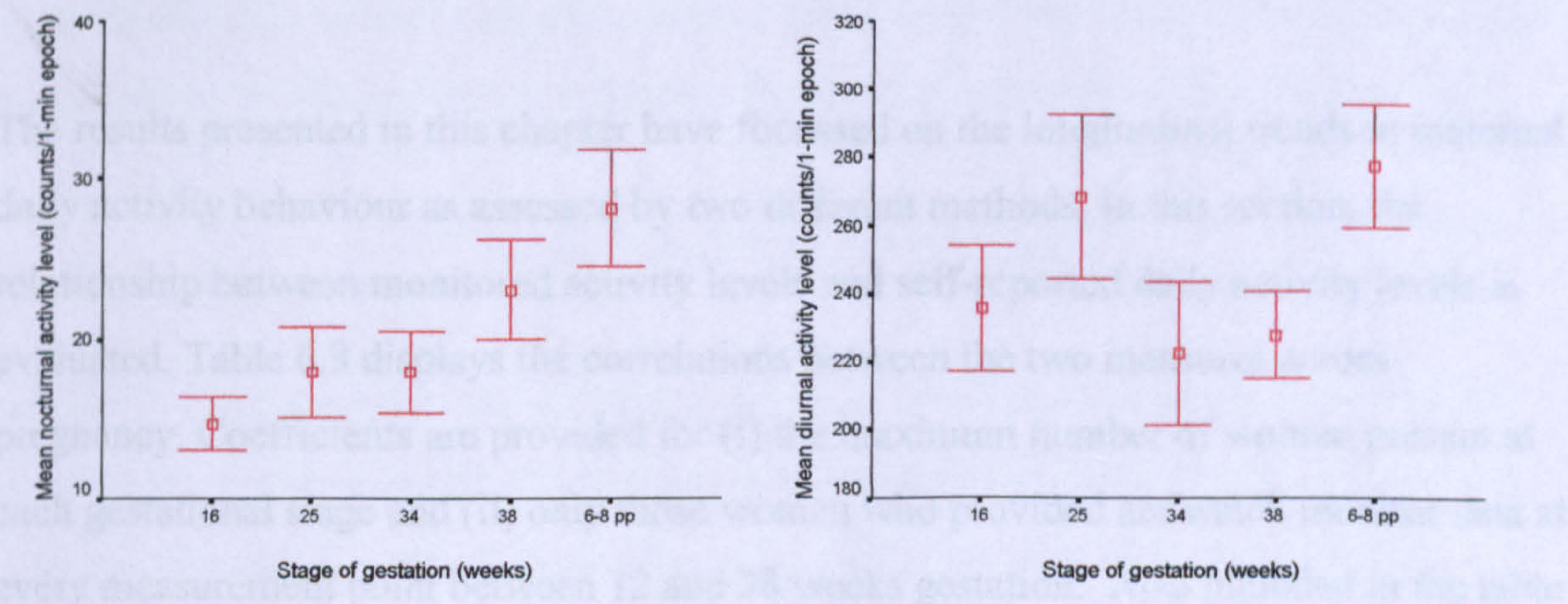


Figure 6.8: Mean nocturnal activity levels (± 1 S.E.) as a function of advancing pregnancy (n=20)

Figure 6.9: Mean diurnal activity levels (± 1 S.E.) as a function of advancing pregnancy (n=20)

Figure 6.9 considers the pattern of change in mean diurnal activity levels as a function of advancing pregnancy in the same women. In this instance mean diurnal activity at 6-8 weeks postpartum was found to be significantly higher than that at 34 weeks ($t=2.16$, $df=19$, $p<0.05$) and 38 weeks gestation ($t=2.47$, $df=19$, $p<0.05$). These findings suggest that the increase observed in maternal activity at 6-8 weeks postpartum originated from both an increased level of activity at night and an increased level of activity during the day.

Despite declining significantly during the latter stages of pregnancy, it is evident that maternal activity may return to near habitual levels in the early postpartum period. Given that women will be caring for a new baby however, it is unlikely that the nature of this activity will remain the same. Further studies are therefore needed to establish whether the increase that is observed in maternal daily activity is merely a transient effect of parental responsibilities during the early postpartum period or is instead, a more prolonged response. It must also be acknowledged that the women who provided postpartum data in the present study differed significantly from other participants in terms of their sociodemographic and psychosocial characteristics. Future studies should therefore also consider whether the activity levels of younger, less educated women demonstrate a similar trend.

6.6 Comparison of Monitor Data with Self-Reported Data

The results presented in this chapter have focussed on the longitudinal trends in maternal daily activity behaviour as assessed by two different methods. In this section, the relationship between monitored activity levels and self-reported daily activity levels is evaluated. Table 6.8 displays the correlations between the two measures across pregnancy. Coefficients are provided for (i) the maximum number of women present at each gestational stage and (ii) only those women who provided actiwatch monitor data at every measurement point between 12 and 38 weeks gestation. Also included in the table is the correlation coefficient that was obtained in a separate sample of non-pregnant women during the pilot study (see chapter 3, section 3.9).

Table 6.8: Correlations Between Self-reported and Monitored Daily Activity Levels

Sample	Stage of gestation (weeks)	All subjects		Subjects with a complete data set	
		n	Correlation	n	Correlation
A (pilot study)	Non-pregnant	17	0.72**	-	-
B (main study) ^a	12	29	0.55**	16	0.51*
	16	56	0.26	16	0.14
	25	53	0.15	16	0.10
	34	43	0.13	16	0.08
	38	33	0.22	16	0.20

**p<0.01 ^a sample comprises all women providing at least 1 complete 24-hour activity profile.

Despite previous results from the pilot study suggesting that a moderate relationship existed between the two measures, activity levels as assessed by self-report and ambulatory monitor were not strongly associated during pregnancy. The highest correlation between the two scores occurred early in pregnancy at 12 weeks gestation. The weakest relationship occurred late in pregnancy at 34 weeks gestation.

Several explanations for a lower level of agreement during pregnancy can be offered. Firstly one must acknowledge that the size of '*r*' is very much dependent upon the variability of the values measured (Guildford, 1956). Thus, since the non-pregnant sample displayed a wider range of activity levels than the pregnant sample, it is inevitable that a higher correlation coefficient was observed in this sample. Guildford (1956) provides a formula to correct for this effect. Where restriction occurs on the basis of one variable and there is knowledge of standard deviations in that variable for both restricted and unrestricted groups, then correlations for an unrestricted group can be given by:

$$R_b = r_a (\Sigma_a / \sigma_a) / \sqrt{(1 - r_a^2 + r_a^2 (\Sigma_a^2 / \sigma_a^2)}$$

where R_b = correlation in unrestricted group; r_a = correlation between monitor and questionnaire scores in restricted group; σ_a = standard deviation of monitor scores in restricted group; Σ_a = standard deviation of monitor scores in unrestricted group.

Table 6.9 displays the corrected correlation coefficients at each stage of pregnancy. It can be seen that although the strength of association between the measures is increased, the correlation coefficients obtained between 16 and 38 weeks gestation still fail to reach a magnitude comparable to that of the pilot study. This observation thus raises the possibility that the accuracy of one or both techniques was reduced during the pregnancy period.

Table 6.9: Corrected Correlations Between Self-reported and Monitored Daily Activity Levels

Sample	Stage of gestation (weeks)	All subjects		Subjects with a complete data set	
		n	Correlation	n	Correlation
A (pilot study)	Non-pregnant	17	0.72**	-	-
B (main study) ^a	12	29	0.75**	16	0.84**
	16	56	0.46	16	0.30
	25	53	0.26	16	0.20
	34	43	0.21	16	0.12
	38	33	0.35	16	0.46

^a sample comprises all women providing at least one complete 24-hour activity profile.

6.6.1 Potential Inaccuracies in the Self-Reported Data

Support for an increased inaccuracy of the self-report data comes from a number of sources. The first involves a simple difference in the methodological approach that was used to study the behaviour of the pregnant and non-pregnant samples. In addition to wearing an ambulatory activity monitor and completing an interviewer administered questionnaire, non-pregnant women also maintained a 15-minute activity diary over three of the seven days for which activity was assessed. It is possible that having completed this diary, women were able to recall the past week's activity with greater precision during their interview. Because the diary was not well received by pregnant women (see Chapter 3, section 3.5.2.3.2), a decision was made not to incorporate it into the study protocol. This decision may inadvertently have reduced the accuracy of interview responses in the pregnant sample.

Ultimately however, this hypothesis is contradicted by the significant correlation that is observed between the ambulatory monitor and interview data at 12 weeks gestation. Indeed, the significant relationship that exists between the two measures at this point suggests that, even in the absence of an activity diary, the interviewer-administered questionnaire may elicit accurate responses in the early stages of pregnancy. An alternative explanation therefore lies in the possibility that self-reported data may reduce in accuracy as pregnancy advances. Certainly, it is possible that the various social, psychological and lifestyle changes that often accompany pregnancy and motherhood could impact on women's recall ability, since it may be much harder to recount activities when routine is disrupted than when behaviour follows a habitual pattern. Moreover, this problem may also be exacerbated by the fact that activity levels typically decline during pregnancy. Bassett et al. (2000) document that whilst subjects can recall vigorous and structured exercise with a high degree of accuracy, they are not as good at describing more ubiquitous moderate intensity activities such as walking. Ultimately, the lower saliency of the sedentary activities that are performed in late pregnancy may hamper the reliability of pregnant women's recall.

In addition, it is necessary to acknowledge that women's perceptions of the intensity of their activity may also alter during pregnancy. Whilst provisions were made in the questionnaire for women to report the general intensity of their pursuits, no allowance was made for more subtle alterations to their behaviour. Faced with the physical discomforts of pregnancy and especially fatigue, it is possible that women approached their activities with less efficiency. A participant suffering from a high level of fatigue may thus have reported engaging in a household task such as Hoovering but may ultimately have invested less physical effort and covered a smaller area than another woman who felt more energetic.

This accepted, it would be wrong to suggest that the potential for inaccurate activity assessment lies solely with the self-report measure. Indeed, there are several ways in which the monitor data could have influenced the observed results and these also demand attention.

6.6.2 Potential Inaccuracies in the Monitor Data

The previous section served to highlight that, compared to non-pregnant women, pregnant women showed a reduced level of compliance with the ambulatory activity monitor. At 25 and 34 weeks gestation, 93% and 72% of the sample wore an activity monitor for at least 24 hours. Of these approximately one third (32% and 34% respectively) did not provide a full 72-hour activity profile. Baranowski & de Moor (2000) highlight the problem of intra-individual variability in the assessment of physical activity by emphasising the fact that no two days are exactly alike. It is therefore possible that the smaller number of days over which data were recorded may have introduced error into the measurements (Rikli, 2000). This may be particularly so if the actual recording period was selected on the basis of the nature or level of activity that was to be performed.

This accepted, the inaccuracies that were observed might have arisen as much from a reduction in mean daily activity level as from a reduction in the length of the monitoring period. Initial results from the pilot study suggested that the ambulatory activity monitor may not perform so well when participants perform lower levels of daily activity. As Bassett (2000) has recently observed, motion sensors may be unable to detect the metabolic cost associated with standing, upper body movements, static work and vertical lift. Thus, as daily activity levels decline and pregnant women withdraw from sports, exercise and other vigorous activities, the ability of the monitor to accurately estimate their energy expenditure could deteriorate.

Compounding this problem further, is the possibility that the physical effects of pregnancy may also influence the type and amount of movement that is recorded. One particular example may be the change in gait that occurs as pregnancy advances. Miller et al. (1973) have shown that by 20 weeks gestation the growing uterus has reached umbilical level and protrudes from the pelvis. This protrusion limits the range of motion that can be experienced at the hip. In addition symphysis, or pubic pain, combined with an increased foetal mass and altered centre of gravity may also cause difficulty in

ambulation. If these difficulties cause changes in walking patterns they will inevitably be reflected in the number of accelerometer counts that are recorded. Nichols et al. (2000) posit for example, that accelerometer counts may vary considerably with alterations in stride length or frequency. Significantly different accelerometer readings have also been found in people walking under normal conditions as compared to walking under simulated orthopaedic conditions, such as while wearing a knee brace (Mulcare et al., 1999). Even in younger people with normal movement patterns significantly different readings have been found for a motion sensor on one hip when compared to one on the other (Nichols et. al., 1999). The change in gait across pregnancy may therefore provide a credible explanation for why objective monitor demonstrates an unusually weak association with subjective activity descriptions.

Likewise, the physical sequelae of pregnancy may also affect the amount of movement experienced during more stationary activities. Restless Leg Syndrome (R.L.S) for example, is an extreme form of fidgeting for which pregnancy has been identified as a secondary cause. Patients with R.L.S. have an irresistible urge to move their legs, a symptom which is due to disagreeable sensations that usually increase in severity during periods of inactivity. It is not known definitively whether any of the women in the current study suffered from this complaint (certainly, no women reported it during their interviews) but general restlessness may itself be sufficient to create inaccuracies in monitor data during pregnancy. Artal et al. (1991) document how aching pains in the knee joint frequently increase with periods of prolonged sitting in pregnant women. Symptoms of backache, anxiety or increasing body mass may also make it difficult for individuals to find a comfortable resting position. A variety of situations can therefore be imagined in which individuals may report sitting yet nonetheless record significant levels of bodily movement on an ambulatory activity monitor. The differences that are observed between questionnaire and activity monitor data may thus be attributed less to inaccuracies in the data and more to systematic differences in the types of activity that the two techniques measure - differences which are exacerbated by the changes in activity which occur as pregnancy progresses.

6.7 Chapter Summary

The present study investigated the use of two different techniques for estimating maternal daily activity levels in pregnancy. Both data from the self-report measure and data from the activity monitor demonstrated a significant decline in mean daily activity levels between 25 and 38 weeks gestation. However, findings also suggested that this decline may depend less upon the experience of pregnancy *per se* and more upon the perceived opportunity for behavioural change. The effect of pregnancy on different activity types will therefore be considered further in Chapters 7-9.

Unfortunately, whilst the activity questionnaire and the activity monitor demonstrated comparable trends in the mean activity levels of the sample, correlations between the two methods were low. A comparison of the two techniques revealed that different methods of assessing daily activity during pregnancy may create very different problems for the researcher.

Both the accuracy of activity questionnaires and the accuracy of ambulatory activity monitors may be affected by an increased prevalence of sedentary activities in the latter stages of gestation. However, the accuracy of data obtained from activity monitors may also be influenced by variations in maternal gait, increased maternal restlessness and a reduced compliance with the measurement technique. One particularly salient barrier to the use of activity monitors in pregnant women may involve their unique status as recipients of unwanted advice and attention (see Chapter 11, section 11.2.2.2). More pertinently however, the value of ambulatory activity monitors may also be limited by their inability to distinguish between stationary activities such as sitting, lifting and standing. Since standing activities have previously been proposed as a significant risk factor for adverse pregnancy outcome, this limitation may preclude the use of activity monitors in any study that seeks to examine the relationship between maternal daily activity level and fetal health. In such situations, self-report measures may remain the only feasible choice. The next chapter uses questionnaire data to examine in detail the occupational activity patterns of the study participants.

CHAPTER SEVEN

The Impact of Low-Risk Pregnancy on the Self-reported Occupational Activity of British Nulliparous Women

7.1 Introduction

A central theme of the current research lies in identifying and describing the daily activity patterns of healthy, pregnant women, in an attempt to improve the minimal level of information and knowledge currently available in this area. The previous chapter provided a detailed overview of the longitudinal patterns of total daily activity displayed by the study sample. Ultimately however, total daily activity represents the product of four main activity domains: (i) occupational responsibilities, (ii) domestic chores (iii) recreational pursuits and (iv) nocturnal resting. Thus, in order to understand maternal physical activity behaviour in detail, it is necessary to consider in turn these different aspects of daily life.

Consideration of occupational activity is of primary importance. As Chapter 5 served to demonstrate, the vast majority of the sample were in paid employment prior to pregnancy, a substantial proportion of whom reported working more than 40 hours a week. This bias towards employed women broadly reflects the national picture (see section 5.9.2). The number of economically active women in Britain has increased substantially over the past decade. As Callender et al. (1997) point out, this trend has clear implications, not only for the women who will be seeking to combine employment and motherhood but also for the employers who will increasingly need to adapt to the needs of mothers among their workforce.

In this chapter, data from the interview-administered questionnaire is presented. The respondents' time of stopping work; their work duration and range of activities they performed within the workplace are considered. This information provides a valuable

insight into the manner by which healthy, nulliparous women may manage the demands of employment during pregnancy.

7.2 Statistical Analyses

Quantitative data were analysed using the Statistical Package for the Social Sciences 9.0 (SPSS Inc., Chicago). All data are reported as mean (S.D.) or as percentages.

Relationships between the onset of maternity leave and independent variables were assessed using independent sample t-test or Mann-Whitney-U test for dichotomous variables, one way ANOVAs or Chi-square tests for categorical variables and Pearson's correlation or Spearman's Rank correlation coefficients for continuous variables.

Longitudinal trends in occupational activity were assessed using repeated measures ANOVAs or Friedman's tests. All tests were two tailed. Qualitative data were analysed by sorting verbatim material into emergent themes as described by Dey (1993).

7.3 Time of Stopping Work

Of the 50 women who were employed at the time that they became pregnant, three had stopped working prior to the first interview. Thus, at the time of entry into the study a total of 47 individuals remained in paid employment. One participant had changed from working on a full- to part-time basis. This meant that by 16 weeks of pregnancy, 43 women were working full-time and 4 were working part-time. One woman was self-employed and 8 women performed shift work (2 part-time), 5 of whom worked nights.

The nature of the occupations undertaken by the sample has been described previously (Ch.5, section 5.9). Of the three participants who stopped work early in pregnancy, two were employed in sales and one was employed in clerical work. In each case, the individual concerned indicated that they had left paid employment for personal reasons rather than for reasons related to their pregnancy. These personal reasons included (i) dislike for one's job, (ii) boredom in the workplace and (iii) commuting inconvenience.

As Harris & Campbell (1999) point out however, pregnancy may still play a facilitating role in establishing such permanent lifestyle changes.

Of those who remained in full time employment at point of entry into the study (n=43) the mean time of ceasing work was 33.5 (S.D. 5.1) weeks gestation (table 7.1). The proportion of women remaining in employment at each stage of pregnancy is given in table 6.2. Two thirds (66%) of these women believed that they had stopped work at the ideal time. 20% would have preferred to continue working for longer than they did and 14% would have preferred to have stopped working earlier. All women who preferred to stay in active employment for longer than they did had stopped working prior to 33 weeks of pregnancy. Likewise, all women who had expressed a preference for leaving work earlier than they did remained in paid employment beyond this time. Ultimately, the mean preferred time for stopping work was found to match the mean actual time of stopping work (33.5 weeks), although variation around this value was slightly reduced (S.D. 4.3 weeks).

Table 7.1: Proportion of Sample in Paid Employment During Pregnancy

Proportion of sample employed:		Gestation (weeks)				
		12	16	25	34	38
Full time	n	23	43	41	26	4
	%	77	75	72	46	8
Part time	n	3	4	3	-	-
	%	10	7	5	-	-
Total	n	26	47	44	26	4
	%	87	82	77	46	8

In the current study 52% of women working full-time continued working beyond 34 weeks gestation. This percentage is slightly higher than that observed by a previous study, which indicated that, in 1996, 37% of pregnant women worked beyond this point (Callender et al., 1997). Whilst such a difference may partially reflect a change in

legislation not obvious in the 1996 figures⁸, it may also result from an over-representation of higher level occupations (and thus higher levels of career commitment and/or financial reward) within the present study (see section 7.3.1 below).

7.3.1 Who Decided When Respondents Should Stop Work and Why?

Whilst the majority of women (82%) stated that they themselves were the main decision-maker in choosing when to stop work, 2 individuals (4%) had made a joint decision with their partners and 2 had made a joint decision with their employers. Four individuals (9%) reported that they were acting on the advice of their midwife.

A comparison of the 20 women who left full-time paid employment before 34 weeks (50th centile) with the 23 women who left after this point revealed that the two groups did not differ significantly from one another in terms of any of the measured sociodemographic, psychosocial or pregnancy-related characteristics. Likewise, neither differences in work satisfaction nor habitual working hours were significantly associated with the stage of pregnancy at which women gave up work. Maternal attitude was the only variable to approach statistical significance at the $\alpha=0.05$ level. The direction of this trend was such that women who demonstrated a more positive attitude towards motherhood and the baby were more likely to stop work before 34 weeks gestation ($p=0.083$).

This accepted, there was also evidence that the onset of maternity leave may have been influenced directly by the nature of the women's occupations (Table 7.2). Compared to women working in higher level occupations, women employed in the three lowest occupational groups (personal and protective occupations, sales and other) were significantly more likely to leave work before 34 weeks of pregnancy ($\chi^2=4.08$, $d.f.=1$,

⁸ Since 1994, women no longer encounter a financial penalty in lost statutory maternity pay for working beyond the sixth week before the baby is due and if they wish, they may continue working until the day of childbirth (UK response to EU Directive 92/85).

$p=0.043$). Four fifths of women employed in sales and three quarters of women employed in personal and protective services stopped work before this time.

Table 7.2: Time of Stopping Work According to Occupational Activity Level (%)

Occupational Sector	Onset of maternity leave	
	34 weeks or less	More than 34 weeks
Managers & Administrators	40	60
Professionals	38	62
Associate professionals and technical	50	50
Clerical & Secretarial	33	66
Personal & Protective Services	75	25
Sales	80	20
Other	66	33

When asked why they had given up work at the time they had, women who stopped work prior to 34 weeks gestation cited one of three main reasons. Twenty-nine percent of respondents explained that it was convenient for their employer if they left at that time whilst 12% reported that they wanted to avoid the psychological stress associated with their job. However, 59% of respondents (and 88% of respondents in lower level occupations) referred solely to a physical influence, either reporting that they were tired and wanted to rest or stating that their levels of physical activity had simply “become too much” for them. One 22-year old shop worker explained:

“I was standing all the time and it wasn’t doing me any good so last week I decided to stop, I was just too tired.”

Jane (33 weeks gestation)⁷

Women who stopped work after 34 weeks of pregnancy offered a wider variety of reasons for leaving paid employment. Once again, the most common factor was tiredness (57%) although several other factors were also found to compete with the women’s occupational interests at this time. These included a specific convenience of giving up

⁷ NB. To protect participant anonymity, all names accompanying qualitative quotes have been changed.

work (14%), a belief that women should conform to “normal practice” (14%), a desire to prepare for birth or the baby (10%) and concerns about the safety of commuting to work (5%). Most women cited only one main factor. One 23-year old personal assistant clearly highlighted how, by 36 weeks gestation, a need to prepare for the impending birth of her baby had finally superseded her desire to continue in her career:

“I felt OK before so I didn’t stop earlier. I would have got bored at home but I feel ready now, I really need to prepare.”

Rebecca (38 weeks gestation)

7.3.2 Summary: Time of Stopping Work

This section has investigated the different stages of pregnancy at which the study participants elected to give up work. The mean time of stopping work in the present study was 33.5 (S.D. 5.1) weeks gestation. Ultimately however, the stage of pregnancy at which low-risk nulliparous women choose to leave paid employment may be determined by a complex trade-off between an individual’s maternal attitude, her intrinsic job motivation and the level of physical activity demanded by her job.

In the current study, an analysis of quantitative data demonstrated a strong trend for women with a more positive maternal attitude to leave paid work before 34 weeks gestation whilst qualitative data suggested that higher-level occupations may prolong periods of maternal employment. Previous studies have also documented a greater tendency for better-educated women who have more skilled jobs to continue in full-time paid employment after childbirth than less well educated, lower skilled women who typically drop out or start working part-time (McRae 1991; Romito, 1996). Often, this distinction is believed to be a consequence of better educated women possessing higher levels of career commitment and/or receiving greater financial rewards, both of which may facilitate employment during the postpartum period. During pregnancy, the same factors may also encourage women to continue working until late into the third trimester.

In this instance however, none of the study respondents cited financial gains as a reason for continuing in paid employment. Rather, maternal reports suggested that women often remained in employment for their own psychological wellbeing. The notion that the vast majority of respondents attributed some intrinsic value to their occupational role is supported by the fact that the mean levels of occupational satisfaction for the sample were initially found to be quite high (see Chapter 5, section 5.9.2.1). Nonetheless, one must also acknowledge that the less-skilled jobs (i.e. sales and personal or protective services) are often those identified as requiring prolonged periods of standing (see section 5.9.2.2). Such findings thus suggest that the type of job activities that pregnant women perform may also influence the stage of gestation at which they give up work.

Irrespective of the stage of pregnancy at which women left paid employment, the somatic symptoms of pregnancy, and in particular tiredness, were frequently cited as being an influential factor in the women's decisions to leave paid employment. This observation therefore raises the question of whether pregnancy has a sudden or more gradual effect on women's occupational responsibilities.

7.4 Total Occupational Activity Ratios

From all the information derived from the activity questionnaire, an overall occupational activity ratio could be computed for each individual. This ratio took into account the nature of the different activities performed when at work, the nature of activities performed during work breaks and mode of travel to and from work. Each of these activities were scored according the method of Ainsworth et al. (1993), and an occupational activity ratio obtained by dividing the sum of the total energy expended by the length of time over which it occurred.

Mean occupational activity ratios across the five stages of pregnancy are presented in table 7.3. These figures have been calculated for the number of women registered as working full time at each visit. Temporary absences from work due to extraneous influences have been excluded.

Table 7.3: Self-reported Occupational Activity Ratios

Gestation (weeks)	Total Occupational Activity Ratio (METs)		
	n	Mean	S.D.
12	21	2.41	0.57
16	41	2.44	0.59
25	36	2.26	0.54
34	26	2.05	0.43
38	4	2.05	0.53

During pregnancy, total self-reported occupational activity ratios ranged from 1.62 to 3.41 METs. To put these values in context, a woman who spent the entire duration of her working day sitting down would score an occupational intensity ratio of approximately 1.5 METs. Conversely a woman who spent the day in light standing activities would score approximately 2.5 METs whilst a woman who spent the day walking at a moderate speed but not carrying anything would score an intensity ratio of 3.5 METs.

7.4.1 Longitudinal Trends in Maternal Occupational Activity Ratios

To assess longitudinal trends in occupational activity ratios, consideration was limited to only those women who had reported working in full-time employment throughout pregnancy. Figure 7.1 shows mean occupational activity ratios as a function of advancing pregnancy in the 25 women who reported working in full time employment at every visit between 16 and 34 weeks of pregnancy. Mean self-reported occupational activity levels can be seen to decrease steadily over time ($F(1.50, 35.88)=6.09, p=0.01$). Mean occupational activity ratio at 34 weeks was significantly lower than both that at 16 weeks ($t=3.48, df=24, p<0.01$) and 25 weeks of pregnancy ($t=2.64, df=24, p<0.05$).

Of the 25 women included in the first analysis, 11 also provided data at 12 weeks gestation (figure 7.2). Once again a significant decline in mean occupational activity level was observed ($F(3,30)=4.51, p=0.01$). Pairwise comparison tests with Bonferroni adjustment revealed mean occupational activity ratio at 34 weeks gestation to be significantly lower than at 12 weeks gestation ($t=3.36, df=10, p<0.05$).

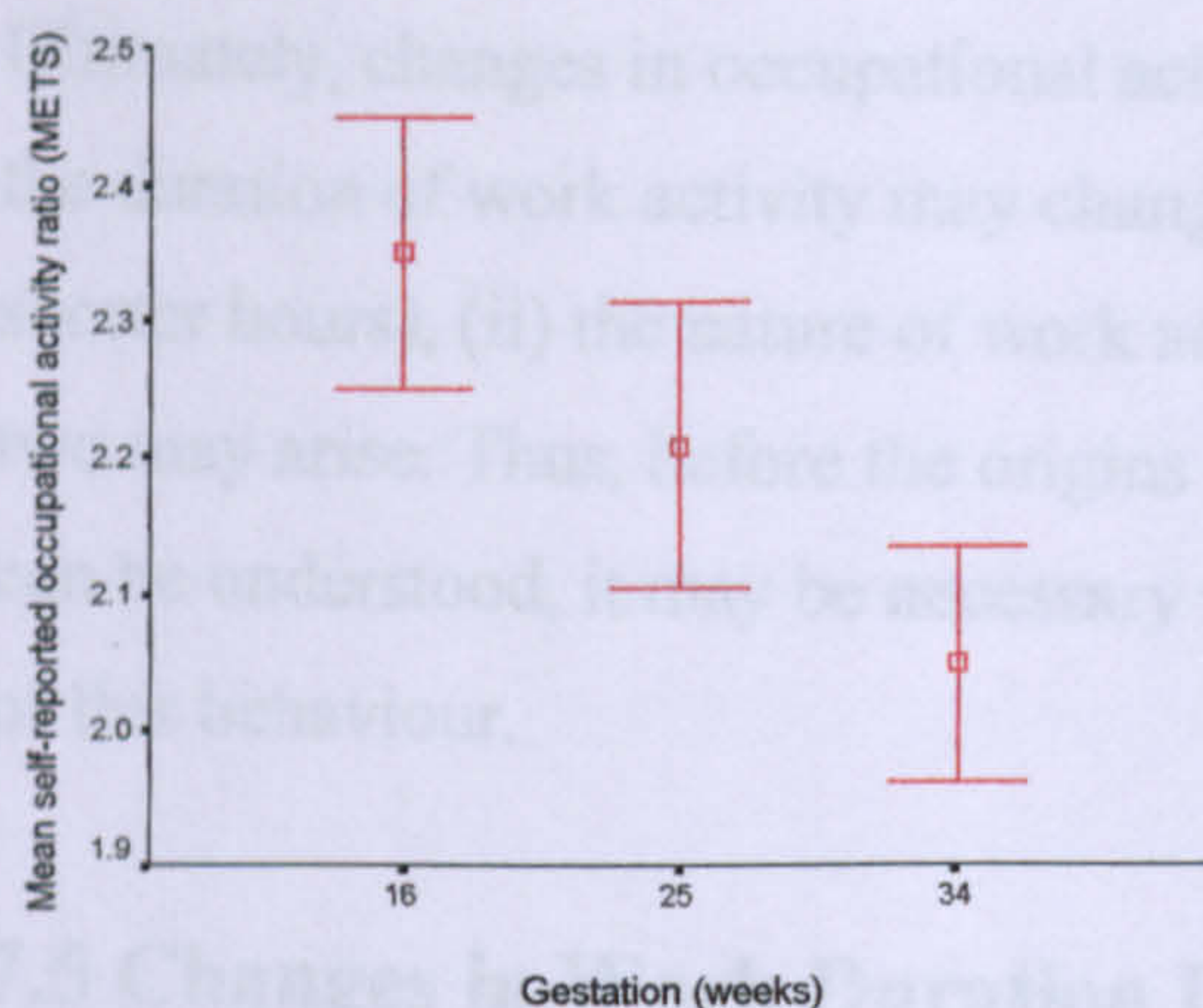


Figure 7.1: Mean (± 1 S.E.) self reported occupational activity ratio across low risk pregnancy (n=25)

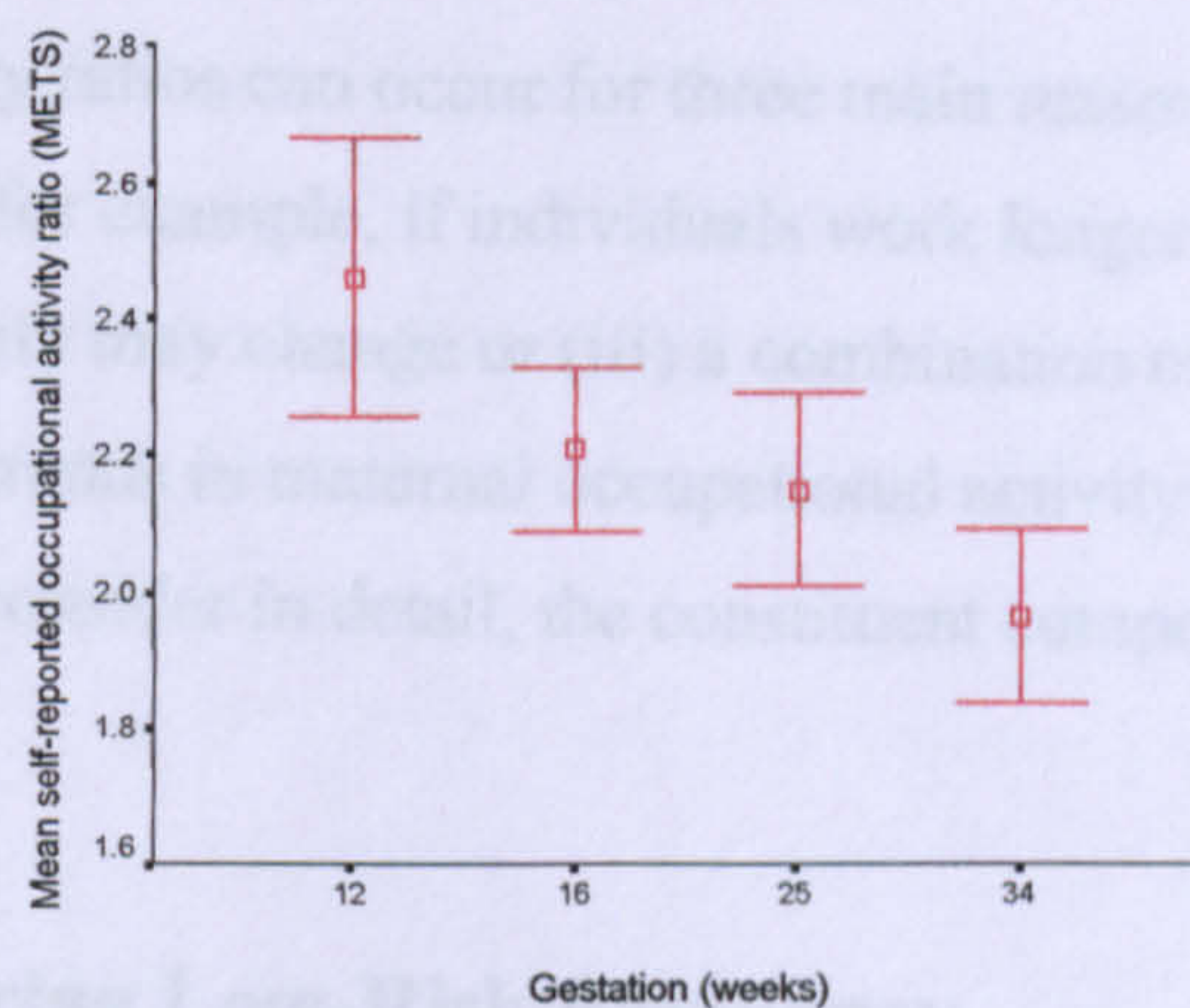


Figure 7.2: Mean (± 1 S.E.) self reported occupational activity ratio across low risk pregnancy (n=11).

The progressive decline that was observed in the mean occupational activity ratios of women working full-time during pregnancy contrasts sharply with the longitudinal trends that were observed in the sample's mean levels of integrated daily activity (Chapter 6, section 6.3.1). Whereas mean levels of maternal daily activity increased between 12 and 25 weeks gestation, mean occupational activity ratios did not. In contrast to mean levels of maternal daily activity, no second trimester peak in the mean occupational activity levels of the sample was observed. This finding is suggestive of an immediate and ongoing adaptation in maternal occupational behaviour, the outcome of which is to limit women's physical activity during working hours.

The mean decline in maternal occupational activity ratio between 16 and 34 weeks gestation was 0.33 (S.D. 0.45) METS. However, the magnitude of the change that occurred in maternal occupational activity ratios during this period was variable, ranging from a decline of 1.17 METS to an increase of 0.57 METS. The sociodemographic, psychosocial or pregnancy-related characteristics of the 12 women who reduced their occupational activity ratio by more than 0.32 METS (50th centile) were compared with those of the 13 women who reduced their occupational activity ratio by less than this amount. No significant differences were observed.

Ultimately, changes in occupational activity ratios can occur for three main reasons: (i) the duration of work activity may change (for example, if individuals work longer or shorter hours), (ii) the nature of work activity may change or (iii) a combination of the two may arise. Thus, before the origins of trends in maternal occupational activity ratios can be understood, it may be necessary to consider in detail, the constituent components of this behaviour.

7.5 Changes in Work Duration During Low-Risk Pregnancy

Over the period that the study participants remained in paid work, respondents were asked to recall the times that they had started and finished work in the last 7 days prior to interview. This enabled the total number of hours each individual worked per week to be estimated.

Table 7.4: Hours Worked/Week by Full-time Employees

Gestation (weeks)	n	Hours worked / week	
		Mean	S.D.
12	22	37.64	12.38
16	42	35.93	9.44
25	40	34.81	10.41
34	26	30.26	11.39
38	4	25.29	15.94

The mean number of hours worked each week by women working full-time is given in table 7.4. These figures have been calculated according to the number of women registered as working full time at each visit. Temporary absences from work caused by known extraneous influences (for example an employer's re-organisation of working patterns) have been excluded. Only two individuals reported an absence from work due to pregnancy-related sickness. In both instances, this absence occurred early in pregnancy (at 12 and 16 weeks gestation) and affected only one working day out of five. By comparison, much greater reductions to working hours were caused by perceptions of tiredness, combined with exceptional cases of employer leniency. Because the objective

of this section is to examine how pregnancy affects activity, all women attributing absences from work to the influence of their pregnancy are included in the analysis. Figures 7.3. and 7.4 display the longitudinal patterns of change that were observed in the mean work duration of the study sample. In both instances data were skewed and a transformation⁸ was used to normalise the distributions.

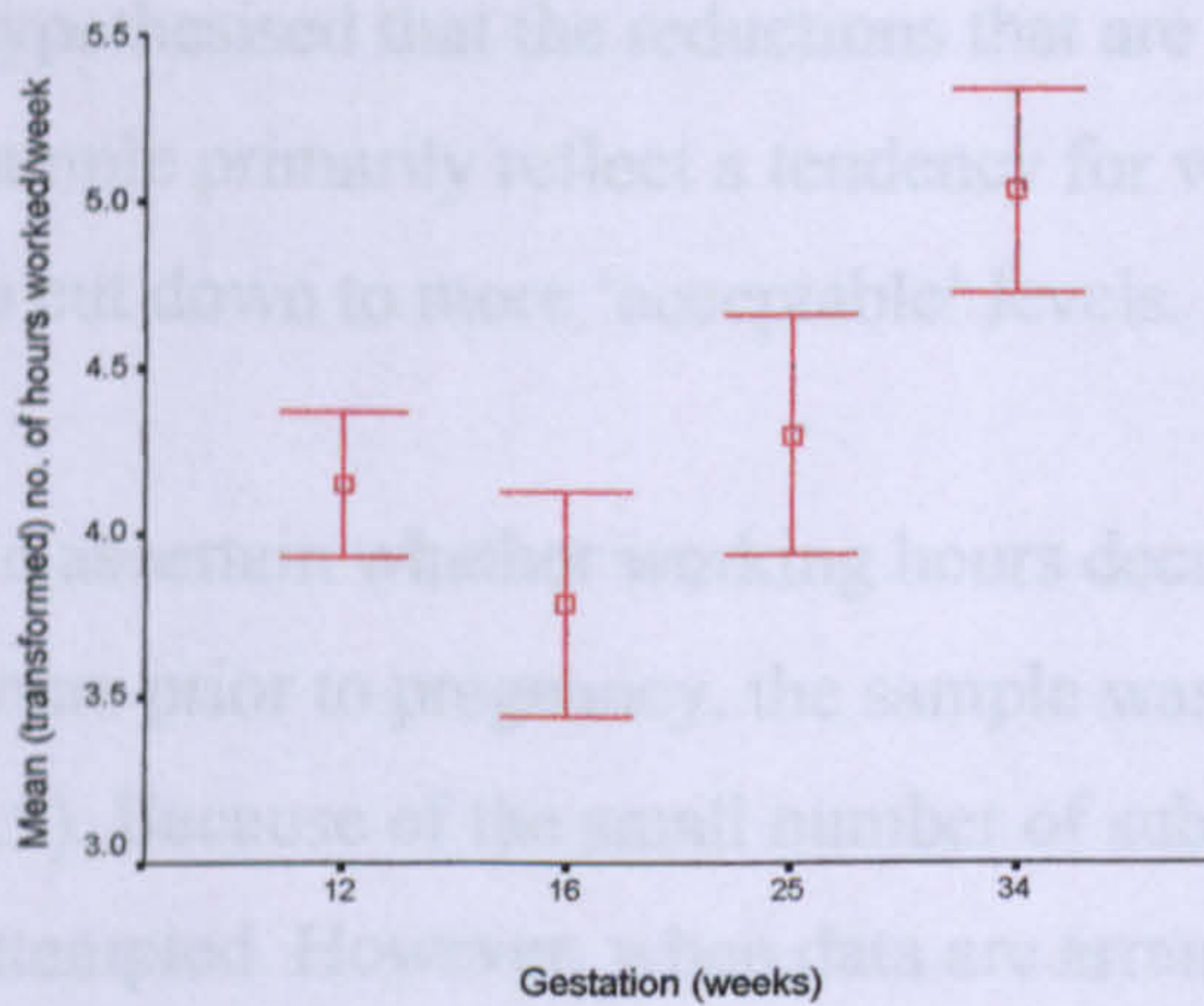


Figure 7.3: Mean transformed number of hours worked per week (± 1 S.E.) by full time employees during pregnancy (n=11)

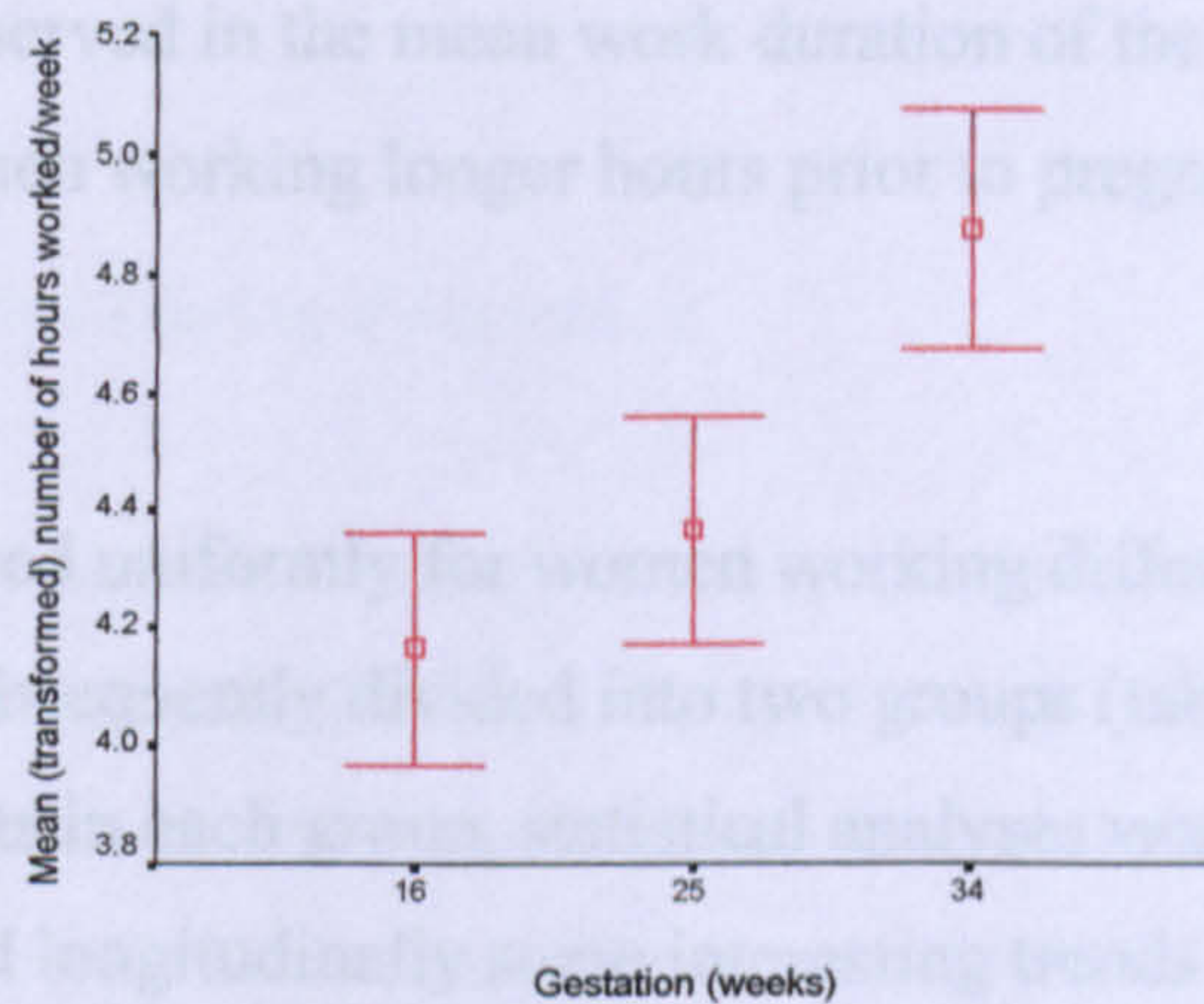


Figure 7.4: Mean transformed number of hours worked per week (± 1 S.E.) by full time employees during pregnancy (n=25)

Within the first sample (n=11), a repeated measures ANOVA just missed significance at the $\alpha=0.05$ level ($F(3,30)=2.59, p=0.07$). Before Bonferroni adjustment, paired comparisons showed mean (transformed) number of hours worked per week to be significantly higher at 34 weeks than at 16 weeks of pregnancy ($t=2.53, df=10, p<0.05$). Within the second sample (n=25), a repeated measures ANOVA revealed that the mean (transformed) number of hours worked per week varied significantly between 16 and 34 weeks of pregnancy. The mean (transformed) number of hours worked per week steadily increased with advancing pregnancy such that it was significantly higher at 34 weeks than at 16 weeks gestation ($t=-2.16, df=24, p<0.05$). This finding corresponds to a significant *decrease* in the mean number of hours worked per week during pregnancy.

⁸ $\sqrt{(k-X)}$ where K = a constant equal to the largest score + 1.

7.5.1 The Impact of Habitual Working Hours on Work Duration During Pregnancy

During pregnancy, a progressive decrease in the number of women working more than 40 hours per week was observed. 30% of individuals working full-time in the 12th week of their pregnancy reported working a total of 40 hours or more. At 16, 25 and 34 weeks of pregnancy these proportions were 33%, 29% and 15% respectively. It may thus be hypothesised that the reductions that are observed in the mean work duration of the sample primarily reflect a tendency for women working longer hours prior to pregnancy to cut down to more 'acceptable' levels.

To ascertain whether working hours decreased uniformly for women working different hours prior to pregnancy, the sample was subsequently divided into two groups (table 7.5). Because of the small number of subjects in each group, statistical analyses were not attempted. However, when data are arranged longitudinally some interesting trends emerge.

Table 7.5: Hours worked per week in pregnancy by full time-employees according to work duration pre-pregnancy

Hours worked / week pre-pregnancy	Gestation (weeks)	n	Hours worked / week			
			Mean	S.D.	Min	Max
<40	Pre-pregnancy	22	36.59	2.48	30.00	39.00
	12	14	35.97	5.77	22.67	44.50
	16	27	35.95	8.77	6.25	55.00
	25	26	34.80	10.25	7.50	52.50
	34	18	29.14	9.81	3.75	39.50
	38	2	26.08	23.22	9.67	42.50
40+	Pre-pregnancy	16	43.09	4.82	40.00	55.00
	12	8	40.55	4.49	36.50	50.00
	16	15	35.90	10.88	14.50	55.00
	25	14	34.83	11.09	8.97	43.50
	34	8	32.78	14.81	7.25	46.67
	38	2	24.50	14.85	14.00	35.00

Whilst mean work duration declined throughout pregnancy, the maximum values included in table 7.5 demonstrated that a small number of individuals continued to maintain exceptionally long working hours. Irrespective of the hours they had worked prior to pregnancy, some women reported working up to 55 hours per week during the

antenatal period. Other women experienced a substantial decline in the length of their working day. The minimum values displayed in table 7.5 demonstrated that at least two women reporting reducing their working levels to such an extent that they became almost unemployed. This decline occurred regardless of whether women worked more or less than 40 hours per week prior to pregnancy. Such findings therefore suggest that habitual working hours may not be the primary determinant of the changes observed in maternal work duration during pregnancy.

7.5.2 Predictors of Change in Work Duration During Pregnancy

The mean decline in the number of hours worked per week by full time employees between 16 and 34 weeks gestation was 6.41 hours (S.D. 14.88 hours). However, the magnitude of the change that occurred in weekly work duration across this period was extremely variable, ranging from a decline of 40.25 hours to an increase of 28.00 hours.

Table 7.6 shows the characteristics of the 13 full-time employees who reduced their weekly working hours by more than 5.75 hours (50th centile) compared to the 12 women who reduced their weekly working hours by less than this amount. Women who reported the smallest reductions in their working hours between 16 and 34 weeks of pregnancy were likely to be significantly older ($p=0.009$), better educated ($p=0.027$), of higher social class ($p=0.002$) and in higher- skilled occupations ($p=0.036$) than were women who reported larger reductions in their working hours.

7.5.3 Summary: Changes in Work Duration During Low-Risk Pregnancy

This section has examined longitudinal trends in work duration during low-risk pregnancy. Analyses of self-reported data from the activity questionnaire suggested a tendency for maternal working hours to decrease significantly during pregnancy. However, the changes that were experienced in working hours were extremely variable, with some women continuing to work in excess of 40 hours week well into the third trimester. In the current study, pregnancy-induced sickness was found to have little

Table 7.6: Maternal Characteristics According to Reduction in Weekly Working Hours

Maternal characteristic	Women reducing weekly work duration by < 5.75 hours	Women reducing weekly work duration by > 5.75 hours
<i>Sociodemographic:</i>		
Maternal Age (yrs) **	30.54 ± 4.24	26.07 ± 3.55
Marital Status: Married/Cohabiting	85	83
Single	15	17
Social Class: I & II**	92	31
III & below	8	69
Educational Level : GCSE or below *	25	69
Above GCSE	75	31
<i>Psychosocial:</i>		
Extroversion	11.83 ± 3.21	11.38 ± 4.96
Neuroticism	10.33 ± 3.89	10.62 ± 3.91
Generalised Self-Efficacy	30.63 ± 2.73	10.61 ± 3.91
Health Value	17.17 ± 4.11	14.69 ± 2.72
<i>Pre-pregnancy Lifestyle:</i>		
Occupational Activity Level (Baecke)	2.72 ± 0.65	2.71 ± 0.76
Work Duration (hours/week)	36.91 ± 4.34	32.46 ± 16.18
Occupational Sector: Higher-skilled ^b *	100	69
Lower-skilled	-	31
<i>Pregnancy-related:</i>		
Pregnancy History: None	62	67
Previous miscarriage	15	17
Previous termination	23	17
Pregnancy Planned: Yes	69	67
No	31	33
Maternal Attitude (MAMA)	24.67 ± 4.50	23.31 ± 3.71
Body Image (MAMA)	29.15 ± 3.17	27.88 ± 4.39
FHLC-I	37.68 ± 5.24	36.08 ± 6.32
FHLC-C	25.97 ± 8.60	27.28 ± 8.43
FHLC-P	21.45 ± 8.00	16.62 ± 6.69
Depression Change (EPDS) ^a	2.15 ± 4.85	0.33 ± 4.85
State Anxiety Change (STAI) ^a	4.75 ± 9.59	5.62 ± 8.19
Somatic Symptoms Change (MAMA) ^a	1.67 ± 5.14	1.69 ± 4.63
Social support Change (SPQ) ^a	-1.42 ± 10.57	0.42 ± 7.39
BMI Change (kg/m ²) ^a	2.75 ± 0.85	3.74 ± 1.81

*p<0.05 ** p<0.01 ^a change in scores between 16 and 34 weeks of pregnancy ^b higher-skilled occupations managers, administrators, associate professionals & clerical; lower skilled = personal & protective services, sales, other.

N.B. Lower maternal attitude, body image, somatic symptoms & social support scores denote a more positive level of maternal adjustment

influence on working hours, although specific cases of employer leniency did allow some women who reported feeling tired to dramatically reduce their time at work. Previous work has shown that approximately one quarter of women who work during their pregnancies may report being treated differently by their employer as a result, the majority of whom report better treatment, for example being given general sympathy or being asked to do less work. (Callender et al., 1997). Of much greater significance in low-risk pregnancy however, may be the influence of maternal age, educational level and occupational type.

The fact that better-educated women in more highly skilled occupations are more likely to maintain their working hours during pregnancy than are less well educated, lower-skilled may simply reflect a greater need for these women to prepare their work for temporary cover during maternity leave. However, it is also once again suggestive of an association between a woman's occupational behaviour and her intrinsic job motivation. This factor, along with the physical activity requirements of an individual's job, have already been shown to influence the stage of pregnancy at which women decide to give up work (see section 7.2).

The absence of a significant association between the change in maternal work duration and women's pre-pregnancy occupational activity ratios suggests that the physical demands of a job may be less influential in determining the extent to which women will adapt their behaviour during the time that they remain at work. Ultimately, this finding may be an artefact of the present study incorporating only light intensity or sedentary occupations (see Chapter 5, section 5.9). However, given that less than 1% of British women may be employed in vigorous forms of employment (ADNFS, 1992), it is likely that the results described above will also extend to the wider population.

7.6 The Influence of Pregnancy on the Organisation of Work Breaks

Whilst the findings of the previous section suggested that women of higher job motivation may not markedly reduce their working hours, there nonetheless remain

several other ways in which these individuals may adapt their occupational behaviour. One change that was particularly evident in the current study for example was in the women's organisation of their lunch and coffee breaks.

The mean total duration of work breaks reported at each stage of pregnancy is given in table 7.7. Only three women reported that they did not normally take a break during their working day. Of these, two were maintaining the same behaviour pattern at 34 weeks of pregnancy. The third had incorporated rest periods into her working day from 25 weeks of pregnancy onwards.

Table 7.7: Duration of Work Breaks Taken by Full-time Employees in Pregnancy

Gestation (weeks)	Total break duration (minutes/day)		
	n ^a	Mean	S.D.
12	18	55	22
16	35	59	18
25	33	60	21
34	23	50	20
38	4	40	24

^a sample size refers to all women taking at least one work break

Twenty-two of the 25 women who were working full time at every visit between 16 and 34 weeks of pregnancy reported taking some form of work break at their first interview. Within this sample, a significant change in the mean total duration of work breaks was observed ($F(2,42)=7.20, p<0.01$). Planned pairwise comparisons showed mean total break duration at 34 weeks of pregnancy to be significantly lower than both that at 16 weeks ($t=2.59, df=21, p<0.05$) and 25 weeks of pregnancy ($3.43, df=21, p<0.01$). Ultimately however, this reduction in total work break duration was insufficient to maintain actual working hours. Even after subtracting work breaks from the total number of hours spent at work, the mean number of hours worked per week decreased with advancing pregnancy such that by 34 weeks gestation, it was significantly lower than it had been at 16 weeks gestation ($t=-2.08, df=22, p=0.05$).

Although total break duration decreased over the course of pregnancy, women's responses to the activity questionnaire revealed that break frequency had a tendency to increase. At 34 weeks gestation, 86% of women employed in full-time occupations reported that they were taking breaks more frequently throughout the working day. Moreover, almost three-quarters of these (64% of all full-time employees) indicated that this increase in work break frequency was accompanied by reduced levels of work-break activity. For example, one 31-year old laboratory technician responded:

"I take breaks whenever I feel I need to, not just at lunch-time. I used to go into town for shopping but just recently I've started staying in my department. I sit and read."

Paula (34 weeks gestation)

Earlier in pregnancy, a 27-year old customer services manager had reported a similar change in her occupational behaviour:

"I've always worked through my dinner hour but now I make sure I take it. I leave my desk so I don't have to answer the phones. I just go to the staff room and relax."

Carol (16 weeks gestation)

Whether or not this behavioural change was sufficient to affect women's working productivity during pregnancy remains unclear. Further insight into the manner by which healthy, pregnant women may manage their occupational responsibilities during the reproductive process can only be obtained by examining the nature of the activities that these individuals perform during working hours.

7.7 Physical Activity in the Workplace

Given that the primary aim of the current research is to examine how the experience of pregnancy may impact on maternal daily activity, this section focuses on the range of physical activities performed by the study sample as part of their occupational routines. Two different types of physical activities were identified: (i) fixed activities that were

inherent to the women's jobs and (ii) modifiable activities that were often supplementary to their main occupational tasks. Both of these activity types are discussed in detail below.

7.7.1 Fixed Activities

7.7.1.1 Travel to Work

The most popular method of travelling to work before pregnancy was by car. 71% of women working full-time drove themselves to work and 5% were passengers in somebody else's vehicle. 19% of full time employees typically caught the bus to work and 7% travelled on foot. These proportions varied little throughout pregnancy such that, by 25 weeks of pregnancy, 77% of women working full time were travelling by car, 17 % caught the bus and 6% walked to work. At 34 weeks of pregnancy the proportion of women using a car had increased to 95%, with 5% of employees catching a bus.

7.7.1.2 Main Workplace Posture

As part of the activity questionnaire, all employed participants were asked to rate the frequency with which they performed different activities in the workplace. These activities consisted of (i) *sitting*, (ii) *standing*, (iii) *walking*, (iv) *lifting*, (v) *carrying* and (vi) *driving*. Only two individuals indicated that they routinely carried out heavy lifting, carrying or driving tasks at 12, 16 and 25 weeks of pregnancy. Nobody performed these activities at weeks 34 or 38 weeks gestation (see section 7.7).

Throughout pregnancy, the majority of women in the sample (59-74%) reported spending at least half of their working day sitting down. This compared to 10%-28% who reported spending at least half their day walking and 10-19% who spent at least half of their day standing (figure 7.5). No significant changes occurred in the women's main working postures between 12 and 34 weeks gestation.

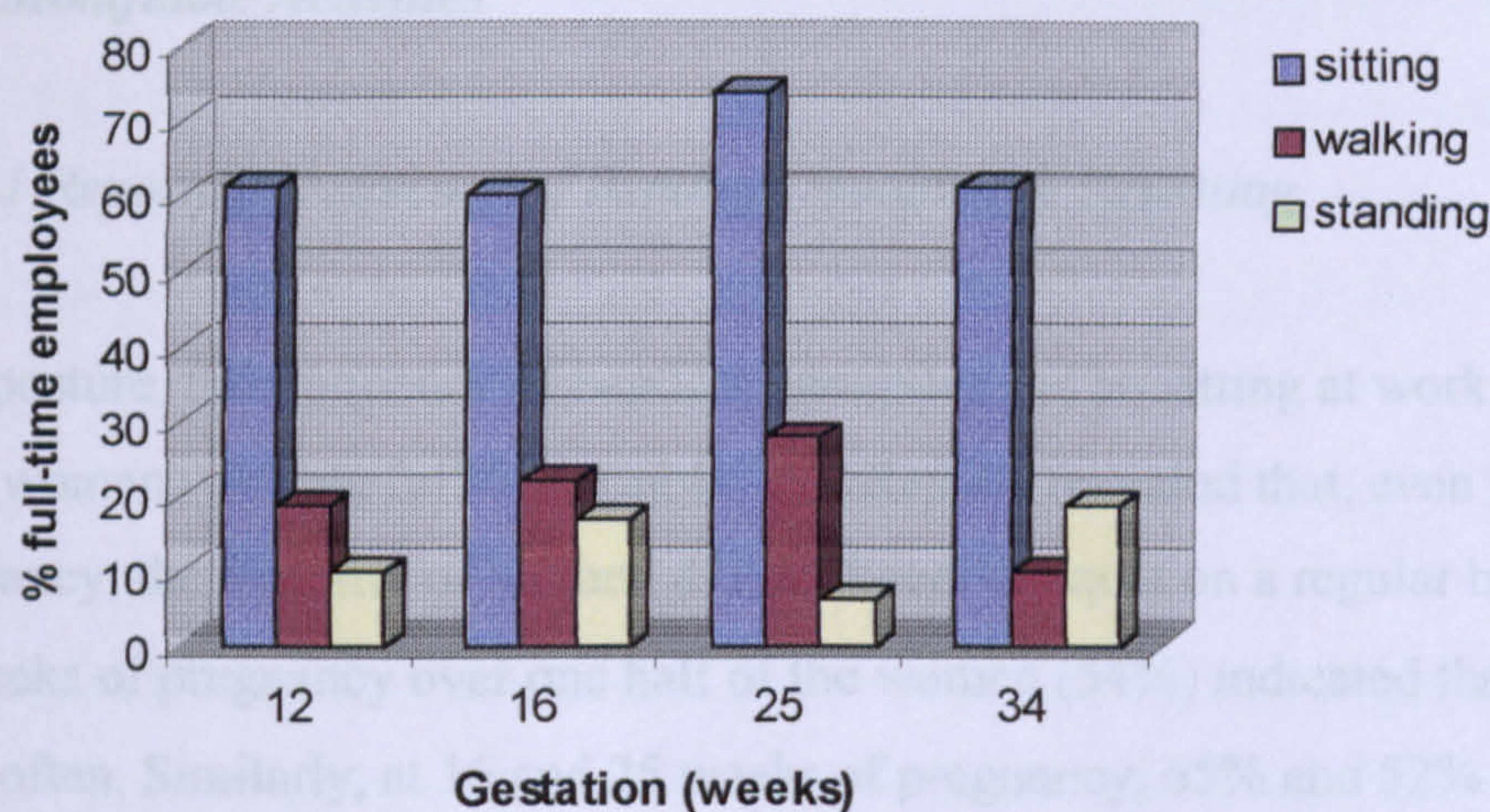


Figure 7.5: Percentage of full-time employees spending at least half of their working day in sitting, walking and standing activities.

7.7.1.3 Flights of Stairs Climbed

Respondents were also asked how many flights of stairs they climbed during the course of a working day (table 7.8). Nineteen women who were working full time at every visit between 16 and 34 weeks of pregnancy reported climbing stairs at their first interview. For many of the women, this was the only form of access to their place of work. At each visit, the number of flights of stairs climbed per day was positively skewed and at 16 and 25 weeks of gestation, two outlying scores were noted. A logarithmic transformation adequately normalised the distribution of the data and the extreme scores were no longer outliers. A repeated measures ANOVA subsequently revealed no significant differences across pregnancy in the number of flights of stairs climbed per day at the workplace.

Table 7.8: Flights of stairs Climbed in the Workplace by Pregnant Women Employed Full-time.

Gestation (weeks)	n	Flights of stairs climbed/day	
		Median	Range
12	21	5	0-24
16	41	3	0-24
25	39	4	0-26
34	26	5	0-15
38	4	3	0-10

7.7.2 Modifiable Activities

7.7.2.1 Reported Frequency of Bending, Stooping & Squatting

Like posture, the frequency of bending, stooping and squatting at work was investigated in all women working full-time (table 7.9). Results revealed that, even in early pregnancy, the majority of women did not kneel or squat on a regular basis. In contrast, at 12 weeks of pregnancy over one half of the women (54%) indicated that they had to bend quite often. Similarly, at 16 and 25 weeks of pregnancy, 65% and 52% of women respectively reported bending quite often or always. By 34 weeks however, the vast majority of women (72%) were not often or never bending.

Table 7.9: Distribution of Sample by Frequency of Bending, Kneeling & Squatting (%)

		Gestation (weeks)				
		12	16	25	34	38
n		21	41	39	26	4
Bending:	Never	8	-	3	4	-
	Not often	38	36	47	68	75
	Quite often	54	55	47	28	25
	Always	-	10	5	-	-
Kneeling:	Never	58	29	26	40	75
	Not often	21	55	50	48	25
	Quite often	21	17	21	12	-
	Always	-	-	3	-	-
Squatting:	Never	50	38	34	32	50
	Not often	42	45	58	52	25
	Quite often	8	17	8	16	25
	Always	-	-	-	-	-

The frequency with which individuals reported bending at each stage of pregnancy was subsequently condensed into two categories, '*not often or never*' and '*quite often or always*'. A Friedman test was then conducted to analyse differences between 16, 25 and 34 weeks of pregnancy. The sample for the test comprised all 25 subjects working full

time during this interval and a significant difference in bending frequency was revealed ($\chi^2_r = 8.67$, $df=2$, $p=0.01$). Wilcoxon tests performed between adjacent visits showed bending frequency at 34 weeks gestation to be significantly lower than both that at 16 weeks ($z=-2.53$, $p=0.01$) and 25 weeks gestation ($z=-2.12$, $p<0.05$).

7.7.2.2 Maternal Perceptions of Changing Occupational Activities.

Once specific occupational activities had been quantified, a more general question in the activity interview probed whether the women themselves thought their pregnancy was affecting their working behaviour. Over time a progressive increase was observed in the percentage of working women who believed that pregnancy had influenced at least one aspect of their occupational routine. At 12 weeks 68% reported that their pregnancy was directly influencing their behaviour in the work place. At 16 weeks this had risen to 71% and at 34 and 38 weeks it was 80 & 88% respectively.

At all stages of gestation, the most popular response was that the women were avoiding performing lifting or carrying tasks. Indeed, of those women who reporting changing their behaviour at 12 weeks of pregnancy, 89% stated that they were not lifting or carrying. Fifty six per cent of respondents at 16 weeks gestation, 54% at 25 weeks gestation and 43% at 34 weeks gestation gave the same response. This pattern occurred despite the fact that only 27% of employed women had previously reported that their job often or very often required them to lift heavy loads. Given that current health literature advises individuals to limit their bending activity during pregnancy, this finding suggests that many of the women in the current study had received and assimilated generalised antenatal health advice.

At 16 weeks of pregnancy, other responses included 'putting oneself before the job' (28%), not rushing around so much (12%), avoiding environmental hazards in the workplace (9%) and cutting back on driving (3%). Many of these changes remained popular throughout pregnancy. At 34 weeks gestation, 23% of women who had reported changing their behaviour in some way claimed that they were not rushing around so

much and 6% claimed they were putting oneself before the job. One 24 -year old receptionist responded:

"I'm deliberately slowing down. I'm not offering to find people or do extra now. I carry a few sheets of paper to the photocopier rather than the box and I sit down to file."

Rebecca (34 weeks gestation)

Similarly, a 31-year old technician said:

"I'm delegating lifting and manual handling and I'm only doing what I'm asked to. It's my own choice, I should do really. Other people can do the running around for now."

Paula (12 weeks gestation)

7.8 Chapter Summary

The vast majority of women in the current study continued working until late into the third trimester. Respondents in higher level occupations were more likely to work for longer during pregnancy and more likely to maintain their working hours. This influence was primarily believed to be a consequence of higher levels of job motivation within these individuals. Nonetheless, during the time that they remained at work, many individuals appeared to employ a subtle combination of behaviours in an attempt to minimise the impact of paid employment on both maternal and fetal wellbeing.

When consideration was given to the physical activities that the women performed as part of their work, no significant changes were observed in their mode of travel, their main working posture or the number of stairs that they climbed. Ultimately, these activities may be regarded as routine demands that are crucial to the performance of women's jobs. However, whilst these gross forms of physical activity are not significantly influenced, the findings of the current study suggest that other, more marginal activities may be

altered. In particular, these adaptations include increasing the frequency of rest periods and limiting or adapting certain occupational tasks.

Bending provided a specific example of an occupational activity that was adapted during pregnancy. In part at least, the reduction that was observed in women's bending frequency is likely to reflect a simple ergonomic response to an increasing abdominal mass (Nicholls & Grieve, 1992). However, one must also acknowledge the possibility that a reduction in self-reported bending frequency may just as easily reflect an underlying awareness of current antenatal health advice. This issue is discussed again in Chapters 9 & 11.

At present, the extent to which the observed changes in occupational activity may reflect genuine behavioural changes rather than a mere reporting of antenatal health advice remains unclear. However, since the vast majority of advice that is currently available relates purely to strenuous activities (such as heavy lifting) rather than to more sedentary tasks (such as filing), it is likely that the study participants were at least reporting genuine changes in their light intensity activities. Likewise, the observed increase in work break frequency, and the reduction of physical activity undertaken during this time, are both more likely to reflect genuine maternal adaptations than the mere assimilation of health advice. Nevertheless, to understand more about the way in which low-risk pregnancy may impact on maternal activity behaviour it is necessary to look beyond the occupational domain, towards women's domestic and recreational behaviours.

CHAPTER EIGHT

The Impact of Low-Risk Pregnancy on the Self-reported Domestic, Recreational and Nocturnal Activity Patterns of British Nulliparous Women

8.1 Introduction

The previous chapter established that the mean occupational activity levels of healthy British nulliparous women decrease steadily over the course of low risk pregnancy, a trend which contrasts with the pattern of change that these women experience in their total daily activity levels (see Chapter 6). This finding indicates that pregnancy may have a differential impact on maternal behaviour in different physical activity domains. The present chapter investigates three aspects of women's non-occupational activity, namely domestic chores, recreational pursuits and nocturnal resting. All of these behaviours contribute to maternal daily activity levels (Booth, 2000; Magann, 1996) and thus demand attention.

The activity questionnaire enabled a large amount of detailed information to be collected on a number of domestic, recreational and nocturnal activities. For clarity, the present chapter is divided into three main parts. *Part One* examines the main characteristics of maternal domestic activities. In this section, household chores, grocery shopping, gardening, DIY and caring activities are all investigated. *Part Two* focuses on maternal recreational behaviour and explores levels of participation in structured sports and exercise, unstructured exercise and social activities. Finally, in *Part Three*, nocturnal behaviour patterns are examined. Longitudinal trends in sleep duration, the number of nocturnal awakenings and maternal self-reported sleep quality are discussed. Together, the findings presented in this chapter clarify the extent to which different aspects of daily activity behaviour may change during the course of low-risk pregnancy.

8.2 Statistical Analyses

Quantitative data were analysed using the Statistical Package for the Social Sciences 9.0 (SPSS Inc., Chicago). All data are reported as mean (S.D.), median (range) or as percentages. Relationships between maternal activity and independent variables were assessed using independent sample t-test or Mann-Whitney-U test for dichotomous variables, one way ANOVAs or Chi-square tests for categorical variables and Pearson's correlation or Spearman's Rank correlation coefficients for continuous variables. Longitudinal trends in non-occupational activity were assessed using repeated measures ANOVAs or Friedman's tests. All tests were two tailed. Qualitative data were analysed by sorting verbatim material into emergent themes as described by Dey (1993).

PART ONE

8.3 Maternal Self-Reported Domestic Activity

8.3.1 *The Performance of Household Tasks*

All of the women in the study sample reported that they were primarily responsible for housework prior to becoming pregnant and no individuals ceased performing domestic tasks for the entire length of their pregnancy. At each visit the majority of women (91-98%) were carrying out some form of household work (table 8.1).

The activity questionnaire was designed to estimate the amount of time that the pregnant women dedicated each week to (i) heavy housework (e.g. vigorous hoovering, carrying heavy rubbish bags) and (ii) light household tasks (e.g. tidying up, dusting). At each stage of pregnancy, the number of days a week on which women performed heavy household work was positively skewed and the number of days on which they performed light household work was negatively skewed. Throughout pregnancy, the number of minutes of housework done per day and the total minutes of housework done per week were positively skewed for both variables. At 12 weeks gestation, one individual reported

carrying out 5 hours of heavy work per day for three days out of seven, a total of 15 hours of heavy housework per week. On the basis of other scores, this respondent was considered an extreme outlier and excluded from the analyses.

Table 8.1: Frequency of Performing Household Tasks Across Pregnancy. Figures are median (range).

		Gestation (weeks)				
		12	16	25	34	38
Heavy Household Tasks	n	9	19	22	24	25
	% ^a	30	33	39	42	49
	Days/week	2 (1-5)	2 (1-7)	2 (1-4)	1.5 (1-7)	1 (1-5)
	Mins/day	45 (15-180)	40 (10-180)	60 (5-240)	60 (5-240)	60 (15-300)
	Mins/week	75 (15-240)	60 (10-540)	120 (5-480)	120 (15-480)	120 (30-750)
Light Household Tasks	n	28	53	52	52	50
	% ^a	93	93	91	91	98
	Days/week	7 (1-7)	7 (1-7)	6.5 (1-7)	6 (1-7)	7 (2-7)
	Mins/day	37.5 (5-240)	60 (10-240)	52.2 (10-180)	60 (15-150)	60 (5-180)
	Mins/week	210 (15-840)	240 (30-900)	210 (30-1050)	240 (30-1050)	330 (15-1050)

^a% of total sample

As table 8.1 illustrates, the total amount of time that women reported spending on household work each week was relatively high. It is possible that the participants involvement in household activities was raised simply as result of the interviewer arranging to visit them at their home address. Nonetheless, a cross country comparison of female time allocation has previously documented that women spend an average of between 27 and 34 hours a week on housework (Juster & Stafford, 1991). Likewise Ainsworth (2000) suggests that the mean time currently spent on household tasks by Western women approximates to 120 minutes per day. The figures obtained in the current study can therefore be considered comparable.

8.3.2 Changes in Household Work During Low-Risk Pregnancy

Changes in the total amount of housework undertaken at the different stages of pregnancy were analysed by pairwise comparisons. Zero values were excluded and logarithmic transformations used to normalise the distribution of the data. Between 12 and 34 weeks gestation, no significant differences were observed in the mean amount of time spent on

housework each week. However, between 34 and 38 weeks gestation, the mean amount of time spent in light housework increased significantly ($t = -2.08$, $d.f. = 44$, $p < 0.05$) whilst the mean amount of time spent in heavy housework decreased ($t = 3.27$, $d.f. = 24$, $p < 0.01$).

8.3.2.1. Maternal Perceptions of Changes in Housework

Despite the fact that the mean amount of time that the sample reported spending on household duties did not change significantly until late into the third trimester, a different item in the activity questionnaire suggested that some women may have altered their domestic activity levels much earlier in pregnancy (figure 8.1). Whilst over half the sample (53%) reported doing their usual amount of housework at 12 and 16 weeks gestation, approximately two fifths of respondents reported that they were doing less.

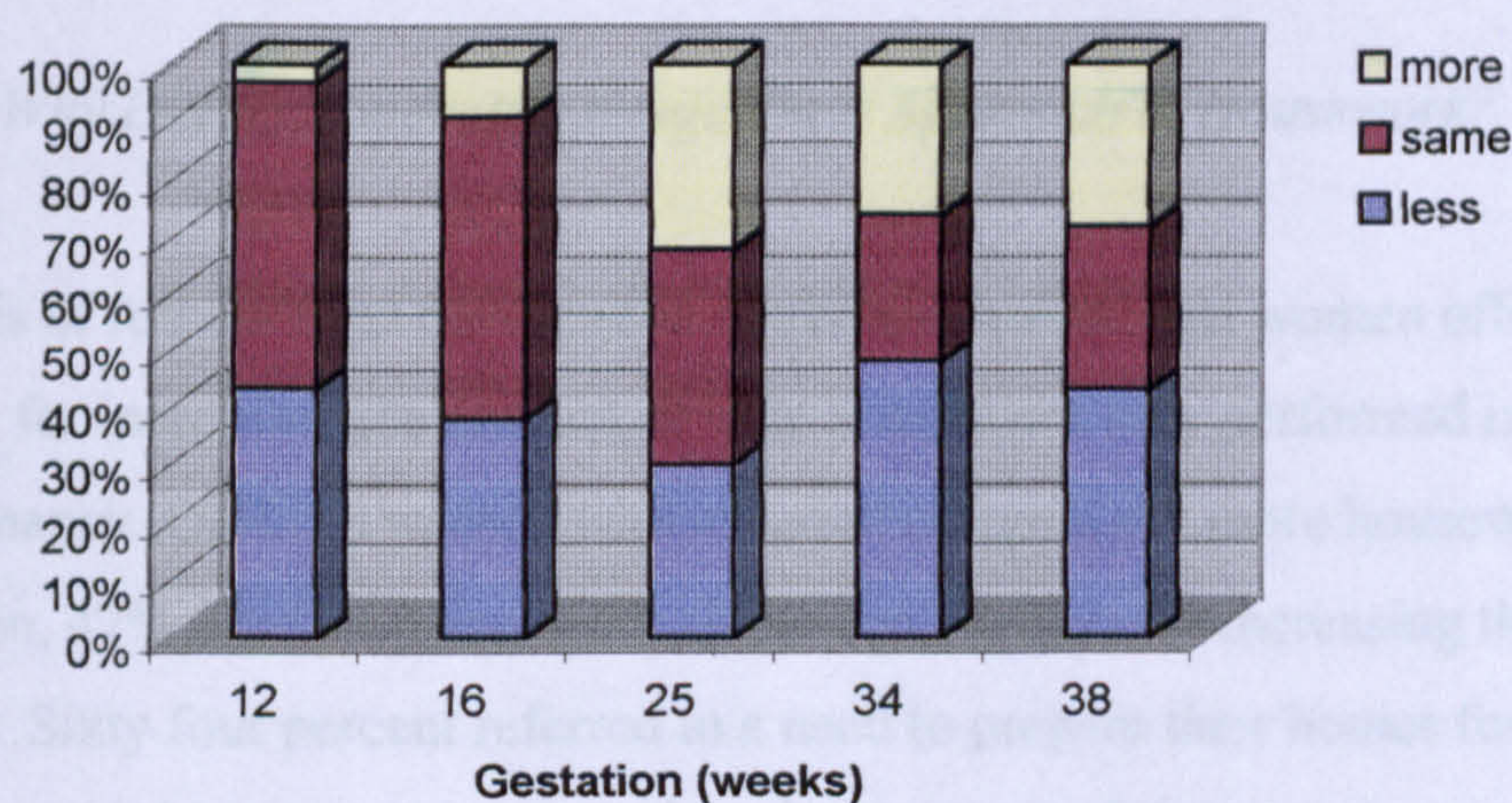


Figure 8.1: Amount of household work reported through low risk pregnancy (relative to pre-pregnancy behaviour)

The sociodemographic, psychosocial and pregnancy-related characteristics of the women who reported changing the amount of housework they performed were compared to those of the women who did not report such changes. At 12 weeks gestation, those who reported doing less housework than normal scored significantly higher on the somatic sub-scale of the MAMA questionnaire than those who reported doing the same amount or

more ($t=2.42$, $df=28$, $p<0.05$). Similarly, at 25 weeks gestation, those who reported doing less housework than normal had gained significantly more weight ($t=2.60$, $df=33$, $p<0.05$) and scored significantly higher on the MAMA somatic sub-scale ($t=2.38$, $df=33$, $p<0.05$) than those who reported doing more. Women who reported doing less housework at 25 weeks gestation also demonstrated a less positive maternal attitude than women who reported doing the same amount or more ($t=2.91$, $df=55$, $p<0.01$).

At 34 and 38 weeks gestation many women continued to report that they were performing less housework than normal. However, 26% and 28% of the sample respectively reported that they were doing more. Compared to women who reported carrying out the same amount of housework or less, women who reported doing more housework at 38 weeks gestation demonstrated a significantly higher level of perceived social support ($t=2.34$, $df=49$, $p<0.05$). Once again, there was also a trend for these women to demonstrate a more positive maternal attitude ($p<0.08$).

8.3.2.2 *Why Did Respondents Change Their Approach to Housework?*

Analysis of responses to open-ended questions showed that women offered two main reasons for increasing the amount of light housework they performed in the latter stages of pregnancy. Of those women who reported carrying out more housework at 38 weeks gestation, 47% cited stopping work as the main reason for increasing their domestic activity. Sixty four percent referred to a need to prepare their homes for the new baby. One 24-year old secretary reported how her housework increased as soon as she left employment:

"I'm not at work now so I've done a lot more housework. It's all I've got to do. I'm even doing my partner's share. It's not fair for him to do it when I'm here all the time"

Michelle (38 weeks gestation)

Likewise, giving up her job as a sales representative allowed another individual to be more active at home:

“I’m doing twice as much housework. I’ve gone mad now I’ve got the time. I want the house to be really clean and tidy, hygienic. Since stopping work I’ve paid attention to the smallest bits of dust!”

Carol (38 weeks gestation)

8.3.2.3 Taking a Break from Household Work

As well as changing the amount of housework that they performed, many respondents also reported that their general approach to household work had altered. As pregnancy progressed, the percentage of women who reported that they never or rarely took a break from their household work steadily declined (Table 8.2).

Table 8.2: Housework Rest Frequency in Low-Risk Pregnancy

	Gestation (weeks)				
	12	16	25	34	38
n	30	57	57	57	51
Rest frequency					
% Never/Not often	50	47	32	15	16
% Sometimes	17	18	27	36	34
% Most times	13	7	14	21	22
% Always	20	27	27	28	28

All women who reported that they sometimes, mostly or always took a break were asked whether this pattern of work and rest was typical of their normal approach to housework. At 34 and 38 weeks of pregnancy, the vast majority of women (82 and 81% respectively) indicated that it was not. One 27-year old responded:

“I take breaks from my housework now. I never used to. I always did it until it was done before. Now I need to rest. I watch some telly, or have a drink then I start again.”

Olivia (34 weeks gestation)

Similarly, a 28-year old woman replied:

"I need to do my housework or it'll never get done, but I can't do it like I used to. I used to do it all in one day, now I space it out more. I do bit here and a bit there. It gets done just the same only it takes much longer."

Tracy (38 weeks gestation)

8.3.3 Summary: The Performance of Household Tasks

In summary, the performance of household tasks appeared to play an important role in the daily activity levels of the study participants. The levels of housework that the women reported were found to be comparable to those of other Western women, and the vast majority of respondents continued to perform such activities until late into the third trimester.

However, the present study provided some evidence to suggest that the women were changing their behaviour as pregnancy progressed. The main factor that caused women to report reduced levels of housework in the earlier stages of pregnancy was physical discomfort. Somatic symptoms and gestational weight gain were found to influence the amount of housework performed between 12 and 25 weeks gestation. Later in pregnancy, heavy housework in particular was found to decrease. In contrast, self-reported levels of lighter housework significantly increased. A similar finding has been documented previously. In a study of sedentary Dutch women, Van Raaij et al. (1990) reported that the amount of time spent on light and moderate household activities increased significantly during the third trimester.

The increase in light household work that was observed in the current study was found to be a consequence of participants giving up paid employment and preparing their homes for the arrival of a new family member. Factors that were found to influence maternal behaviour at this time were perceived levels of social support and, to a lesser extent, maternal attitude. As Wolkind & Zajicek (1981) state, pregnancy serves to separate most

women from their career interests, prompting them to assume a nurturing role within the home. It is therefore not surprising to find that pregnant women with a more positive attitude towards motherhood may stop paid work earlier (see chapter 7, section 7.3) and increase the amount of housework that they perform in later pregnancy.

The association between increased levels of housework and maternal perceptions of available social support is an interesting finding. Wheatley (1998) has recently suggested a link between the levels of emotional and practical support that the women receive and the amount to which they feel they must reciprocate this support. The findings of the current study suggest that the performance of household chores may represent one way in which such reciprocation of support can be achieved, particularly when women are no longer working in paid employment. Certainly, Brines (1994) suggests that women's economic dependency on their husbands will often lead to them allocating more time to domestic work within the home. This relationship manifests in a negative association between the women's proportion of family earnings and the number of hours of housework they perform per week. Within the present study, perceptions of 'household fairness' were included in women's explanations of their behaviour.

The participants' ability to continue light household tasks until late into the third trimester was aided by the fact that, having given up work, women had more time available to them in which to complete their domestic chores. This meant that they could freely adapt their work-to-rest ratios. Eight in ten women reported increasing the frequency with which they took breaks from their household chores at 38 weeks gestation. This behavioural adaptation closely reflected one of the changes that occurred in women's occupational activity (see Chapter 7, section 7.6).

Domestic activity however is not solely confined to work within the home. For example, Schor (1992) reports that household and family care activities may include both indoor and outdoor, chores caring for children, obtaining goods and services and other miscellaneous activities. Thus, to understand the full impact of pregnancy on maternal domestic activity, these tasks were also considered.

8.4 Grocery Shopping

At each visit, a series of questions asked how frequently women went shopping for food and household goods in the 7 days prior to interview. Table 8.3 shows the distributions of responses at the five stages of pregnancy. No significant changes in either shopping frequency or total weekly shopping time were observed.

Table 8.3: Distribution of Sample by Shopping Frequency and Duration

Gestation (weeks)	% Shopping					Total weekly shopping duration ^a (mins)		
	n	< once / week	once / week	2-4 times / week	5-7 times / week	n	Median	(range)
12	30	20	43	33	3	25	60	(30-300)
16	57	18	44	35	4	49	90	(15-180)
25	57	9	58	33	-	48	90	(30-210)
34	57	5	47	42	5	52	90	(30-300)
38	51	8	59	34	2	44	60	(20-360)

^a Women shopping at least once a week

Despite these findings, responses suggested that some subtle changes to shopping activity had been made. All women were asked whether their current approach to shopping was typical of their normal behaviour. Between 12 and 25 weeks of pregnancy the vast majority of individuals (86%-98%) responded that it was. By 34 and 38 weeks of pregnancy this proportion had decreased to 79% and 74% respectively.

At 34 weeks gestation, those who claimed that their approach to shopping had changed highlighted five main ways in which it had done so. 59% indicated that they were making smaller shopping trips, 25% revealed a reduced tendency to shop alone, 8% reported that they currently let others go shopping for them and 8% revealed a tendency to drive or take public transport rather than walk. Most women focused on only one main change. As one 32-year old participant explained:

"I don't buy so much anymore. I don't buy all the extra things, just what we need. It's easier to manage that way."

Helen (34 weeks gestation)

Similarly at 38 weeks gestation, 31% referred to the fact that they were no longer going shopping alone. Another 31% stated they were letting others go shopping for them, 23% had increased the frequency with which they went shopping and 15% indicated that they were driving rather than walking to the supermarket. A desire to go shopping with somebody else was voiced by one 28-year old woman:

“I normally go by myself but the thought of pushing a heavy trolley and lifting the bags made me ask my partner for help.”

Claire (38 weeks gestation)

8.5 Other Domestic Activities

As well as being concerned with housework and shopping tasks, domestic activity can also incorporate gardening, D.I.Y. and adult- or child-centred care. No individuals in the current study were involved in adult-centred care and, at any one time, no more than 9 women were involved in child-centred care. Similarly, no more than one quarter of the sample engaged in gardening activities or D.I.Y. at any stage of pregnancy (table 8.4).

Table 8.4: Participation in Gardening & D.I.Y. During Low-Risk Pregnancy. Figures are median (range).

Gestation (weeks)	Gardening			D.I.Y.		
	n	% of sample	Mins / week	N	% of sample	Mins / week
12	5	17	30 (20-60)	3	10	180 (30-720)
16	9	16	35 (15-600)	6	11	210 (60-360)
25	15	24	120 (10-720)	11	19	300 (30-720)
34	13	23	60 (30-210)	8	14	420 (120-1260)
38	14	25	50 (10-135)	11	22	120 (5-720)

8.5.1 Gardening Activities

At each visit a greater proportion of women performed light gardening tasks (16-25%) than performed heavy gardening tasks (7-14%). However because of the sporadic nature with which gardening activity was performed in the current study, a statistical analysis of

the changes across pregnancy was not possible. This accepted, an open-ended question in the activity questionnaire did probe whether or not the women thought their pregnancy was influencing the type of gardening they were doing. 21 out of 57 individuals (39%) stated that irrespective of their pregnancy they were simply not interested in gardening. Table 8.5 presents the frequency and extent to which pregnancy influenced gardening behaviour in the 61% who did express some interest.

Table 8.5: Extent to Which Pregnancy Influenced Maternal Gardening Activity

	Gestation (weeks)				
	12	16	25	34	38
No. of subjects:					
with gardening interest	19	36	36	36	35
performing gardening that week	5	10	16	13	14
avoiding gardening because of pregnancy	7 (37)	6 (17)	6 (17)	8 (22)	4 (11)
changing gardening because of pregnancy	4 (21)	6 (17)	14 (39)	8 (22)	12 (34)

Brackets refer to % of those with gardening interest

At any one stage of pregnancy, between 34 and 58% of gardeners reported that their pregnancy had either totally prevented them from engaging in gardening activities or had affected the manner by which they had done so. Throughout pregnancy, the most popular reason for this claim was that women were reluctant to perform digging, mowing or other similar tasks perceived to require heavy effort. Indeed, out of the 11 women who reporting changing their gardening behaviour at 12 weeks gestation, 8 (73%) stated that they were avoiding any strenuous gardening work. Sixty seven per cent of gardeners at 16 weeks, 70% at 25 weeks and 100% at 34 weeks gestation gave the same response. One 29 year-old woman explained:

"I should really be keeping the garden tidy but everything I need to do is a big job. It's all digging or mowing and I don't think I can manage that."

Angela (25 weeks gestation)

At 16 weeks of pregnancy, 2 individuals reported that they had also stopped weeding, 1 individual was deliberately allowing herself more time to complete her work and 2

individuals expressed an unwillingness to garden without wearing gloves. These changes were maintained throughout pregnancy such that at 38 weeks gestation, 12 individuals reported avoiding strenuous work, 2 individuals reported not weeding and 2 individuals expressed concerns regarding cat faeces. As one 27-year old responded:

“I would normally be blitzing if I wasn’t pregnant but I’m not doing any grass cutting and I’m definitely not going to dig.”

Zoe (38 weeks gestation)

8.5.2 D.I.Y. Activities

Like gardening, D.I.Y. was rarely undertaken on a regular basis. One participant reporting performing D.I.Y. on 4 out of five occasions whilst another reporting such activities on 3 occasions. A further six subjects reported performing DIY work on two occasions and 20 subjects on 1 occasion only. At all visits, the majority of women reported that pregnancy was not affecting the amount of DIY they did. For some women however, specific changes had been made. In particular, concerns were raised about tasks that involved stretching, lifting or balancing. Along with bending, these activities are often discouraged in antenatal literature.

Over the course of pregnancy, 4 individuals had avoided painting and decorating work because they did not want to inhale fumes and 6 individuals had avoided climbing ladders for fear of falling. One 32-year old homemaker expressed her concern in the following way:

“I haven’t done any heavy jobs or painting. I don’t want to have to balance, especially when I’m in the house alone.”

Joanne (25 weeks gestation)

Later in pregnancy, a 25-year old woman stated:

“We’re painting the spare room but I just hold the tools. It’s difficult for me to do much now I’m big and anyway, it’s too dangerous.”

Elizabeth (34 weeks gestation)

8.5.3 Summary: Other Domestic Activities

Analysis of data relating to participants’ shopping, gardening and D.I.Y. behaviour suggests that pregnant women may make a number of small changes to their domestic behaviour. Ultimately, these adaptations occur whenever the physical experience of pregnancy hampers activities or where the women concerned perceived some form of risk. Barriers to pregnant women’s physical activity participation are considered in more detail in Chapter 9. Of interest here, is whether or not these subtle adaptations were sufficient to reduce women’s overall levels of domestic activity.

8.6 Self-Reported Domestic Activity Ratios

From information collected in the activity questionnaire, an overall home activity ratio could be computed. For each individual, this score took into account activity associated with housework and shopping, gardening, DIY, adult-centred care, childcare and the number of stairs climbed at home. Two subjects who scored zero at one or more visit were omitted from the analysis. A third subject who scored exceptionally high on four of the five visits was also excluded.

Table 8.6: Self-reported Domestic Activity Ratios across Low Risk Pregnancy

Gestation (weeks)	n	Total Domestic Activity Ratio (METS)			
		Mean	S.D.	Minimum	Maximum
12	29	2.69	0.34	1.90	3.42
16	54	2.87	0.43	1.92	4.00
25	54	2.91	0.47	2.25	4.28
34	54	2.89	0.48	2.14	3.93
38	48	2.83	0.38	2.32	3.82

8.6.1 Longitudinal Trends in Maternal Domestic Activity Ratios

To assess longitudinal trends in maternal domestic activity ratios, consideration was first limited to the 48 women who provided scores at all four visits between 16 and 38 weeks gestation (figure 8.2). Although a slight decline was observed in mean domestic activity ratios between 34 and 38 weeks gestation, this difference was not statistically significant.

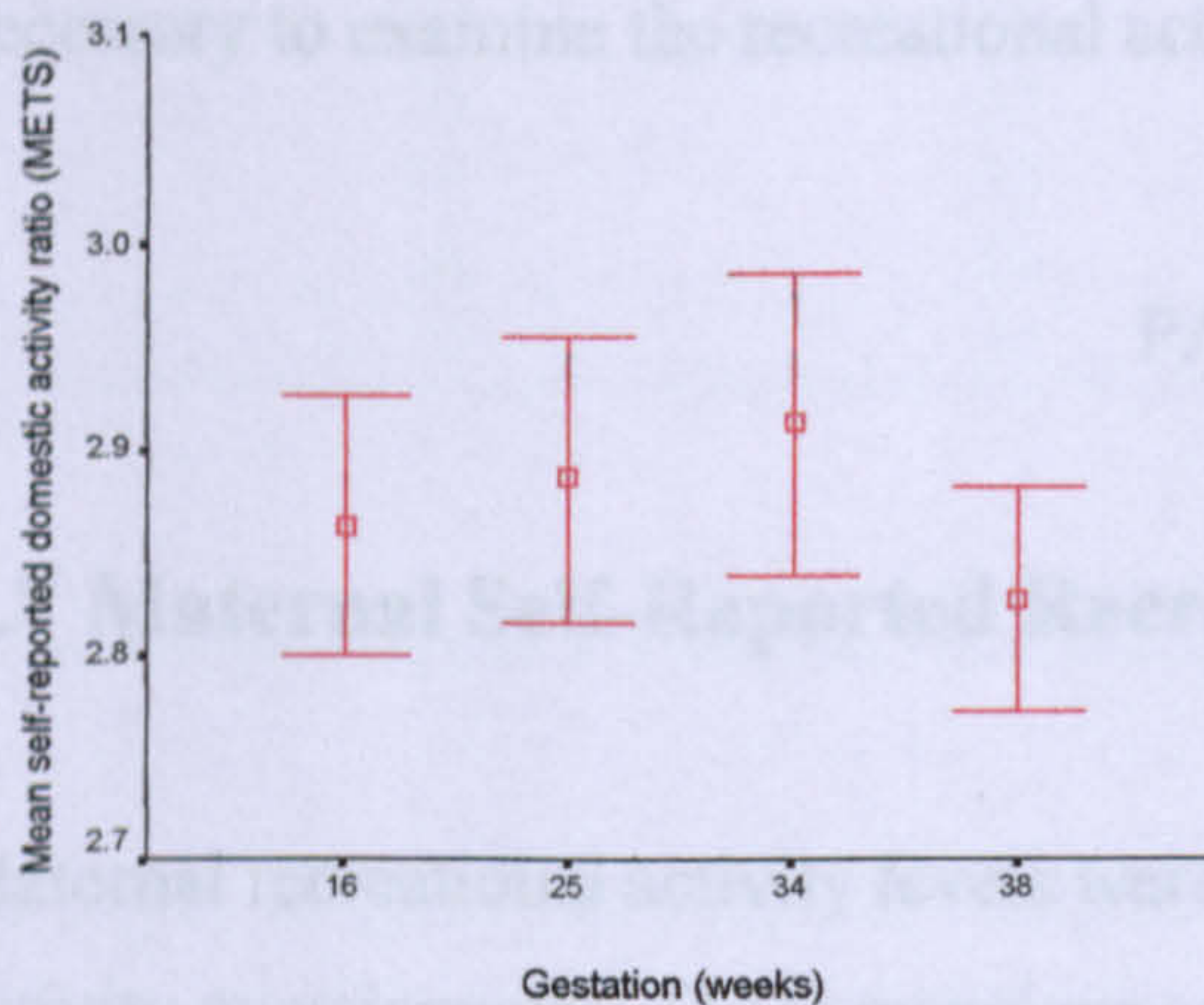


Figure 8.2: Mean (± 1 S.E.) self reported domestic activity ratio across low risk pregnancy (n=48)

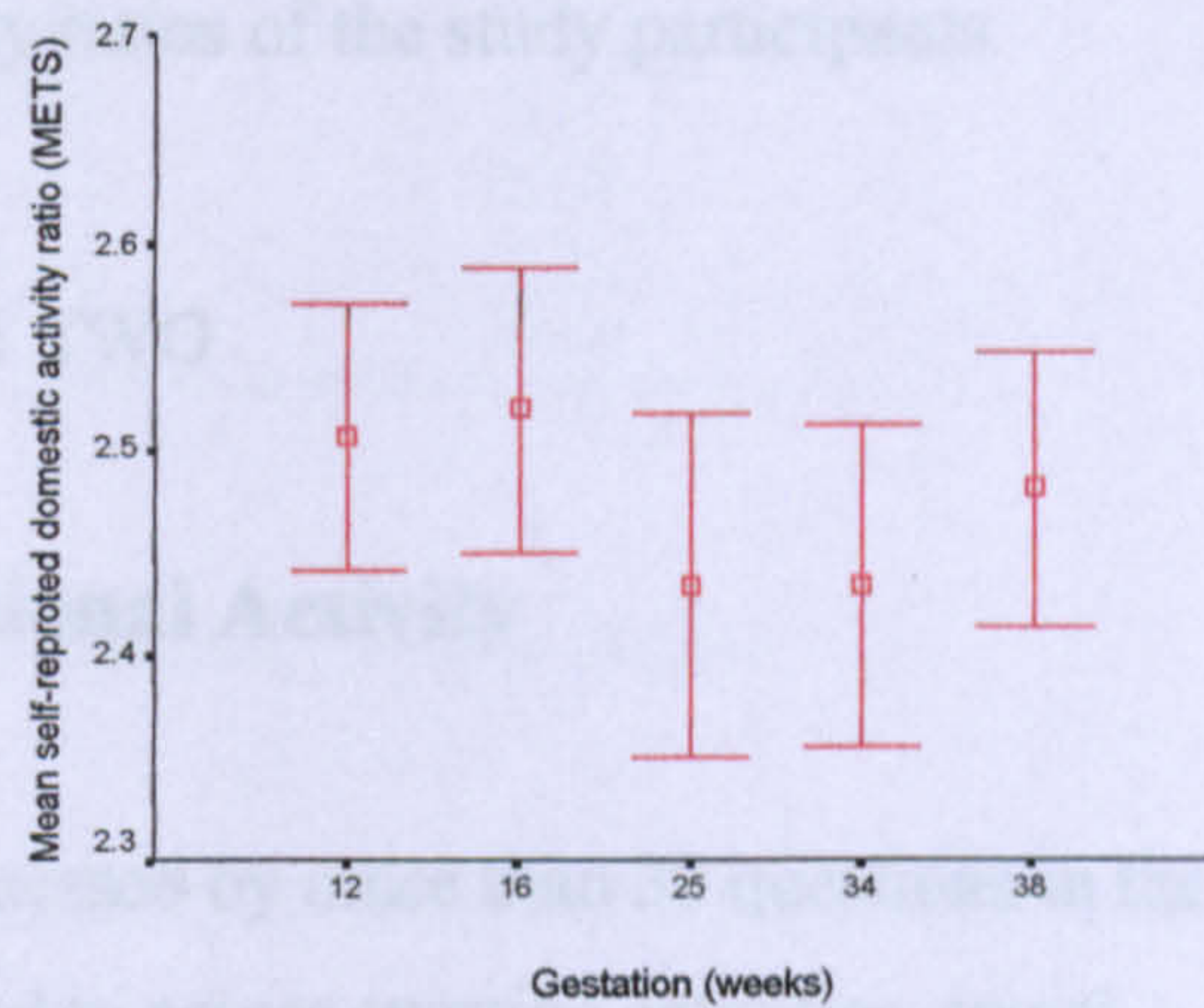


Figure 8.3: Mean (± 1 S.E.) self reported domestic activity ratio across low risk pregnancy (n=28).

Twenty eight of the 48 women also provided data at 12 weeks gestation. In this smaller sample, mean domestic activity ratios were lower at 25 and 34 weeks gestation and higher at 12, 16 and 38 weeks gestation (Figure 8.3). However, a repeated measures ANOVA once again revealed that these differences were not statistically significant. The results of the current study therefore suggest that mean levels of maternal domestic activity are unlikely to change significantly over the course of low-risk pregnancy.

The tendency for levels of maternal domestic activity to be maintained during pregnancy contrasts sharply with the decline that was observed in the participants' occupational activity levels (see chapter 7, section 7.4). This difference is likely to result from differences in the level of control that women can exert over the two activity domains. Within the home environment, women will undoubtedly have more influence over the

amount, the nature and the timing of the activities that they choose to perform. Given that activity pacing has already been identified as an important adaptation during pregnancy, such freedom may ultimately enable individuals to regulate their activities better and thus maintain their levels of performance within the domestic domain. This possibility raises interesting questions with regard to other forms of non-occupational behaviour. Is for example, maternal recreational activity maintained during pregnancy, or does this also decline in the same way that occupational activity does? To answer this question it is necessary to examine the recreational activity ratios of the study participants.

PART TWO

8.7 Maternal Self-Reported Recreational Activity

Maternal recreational activity levels were assessed by more than 30 questions in the activity questionnaire. These questions served to assess sporting activities, social activities and home-based leisure activities. Each activity was scored according the method of Ainsworth et al. (1993), and a recreational activity ratio obtained by dividing the sum of the total energy expended by the length of time over which it occurred.

8.7.1 Total Recreational Activity Ratios

On the basis of her total recreational activity ratio, one active individual was noted as an outlier at 16 weeks gestation (2.68 METS) whilst another was identified as an outlier at 25 weeks gestation (2.62 METS). Both women were excluded from subsequent analyses. Mean recreational activity ratios at each stage of pregnancy for the remaining cases are presented in table 8.7.

In accordance with the impression given by the pre-pregnancy data, mean self-reported recreational activity ratios revealed a primarily sedentary population. Once outliers were excluded, mean self-reported recreational activity ratios ranged from 1.42 (S.D. 0.25) METS to 1.52 (S.D. 0.24) METS. From the scoring system of Ainsworth et al. (1993), an

individual who spent her free time watching television would score a recreational activity ratio of 1.00 MET whilst a woman who spent her free time sitting and talking would score a recreational activity ratio of 1.5 METS.

Table 8.7: Self reported Recreational Activity Ratios Through Low Risk Pregnancy

Stage of pregnancy (weeks)	n	Recreational Activity Ratio (METS)	
		Mean	S.D.
12	28	1.42	0.25
16	55	1.48	0.22
25	55	1.52	0.24
34	55	1.47	0.22
38	50	1.42	0.18

8.7.2 Longitudinal Trends in Maternal Recreational Activity Ratios

To assess longitudinal trends in recreational activity ratios, consideration was limited to those women who provided data at all stages of gestation. Figure 8.4 shows mean self-reported recreational activity ratios as a function of advancing pregnancy for the 50 participants completing every visit between 16 and 38 weeks gestation. Mean recreational activity ratios can be seen to peak at 25 weeks gestation. A repeated measures ANOVA was performed and a significant difference in mean self-reported recreational activity ratios revealed ($F(3,147) = 2.90, p<0.05$). Pairwise comparison tests with a multistage Bonferroni adjustment subsequently showed mean recreational activity ratio at 38 weeks gestation to be significantly lower than at 25 weeks of pregnancy ($t=2.78, df=49, p<0.05$).

Of the 50 women included in the above analysis, 27 also provided data at 12 weeks gestation (figure 8.5). Despite the inclusion of an extra data point, mean recreational activity ratios once again peaked at 25 weeks gestation. Mean recreational activity ratio at 38 weeks gestation was significantly lower than at 25 weeks gestation ($t=2.26, df=26, p<0.05$).

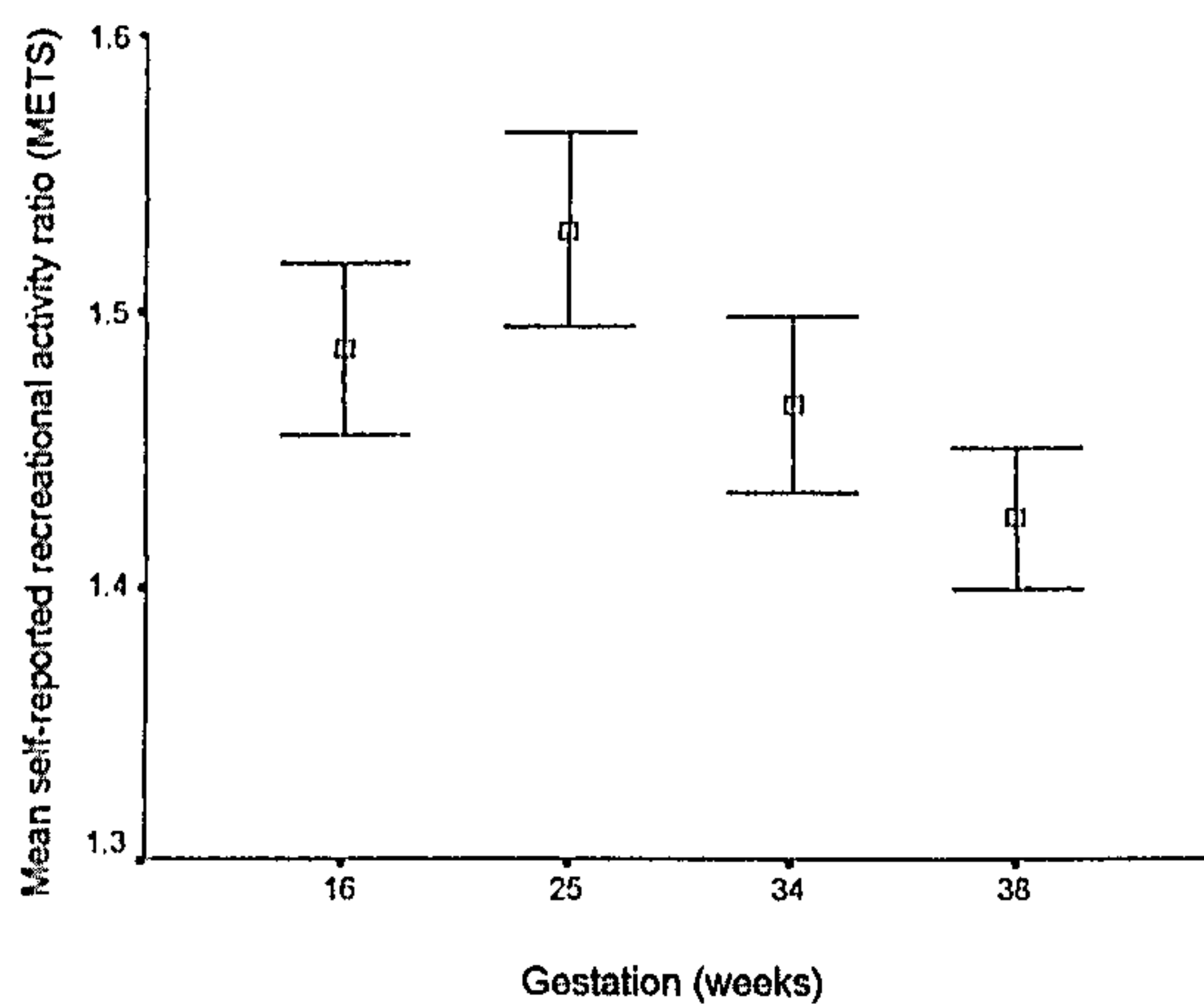


Figure 8.4: Mean self-reported recreational activity ratio (± 1 S.E.) as a function of advancing pregnancy (n=50)

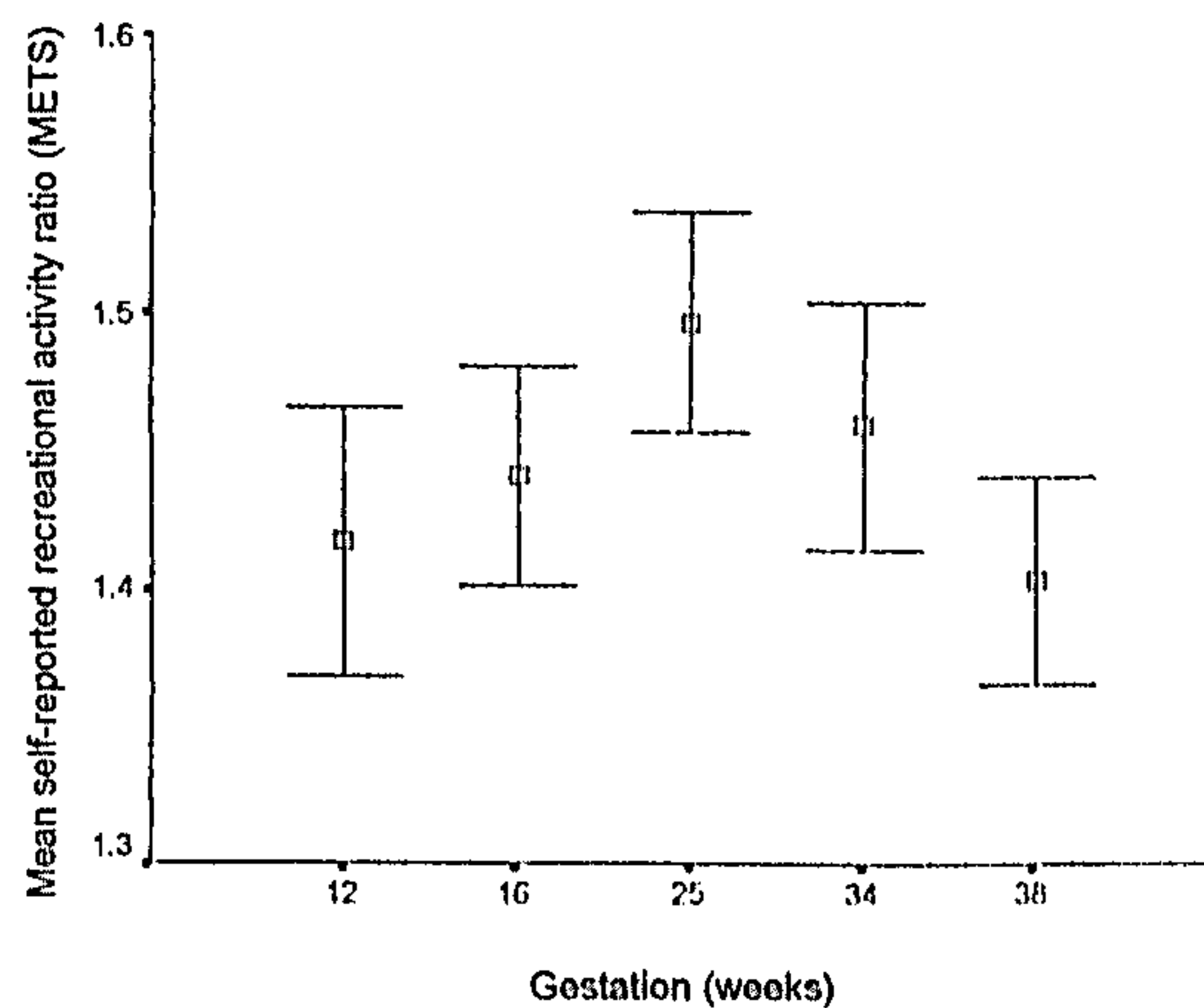


Figure 8.5: Mean self-reported recreational activity ratio (± 1 S.E.) as a function of advancing pregnancy (n=27)

The decline in mean self-reported recreational activity ratios between 25 and 38 weeks gestation suggests that, unlike domestic activity levels, recreational behaviour patterns were not maintained through pregnancy. To examine the reasons for this, it is necessary to consider in detail the women's behaviour patterns within this domain.

8.7.3 Structured Sports & Exercise Pursuits

In the current study, participation in structured sport and exercise was low. 39% of women who reported participating in some form of weekly exercise or sports activities outside the home before becoming pregnant did not report pursuing similar activities at any time during their pregnancy. 31% reported participating in such activities on one occasion during pregnancy, 19% on two occasions and 11% on three or more. Table 8.8 displays the range of activities that were pursued and the small number of individuals performing each one at the five different stages of pregnancy.

Table 8.8: Sporting Activities Pursued During Low Risk Pregnancy (n)

Activity	Level	Gestation (weeks)				
		12	16	25	34	38
Keep fit	High Impact	-	1	-	-	-
	Low impact	-	2	2	-	3
Yoga	-	-		4	2	2
Swimming	Fast laps	-	1	2	2	-
	Slow laps	2	2	3	4	1
	Leisure	-	6	5	3	4
Water aerobics	-	-	1	1	3	2
Gym	-	-	2	1	-	-
Tennis	Social	-	-	1	-	-
Badminton	Social	-	1	-	-	-
Ballet	-	-	1	1	-	-
Modern Dance	-	-	1	1	-	-

8.7.3.1 Why Did Women Stop Participating in Structured Sports and Exercise?

When asked why they had stopped participating in such activities the vast majority of women (63% of habitual exercisers) referred to a physical limitation. Thirty two per cent referred to risks or dangers that they believed to be associated with strenuous activities whilst 5% referred to difficulties in finding a suitable facility or area in which to exercise. One 28 year old said:

“I’ve stopped going to the gym because I’ve been tired and sick. I’ve cancelled my membership.”

Catherine (16 weeks gestation)

A different respondent explained:

“I’ve stopped line-dancing to be careful. I’m not swimming either, I don’t want to be kicked.”

Anna (25 weeks gestation)

Compared to those who stopped all sporting activities during pregnancy, those who participated in some form of weekly exercise or sports activities on two occasions or more were significantly more active prior to pregnancy ($t=-2.17$, $df=22$, $p<0.05$) and significantly more active in terms of habitual sporting activity ($t=-2.32$, $df=22$, $p<0.05$). They also scored significantly lower on the internal dimension of the FHLC scale ($t=3.60$, $df=22$, $p<0.01$). These findings suggest that women's participation in structured sporting activities during pregnancy may ultimately depend upon an interaction between a previous level of exercise commitment or enjoyment, the perceived effort involved in an activity and perceptions of the extent to which such behaviour may impact on fetal wellbeing.

8.7.4 Unstructured Sports & Exercise Pursuits

As well as probing participation in structured sports, the activity questionnaire also investigated respondents' participation in other forms of exercise. Specific activities that were mentioned in the questionnaire included walking, cycling and running. Only two individuals reported cycling during pregnancy and one reported running. In contrast, walking was a much more popular activity. Only 9 individuals (16% of the sample) reported that they had never walked for pleasure during the course of the study.

Table 8.9: Frequency & Total Duration of Walking During Low Risk Pregnancy. Data are median (range)

Walk length		Gestation (weeks)				
		12	16	25	34	38
Long	n	7	10	15	9	12
	% ^a	23	18	26	16	24
	No/wk	2 (1-7)	2 (1-7)	2 (1-5)	1 (1-3)	1.5 (1-5)
Moderate	n	7	21	17	27	18
	% ^a	23	37	30	47	35
	No/wk	2 (1-7)	2 (1-20)	2 (1-7)	2 (1-7)	2 (1-14)
Short	n	5	11	11	16	11
	% ^a	17	19	19	28	19
	No/wk	4 (2-7)	3 (1-20)	3 (2-25)	3 (1-14)	3 (1-7)
Total Duration	n	9	26	28	35	22
	% ^a	30	46	49	61	43
	Mins/wk	180 (60-405)	75 (22.5-360)	102 (15-510)	60 (7.5-330)	60 (7.5-420)

^a % of total sample Short walks = 5-20 minutes, medium walks = 21-30 minutes, long walks = 30+ minutes.

The mean duration of a long walk at 12 weeks gestation was reported to be 63.57 (S.D. 30.24) minutes and at 16 weeks it was 60.5 (22.66) minutes. By 25 weeks it had increased to 81.33 (38.29) minutes, at 34 weeks gestation it was 96.11 (34.62) minutes and at 38 weeks it was 75 (35.48) minutes. All medium walks were assumed to last for 25 minutes and all short walks for 12.5 minutes. These approximations, together with the reported duration of any long walks provided an estimate of the total amount of time each woman spent walking (table 8.9). Twenty-two women reported walking for pleasure at each stage of pregnancy between 16 and 38 weeks gestation. Within this sample, no significant differences in total weekly walking duration were observed.

8.7.4.1 Self-Reported Walking Pace

A separate question in the activity interview asked women to estimate their pace of walking (table 8.10). At 12 weeks gestation, the majority of women (61%) reported walking at an average or normal pace. However by 34 weeks gestation, the majority reported that they walked at a casual or strolling pace (70%). Throughout the study, nobody reported walking at a brisk or striding pace.

Table 8.10: Self-Reported Walking Pace During Low Risk Pregnancy (%)

Pace of walking	Gestation (weeks)				
	12	16	25	34	38
Casual or strolling (<2 mph)	26	28	39	70	74
Average or normal (2-3 mph)	61	46	47	25	20
Fairly brisk (3-4 mph)	13	26	14	3	6
Brisk or striding (>4 mph)	-	-	-	-	-

Fifty-one subjects estimated their walking pace at every visit between 16 and 38 weeks gestation. A significant decline in walking pace was revealed ($\chi^2_F = 37.67$, $df = 3$, $p = 0.01$). Wilcoxon tests showed walking pace at 34 weeks to be significantly slower than at 16 weeks ($z = -3.94$, $p < 0.01$) and 25 weeks gestation ($z = -3.91$, $p < 0.01$). Walking pace at 38 weeks was also significantly slower than at 16 weeks ($z = -3.47$, $p < 0.01$) and 25 weeks gestation ($z = -3.76$, $p < 0.01$).

8.7.5 Summary: Maternal Sports & Exercise Pursuits

Despite study participants appearing typical of a wider adult female population in terms of their sport and exercise participation pre-pregnancy (Chapter 5, section 5.9.1), very few women engaged in such activities during the antenatal period. It is acknowledged that this difference may partially reflect a reliance on the retrospective reporting of women's pre-pregnancy behaviour patterns. However, this does not preclude the possibility that the experience of pregnancy may itself have impacted on maternal behaviour. Indeed, even those women who reported engaging in sports on both occasions demonstrated a reduced frequency of participation during pregnancy.

The trend for structured sports to decline contrasted with maternal participation in more unstructured pursuits. Walking in particular remained a popular activity throughout pregnancy. Since walking or cycling may serve several purposes simultaneously (Booth, 2000) it is possible that these activities may have been wrongly reported as recreational activity. This accepted, the activity questionnaire that was used in the current study provided a clear definition of the type of activities that should be included in participants' responses. Such ambiguity was therefore unlikely to be prevalent. Rather, the different levels of participation that were observed between structured and unstructured forms of exercise may be assumed to result from differences in perceived physical effort.

During pregnancy, the consequences of participating in physical exercise may range from minor nuisances such as perspiration through fatigue and discomfort to serious pain. Loosening of the ligaments in pregnancy may lead to symphysitis, an irritation of the pubic symphysis caused by increased motion at the joint. This condition is often associated with sacroiliac back pain (Berg et al., 1988) and is usually worsened with exercise or straining. Such discomfort is likely to be more punishing at higher activity intensities. It is not therefore surprising to find that many women may choose to maintain walking yet reduce more vigorous sporting pursuits. Consistent with this hypothesis is the fact that the women in the study voluntarily reduced their pace of walking throughout

pregnancy. Waterlow (1990) has previously shown that slow travel speeds are likely to reflect a concern for minimising energy expenditure.

However, as well as involving greater physical effort, more vigorous activities may also be associated with a greater perception of health risks. Findings from the present study certainly suggested that women's participation in structured sporting activities may have been influenced by the extent to which they believed such behaviour would compromise fetal health. A higher level of participation in casual walking activities may thus reflect the fact that this pursuit was judged to be a safer and more acceptable form of exercise. Only by examining maternal responses to other forms of recreational behaviour can other reasons for the reduced recreational activity ratios be established.

8.7.6. Social Activities

Given that few women in the study regularly participated in sports and exercise during pregnancy, much of the respondents recreational time was spent in social activities.

Table 8.11: The Nature and Popularity of Social Activities in Low Risk Pregnancy (%)

	Gestation (weeks)					Total
	12	16	25	34	38	
Visited family or friends	80	84	75	77	88	80.8
Went shopping	50	49	61	53	39	50.4
Had family or friends to visit	37	30	46	40	53	41.2
Visited the pub	50	47	37	39	33	41.2
Visited a Restaurant	33	28	28	26	24	27.8
Visited the cinema	10	4	14	12	12	10.4
Attended a sports event as a supporter	10	5	2	4	6	5.4
Other:						
Party/Wedding/Funeral		5	4	6	6	4.2
Church	3	5	2	2		2.4
Collectors fair	3	2				1.0
Concert		2		4		1.2
Slimming Class		2				0.4
Viking Reinactment			2	2		0.8

During pregnancy the five most popular social activities were: (i) visiting family or friends, (ii) shopping, (iii) having friends or family to visit, (iv) going to the pub and (v) going to a restaurant. Table 8.11 presents the full range of activities that were reported and the percentage of individuals who performed each activity at least once in the seven days prior to interview.

8.7.6.1 Time Spent in Public Places

From the responses that the women gave, the total amount of time that participants spent in public places could be calculated. For the purpose of analysis, 'public places' were defined as any locations outside of the participant's own home or the home of friends and family. Changes in this variable were examined for the 51 subjects completing every visit between 16 and 38 weeks gestation. Two individuals at 34 weeks gestation scored unusually high values (940 and 1020 mins/week), as did two individuals at 38 weeks gestation (600 and 750 mins/week). All four respondents were excluded from subsequent analyses.

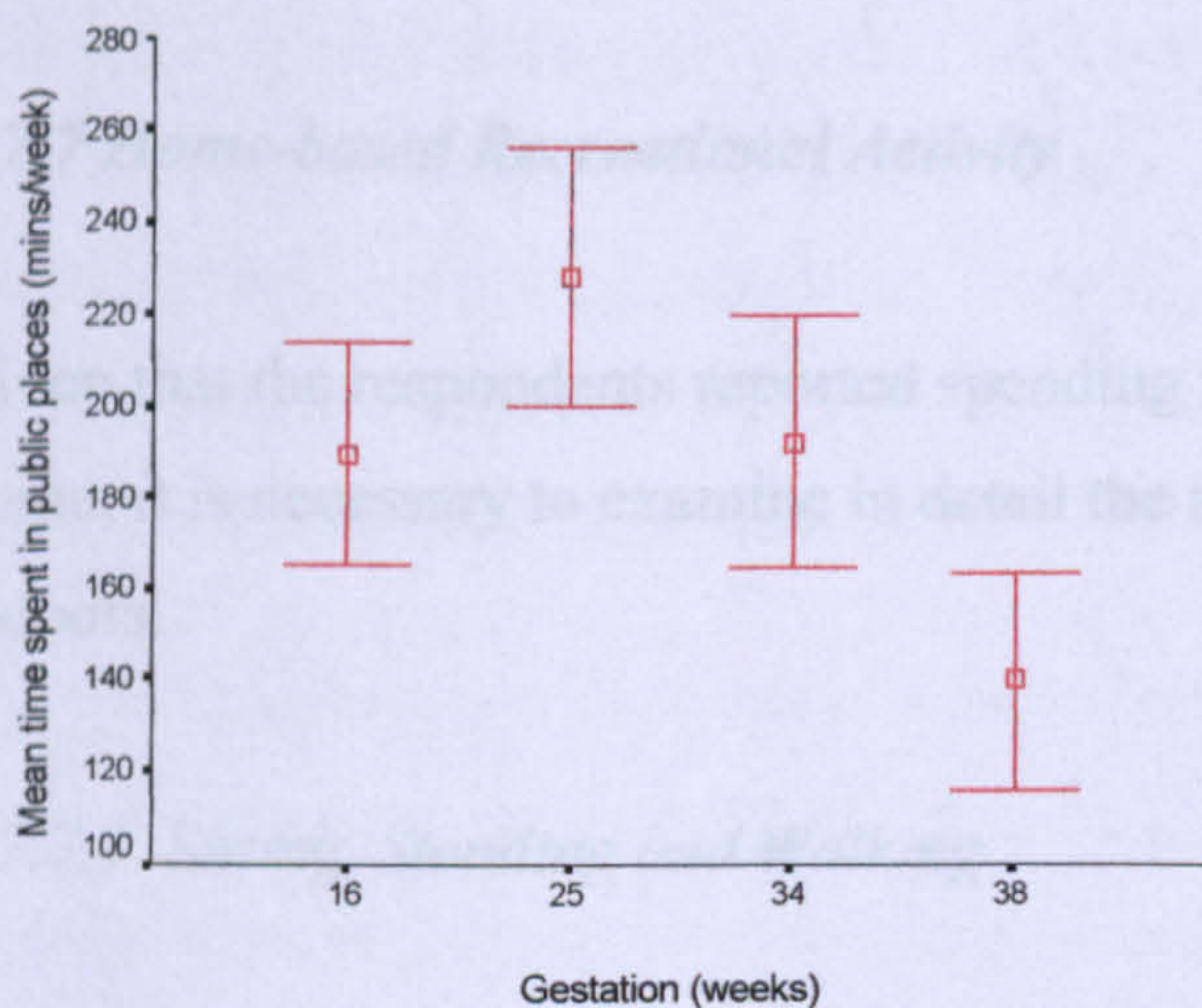


Figure 8.6: Mean time spent in public places (± 1 S.E.) as a function of advancing pregnancy ($n=47$)

Figure 8.6 displays the mean amount of time spent in public places by the 47 women remaining in the sample. Mean time can be seen to increase between 16 and 25 weeks of

pregnancy and decrease steadily thereafter. A repeated measures ANOVA revealed a statistically significant difference between visits ($F(3, 138)=2.72, p<0.05$). Pairwise comparison tests with multistage Bonferroni adjustment showed mean time at 38 weeks gestation to be significantly lower than that at 25 weeks ($t=-2.79, df=46, p<0.05$). These results suggest that as pregnancy progressed women were significantly less likely to spend time outside of their own home or the homes of friends and family.

Several different explanations for this trend can be offered. For example, O'Brien & Naber (1992) report that most women reduce their social commitments during the early months of pregnancy due to nausea and vomiting. Thus, in later pregnancy, it is possible that the effects of an increased fetal mass and decreased energy levels may exert a similar effect. Of note however, is the fact that domestic activity did not diminish in the same way, despite the fact that household tasks typically require a similar if not greater amount of physical effort. This observation suggests that, during pregnancy, the social setting of an activity may be an equally important influence on maternal daily activity behaviour. Specific factors that discouraged recreational activity within the public domain are discussed in Chapter 9.

8.7.7 Home-based Recreational Activity

Given that the respondents reported spending increasing amounts of their leisure time at home, it is necessary to examine in detail the nature of the activities they performed indoors.

8.7.7.1 Sitting, Standing and Walking

As part of the activity questionnaire, participants were asked to rate the frequency with which they performed specific activities in their 'free' time at home. These activities consisted of *watching TV, reading and walking within the home*. At each visit, a substantial proportion of the sample (51-67%) spent at least half of their free time at home watching television. In contrast, 17-32% spent at least half of their time walking

around their home and only 11-23% spent at least half of their free time reading (figure 8.7).

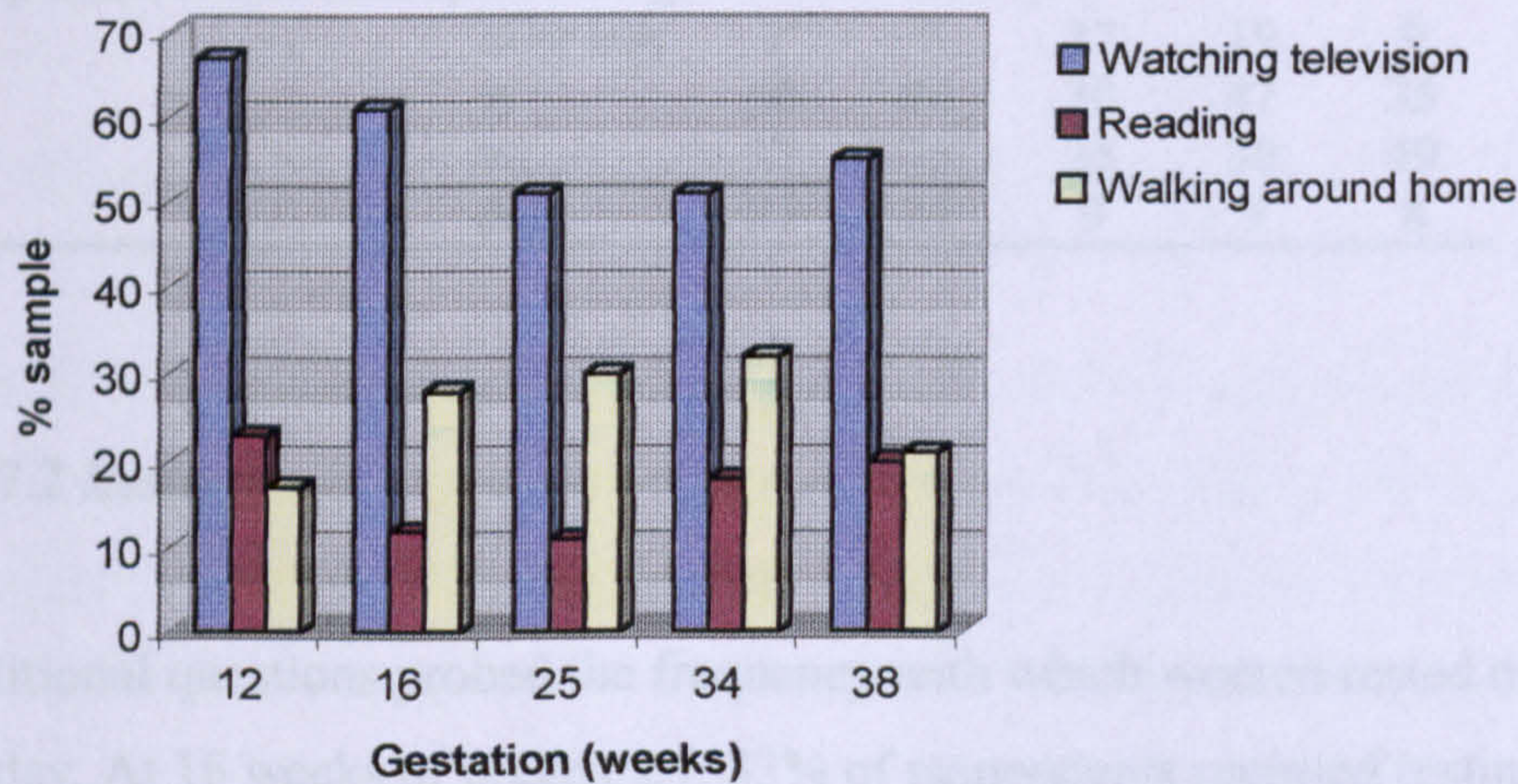


Figure 8.7: Percentage of sample spending at least half of their home-centred free time in different activities.

Between 23 and 42% of the sample also indicated that they spent at least a quarter of their time in other sitting activities. These activities included listening to music, playing board games, sewing and knitting. In contrast, very few individuals (0-7%) reported spending time in standing activities. The exceptions were two individuals who spent approximately a quarter of their home-centred 'free' time cooking or baking, and two individuals who spent time talking.

The total proportion of time spent in home-based sitting activities was calculated at each stage of pregnancy (table 8.12). Fifty one women provided data between 16 and 38 weeks of pregnancy. In this sample, the proportion of time that respondents spent sitting was significantly greater at 38 weeks than at either 25 weeks ($z=-2.13$, $p<0.05$) or 34 weeks gestation ($z=-2.03$, $p<0.04$).

Table 8.12: Distribution of Sample by Frequency of Sitting During Home-centred FreeTime

	Gestation (weeks)				
	12	16	25	34	38
n	30	57	57	57	51
Proportion of free time spent sitting:					
$\frac{1}{4}$ or less	7	9	27	19	9
$\frac{1}{2}$	30	46	30	42	35
$\frac{3}{4}$	37	25	35	30	49
All	27	21	9	9	8

8.7.7.2 *Resting*

Additional questions probed the frequency with which women rested or took naps during the day. At 16 weeks of pregnancy, 33% of respondents reported resting and 37% reported napping. Eighteen per cent of the sample reported doing both. By 38 weeks of pregnancy, these proportions had increased such that 65% of respondents were resting and 58% were napping. Almost half of the sample (49%) reported doing both.

8.7.8 *Summary: Maternal Recreational Activities*

During pregnancy, participation in structured sporting pursuits ceased. Maternal reports suggested that this was primarily for reasons of increased physical effort and perceptions of fetal risk. The vast majority of respondents' recreational activity was therefore spent in non-sporting activities. These activities comprised both social and home-based pursuits. However, the total amount of time that women spent on social pursuits outside the home declined significantly in the second half of pregnancy. As a consequence virtually all recreational activity performed in the third trimester took place within the home.

The activities that women performed within the home were mostly sedentary and, as pregnancy progressed, the proportion of time that individuals spent in sitting and resting activities increased. It is therefore likely that an identification of the main factors serving to discourage social activity in pregnancy will also establish the main factors responsible

for the decline observed in women’s total recreational activity ratios (see section 8.6.2). This issue is addressed fully in Chapter 9.

PART THREE

8.8 Maternal Self-Reported Nocturnal Activity

To provide a complete picture of women’s daily activity patterns during low-risk pregnancy it was also necessary to assess periods of inactivity. The activity questionnaire therefore included a series of questions designed to investigate women’s nocturnal activity patterns. The main characteristics of this activity are described below.

8.8.1 Total Nocturnal Activity Ratios

Nocturnal activity was assessed by taking into account duration of time reportedly spent in bed, the duration of sleep, the frequency and length of nocturnal awakenings and the nature of activities performed when awake. At 16 weeks of pregnancy two subjects scored exceptionally high (1.11 & 1.05 METS respectively) and were identified as outliers. At 34 weeks the high scores of another two subjects were also noted as outliers (1.14 & 1.09 METS respectively). All four cases were excluded from subsequent analyses. Mean nocturnal activity ratios at each stage of pregnancy for the remaining respondents are presented in table 8.13.

Table 8.13: Self reported Nocturnal Activity Ratios in Low Risk Pregnancy

Stage of pregnancy (weeks)	n	Nocturnal Activity Score (METS)	
		Mean	S.D.
12	30	0.92	0.02
16	53	0.91	0.01
25	53	0.92	0.02
34	53	0.92	0.02
38	47	0.92	0.02

8.8.2 Longitudinal Trends in Maternal Nocturnal Activity Ratios

Figure 8.8 shows mean nocturnal activity ratios (± 1 S.E.) as a function of advancing pregnancy for the 47 subjects completing all visits between 16 and 38 weeks gestation. Mean self reported nocturnal activity ratios can be seen to steadily increase throughout ($F(3,138)=5.70, p<0.01$). Mean nocturnal activity level at 16 weeks was significantly lower than at 25 weeks ($t=-2.67, df=46, p<0.05$), 34 weeks ($t=-3.42, df=46, p=0.01$) and 38 weeks gestation ($t=-3.67, df=46, p=0.01$).

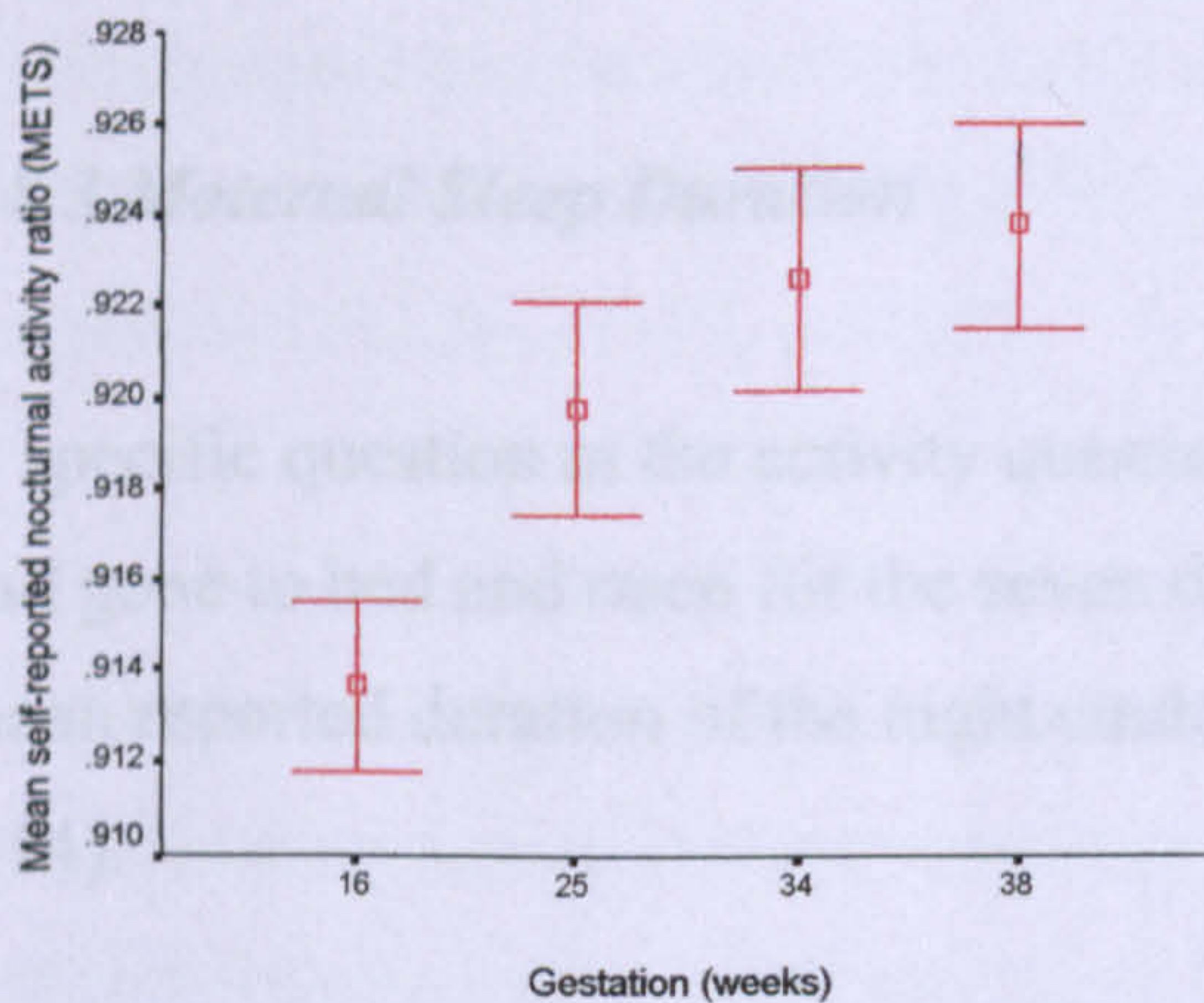


Figure 8.8: Mean self-reported nocturnal activity ratio (± 1 S.E.) as a function of advancing pregnancy (n=47)

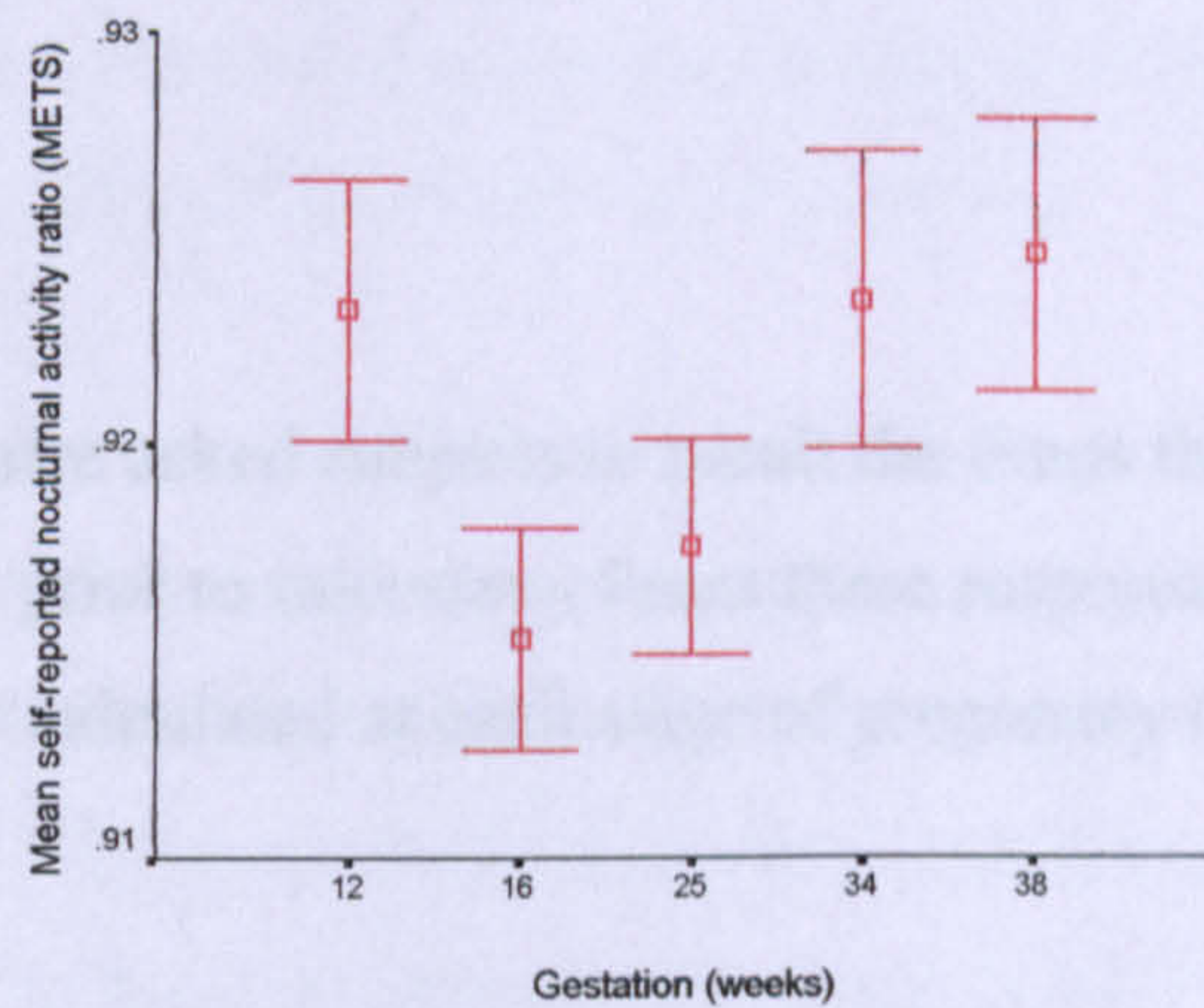


Figure 8.9: Mean self-reported nocturnal activity ratio (± 1 S.E.) as a function of advancing pregnancy (n=28)

Figure 8.9 plots mean nocturnal activity ratios over pregnancy for the 28 subjects who completed all five visits. Once again a significant difference was revealed ($F(3.08, 83.15)=2.98, p<0.05$). Pairwise comparisons showed mean nocturnal activity ratio at 38 weeks to be significantly higher than at 16 weeks ($t=-2.24, df=27, p<0.05$) and 25 weeks gestation ($t=-2.00, df=27, p=0.05$). Mean nocturnal activity ratio at 34 weeks of pregnancy was also significantly higher than at 16 weeks gestation ($t=-2.24, df=27, p<0.05$). Mean nocturnal activity ratio at 12 weeks gestation was both significantly

higher than at 16 weeks ($t=-2.30$, $df=27$, $p<0.05$) and 25 weeks gestation ($t=2.35$, $df=27$, $p<0.05$).

Ultimately, changes in nocturnal activity levels can occur for three main reasons. Firstly, the duration of the night may change (if individuals sleep for longer or shorter periods), secondly the nature of the activity performed may change (if individuals wake less or more frequently throughout the night) and thirdly, a combination of the two may arise. Thus it is necessary to consider the characteristics of nocturnal behaviour before the observed pattern of change in the current study can be fully understood.

8.8.3 Maternal Sleep Duration

A specific question in the activity questionnaire asked subjects to recall the times they had gone to bed and risen for the seven days prior to interview. From these responses, the mean reported duration of the night could be calculated at each stage of pregnancy (Table 8.14).

Table 8.14: Self reported Nocturnal Length Across Low Risk Pregnancy

Stage of pregnancy (weeks)	N	Duration of night (Hrs)	
		Mean	S.D.
12	28	10.41	1.40
16	54	9.45	1.31
25	54	9.76	1.35
34	54	10.34	1.70
38	48	11.08	1.50

Forty eight women provided data at all four visits between 16 and 38 weeks gestation. In this sample, a significant difference in mean nocturnal length was observed ($F(3,141)=20.23$, $p<0.01$). Mean nocturnal length increased steadily through pregnancy such that it was significantly longer at 38 weeks gestation than at 16 weeks ($t=-7.26$, $df=47$, $p<0.01$), 25 weeks ($t=-5.68$, $df=47$, $p<0.01$) and 34 weeks gestation ($t=-3.13$, $df=47$, $p<0.01$). Mean nocturnal length at 34 weeks was also significantly longer than at 16 weeks ($t=-3.71$, $df=47$, $p<0.01$) and 25 weeks gestation ($t=-2.28$, $df=47$, $p=0.05$). A

further significant increase in mean nocturnal length occurred between 16 and 25 weeks gestation ($t=-2.06$, $df=47$, $p<0.05$).

Twenty six subjects also provided data at 12 weeks gestation. In this smaller sample, a similar trend was revealed ($F(2.78, 69.44)=10.01$, $p<0.01$). Pairwise comparisons showed mean nocturnal length at 38 weeks to be significantly higher than at 16 weeks ($t=-5.63$, $df=25$, $p<0.01$) and 25 weeks gestation ($t=-5.58$, $df=25$, $p<0.01$). Likewise, mean nocturnal length at 34 weeks of pregnancy were significantly higher than at 16 weeks ($t=-2.96$, $df=25$, $p<0.05$) and 25 weeks of pregnancy ($t=-4.73$, $df=25$, $p<0.01$). In addition, mean nocturnal activity levels at 12 weeks of pregnancy were also significantly lower than at 38 weeks ($t=-2.83$, $df=25$, $p<0.05$) but higher than at 16 weeks of pregnancy ($t=2.96$, $df=25$, $p<0.05$).

Of note however is the fact that *nocturnal* length is not necessarily equivalent to total *sleep* duration. Thus it is also necessary to consider the impact that pregnancy may have on actual sleep behaviour. An examination of the distribution of the data revealed two additional outliers. One individual at 16 weeks gestation reported sleeping for an unusually small amount of time per night (3.79 hours) as did another at 34 weeks gestation (1.39 hours). Transformations of the data were unable to rectify these extreme values and both were therefore excluded from the analysis. Mean self reported sleep duration for the remaining participants is shown in table 8.15.

Table 8.15: Self-Reported Sleep Length Across Low Risk Pregnancy

Stage of pregnancy (weeks)	N	Duration of sleep (Hrs/night)	
		Mean	S.D.
12	27	8.23	1.59
16	52	8.30	1.27
25	52	8.02	1.38
34	52	8.12	1.35
38	46	8.67	1.17

A significant increase in the mean sleep duration of the 46 women who provided data between 16 and 38 weeks gestation was observed ($F(3,135)=3.75$, $p=0.01$). Mean sleep

length at 38 weeks gestation was significantly longer than at either 25 weeks ($t=-2.85$, $df=45$, $p<0.05$) or 34 weeks gestation ($t=-2.85$, $df=45$, $p<0.05$). These findings suggest that, like night duration, maternal sleep duration also increased.

8.8.4 Periods of Wakening

In effect, the difference between nocturnal length and sleep duration represents the total amount of time spent awake during the night. This in turn comprises the duration for which an individual is awake before falling asleep at night (sleep latency), the length of time for which she remains in bed after waking in the morning and the summed length of nocturnal awakenings she has experienced between the two.

The mean amount of time spent awake before falling asleep and after waking were combined to produce an overall '*lying awake*' time. Median lying awake times ranged from 35 minutes/night at 25 weeks gestation to 60 minutes/night at 38 weeks gestation. The differences observed in median lying awake times across pregnancy were not statistically significant. There was however, a marked increase in the frequency and duration with which respondents reported waking up at night.

8.8.4.1 Frequency and Duration of Nocturnal Wakenings

The frequencies with which respondents reporting waking up during the night are given in table 8.16. At 12 and 16 weeks gestation, the majority of women indicated that they woke up no more than once or twice a night (68% and 72% respectively). By 34 and 38 weeks of pregnancy however the majority of individuals were reporting waking up three or more times each night (59% and 73% respectively).

Self reported waking frequency at each stage of pregnancy was classified as *either* '*two or less times per night*' or '*three or more times a night*' and a significant increase in waking frequency was revealed ($\chi^2_F = 36.67$, $df=3$, $p<0.01$). Wilcoxon tests showed waking frequency at 16 weeks gestation to be significantly lower than at 25 weeks ($z=-$

2.67, $p<0.05$), 34 weeks ($z=-4.12$ $p<0.01$) and 38 weeks gestation ($z=-4.90$, $p<0.01$). Waking frequency at 25 weeks gestation was also significantly lower than at 38 weeks gestation ($z=-3.13$, $p<0.01$) whilst the difference between 34 and 38 weeks just failed to reach significance ($p<0.07$).

The next question in the activity questionnaire asked subjects to estimate for how long they normally remained awake each time they woke up during the night (table 8.16). Between 16 and 38 weeks of pregnancy, a significant increase in the length of each wake period was observed ($\chi^2_F = 10.59$ $df=3$ $p<0.05$).

Table 8.16: Self-Reported Waking Frequency Across Low Risk Pregnancy

	Stage of pregnancy (weeks)				
	12	16	25	34	38
Waking frequency:					
n	28	54	54	54	48
% waking					
Never / hardly ever	11	33	9	6	2
1-2 times per night	57	39	44	35	25
3-5 times per night	29	36	41	48	60
6-10 times per night	4	2	6	11	13
Waking duration:					
n ^a	25	36	49	51	47
% waking for					
Less than 10 minutes each time	28	64	57	39	34
11-30 minutes each time	48	36	35	45	51
31-60 minutes each time	24		8	16	15

^a all subjects who indicated that they usually woke up once a night or more

8.8.4.2 What Reasons Did Respondents Give for Waking Up?

When asked why they thought they had woken up during the night, women offered a variety of reasons for their interrupted sleep. Of those who reported waking up at 16 weeks gestation, 54% referred to physical discomforts such as heartburn or stomach pains. Thirteen percent reported having a bad dream, 9% reported anxiety regarding impending antenatal tests, 7% blamed work-related anxiety and 5% said their partner had

been unwell. A final 12% did not know why they had woken up. One 28-year old woman referred to several different physical discomforts:

“I just couldn’t get comfortable. My arms and legs have been aching. Last night I had really bad heartburn, I thought it was never going to go.”

Lindsay (16 weeks gestation)

Similar reasons were offered in late gestation. At 38 weeks of pregnancy, 38% of respondents referred to physical discomfort, 26% to the need to urinate, 16% to fetal movements and 5% to bad dreams. Fifteen per cent could give no reasons for their interrupted sleep. When asked why she had woken up during the night, one 26-year-old woman responded:

“I’m not sure. The baby was moving around a lot, I think it was doing it deliberately, just to keep me awake”.

Jane (38 weeks gestation)

8.8.4.3 What Did Respondents Do Once They Were Awake?

A separate question asked subjects to describe their typical behaviour during the periods that they were awake at night. Thirty two subjects reported waking up at least once a night at each stage of pregnancy between 16 and 38 weeks. Of these 95% at 16 weeks of pregnancy spent the majority of this time in bed. By 25 weeks of pregnancy this figure had dropped to 90% and by 34 and 38 weeks of pregnancy it was 82% and 79% respectively. As pregnancy progressed, an increasing number of respondents reported more activity behaviours during the time that they were awake. In the latter stages of pregnancy, common activities comprised watching television or reading, walking around the house, ironing and washing up.

8.8.5 Perceived Sleep Quality

The fact that low-risk pregnancy was accompanied by an increase in both the frequency

and duration of nocturnal waking was reflected in the participants' ratings of their perceived sleep quality. At each visit, individuals were asked to indicate how well they thought they had been sleeping in the 7 days prior to interview. Responses were scored on a five-point scale that ranged from 'extremely badly' to 'extremely well'.

Figure 8.10 presents the distribution of responses at each stage of pregnancy as a percentage of the total sample available at each measurement point. The proportion of women who indicated that they slept 'fairly well' or better was greatest at 16 weeks of pregnancy. From 25 weeks of pregnancy onwards this percentage steadily declined such that by 38 weeks of pregnancy, the most common response was that individuals had slept 'rather badly'.

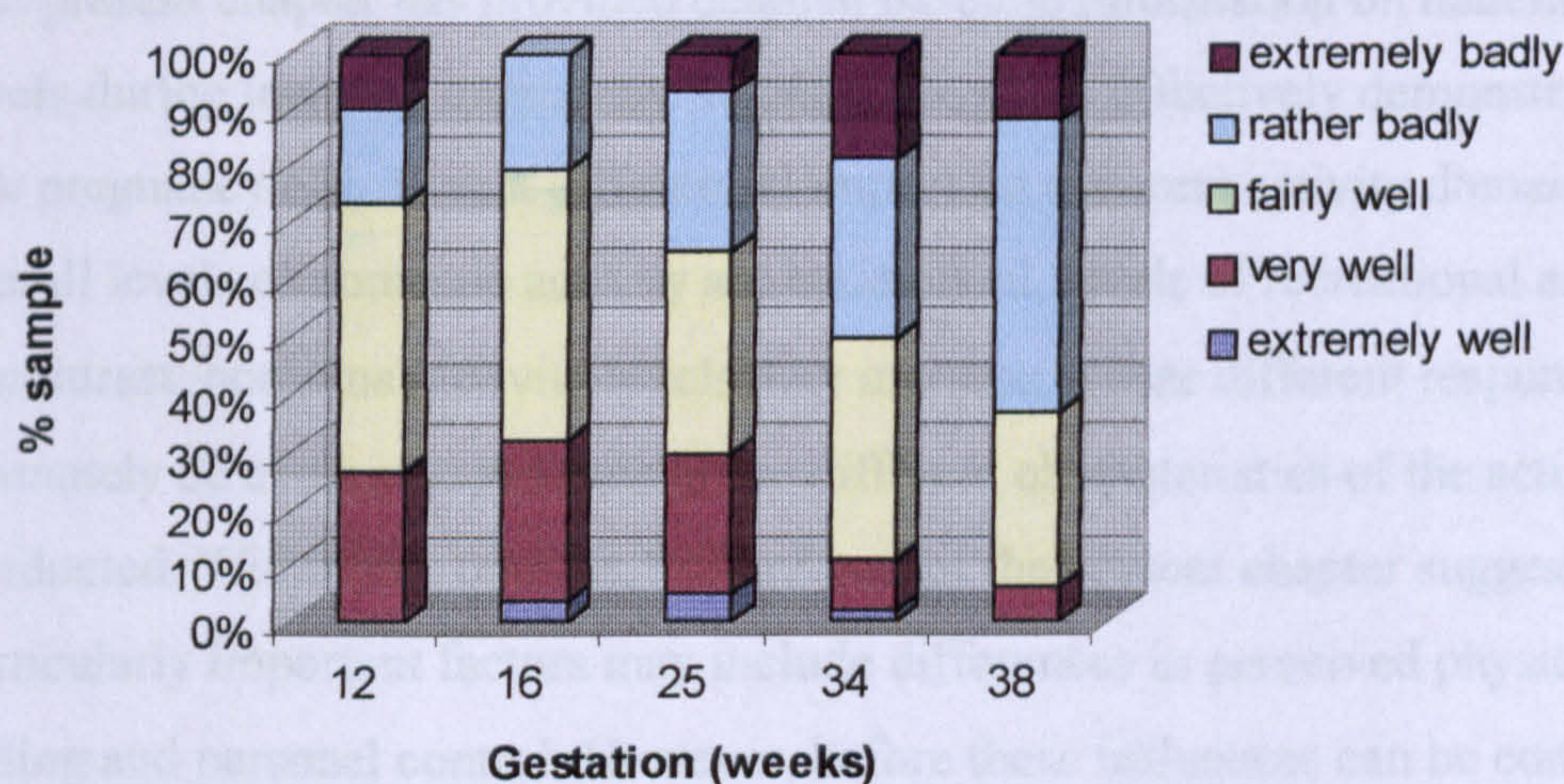


Figure 8.10: Distribution of sample by perceived sleep quality.

8.8.6 Summary: Maternal Nocturnal Activity

The present study has demonstrated that, as pregnancy advances, women will typically spend increasing amounts of time in bed. This behaviour is the direct result of a lengthening of nocturnal sleep periods. Concomitantly however, both the frequency and duration of nocturnal wake periods increase, and during the time that they are awake women may engage in progressively higher levels of activity. These findings are supported by a number of other studies. Lee et al. (2000) have recently shown that,

compared to pre-pregnancy sleep characteristics, significant changes in maternal sleep patterns may be evident by 11-12 weeks gestation. In particular, these authors report a significant increase in total sleep time, a reduction in deep sleep and an increased number of nocturnal awakenings. Similar findings have been reported elsewhere (Baratte Beebe & Lee, 1999; Sugihara & Kobayashi, 1998). Whilst the precise origins of such nocturnal awakenings remain unclear, findings from the present study suggest that a combination of physical and psychosocial factors may ultimately be responsible for their occurrence in pregnant women.

8.9 Chapter Summary

The present chapter has provided detailed baseline information on maternal daily activity levels during low-risk pregnancy. In doing so, it has effectively demonstrated that low-risk pregnancy may have a differential impact on different activity domains. Whilst overall levels of domestic activity are maintained, levels of recreational activity decrease. In contrast, nocturnal activity levels may increase. These different responses can ultimately be explained in terms of the different characteristics of the activities that are conducted. Within this context, the findings of the present chapter suggest that particularly important factors may include differences in perceived physical effort, risk, setting and personal control. However, before these influences can be confirmed further investigations are needed. The next chapter thus addresses the determinants of maternal daily activity behaviour in greater detail.

CHAPTER NINE

Explaining Changes in Maternal Daily Activity Behaviour

9.1 Introduction

As discussed elsewhere, daily activity is a composite measure of several different activity domains. For women especially, these domains can include occupational activities; domestic chores and family-care; shopping; social or community involvement; personal (free) time and physical recreation activities (Ainsworth, 2000). The previous chapters have effectively demonstrated that the proportion of time that individuals spend on some of these activities, and the way in which they perform them, can alter significantly over the course of low-risk pregnancy. Nonetheless, the precise reasons why these behavioural adaptations occur remain unclear. Within the general population, self-reported levels of physical activity participation are known to be associated with a number of sociodemographic and psychosocial factors (see Chapter 2, section 2.6). As yet however, very few studies have considered the relative importance of these characteristics during pregnancy. The present chapter serves to address this issue.

9.2 Statistical Analyses

Quantitative data were analysed using the Statistical Package for the Social Sciences 9.0 (SPSS Inc., Chicago). All data are reported as mean (S.D.) or as percentages.

Associations between maternal daily activity levels and the independent variables were assessed using independent sample t-test or Mann-Whitney-U test for dichotomous variables, one way ANOVAs or Chi-square tests for categorical variables and Pearson's correlation or Spearman's Rank correlation coefficients for continuous variables. The independent associations between maternal daily activity and the variables under test were analysed by multiple regression. The data were checked for multivariate outliers using the criterion of Mahalanobis distance at $p < 0.001$. The form of regression was assessed by examining a scatterplot of the residuals (SPSS Inc., Chicago). Qualitative

data were analysed by sorting verbatim material into emergent themes as described by Dey (1993).

9.3 Predictors of Maternal Daily Activity Levels in Low-Risk Pregnancy

The potential impact of a wide range of factors on maternal physical activity behaviour is summarised in table 9.1. Significant associations between self-reported levels of maternal daily activity and various sociodemographic, lifestyle and psychosocial characteristics are identified and discussed below.

9.3.1 Pre-Pregnancy Lifestyle Characteristics

Pre-pregnancy lifestyle characteristics may be particularly important in determining daily activity levels during pregnancy. Women who reported higher levels of physical activity prior to becoming pregnant were significantly more likely to report higher levels of daily activity at 16 weeks ($p=0.020$), 25 weeks ($p=0.002$) and 34 weeks gestation ($p=0.031$). There was also a trend for these women to report higher levels of activity at 12 weeks gestation ($p=0.079$). More specifically, women who reported high levels of occupational activity pre-pregnancy were significantly more likely to report higher levels of daily activity at 12, 16 and 25 weeks gestation ($p=0.050$, 0.013 & 0.010 respectively). In contrast, women who reported higher levels of leisure activity pre-pregnancy were significantly more likely to be active at 25 weeks ($p<0.001$) and 38 weeks of pregnancy ($p=0.007$).

9.3.2 Sociodemographic Factors

Certain sociodemographic factors also demonstrated significant associations with maternal daily activity levels. Women who were of a higher educational attainment were significantly more likely to be active at 25 weeks ($p=0.011$) and 34 weeks of pregnancy ($p=0.023$). Likewise, women of a higher social class were significantly more likely to be active at 34 weeks gestation ($p=0.034$). There was also a very strong trend for women of

Table 9.1: Associations Between Maternal Daily Activity Levels and Various Sociodemographic, Psychosocial and Behavioural Characteristics (Figures presented as probability p-values)

Variable	Total Self-Reported Maternal Daily Activity Level (METs)				
	12 wks	16 wks	25 wks	34 wks	38 wks
<i>Sociodemographic:</i>					
Maternal Age	.58	.26	.11	.40	.36
Marital Status	.06	.56	.54	.69	.65
Social Class	.87	.06	.27	.03	.14
Education Level	.97	.40	.01	.02	.06
<i>Psychosocial:</i>					
Extroversion	.20	.08	.73	.86	.07
Neuroticism	.60	.95	.57	.18	.05
Generalised Self-Efficacy	.28	.83	.33	.07	<.01
Health Value	.16	.11	.11	.02	.06
<i>Pre-pregnancy Lifestyle:</i>					
Occupational Activity Level (Baecke)	.05	.01	.01	.16	.99
Sport Activity Level (Baecke)	.96	.27	.49	.13	.87
Leisure Activity Level (Baecke)	.21	.31	<.01	.13	<.01
Total Activity Level (Baecke)	.08	.02	<.01	.03	.28
<i>Pregnancy-related:</i>					
Pregnancy History	.70	.39	.23	.21	.58
Degree Pregnancy Planned	.99	.52	.16	.11	.72
Maternal Attitude (MAMA)	.73	.49	.73	.05	.18
Body Image (MAMA)	.34	.54	.19	.02	.18
FHLC-I	.45	.44	.50	.74	.34
FHLC-C	.51	.28	.33	.93	.26
FHLC-P	.89	.03	.08	.06	.63
Depression (EPDS) ^a	.45	.48	.63	.31	.54
State Anxiety (STAI) ^a	.29	.97	.55	.21	.52
Somatic Symptoms (MAMA) ^a	.78	.85	.92	.53	.32
Social support (SPQ) ^a	.03	.91	.73	<.01	.37
BMI (kg/m ²) ^a	.94	.85	.53	.10	.12

Social Class = (i) IV & V (ii) III_m & III_n (iii) II & I; Educational level = (i) GCSE or below (ii) Above GCSE; Marital Status = (i) Single (ii) Married/cohabiting; Pregnancy history = (0) None (i) miscarriage (ii) termination
^a at corresponding stage of pregnancy

Figures emboldened in blue denote significant positive relationships; Figures emboldened in red denote significant negative relationships

N.B. Lower maternal attitude, body image, somatic symptoms & social support scores denote a more positive level of maternal adjustment

a higher educational level and a higher social class to be more active at 38 weeks of pregnancy ($p=0.058$ & $p=0.059$ respectively).

9.3.3 *Psycho-Social Factors*

In addition, several psychosocial factors also appeared to impact on women's activity behaviour. At 12 weeks gestation women who reporting being more active were significantly less likely to perceive a high level of social support ($p=0.027$), whilst women who reported being more active at 16 weeks gestation were significantly less likely to hold health professionals responsible for the health of their baby ($p=0.028$). Women who were more active at 34 weeks gestation were more likely to report a higher health value ($p=0.024$), a more positive maternal attitude ($p=0.045$) and body image ($p=0.016$) and a higher level of perceived social support ($p=0.005$). In addition, women who were more active at 38 weeks gestation were less likely to be neurotic ($p=0.045$) and more likely to have a higher level of generalised self-efficacy ($p=0.004$). At 38 weeks gestation, there was also a very strong trend for women with a higher health value to be more active ($p=0.061$).

9.3.4 *Independent Associations between Maternal Daily Activity Levels and Predictor Variables*

To establish whether there were any independent associations between the above variables and maternal daily activity levels, a series of standard multiple regression analyses were performed. The predictor variables included in the regression models were chosen to provide an appropriate sample of the sociodemographic circumstances (*level of educational attainment*), psychosocial factors (*extroversion, neuroticism, generalised self-efficacy and health value*), pre-pregnancy lifestyle characteristics (*occupational and leisure activity levels*) and pregnancy-related variables (*maternal attitude, body image, HLC_P and social support*) that were most strongly related to maternal daily activity levels in table 9.1. These variables were simultaneously entered into the regression model. To improve the predictive power of each model, the factors that explained the least amount of variance were then removed one by one in a backward, stepwise

approach until the model with the highest adjusted variance was obtained.

The final model for each stage of pregnancy is given in tables 9.2a-9.2e. Although the use of different sample sizes may ultimately have influenced the nature of relationships observed in each model, results suggest that activity levels may be determined by a variety of different factors. At 12 weeks gestation, self reported maternal daily activity level was independently associated with levels of occupational activity level pre-pregnancy ($p=0.020$) and perceived social support ($p=0.040$). More active women were significantly more likely to report higher levels of occupational activity pre-pregnancy yet perceive less social support during the early stages of pregnancy. At 16 weeks gestation more active women were significantly more likely to report a higher level of occupational activity pre-pregnancy ($p=0.004$) and significantly less likely to hold health professionals responsible for the health of their baby ($p=0.035$). At 25 weeks gestation, maternal daily activity level was independently associated with occupational level pre-pregnancy ($p=0.013$), pre-pregnancy levels of recreational activity ($p=0.005$) and maternal body image ($p=0.027$). The direction of these relationships was such that more active women were more likely to report a higher level of leisure-time activity prior to pregnancy yet significantly less likely to report a positive body image in pregnancy. At 34 weeks gestation, more active women were significantly more likely to be of higher educational attainment ($p=0.016$) and perceive higher levels of social support ($p=0.048$), whilst at 38 weeks gestation more active women were more likely to be extroverted ($p=0.012$), of higher self-efficacy ($p=0.040$) and report higher leisure-time activity levels prior to pregnancy ($p=0.049$).

Table 9.2a: Final Regression Model with Maternal Daily Activity Level at 12 weeks gestation as the Dependent Variable (n=26)

<i>Criterion:</i> Self-reported maternal daily activity level at 12 weeks gestation (MET'S)				
$R^2=0.40$	Adjusted $R^2=0.21$	$F=2.11$	d.f. = 6, 19	$p=0.100$
		Unstandardized B	S.E.	p
<i>Predictors:</i>				
Neuroticism		0.014	0.009	
Generalised self-efficacy		0.019	0.009	
Occupational activity pre-pregnancy		0.132	0.053	*
Maternal Attitude		-0.018	0.011	
Body Image		0.015	0.011	
Perceived social support		0.004	0.002	*

Table 9.2b: Final Regression Model with Maternal Daily Activity Level at 16 weeks gestation as the Dependent Variable (n=51)

<i>Criterion:</i> Self-reported maternal daily activity level at 16 weeks gestation (METS)				
$R^2 = 0.30$	Adjusted $R^2 = 0.21$	$F = 3.19$	d.f. = 6, 44	$p = 0.011$
		Unstandardized B	S.E.	p
<i>Predictors:</i>				
Extroversion		-0.009	0.006	
Generalised self-efficacy		0.005	0.006	
Health value		0.006	0.007	
Occupational activity pre-pregnancy		0.110	0.034	**
FHLC-P		-0.006	0.003	*
Perceived social support		0.001	0.001	

Table 9.2c: Final Regression Model with Maternal Daily Activity Level at 25 weeks gestation as the Dependent Variable (n=51)

<i>Criterion:</i> Self-reported maternal daily activity level at 25 weeks gestation (METS)				
$R^2 = 0.48$	Adjusted $R^2 = 0.41$	$F = 6.67$	d.f. = 6, 44	$P < 0.001$
		Unstandardized B	S.E.	p
<i>Predictors:</i>				
Educational level		0.127	0.064	
Generalised self-efficacy		0.008	0.007	
Occupational activity pre-pregnancy		0.114	0.044	*
Leisure activity pre-pregnancy		0.194	0.065	**
Body Image		0.017	0.007	*
FHLC-P		-0.007	0.004	

Tables 9.2d: Final Regression Model with Maternal Daily Activity Level at 34 weeks gestation as the Dependent Variable (n=56)

<i>Criterion:</i> Self-reported maternal daily activity level at 34 weeks gestation (METS)				
$R^2 = 0.34$	Adjusted $R^2 = 0.27$	$F = 5.04$	d.f. = 5, 50	$p = 0.001$
		Unstandardized B	S.E.	p
<i>Predictors:</i>				
Educational level		0.117	0.047	*
Occupational activity pre-pregnancy		0.059	0.034	
Body Image		-0.010	0.006	
FHLC-P		-0.004	0.003	
Perceived social support		-0.003	0.002	*

Table 9.2e: Final Regression Model with Maternal Daily Activity Level at 38 weeks gestation as the Dependant Variable (n=46)

<i>Criterion:</i> Self-reported maternal daily activity level at 38 weeks gestation (METs)				
$R^2 = 0.43$	Adjusted $R^2 = 0.36$	$F = 6.00$	d.f. = 5, 40	$p < 0.001$
		Unstandardized B	S.E.	p
<i>Predictors:</i>				
Educational level		0.063	0.038	
Extroversion		0.012	0.004	*
Generalised self-efficacy		0.009	0.004	*
Leisure activity pre-pregnancy		0.007	0.036	*
Body Image		-0.005	0.004	

9.3.5 Predictors of Change in Maternal Daily Activity Levels

As well as identifying significant predictors of daily activity for each stage of pregnancy, it was also important to establish which variables were most likely to influence changes in this behaviour. Such variables may ultimately provide a simple indication of the extent to which pregnancy may impact on a woman's daily activity level.

In Chapter 6, an analysis of the longitudinal trends in maternal daily activity behaviour revealed that mean self-reported daily activity levels were highest between 16-25 weeks gestation and lowest at 38 weeks gestation (see section 6.3.1). The mean decline in maternal self-reported daily activity levels between 25 and 38 weeks gestation was 0.20 (S.D. 0.25) METS. However, the magnitude of the change that occurred in maternal daily activity levels during this period was variable, ranging from a decline of 1.13 METS to an increase of 0.28 METS.

Table 9.3 shows the characteristics of the 26 women who reduced their activity by more than 0.19 METS (50th centile) compared to the 25 women who reduced their daily activity levels by less than this amount. Significant differences between the two groups were in terms of generalised self-efficacy ($p=0.027$), total daily activity level pre-pregnancy ($p=0.004$), occupational activity level pre-pregnancy ($p=0.017$) and sporting activity level pre-pregnancy ($p=0.023$). That is, women who reduced their activity by

Table 9.3: Maternal Characteristics According to Change in Daily Activity Level

Maternal characteristic	Women with daily activity reductions < 0.19 METS	Women with daily activity reductions > 0.19 METS
<i>Sociodemographic:</i>		
Maternal Age (yrs)	26.88 ± 4.44	26.15 ± 5.63
Marital Status: Married/Cohabiting	76	92
Single	24	8
Social Class: I & II	48	46
III & M	36	46
IV & V	16	8
Educational Level: GCSE or below	64	42
Above GCSE	36	58
<i>Psychosocial:</i>		
Extroversion	12.92 ± 3.87	11.54 ± 3.61
Neuroticism	10.52 ± 3.85	12.23 ± 4.51
Generalised Self-Efficacy*	31.26 ± 3.91	28.47 ± 4.32
Health Value	15.64 ± 2.69	16.27 ± 4.17
<i>Pre-pregnancy Lifestyle:</i>		
Occupational Activity Level (Baecke)*	2.45 ± 0.56	2.90 ± 0.71
Sport Activity Level (Baecke)*	2.17 ± 0.57	2.59 ± 0.69
Leisure Activity Level (Baecke)	2.31 ± 0.53	2.43 ± 0.44
Total Activity Level (Baecke)**	6.94 ± 1.13	7.91 ± 1.19
<i>Pregnancy-related:</i>		
Pregnancy History: None	56	81
Previous miscarriage	24	8
Previous termination	20	12
Pregnancy Planned: Yes	76	69
No	24	31
Maternal Attitude (MAMA)	23.34 ± 4.32	23.85 ± 4.34
Body Image (MAMA)	27.78 ± 4.43	27.90 ± 4.52
FHLC-I	37.62 ± 6.38	36.62 ± 5.88
FHLC-C	28.55 ± 9.64	28.29 ± 8.41
FHLC-P	20.90 ± 8.45	21.00 ± 8.73
Depression Change (EPDS) ^a	0.68 ± 4.37	- 0.65 ± 4.74
State Anxiety Change (STAI) ^a	4.56 ± 11.21	2.54 ± 7.72
Somatic Symptoms Change (MAMA) ^a	- 0.84 ± 5.88	0.27 ± 4.05
Social support Change (SPQ) ^a	- 6.28 ± 15.78	- 10.92 ± 29.87
BMI Change (kg/m ²) ^a	4.33 ± 1.54	3.53 ± 1.67

*p<0.05 **p<0.01 ^a change in scores between 25 and 38 weeks of pregnancy * p<0.05 ** p<0.01

N.B. Lower maternal attitude, body image, somatic symptoms & social support scores denote a more positive level of maternal adjustment

more than 0.19 METS between 25 and 38 weeks gestation were more likely to possess a lower level of self-efficacy and more likely to report a higher level of total daily activity, occupational activity and sporting activity prior to pregnancy.

A logistic regression analysis was performed to establish whether there were any independent associations between these variables and the extent to which maternal daily activity level declined during pregnancy (table 9.4). Reduction in daily physical activity level remained significantly associated with maternal self-efficacy ($p = 0.013$) whilst levels of occupational and sporting activity prior to pregnancy just missed significance at the $\alpha=0.05$ level ($p=0.076$ and $p=0.074$ respectively)

Table 9.4: Regression Model with Change in Maternal Daily Activity Level as the Dependent Variable

Criterion: Change in maternal daily activity level between 25 & 38 weeks gestation (n=51)			
$\chi^2 = 18.386$ d.f. = 4 $p = 0.001$			
	B	Wald	p
<i>Predictors:</i>			
Generalised self-efficacy	-0.244	6.120	*
Total activity pre-pregnancy	-0.566	0.453	
Occupational activity pre-pregnancy	2.134	3.145	
Sporting activity pre-pregnancy	2.373	3.200	

9.3.6 Summary: Predictors of Maternal Daily Activity Levels in Low-risk Pregnancy

The findings presented in this section have demonstrated that a number of different sociodemographic, psychosocial and lifestyle characteristics may ultimately influence levels of maternal daily physical activity during low-risk pregnancy. Moreover, as pregnancy progresses, the relative importance of these characteristics may change.

After adjusting for the effects of potential confounders, one of the strongest and most consistent predictors of maternal activity behaviour during pregnancy was that of maternal activity behaviour *prior* to pregnancy. This suggests that maternal activity behaviour during low-risk pregnancy may be under a strong habitual influence. In particular, women who were employed in more active occupations prior to becoming

pregnant reported higher levels of daily activity between 12 and 25 weeks gestation. Given that occupational activities have previously been shown to take up a significant proportion of Western women's daily energy expenditure (Weller & Corey, 1988), this trend provides some evidence for the maintenance of daily routine during the first and second trimesters. It must be acknowledged however, that whilst past levels of occupational activity are strongly and consistently related to current levels of daily activity in the first half of pregnancy, they are unable to predict maternal daily activity levels in the latter stages of pregnancy. At 38 weeks gestation, pre-pregnancy recreational activity level becomes a more accurate predictor of maternal daily activity behaviour. Given that most women in the current study relinquished their occupational interests during the third trimester (see Chapter 7, section 7.3) this finding is not unreasonable.

Contrary to expectation, maternal health value (a significant predictor of daily activity prior to pregnancy) did not directly influence activity behaviour at any of five stages of pregnancy. Whilst this in part may be due to a difference in measurement scales between the two dependent variables, one must also consider the possibility that, in pregnancy, the motivational forces that cause a person to become active or inactive may change. If this is so, then the findings may provide evidence for the fact that a perceived need or desire to engage in physical activity for reasons of personal health may no longer be the defining issue. In a culture where both lay and medical discourses have previously renounced the performance of physical activity during pregnancy, any perceived benefits of activity to the mother may ultimately be masked by perceptions of risk to the foetus. Of note here however is the fact that maternal FHLC scores rarely emerged as a significant predictor of maternal daily activity levels or indeed, as a predictor of the change in maternal daily activity level. Possible reasons for this lack of association are discussed in Chapter 11 (section 11.4).

Ultimately, the findings of the present study suggest that many other stresses may also initiate a decline in maternal activity. Late pregnancy in particular may be an important transitional time both in terms of women's physical and psychological wellbeing. At 38 weeks gestation, self-efficacy and extroversion were both identified as significant

predictors of daily activity. Self-efficacy was also a significant predictor of the change that occurred in maternal daily activity levels between 25 and 38 weeks gestation. This leads one to assume that those who are confident they will cope with the experiences of pregnancy will be more likely to continue with everyday routines and perform higher levels of daily activity. Certainly, the observed relationship between self-efficacy and activity is likely to be causal rather than due to a selection bias since the data in the current study was collected prospectively.

The significance of self-efficacy in predicting maternal activity patterns demands a more detailed consideration of its effect. This can be achieved by examining the range of explanations that women gave for changing their behaviour. When asked why they had altered their activity behaviour, respondents highlighted six main issues that prevented them from maintaining their habitual activities during pregnancy. These issues comprised physical limitations (89%), outside influences (30%), maternal perceptions of risk (78%), reduced levels of motivation (30%), poor maternal body image (14%) and a reduced opportunity for engaging in physical activity outside the home (22%). Each of these issues is discussed in turn below.

9.4 The Impact of Physical Limitations on Maternal Daily Activity Behaviour

Physical limitations were cited as the most common reason for reducing daily activity. Figure 9.1 summarises the total percentage of the current sample that attributed some aspect of their general behaviour to their physical health during pregnancy. Between 12 and 25 weeks gestation, 46-50% of women reported that some aspect of their behaviour had been affected by their physical wellbeing. At 34 weeks and 38 weeks of pregnancy, this proportion had risen to 84% and 82% respectively. Non-occupational activities were consistently reported to have been affected more frequently than occupational activities.

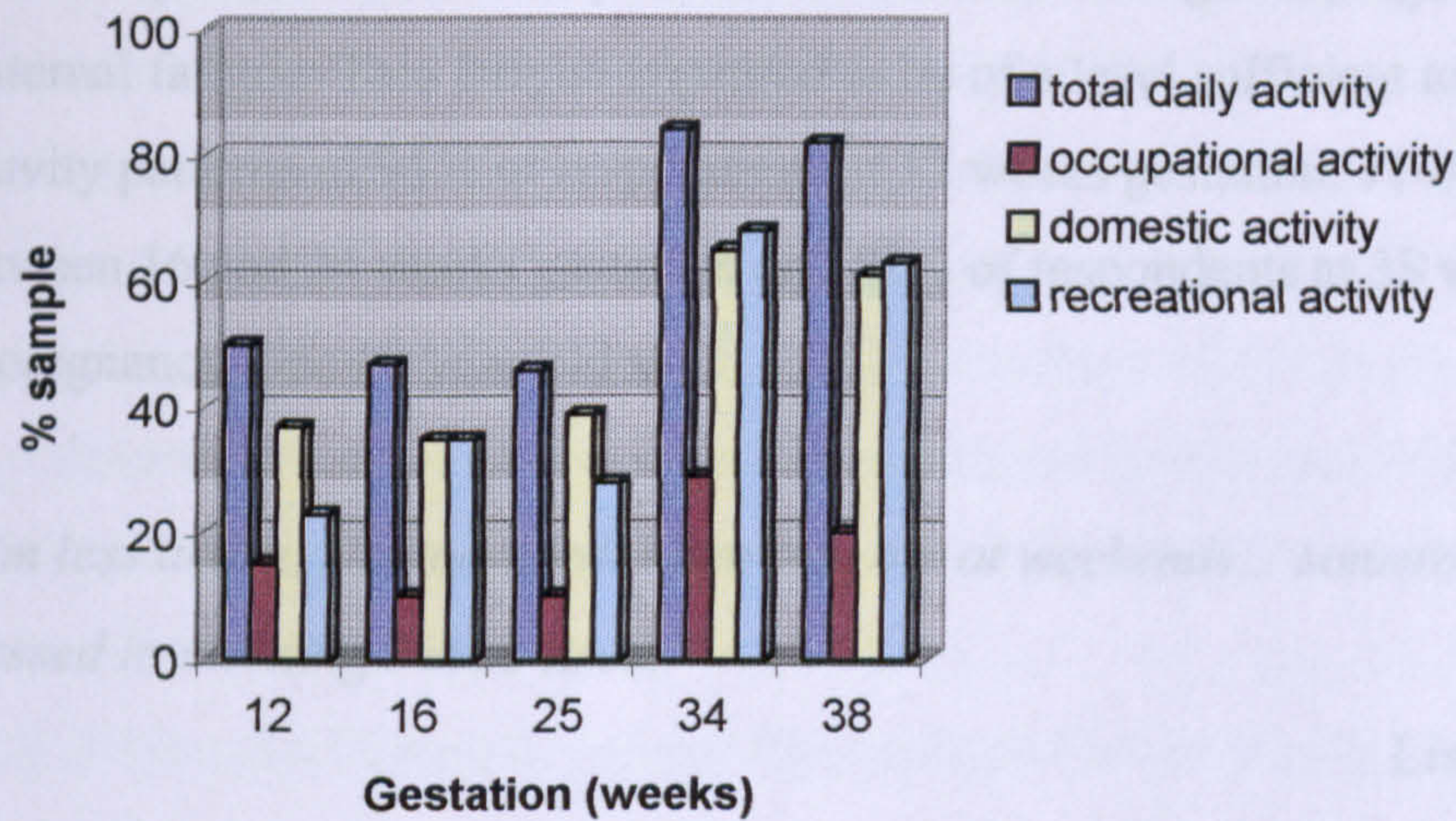


Figure 9.1: Proportion of women attributing a change in daily activity behaviour to a change in physical wellbeing

9.4.1. The Nature of the Physical Limitations

When asked why they had reduced their levels of daily activity, respondents referred to six main somatic symptoms (figure 9.2). In the earlier stages of pregnancy, 19-32% of respondents cited nausea and vomiting as a prominent influence on their daily activity behaviour. Later, these symptoms were replaced by perceptions of breathlessness and an increase in size and weight.

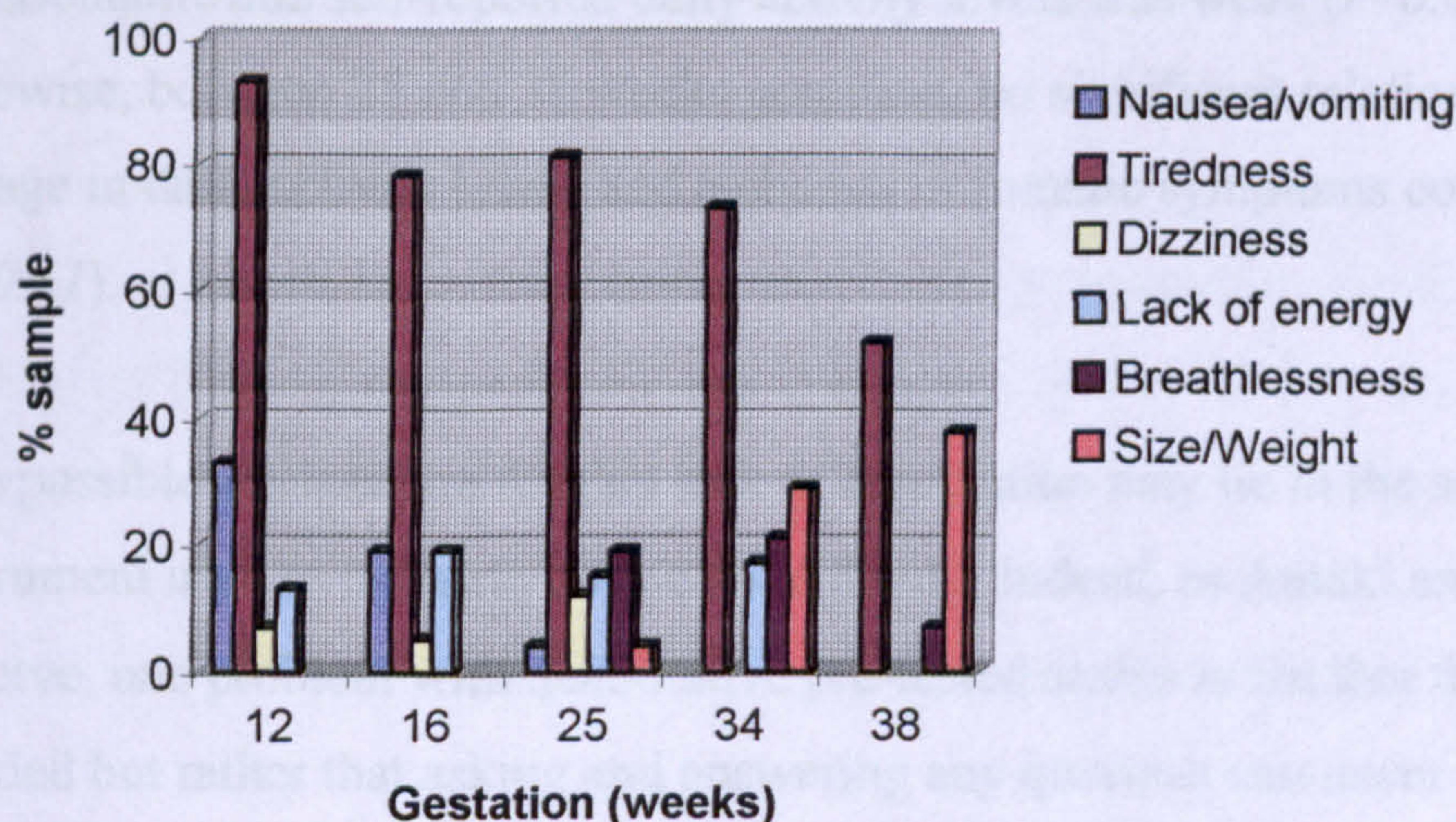


Figure 9.2: Somatic symptoms reported to affect participants' daily activity behaviour

This accepted, a much more prominent influence throughout pregnancy, was that of maternal fatigue. This fatigue appeared to be of a level sufficient to affect the daily activity patterns of 94% of respondents at 12 weeks gestation, 71-80% of respondents between 16 and 34 weeks gestation and 52% of respondents at 38 weeks gestation. Early in pregnancy, one 19 year-old said:

"I'm less active, I'm too tired. I can't go out at weekends... sometimes I struggle to get dressed in morning I'm so tired."

Lisa (12 weeks gestation)

Late in her third trimester, another 24-year old participant commented:

"My brain is active but my body doesn't want to know." Sarah (38 weeks gestation)

9.4.2 A Comparison of Qualitative and Quantitative Data.

Although many women attributed change in their daily activity behaviour to changes in their physical wellbeing, statistical analyses of the relationship between somatic symptoms and activity levels did not show a significant relationship. At each stage of pregnancy, the association between scores on the somatic sub-scale of the MAMA questionnaire and self-reported daily activity levels was weak ($r=0.01$ to -0.14). Likewise, between 25 and 38 weeks gestation, no significant relationship between the change in daily activity levels and a change in somatic symptoms could be observed ($r=0.11$).

One possible explanation for this lack of association may lie in the sensitivity of the instrument used to evaluate physical wellbeing. Indeed, as Antaki and Rapley (1996) observe, one problem with quantitative pre-tested scales is not that they are ambiguously worded but rather that asking and answering any question can never be separated from interpretations which are themselves inherently local and non-standardisable. Thus, one person's understanding of what is meant by a particular somatic symptom (for example,

tiredness) may not be commensurate with another's. In terms of effect, the extent to which a given level of discomfort might influence daily activity may also vary and depend upon the nature of the activity in question, the financial or social opportunity for change, and the personality of the woman concerned. Maternal self-efficacy may be particularly influential in this context. Whilst women with high levels of self-efficacy may ultimately cope with the physical changes that accompany pregnancy, women with lower self-efficacy may perceive the same somatic symptoms to be insurmountable.

9.4.2.1 Were the Women Reporting Physical Limitations Really of Poorer Health?

To investigate whether the women providing physical explanations for their behaviour during pregnancy were indeed of poorer physical health than those who did not provide such explanations, the sample was divided into two groups. This division was made on the basis of whether or not participants believed a physical symptom of pregnancy had altered their behaviour at 16 weeks gestation. Group A thus comprised all women citing at least one physical symptom (n=28) whilst Group B comprised those participants who had made no reference to such problems (n=29). The two did not differ in their scores on the somatic sub-scale of the MAMA questionnaire at either 12 or 16 weeks gestation. Likewise, their responses to three closed items within the activity interview, which assessed the frequency with which they had felt tired or ill or had had no energy in the seven days prior to interview, were not significantly different.

Such findings raise the possibility that in early pregnancy at least, the perception of a physical influence on activity may not be an accurate marker of actual physical health. Rather, the likelihood that such a perception will occur may also depend upon the background characteristics of the women involved.

9.4.2.2 Factors Influencing the Reporting of Somatic Symptoms

To explore whether the women reporting physical limitations differed from those who did

not report such limitations, further analyses were performed. The variables that were considered comprised sociodemographic circumstances (age and social class); pre-pregnancy characteristics (*previous sufferer of PMT, BMI pre-pregnancy and activity level pre-pregnancy*); personality (*neuroticism, health value and self-efficacy*); psychological wellbeing (*anxiety and depression*) and pregnancy-specific factors (*current BMI, perceived social support and maternal attitude*). Results revealed that those offering a physical explanation for their behaviour were more likely to be in social classes I or II than in III & IV ($\chi^2=6.32$, $df=1$, $p<0.05$), more neurotic ($t=2.48$, $df=55$, $p<0.05$) and more supported by their partner ($t=-2.94$, $df=55$, $p<0.01$). A difference in age, with older women reporting more physical symptoms, just missed significance at the $\alpha=0.05$ level ($p<0.08$).

To determine which of these variables were the best predictors of the dependent variable, the four factors most strongly related to the women's reporting of somatic symptoms were simultaneously entered into a logistic regression model (table 9.5). The perception that physical health was influencing maternal activity behaviour in early pregnancy was significantly associated with neuroticism ($p=0.007$) and levels of partner support ($p=0.032$).

Table 9.5: Regression Model on Perceived Physical Causes of Activity Reduction

<i>Criterion: Perceived physical influence on daily activity at 16 weeks gestation</i> (n=57)			
$\chi^2=24.200$ d.f. = 4 p= 0.001			
	B	Wald	p
<i>Predictors:</i>			
Maternal Age	0.08	1.02	
Social class	-1.40	5.46	
Partner support	-0.16	8.33	*
Neuroticism	0.26	2.93	**
p<0.05, p<0.01			

9.4.2.3 Summary: The Impact of Physical Limitations on Maternal Daily Activity

The physical changes that accompany pregnancy undoubtedly exert some influence on maternal activity behaviour. However, there is also evidence to suggest that the level of

physical symptoms that are experienced may themselves be influenced by expectation. An expectation of poorer health during pregnancy, either from the woman herself or from her primary group, may lead an individual to focus more closely on changes in her physical wellbeing. Any changes that are perceived in an individual's daily activity behaviour may then be attributed to changes in physical health. In studying the psychological aspects of the menstruum & pre-menstruum, Fielding & Bosanko (1984) report that manipulation of expectation can indeed produce alterations in the level of symptoms reported. In summary therefore, whilst certain physical limitations may indeed influence physical behaviour during pregnancy, other factors may also impact on the patterns of daily activity that women reportedly perform.

9.5 The Effect of Outside Influences

As part of the activity questionnaire, respondents were asked if they had received any advice regarding their physical activity behaviour in the four weeks prior to interview. Although the percentage of women who responded positively to this question decreased over time (from 80% at 12 weeks to 53% at 38 weeks), virtually all participants (96%) indicated that they had been in receipt of such advice at least once during the course of their pregnancy. Almost half of the sample (49%) indicated that they had received advice on three or more occasions. The primary sources of this advice are displayed in figure 9.3.

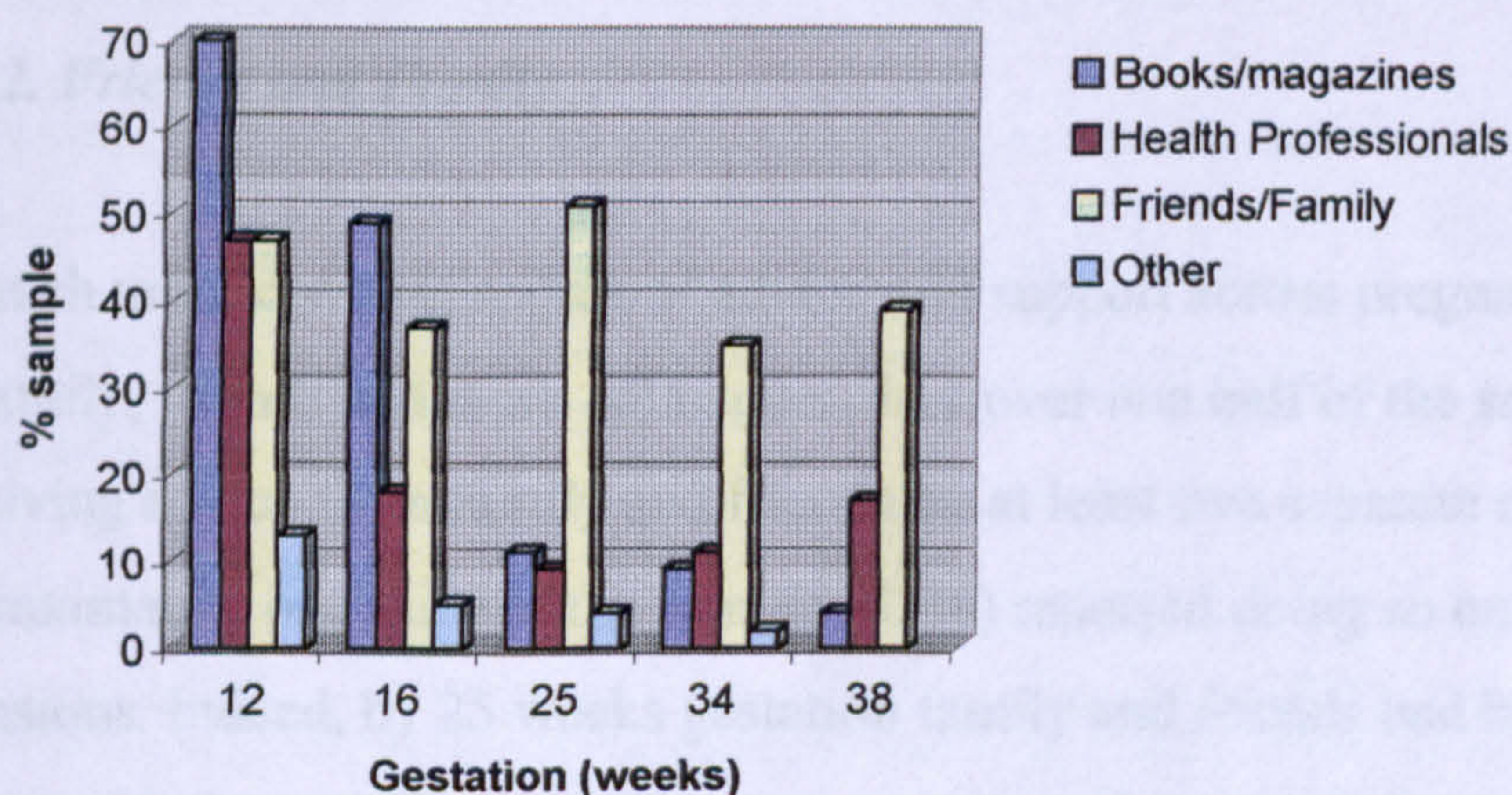


Figure 9.3: Sources of antenatal health advice reported by the study sample

9.5.1 Written Sources of Advice

In early pregnancy, reading was a particularly popular information gathering strategy. Ninety per cent and sixty one percent of women reported undertaking some form of reading at 12 and 16 weeks gestation respectively. Those who reported reading at 16 weeks of pregnancy did not differ significantly from those who did not either in terms of their sociodemographic circumstances, their personality or their attitude to the pregnancy. This finding suggests that written sources of health advice were used by the vast majority of women, irrespective of their social backgrounds. Approximately three-quarters of those who reported reading antenatal literature recalled seeing advice specifically regarding maternal physical activity behaviour. This advice appeared in a variety of written sources that ranged from professional and lay self-care books through to parenting magazines, leaflets and newspapers.

Prenatal care also appeared to play a substantial role in disseminating advice at or before 12 weeks gestation whilst a small number of participants received additional advice from other sources. These sources comprised gym supervisors, aerobic teachers and dance instructors. In all cases the nature of the advice that was read or received centred on two main aspects of structured recreational activity. The first was concerned with informing participants about the specific benefits and risks of different leisure time pursuits. The second focused on the importance of prenatal exercise and home stretching routines.

9.5.2. Friends and Family

A much more constant source of advice and support across pregnancy proved to be that of family, friends and work colleagues. Just over one half of the sample (52%) reported receiving advice from family and friends on at least two separate occasions and approximately one third of the sample (32%) reported doing so on three or more occasions. Indeed, by 25 weeks gestation family and friends had become the principal source of information. At this time, participants who reported receiving such advice were significantly older ($t=2.43$, $df=55$, $p<0.05$), more likely to have been educated beyond

the age of 16 ($\chi^2 = 4.03$, $df=1$, $p<0.05$) and of a higher pre-pregnancy activity level ($t=2.00$, $df=55$, $p=0.05$).

The nature of the advice given by participants' family, friends and colleagues was found to be much more generic in its approach than provided elsewhere, with study participants frequently responding that they had been told to "*take it easy*" or to "*slow down*." On four out of five stages of pregnancy, family discouragement of activity vastly outweighed family encouragement. This effect was particularly evident in the later stages of pregnancy. At 34 and 38 weeks gestation, 85% and 79% of those receiving advice indicated that their family and friends had discouraged them from being more active. The only exception was at 16 weeks gestation when the sample was divided much more equally. On this occasion 54% reported being discouraged compared to 46% who reported being encouraged. Thus, although the details of activity recommendations were found to vary between different individuals and different stages of gestation, the general lay consensus was that physical activity should be limited.

9.5.3 How Much Did Participants Report Following Advice?

The extent to which women reported following the advice that they had received was variable (table 9.6). At 38 weeks of pregnancy, the vast majority of women (95%) who had received advice were making some attempt to follow it. This compares to 78% at 25 weeks gestation and only 67% at 12 weeks gestation.

Table 9.6: Extent to Which Respondents Reported Following Physical Activity Health Advice

	Gestation (weeks)				
	12	16	25	34	38
% sample receiving advice ^a	80	58	32	35	31
% following advice					
Not at all	26 (33)	14 (24)	7 (22)	4 (10)	2 (5)
A little	13 (17)	18 (30)	7 (22)	12 (35)	4 (13)
Quite a lot	26 (33)	19 (33)	12 (39)	14 (40)	22 (69)
A lot	13 (17)	7 (12)	5 (17)	5 (15)	4 (13)

^a From books or professional sources. Brackets refer to % of those receiving advice

To investigate whether those individuals who followed advice in the first half of pregnancy differed in any way from those who did not, the sample was divided into two groups on the basis of their responses at 16 weeks gestation. Group A comprised those women who claimed to be following advice quite a lot or a lot (n=15). Group B comprised those women who indicated they were following advice only a little or not at all (n=18). No significant differences between the groups could be observed.

However, an analysis of open-ended comments suggested that the extent to which respondents followed advice may not have depended so much on the women themselves as on the clarity and applicability of the information they were given. Irrespective of whether they had been seeking information on a specific activity or had simply recalled seeing activity-orientated advice, approximately one in five individuals reported that they had often been met with a confusing and contradictory array of recommendations. As two participants stated:

"I asked various people if it was O.K to carry on running. My G.P. advised me to do my normal level, but my midwife told me to take it easy, to listen to my body. The practice nurse told me not to do it at all."

Nicola, aged 26 (12 weeks gestation)

"The books I've read have been very vague. They recommend swimming and yoga but little else. There's no black and white about what you should and shouldn't do so I don't, I can't follow it at all"

Julia, aged 27 (16 weeks gestation)

Despite these irregularities, there was strong evidence to suggest that women did respond to prevailing cultural pressure. Ultimately, 63% of the sample held other people responsible for a decline in their daily activity level at least once during the course of their pregnancy. Of these, 32% referred to an enforced change in their occupational activity, 54% to a change in their domestic activity, and 14% to a change in their

recreational activity. When asked if she thought she was behaving differently at work one 26-year old nursery nurse replied:

"Yes I am but only in that people make it influence the way I do things. I would behave normally if it was left up to me"

Sue (16 weeks gestation)

A similar pressure to behave differently was voiced by another individual:

"I'm doing a lot less housework now, I haven't got the choice. My family are trying to look after me. My partner does most of it he says he wants to so I can rest, otherwise I'd do it."

Amy, aged 25 (34 weeks gestation)

9.5.3.1 The Effect of Imposed Activity Restriction on Women's Wellbeing.

In total, 11% of respondents (and 37% of those receiving advice) indicated that they would perform more activity if their friends and family did not stop them. Almost half of these women suggested that the restrictions that others had placed upon them had caused feelings of boredom and social isolation. As one 29-year old woman commented:

"My friends don't think I should be going out, so they don't bother phoning me. I haven't seen anyone for ages. I feel like I've given everything up, my job, my life. There's nothing I can do except sit and wait."

Lindsay (34 weeks gestation).

A second respondent explained how her partner's decision to limit her domestic work had resulted in the same kind of sentiment:

"I'm not allowed to do things like gardening or housework. My partner stops me so I try

to rest more but then I get very frustrated. I know when to stop but he won't believe me. It's so boring, just sitting"

Wendy, aged 24 (38 weeks gestation)

For other women however, strong cultural pressures provided an excuse to be less active. This issue is addressed further in section 9.7.2.

9.6 Maternal Psychological Factors

Although outside influences often served to discouraged physical activity in pregnancy, other qualitative data provided evidence for the fact that women's reported behaviour during pregnancy was as much a condition of their own personal preferences as it was of external expectation.

9.6.1 Perceptions of Risk

When asked why they had made specific or general changes to their activity routine during pregnancy, 39% of respondents claimed that at least part of this decision had been their own choice. This justification for a decline in activity was cited at a similar frequency across all five stages of gestation and was offered both as a rationale for avoiding specific tasks and for modifying more general behaviour. As one 31-year old technician explained:

"At work I delegate lifting and manual handling. Generally I'm sitting down more. It's my own choice, I think I should do."

Jennifer (12 weeks gestation)

Later in pregnancy, a younger woman pointed to modifications that had been made to her recreational activity

"I'm not socialising so much, I've slowed down. It's common sense really isn't it?"

Stephanie, aged 27 (34 weeks gestation)

The extent to which women were prepared to modify their behaviour in response to such risks demonstrated that for many, the responsibilities of motherhood began quite early in pregnancy. A similar phenomenon has been documented elsewhere. For instance, cross-culturally and throughout time both pregnant women and those around them have expressed a concern for maternal diet (Thompson et al., 1990; Kitzinger, 1995). The findings of the present study suggest that, for many pregnant women, the nature of their energy expenditure may be an equally salient issue.

9.6.1.1 Maternal Self-Reported Activity Beliefs

In order to examine the importance that the women attributed to their physical activity behaviour during pregnancy, subjects were asked to rate the importance of 10 different behaviours in pregnancy on a 5 point Likert scale. This scale ranged from '*not at all important*' to '*very important*'. Mean ratings for each behaviour were calculated and, within a limited range, the three most important behaviours were found to be '*to get a good night's sleep*', '*not to smoke*' and '*not to drink too much alcohol*'. The three least important behaviours were to '*exercise regularly*', '*avoid fatty foods*' and '*have an active lifestyle*' (table 9.7). Over four fifths (81%) of the sample rated getting a good night's sleep as very important during pregnancy whereas only one quarter of the sample rated active living and exercise the same way (21% and 26% respectively). This accepted, no individuals rated any of the items as not important or not at all important.

Table 9.7: Relative Importance of Different Health Behaviours in Pregnancy as Judged by Nulliparous Healthy Pregnant Women.

Statement	Mean rating
How important is it for a pregnant woman to...	
.. get a good night's sleep	4.81
.. not smoke	4.79
.. not drink much alcohol	4.53
.. rest and relax	4.53
.. avoid worrying too much	4.40
.. get out and about	4.23
.. avoid getting overweight	4.12
.. exercise regularly	4.00
.. avoid fatty foods	3.93
.. have an active lifestyle	3.93

Five statements of the ten statements were concerned specifically with activity or inactivity. These have been highlighted in table 9.7 and can be seen to differ from one another in terms of the mean ratings they each received. '*Getting a good night's sleep*' and '*resting and relaxing*' were rated the most important whilst '*exercising regularly*' and '*having an active lifestyle*' were judged the least important.

Using pairwise comparisons with Bonferroni adjustment, the importance of sleep was rated significantly higher than any of the other four behaviours ($p < 0.05$). The mean importance of rest was also rated significantly higher than the mean importance of regular exercise ($t = -3.099$; $df = 56$; $p < 0.05$), and the mean importance of having an active lifestyle ($t = 3.380$; $df = 56$; $p = 0.01$). Moreover, in a separate analysis the mean ranking given to good sleep, regular exercise and an active lifestyle all differed significantly from the mean rating of all ten health statements ($p < 0.01$). In this instance, the importance of sleep was found to be significantly higher than the mean importance of all ten behaviours whilst, as expected, the mean ratings given to exercise and an active lifestyle were both significantly lower. It therefore appeared that, during pregnancy, the study participants attributed a high level of importance to rest and a lower level of importance to physical activity.

9.6.1.1.1 Possible Factors Influencing Maternal Activity Beliefs

No significant relationships between the perceived importance of the five activity-related variables and either pre-pregnancy activity or educational level could be found. This accepted, the importance of getting a good night's sleep increased with health value ($r = 0.28$, $p < 0.05$) whilst the importance of rest and relaxation increased with both FHLC(I) beliefs ($r = 0.34$, $p < 0.01$) and age ($r = 0.27$, $p < 0.05$). Partial correlations subsequently revealed that only the internal dimension of the FHLC scale directly affected the value given to this behaviour.

Similarly, pregnancy history was also found to influence certain responses. Regular exercise was rated as significantly less important by those who had experienced a previous miscarriage than it was by those who had had no such experience ($t = 2.20$,

$df=55, p<0.05$). Likewise, women who had reported a previous miscarriage attributed significantly less importance to the maintenance of an active lifestyle ($t=2.36, df=55, p<0.05$).

These findings suggested that many women entered pregnancy already aware of the importance of antenatal health information and the influence of their behaviour on fetal health. Moreover, the importance that women attributed to rest during pregnancy found to be comparable to the importance that they attributed to other well-established health behaviours such as not smoking or abstaining from alcohol consumption. It is possible that the high importance attributed to sleep and rest during pregnancy may partially reflect an expectation of a disrupted sleep pattern or hectic lifestyle postpartum.

However, a direct association between maternal physical activity beliefs and scores on the internal dimension of the FHLC scale suggests that some women in the current study were indeed concerned about the impact their activity behaviour could have on fetal wellbeing. Further support for this finding was provided by the fact that maternal physical activity beliefs also varied according to reproductive history and in particular to the experience of a previous miscarriage.

9.6.1.2 *The Nature of the Risks that the Women Perceived*

Overall, 68% of the sample indicated that, during pregnancy, they perceived an unnecessary degree of risk to be associated with some of the activities that they had routinely performed prior to becoming pregnant. Of these, approximately three-quarters (75%) believed an aspect of their former behaviour could *directly* jeopardise the progress of their pregnancy. This compared to just over half of the respondents (54%) who felt that behavioural modifications were necessary to avoid an *indirect* risk.

9.6.1.2.1 Direct Risks

Direct risks arose from various aspects of occupational, domestic and recreational activity and usually occurred wherever a particular task was assumed to be too strenuous or too

dangerous to perform. Many women however, left the precise nature of the perceived risk unspecified. As one 25-year old vaguely recounted:

"I haven't done any DIY, I won't lift the heavy toolbox. I just don't want to overdo it."

Tracy (34 weeks gestation)

In effect, only 16 women (28% of the sample) provided specific details as to the nature of the risk they were trying to avoid. Eleven references were made to maternal welfare and the possibility of 'strenuous' physical activity leading to unwanted accidents, falls or muscular strain. In early pregnancy four references were made to foetal welfare, 2 of which were concerned with hampering development and 2 with a risk of miscarriage. In late pregnancy one reference was made to a risk of premature delivery. Individuals who provided such explanations for their behaviour typically described how they were deliberately tailoring their activity to place the perceived needs of the foetus above their own. As one respondent stated:

"I don't rush around so much or carry heavy things or go dancing. It's my own choice, something growing in me needs as much help as it can get."

Kay, aged 24 (12 weeks gestation)

9.6.1.2.2 Indirect Risks

Indirect risks arose more from the notion that, whilst the performance of an activity in itself might not be dangerous, there were associated with it, other potential hazards that may threaten health.

The vast majority of indirect risks arose from recreational pursuits. Within this context, three specific limitations to activity were cited. These occurred in roughly equal proportion and referred to the potential harm that could be caused by activities commonly associated with passive smoking (14%), overcrowded locations (14%) and alcohol consumption (18%). The overriding effect of these concerns was to discourage women

from engaging in social activities outside the home. As one 24-year old woman explained:

"I don't go as much, I don't go to the pub. I don't want to drink or be in smoky atmospheres. I don't go out as much generally."

Melanie (25 weeks gestation)

For another, the practicalities and perceived risks of a busy environment were a greater deterrent:

"I always have to try to protect myself in crowded rooms so I don't want to go out. I like swimming but I can only go when it's adults only. I went before and got kicked by the children"

Angela, aged 25 (16 weeks gestation)

A shift in responses at 34 and 38 weeks gestation saw more women referring to issues concerning the impending birth. At this time, seven women (12%) indicated that they were spending less time away from their homes for fear that labour would start in a public place:

"I go out less. I'm frightened to be stuck somewhere when my waters break so I don't want to go out."

Louise (38 weeks gestation)

I won't go out for so long shopping. I want to stay nearer Leicester so I go on shorter journeys. I don't visit people so much just in case labour starts. I can't really go anywhere. "

Fiona (38 weeks gestation)

9.6.2 A Loss of Motivation

A further explanation for the observed reduction in daily activity levels during low-risk

pregnancy came from an inherent loss of motivation. In late pregnancy, a small proportion of individuals (13%) indicated that this antipathy was a secondary effect of a reduction in physical wellbeing. As one individual explained:

"I don't go out as much, to the pub and so on, it's too much effort. I don't do anything, it's difficult with no energy so I don't bother trying."

Rebecca, aged 23 (38 weeks gestation)

Much earlier in pregnancy however, a greater percentage of women (53%) had referred to the effects of a compelling psychosocial influence. At each stage of pregnancy, at least three references were made to the fact that pregnancy itself could be a buffer to activity. One individual stated:

"I'm more lazy than I used to be, it's easy to be like that now, no-one complains."

Lisa, aged 19 (16 weeks gestation).

For another respondent, pregnancy was seen as a legitimate reason for avoiding tasks that she had never really enjoyed:

"I do less housework, I don't go down the cellar. It's a good excuse really, I was always scared there were rats down there."

Anna, aged 25 (25 weeks gestation).

The responses documented above provide clear evidence for the fact that for some individuals, pregnancy may represent a period during which normal levels of responsibility are reduced and the need to conform to certain cultural expectations is removed (Clark & Ogden, 1999). Nonetheless, it must also be acknowledged that numerous other factors may discourage a childbearing woman from maintaining her habitual daily activity pattern. In the present study, one issue that was repeatedly found to compound a loss of maternal motivation for activity was maternal body image.

9.6.2.1 The Influence of Maternal Body Image

When asked why they had altered their daily activity behaviour, 14% of respondents (and 47% of women reporting reduced motivation for physical activity) voiced concerns over their appearance. In total 4 main concerns were highlighted in roughly equal proportions. These comprised 'feeling fat', 'feeling heavy', 'feeling awkward' and 'having no clothes to wear'. The impact of body image on daily activity was clear in the statement of one 21-year old:

I'm less active in my leisure time. I feel like a whale, very body conscious. I feel like people are looking at me a lot. It puts me off swimming. Maybe I'm just paranoid."

Claire (16 weeks gestation)

Another woman similarly commented:

"I'm going out less. I feel fat. You can't do the normal 'get the summery clothes out' thing, you don't get the same buzz. I'm trying to come to terms with my shape. "

Amy, aged 32 (16 weeks gestation)

Previous research on non-pregnant women has suggested that anxiety over physique or bodily appearance may be responsible for low levels of participation in a variety of social and recreational activities (e.g Spink, 1992; Wiles, 1994). It is therefore not surprising that, even in the earlier stages of pregnancy, concerns over body image may have influenced some women's activity levels. Nonetheless, other more practical factors also appeared to restrict maternal activity participation at this time.

9.7 Practical Limitations

The previous sections have demonstrated that a number of physical and psychosocial factors may ultimately limit physical activity participation during pregnancy. A less frequently mentioned but equally important issue was that of practical limitations. Within this context, three main factors were cited in roughly equal proportion. These referred to

a perceived lack of time (7%), a need to save money for the baby (7%), and a lack of appropriate facilities (5%). Most women focussed on only one main issue.

A lack of time for activity is one of the most commonly cited reasons for a low level of activity participation in adult populations (Jaffee et al, 1999). In contrast, a perceived lack of appropriate facilities may well be a unique phenomenon of pregnancy since this issue is likely to relate directly to prevailing patterns of advice and perceived risk (see section 9.5.2). When asked if she was happy with her current activity level for example, one 33-year old woman replied:

"I would have preferred to do more but there's nothing available for pregnant women in my area. I asked my midwife about the availability of exercise classes but there are none during the day. I want one run by a midwife so I know what I'm doing is O.K., that it's safe."

Fiona (34 weeks gestation)

Another highlighted how prevailing social attitudes had also restricted her access to exercise facilities:

"I used to go to the gym but when I asked an instructor what to do he said I should stop going. They weren't prepared to cover me, it was something about their insurance. He looked very nervous!"

Joanne, aged 25 (16 weeks gestation)

9.8 Summary: Limitations on Physical Activity During Pregnancy

This section has examined the primary reasons why women might reduce their daily activity levels during pregnancy. Findings suggest that several potential barriers to physical activity exist. In particular, the somatic symptoms of pregnancy, prevailing cultural expectations, maternal perceptions of risk and poor maternal body image may all discourage physical activity participation.

However, as discussed in chapters 7 and 8, not all maternal activities decline in pregnancy. This suggests that as well as perceiving barriers to their physical activity participation, pregnant women may also consider some aspects of their behaviour to be of benefit. Indeed, although incitements to activity were cited considerably less frequently than barriers in the current study, they were by no means absent from participant's responses.

9.9 Factors Encouraging Daily Activity in Pregnancy

The analysis of qualitative data highlighted two main reasons for increasing daily activity during pregnancy. Thirty per cent of respondents referred to a need to prepare for labour and the impending birth whilst a further fifteen per cent of respondents referred to a desire to maximise their opportunities for socialising.

The need to prepare for childbirth and the postpartum period provided one explanation for why the mean domestic activity ratio of the sample may have been maintained across pregnancy (see chapter 8). One 25-year old shop assistant explained how throughout the reproductive process, preparing the home had become a major source of activity:

"I'm doing more gardening at the minute. I want it to be tidy for the baby therefore I'm doing a bit more than before"

Emma (12 weeks gestation)

"I've been doing more housework. I want everything to be tidy now. I was never bothered before. I must be nesting, I don't know."

Emma (34 weeks gestation)

Other women however, used the approach of labour and birth as a reason for engaging in more social pursuits. As one respondent explained:

“I’m going out a lot more, I’m getting as much in as I can. I’m more restless and need to have plans to be going out. I need to see people, I’m probably going out more than if I wasn’t pregnant and still at work.”

Catherine, aged 31 years (34 weeks gestation)

Such responses suggested that the study participants were often using their pregnancy as time of practical and psychological preparation. As the women began to acknowledge their transition to the maternal role, they confronted a range of needs and desires. An important outcome of this behaviour was that each individual gradually developed a level of accommodation in which she could negotiate both her lifestyle demands and her concerns regarding the health of her baby.

9.9.1 The Use of Balancing Strategies

Responses to open-ended questions within the activity interview suggested that women employed certain strategies whenever the demands of their habitual lifestyles competed with their perceptions of the need to reduce their activity behaviour. These strategies included monitoring, prioritising, pacing and forward planning. The vast majority of respondents reported engaging in one or more of these strategies in order to manage the experience of pregnancy.

9.9.1.1 Monitoring

Monitoring was employed by 30% of respondents on one or more occasion during pregnancy. This strategy involved trying out different activities and monitoring the consequences. This approach provided women with an indication of the different activities and activity levels that they as an individual could maintain. Where no adverse effects were experienced women continued to meet the obligations and requirements of their daily life. However, where routine activities resulted in unwanted negative effects, subsequent behaviour patterns were modified to exclude or reduce the original task. For

example, one shop assistant was able to engage in occupational activities longer than most because she continually monitored her ability to do so:

"I stopped work at 36 weeks. That's quite late isn't it but I continued as long as I could. I would have got bored at home so while I felt O.K. I carried on. I didn't see the need to stop."

Sally (38 weeks gestation)

For other more active individuals testing placed limits on their behaviour much earlier in pregnancy. As one woman explained:

"I'm running less miles a week, five maximum versus my usual ten. I tried it but I had to stop. I felt too sick and shaky"

Nicola (12 weeks gestation)

Likewise another woman stated:

"I'm being careful now. I'm not going to line dancing any more. It gave me a bad stomach ache last time so I've decided not to go this week."

Anna (16 weeks gestation)

However, in instances where it was deemed impossible to avoid the demands and commitments of daily life, other strategies became equally important.

9.9.1.2 Prioritising

Prioritising occurred as women organised their various obligations into a hierarchy within which certain activities were maintained at the expense of others. In total this approach was cited by 32% of participants. In trying to manage the dual demands of pregnancy and daily life, these women revealed a characteristic grading of task domains. Occupational activity was consistently maintained over non-occupational activity and domestic activity

was always placed before recreational activity. For example, as one 29- year old nurse explained:

"I would have liked to have done less this week but my job demanded the activity. I tried to rest in my free time, I've stayed at home. I've done less housework, it's a trade off against going to work really."

Emma (16 weeks gestation)

Later in pregnancy another individual detailed a similar response:

"I've slowed down a lot. I've been the same at work, I've had to be but I've tried to catch my breath in between. I would have liked to do more, especially exercise but I'm trying to get the housework done first."

Linda (34 weeks gestation)

9.9.1.3 Pacing

A third strategy, pacing, was an extremely popular coping strategy and was employed by the vast majority of the sample (79%) on more than one occasion during pregnancy.

'Pacing' referred to the manner by which women were able complete a comparable level of activity to that which they had performed prior to pregnancy by dividing it into shorter, more frequent episodes. The use of this strategy within both the occupational and domestic domains has been described previously (see chapters 7 & 8, sections 7.6 and 8.3.2.3).

9.9.1.4 Forward Planning

Connected with pacing however, was a fourth strategy labelled *forward planning*. Performed by 19% of respondents this method necessitated the consideration of a future activity, the context in which it was likely to occur and the effect it was likely to have. From this, conscious decisions or arrangements could be made in order to limit the

adverse effects of that activity. By incorporating such provisions into their behaviour women were able to successfully manage different areas of their lifestyle. For example one woman explained how with a little forward planning she was able to maintain some degree of social interaction:

“I’m very choosy about where I go. I only go somewhere where I know I can definitely sit down. I try to meet up with my friend in a place that isn’t noisy or where I would have to stand up.”

Jade (25 weeks gestation)

Forward planning also meant that women were able to economise their movement within the home. A different individual indicated how she had started using such a strategy to assist with the household tasks that often confronted her:

“I try not to rush around so much. I leave things at the bottom of the stairs and take them up in one go. I tell myself it will get done eventually, when there’s enough there.”

Elizabeth (34 weeks gestation)

9.10 Chapter Summary

This chapter has examined reasons for the adaptations that occur in maternal daily activity behaviour during the course of low-risk pregnancy. Reasons for reducing levels of activity are varied and may be influenced by levels of maternal self-efficacy. Where levels of self-efficacy are low, women’s physical activity may decline both as a result of the physical changes of pregnancy (such as an increasing fetal mass) and from a combination of the strong social, cultural and medical discourses that continue to renounce physical activity in pregnancy. Often the perceived inappropriateness of physical activity during pregnancy may interact with a poor maternal body image and a low level of maternal motivation. This interaction may cause women to focus on predominantly sedentary home-centred tasks and in particular on tasks that focus attention towards the baby. To some extent, preparations for the postpartum period can

provide a means by which women can retain some control over their own activities whilst still fulfilling the responsibilities of motherhood. This notion may thus help to explain why maternal domestic activity is maintained at a time when maternal recreational activity levels and total daily activity levels are being reduced (see chapters 6 and 8).

Nonetheless, the findings of the present study also demonstrate that the relationship between a woman and the fetus can remain somewhat fluid. Participants sometimes seemed to view themselves as merged with their reproductive state and sometimes as a separate entity. Indeed, responses to open-ended questions within the activity interview often distinguished between those pursuits that were instigated by the pregnancy, such as preparing a home or nursery, and other pursuits that women wanted or needed to do (for example, continuing in their occupational role). To maintain these different activities, women actively engaged in a number of different balancing strategies. These comprised monitoring, prioritising, pacing and forward planning. Similar responses have been documented elsewhere. Durham (1998) for example, examined the behavioural patterns of a sample of women involved in the home management of pre-term labour. Findings indicated the women typically managed their activity restriction by employing several strategies whenever the demands of their relationships, household or career competed with the prescription of bed rest. These strategies included cheating, piggybacking and testing the limits of their activity restriction. Interestingly, the current study has identified similar responses in a healthy, low-risk population. The possible implications of this finding are discussed fully in Chapter 11. First however, it is necessary to consider the extent to which maternal daily activity levels may impact on fetal health.

CHAPTER TEN

The Impact of Maternal Daily Activity Levels on Pregnancy Outcome

10.1 Introduction

The previous chapters have assessed the impact of pregnancy on the daily activity levels of healthy British nulliparous women and investigated potential reasons for the patterns of behaviour that are observed. Of concern to the current chapter are the effects of this activity on pregnancy outcome. In Chapter 1, emphasis was placed upon the fact that the physical activity behaviour of pregnant women has traditionally been investigated purely from a clinical perspective. As a result, the vast majority of literature documents only the potential effects of discrete activity components in high-risk populations. Evidently, this information may be of little relevance to healthy pregnant women performing the more sedentary tasks of daily living. It has thus been proposed that if future standards of care are to be improved, the association between maternal activity and pregnancy outcome must be considered with respect to all the responsibilities that women face throughout the day (Woo, 1997). This chapter examines the impact of integrated levels of daily activity on intrapartum events and fetal health.

10.2 Statistical Analyses

Quantitative data were analysed using the Statistical Package for the Social Sciences 9.0 (SPSS Inc., Chicago). All data are reported as mean (S.D.) or as percentages. Relationships between maternal daily activity levels and birth outcomes were assessed using independent sample t-test for dichotomous variables, one way ANOVAs or Chi-square tests for categorical variables and Pearson's correlation for continuous variables. The independent associations between maternal daily activity levels and birth outcome were assessed by multiple regression. The data were checked for multivariate outliers using the criterion of Mahalanobis distance at $p < 0.001$, and the form of regression was assessed by examining a scatterplot of the residuals variable under test (SPSS Inc., Chicago).

10.3 Measures of Pregnancy Outcome

For the reasons discussed previously (Ch 4, section 4.3.3) all pregnancy outcome data were taken directly from hospital databases. These data related to both intrapartum events and neonatal outcome. Measures of intrapartum events were chosen on the basis of previous literature (see Chapter 2 for a review) and included (i) gestational age at delivery, (ii) levels of intrapartum intervention (including onset of labour and mode of delivery) and (iii) duration of labour. Measures of neonatal outcome included (i) infant birthweight and (ii) 1-and 5-minute Apgar scores.

An examination of the hospital databases revealed that the overall stillbirth rate of the study sample was 2% (n=1). Given that the expected rate of intrapartum still birth is typically 1 in 1000 births, this outcome was not expected on the basis of the sample size used (n=57). Fetal loss was reported to have occurred during delivery and an examination of the woman's data confirmed that she had not been identified as an outlier either in terms of her daily activity behaviour or her psychological wellbeing during pregnancy. All subsequent analyses were based only on pregnancies that resulted in a live birth.

10.4 Intrapartum Events

Data relating to intrapartum events was collected for both the study participants and a sample of non-participants. Participants were matched to non-participants using the entire database of women delivering at the same East Midlands hospital. Matching took place on the basis of time of delivery (± 4 months), maternal age (± 1 year), employment status (*full time, part time, unemployed or homemaker*), ethnicity (*Caucasian*) and smoking behaviour during pregnancy (*smoker, non-smoker or gave up smoking during pregnancy*). This approach allowed the normality of the participants' birth outcomes to be checked.

Table 10.1 displays the intrapartum events of both the participants and non-participants. Data presented in this table can be seen to reflect the low-risk nature of the study sample. For those participating in the study, gestational age at delivery ranged from 37.3 to 42.1 weeks with a

mean of 40.3 (S.D. 1.2) weeks. By comparison, the mean gestational age of non-participants ranged from 32.4 to 42.2 weeks with a mean of 39.6 (S.D. 1.9) weeks. Almost four fifths of study participants (79%) experienced a spontaneous onset of labour and just under three fifths (57%) underwent a non-assisted vaginal delivery. No significant differences were observed between these figures and those obtained for the matched controls. This finding confirmed that, except for the occurrence of the one intrapartum stillbirth, the women participating in the study were not unusual in terms of their pregnancy outcomes.

Table 10.1: Intrapartum Events for Study Participants and Non-participants

	Participants (n=56)	Non- participants (n=56)
Gestational age at delivery (wks)	40.3 (1.2)	39.6 (1.9)
% Preterm birth (<37 weeks)	-	2
Onset of Labour		
% Spontaneous	79	71
% Induction	21	29
Mode of delivery		
% vaginal	57	54
% forceps/ventouse assisted	25	20
% non elective caesarean	18	27

Data are mean and S.D. or percentage as appropriate

10.4.1 Gestational Age at Delivery

Associations between gestational age at delivery and total self-reported daily activity level at each stage of gestation were weak ($r=0.00-0.22$) and having controlled for the effects of maternal age, educational level and smoking status, no significant effects could be found. Furthermore, no individual participating in the study had a pregnancy that resulted in a preterm birth (gestational age <37 weeks). The absence of any such cases prevented further analyses on this variable from being performed.

10.4.2 Levels of Intrapartum Intervention

Figure 10.1 depicts the point of first intervention in the labour and birth experiences of both study participants and non-participants. In total, 18% of women who took part in the study

gave birth vaginally without experiencing obstetric intervention; that is, without their labour having been induced or augmented, the birth having been assisted by forceps or vacuum extraction, or stitches being required as a result of an episiotomy or tear (Brown & Lumley, 1994).

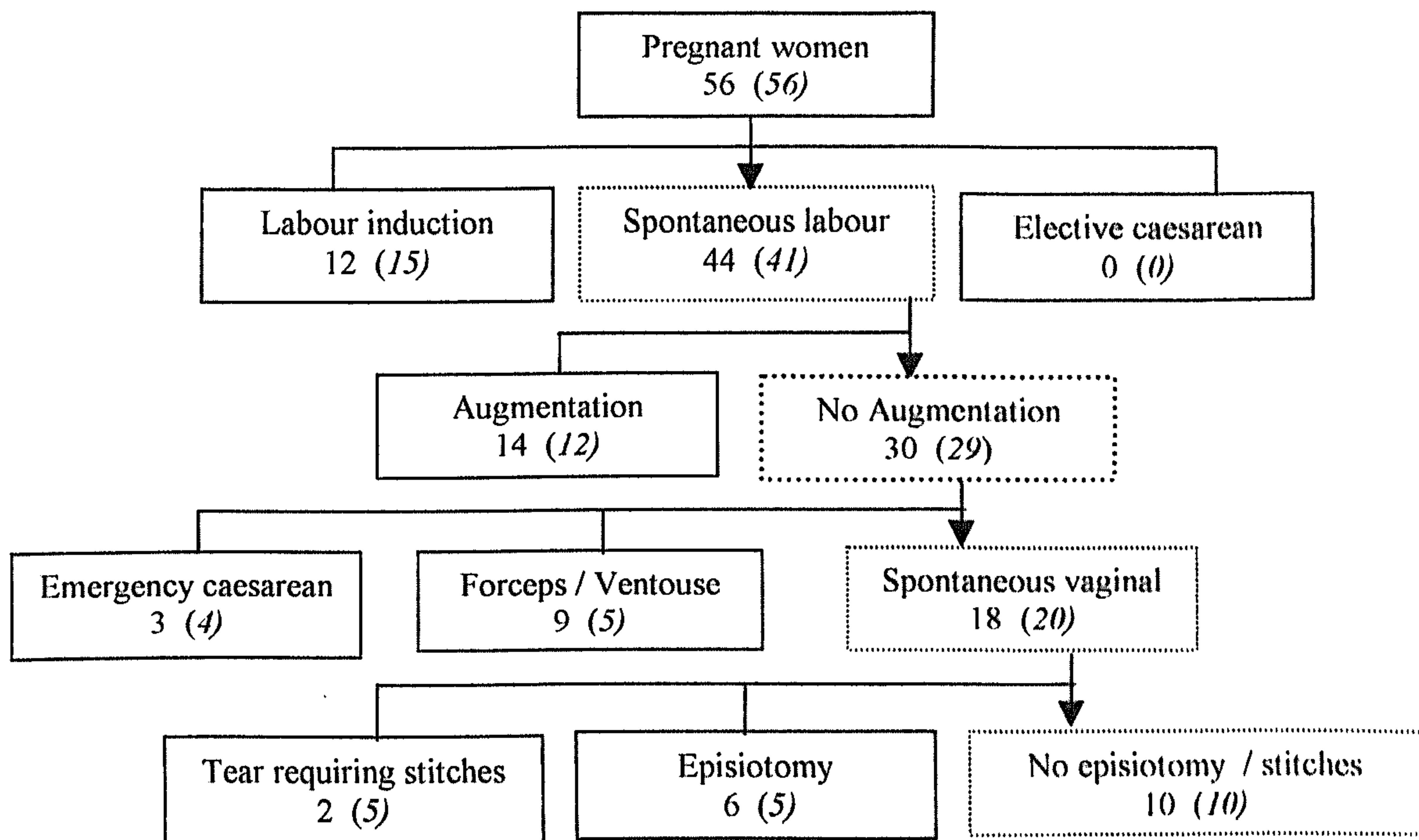


Figure 10.1: Pathway to the point of first intervention in the labour & birth experiences of the study sample and their matched controls (controls in italics). N.B. Numbers refer to numbers of individuals undergoing intervention *at each stage* and not necessarily to the total number of women experiencing that intervention. Dashed line represents path of least intervention.

As figure 10.1 serves to demonstrate, a number of different obstetrical procedures can ultimately contribute to the amount of clinical intervention that an individual experiences. As a consequence, there exist several different ways in which this intervention can be assessed.

10.4.2.1 Methods of Quantifying Intrapartum Intervention

When attempting to quantify levels of intrapartum intervention, simple divisions can certainly be made on the basis of mode of labour onset or mode of delivery. However, as Vance (1985)

argues, reliance on particular types of procedure may ignore small to medium size statistical effects, particularly where stress factors place a person at risk for several types of complication. A preferable alternative may therefore be to quantify the overall level of obstetrical intervention.

The literature relating to obstetric intervention reveals a diversity of scoring systems that have been developed for this purpose. Many previous studies have utilised indices in which a score is derived from tallying the number of abnormalities which have occurred (e.g. Touwen et al., 1980; Gillberg & Gillberg, 1983). Whilst such measures may be considered a crude and unreliable assessment of outcome, Vance (1985) maintains that it is both necessary and statistically sound to combine several interventions into one single value.

The Obstetric Technology Score (OTS) provides a typical example of how intrapartum intervention may be quantified. This method, originally devised by Oakley (1980) has been used and adapted by several other researchers (Elliot et al., 1984; Oakley & Rajan, 1990; Brown et al., 1994). The main drawback of this scale concerns the restricted range of interventions that it currently includes. As Clement et al. (1999) observe, more recent interventions such as transcutaneous electronic nerve stimulation (TENS) and fetal blood scalp sampling are not included in this measure. Likewise, the suturing of tears is only included in the most recent version (Brown et al., 1994) despite evidence suggesting that this can often be experienced by women as a major intervention (Greenshields et al., 1993; Green et al., 1988). Clement et al. (1999) emphasise that scoring systems based on the views of a researcher or the views of medical professionals have rarely been tested empirically. These authors suggest that, for certain purposes, it may be more productive to base an evaluation of intrapartum intervention on women's own perceptions of the procedures they receive. For this reason, Clement et al. (1999) recently developed the intrapartum intervention score (ISS), a much more empirically based scale which covers a wider range of obstetrical procedures.

10.4.2.2 The Method Selected for Scoring Intrapartum Intervention

In the current study, levels of intrapartum intervention were scored twice, firstly by the

standard Obstetric Technology Score (Brown et al., 1994) and secondly, by the newer intrapartum Intervention Score (Clement et al., 1999). The nature of the different interventions included in each scale are shown in table 10.2. With regard to the OTS, no significant differences were observed between participants and non-participants either in terms of the frequency of individual interventions or in the distribution of final scores. The only significant difference between the groups on the ISS was in the frequency with which they made use of TENS ($\chi^2 = 7.69$, $df=1$, $p<0.01$). A lower proportion of women using TENS or Entonox in the non-participant sample combined with a lower proportion of women using Pethidine is reflected in a higher epidural rate within this group. Nonetheless, no significant differences were observed between the total mean scores obtained by participants and non-participants on this scale. This finding provided further support for the normality of the participants' birth outcomes.

Table 10.2: Levels of Intrapartum Intervention Experienced by Participants and Non-participants

OTS			ISS		
Intervention (in order of scored severity)	Participants	Non- participants	Intervention (in order of scored severity)	Participants	Non- Participants
Perineal sutures	48	48	TENS	27	7
Pethidine	45	30	Entonox	64	57
Acceleration/Augmentation	30	29	Artificial R.O.M.	52	46
Labour Induction	21	27	Enema/suppository	-	-
Epidural analgesia	48	59	External electronic fetal monitoring	57	57
Forceps/Ventouse delivery	27	20	Vaginal examination	90	86
General anaesthetic	2	4	Urinary catheter	41	39
Caesarean section	18	27	Pethidine	45	30
			Prostaglandin Induction	9	20
			Syntometrine in third stage of labour	70	61
			Intravenous drip	52	50
			Oxytocin induction/acceleration	41	43
			Internal electronic fetal monitoring	18	14
			Perineal/labial/vaginal sutures	48	48
			Episiotomy	29	25
			Fetal blood scalp monitoring	-	0
			Epidural/spinal analgesia	48	59
			Forceps/Ventouse delivery	27	20
			General anaesthetic	2	4
			Caesarean section	18	27
Mean (S.D.) Score	7.1 (5.8)	8.5 (6.0)	Mean (S.D.) Score	38.8 (15.8)	39.2 (14.1)

In both the participant and non-participant samples, agreement between scores on the OTS and ISS was found to be moderate and significant (*Kendall's Tau coefficient* (τ) = 0.57 & 0.55 respectively, $p < 0.01$). The briefer and more common OTS was therefore selected for use in all subsequent analyses.

10.4.2.3. The Association Between Intrapartum Intervention and Maternal Daily Activity Level

To analyse the association of maternal daily activity with intrapartum intervention independently of confounding factors, a series of one step logistic regression analyses were used. The confounding factors were chosen on the basis of previous literature and comprised maternal age, educational level (*GCE or lower, A-level or equivalent, Degree or equivalent*) and smoking status (*non-smoker, stopped in pregnancy, smoker*). The dependent variable was the level of intrapartum intervention experienced, divided above and below the 66th percentile for the group. This cut-off identified women with the highest intrapartum intervention scores of the sample.

Table 10.3 displays the joint effects of daily activity and other potential confounders on the OTS scores of the sample. Significant and independent associations were observed between overall levels of intrapartum intervention and total maternal daily activity levels at 12 weeks ($p = 0.042$), 16 weeks ($p = 0.005$) and 34 weeks gestation ($p = 0.048$). In all cases, the direction of the relationship was such that lower levels of daily activity were associated with higher levels of intrapartum intervention. Maternal age was also found to exert an effect. This variable was identified as a significant predictor of high intervention scores at all stages of pregnancy ($p = 0.003-0.015$). The direction of the relationship was such that older mothers were more likely to experience a higher level of obstetrical intervention. A similar association has been documented previously. In a recent case-control study, Wong & Ho (1998) compared the labour outcomes of 76 older (40 years or above) and 152 younger (25-30 years) low-risk multiparous women of similar parity. Older women were found to spend significantly longer in the first stage of labour, experience significantly more fetal distress and receive more intramuscular analgesia. The incidence of instrumental delivery and caesarean section were also higher among the older multiparas. Rosenthal & Paterson Brown (1998) suggest that,

Table 10.3 Regression Analyses Examining the Joint Effects of Daily Activity Level and Other Variables on Intrapartum Intervention

Criterion: Total Level of intrapartum Intervention (OTS scores)									
12 weeks gestation (n=30)		16 weeks gestation (n=56)		25 weeks gestation (n=56)		34 weeks gestation (n=56)		38 weeks gestation (n=50)	
$\chi^2=16.576$, df=6 *		$\chi^2=26.801$, df=6 **		$\chi^2=13.53$, df=6 *		$\chi^2=16.981$, df=6 **		$\chi^2=11.175$, df=6	
B	Wald	B	Wald	B	Wald	B	Wald	B	Wald
<i>Predictors:</i>									
Maternal age	0.587*	5.811	0.330**	8.766	0.230*	0.207*	4.841	0.230*	6.166
Educational level:									
GCSE or below (ref)									
A-level or equivalent	1.043	0.513	0.383	0.129	0.521	0.074	0.005	0.580	0.386
Degree or equivalent	2.512	1.902	1.495	1.520	0.935	0.713	0.500	1.206	1.313
Smoking Status:									
Non-smoker (ref)									
Stopped in pregnancy	-1.683	0.727	-0.260	0.058	0.106	0.461	0.193	-0.200	0.0415
Smoker	-6.285	0.022	-2.630	2.379	-1.512	-1.485	0.913	-1.104	0.531
Total daily activity level	-10.623*	4.124	-10.285**	7.767	-2.156	-5.303*	3.846	-2.907	1.159

*p<0.05, p<0.05

whilst many studies may demonstrate a significant effect in women older than 35 years of age, changes in intrapartum intervention may actually occur on a continuum from the teenage years. These researchers studied nulliparous women with singleton cephalic pregnancies delivering at term (37-42 weeks of gestation). Pre-labour and emergency caesarean section, instrumental delivery, induction of labour and epidural usage in spontaneous labour all increased with increasing age. Fetal distress and failure to advance in the second stage of labour, were also more likely to occur as maternal age increased. These findings were interpreted as reflecting a progressive, age-related deterioration in myometrial function.

Within the context of the current study however, the independent association observed between daily activity level and intrapartum intervention scores is a more interesting finding. The review of the literature presented in Chapter 1 has already served to demonstrate that several studies report a relationship between physical activity and mode of delivery. However, most of these have concentrated purely on the effects of volitional exercise and the direction of the association has not always been clear (Erdelyi, 1962; Zaharciva, 1972; Dale et al., 1982; Hall & Kaufmann, 1987; see chapter 1). Perhaps the strongest support for a negative association between total activity level and intrapartum intervention comes from the work of Magann et al. (1996). These authors report a higher rate of induction of labour in individuals expending more than 2900 kcals per day compared to women expending less than this amount, a relationship that appears to hold for both nulliparous and multiparous women.

10.4.2.4. The Factors Contributing to an Association Between Intrapartum Intervention and Maternal Daily Activity

Further investigations were carried out to ascertain whether the effects observed in the current study were the cumulative result of many different interventions or could instead be explained primarily in terms of one or two procedures. Participants were divided on the basis of each of the interventions included in the OTS and compared in terms of their daily activity level at 16 weeks gestation. The only two procedures that approached or met significance were 'induction of labour' ($p < 0.08$) and 'caesarean section' ($t = -2.84$, $df = 54$, $p < 0.01$). The specific

associations between maternal daily activity level, mode of labour onset and mode of delivery were therefore examined in greater detail.

Table 10.4: Daily Activity Levels of the Sample According to Mode of Labour Onset and Delivery.

Stage of gestation:	Total daily activity level (METS)				
	12 wks	16 wks	25 wks	34 wks	38 wks
LABOUR ONSET:					
Spontaneous	20 1.48 (0.21)	44 1.53 (0.19)	44 1.47 (0.25)*	44 1.39 (0.21)	39 1.28 (0.14)*
Induced	9 1.46 (0.23)	12 1.57 (0.18)	12 1.66 (0.27)*	12 1.43 (0.16)	11 1.40 (0.14)*
MODE OF DELIVERY:					
Vaginal	17 1.52 (0.22)*	34 1.58 (0.19)*	34 1.51 (0.30)	34 1.41 (0.20)	29 1.33 (0.12)
Instrumental vaginal ^a	7 1.51 (0.09) *	14 1.51 (0.18)	14 1.54 (0.25)	14 1.41 (0.23)	13 1.27 (0.18)
Non-elective caesarean	5 1.27 (0.21)**	8 1.40 (0.12)*	8 1.48 (0.15)	8 1.31 (0.09)	8 1.27 (0.16)

Data are n, mean (S.D.) ^a Instrumental vaginal = forceps/ventouse deliveries * * $p < 0.05$ by one way Anova & t-test

Table 10.4 displays mean daily activity levels at the five stages of pregnancy according to mode of labour onset and mode of delivery. Compared to women experiencing spontaneous onset of labour, women undergoing induction of labour were significantly more active at 25 weeks ($t=0.22$, $df=54$, $p=0.030$) and 38 weeks gestation ($t=0.25$, $df=49$, $p=0.017$). Compared to women experiencing a spontaneous vaginal delivery, women undergoing non-elective caesarean were significantly less active at 12 weeks ($t=0.23$, $df=20$, $p=0.034$) and 16 weeks gestation ($t=0.26$, $df=40$, $p=0.013$). They were also significantly less active at 12 weeks gestation than those experiencing an instrumental vaginal delivery ($t=0.29$, $df=10$, $p=0.014$).

10.4.2.5 The Association Between Maternal Daily Activity Level and Mode of Labour Onset

Logistic regression modelling controlling for maternal age, educational level and smoking status confirmed that maternal daily activity level at 38 weeks gestation was significantly associated with mode of labour onset ($B=-6.85$, $Wald=4.20$, $p<0.05$). The direction of its

contribution was such that as daily activity levels increased the odds of experiencing spontaneous labour decreased.

Induction of labour may be indicated whenever the benefit of delivery to the mother or fetus outweighs the potential problems caused by continuation of the pregnancy. The reasons for induction in the current study could not be easily identified from hospital databases. However, a comparison of gestational age at delivery did reveal that the mean gestational length of pregnancies resulting in induction of labour was significantly longer than that of pregnancies ending in spontaneous labour (*41.1 vs. 40.1 weeks; $t=2.47$, $df=54$, $p=0.05$). At the East Midlands hospital involved in the current study, induction of labour is routinely performed on women who have not experienced spontaneous onset of labour 14 days after their estimated date of delivery. Nine women in the study (and 75% of those who were induced) fell into this category.*

Such findings raise the possibility that the observed association between daily activity level and mode of labour onset may be a consequence of inaccuracies in the initial assessment of gestational age. For example, if an estimated date of delivery was too early, then a pregnant women may not only be at risk of being called overdue but may also demonstrate a higher level of activity at what is wrongly assumed to be the 38th week of pregnancy. However, all estimated dates of delivery in the current study were based upon routine ultrasound examinations undertaken before the 14th week of pregnancy. A randomised trial has previously shown that an early ultrasound will reduce the risk of women being identified as overdue from 8% to 2% (Gabbe et al, 1991). Thus, this effect is unlikely to provide an adequate explanation. Rather, the results are likely to reflect a genuine relationship between maternal daily activity level and mode of labour onset. As stated previously, Magann et al. (1996) have also reported a trend to a higher rate of induction in a sub-sample of women designated as most active (energy expenditure > 2900 kcal/day) at 16-18 weeks gestation. These authors however, provide no possible explanation for the relationship they observed.

10.4.2.6 *The Association between Maternal Daily Activity Level and Mode of Delivery*

Having controlled for maternal age, educational level and smoking status, the association between daily activity level at 16 weeks gestation and delivery by caesarean section also remained significant ($B=-10.64$, $Wald=4.87$, $p<0.05$). The direction of this relationship was such that as the level of activity increased the odds of undergoing a caesarean section decreased. Daily activity level at 12 weeks gestation just missed significance at the $\alpha=0.05$ level ($p=0.08$).

To date, the evidence for an association between physical activity and mode of delivery has been both limited and variable. Hall and Kaufmann (1987) for example report an inverse relationship between the amount of exercise undertaken and the proportion of caesarean deliveries performed. In direct contrast however, Dale et al. (1982), document a greater risk of caesarean delivery in an active cohort of pregnant runners.

10.4.3 *Duration of Labour*

As well as collecting data relating to intrapartum intervention, the current study also obtained measures of labour duration. Normal labour is a continuous process and is divided into three stages. The first stage of labour is the interval between the onset of labour and full cervical dilation. The second stage of labour is the interval between full cervical dilation and the delivery of the infant. The third stage of labour encompasses the period between delivery of the infant and delivery of the placenta.

Due to different levels of intrapartum intervention and different recording practices between midwives, data on duration of labour was sometimes absent from hospital databases. Table 10.5 displays the mean duration of labour in the women for whom such data was available. Associations between total maternal daily activity levels during pregnancy and the duration of labour (both in terms of its individual stages and its total length) were weak ($r=-0.002-0.255$). Having controlled for the effects of maternal age, educational level and smoking status, no significant relationships between daily activity level and duration of labour could be found.

Table 10.5: Mean (S.D.) Labour Duration for Participants

	n	Labour Duration (hrs)
First stage	46	9.5 (4.8)
Second stage	46	1.2 (0.9)
Third stage	56	0.4 (1.6)
Total Duration	55	10.7 (4.7)

10.5 Neonatal Outcome

Finally, the potential effects of total daily activity on neonatal outcome were considered. Neonatal outcome for both the study sample and their matched controls are shown in table 10.6.

Table 10.6: Neonatal Outcomes Statistics for Study Participants & Non-participants

	Participants (n=56)	Non-participants (n=56)
Crude birthweight (g)	3308 (510)	3201 (487)
% Low birth weight (< 2500g)	7	11
Small for gestational age		
% < 5th percentile	11	7
% < 10th percentile	18	11
Apgar score 1-minute	8.5 (0.8)	8.1 (1.3)
% < 7	2	7
Apgar score 5-minute	9.3 (0.5)	9.2 (0.7)
% < 7	-	2
Infant Sex		
Male	51	68
Female	49	32

Data are mean and S.D. or percentage as appropriate

10.5.1 Infant Apgar Scores

Mean infant Apgar score at 1-minute was significantly higher in the participant group than in the non-participant group ($t=2.11$, $df=108$, $p<0.05$). No significant differences were observed in the 5-minute score. Very few participants ($n=1$) gave birth to an infant who scored less than seven on the Apgar scale. A lack of cases of clinical significance therefore prevented the

relationship between maternal daily activity levels and infant Apgar scores from being explored.

10.5.2 Infant Birthweight

Mean crude birthweight for the sample was 3308g (S.D. 510g) and ranged between 2409g and 4507g. Mean crude birthweight for the non-participants was 3201g (S.D. 487g) and ranged from 1800g to 3960g. No significant differences in birthweight were observed. This accepted, a slightly smaller percentage of participants gave birth to a low birthweight infant (<2500g) and a slightly higher percentage gave birth to an infant designated as small for gestational age (SGA). As documented in Chapter 1, the term 'Small for Gestational Age', which is also known as is as IUGR, is often defined as a birth weight in the lower 10th percentile of the norms for that gestational age (Kramer, 1991). The rates of SGA that were observed the current study were therefore somewhat higher than would be expected to occur in a healthy, low-risk population.

10.5.2.1 Associations between Maternal Daily Activity Level and Infant Birthweight

Potential associations between maternal self-reported daily activity levels and infant birthweight were investigated. Since both neonatal and post-neonatal mortality increase exponentially with decreasing birthweight, this variable can be considered one of the most important predictors of infant survival (Hogue et al., 1987).

A multivariate linear regression model was used to analyse the association of maternal activity with birthweight independently of possible confounding factors. Although partly determined by gestational age, birthweight is also influenced by parental characteristics. Previous studies have shown that maternal height, weight, age and parity can all positively affect infant birthweight whilst hypertension, smoking and lower social class are negative influences (Chamberlain, 1975; Federick & Adelstein, 1978; Brooke et al., 1989). Given that all the women in the study were nulliparous, parity was not included as a confounding variable. Likewise, maternal hypertension was excluded from the model because very few participants

in the current study suffered from this problem. Only two women were diagnosed with mild hypertension. Both cases occurred at 38 weeks gestation and neither required hospitalisation.

All other variables were entered simultaneously into the analysis. The dependent variable was examined as a continuous variable since its association with infant mortality has been shown to be present within the normal birthweight range (Goldstein 1977).

Table 10.7: Regression Analyses Examining the Joint Effects of Daily Activity Level and Other Variables on Infant Birthweight

	25 weeks gestation		34 weeks gestation		Mean (16-38 weeks)	
R ²	0.44**		0.42**		0.56**	
	B	S.E. B	B	S.E. B	B	S.E. B
Predictor variables:						
Maternal age	3.02	13.42	-4.55	13.84	-9.81	13.08
Educational level	186.18*	80.03	194.55*	82.00	228.37**	73.58
Height	-604.60	945.45	-212.43	1003.73	-101.48	906.36
Weight pre-pregnancy	14.57*	5.81	11.26 ^x	6.04	12.48*	5.52
Smoking status	-99.90	79.96	-141.35	87.27	-189.68*	76.09
Gestational age	110.91*	47.28	122.04*	48.00	128.26*	57.96
Sex of neonate	310.20**	112.80	263.34*	115.43	306.34**	105.61
Total activity level	-544.85*	217.95	-706.74*	336.12	-1276.62**	374.96
Constant	-1009.42	2324.11	-1456.40	2352.17	-1087.91	2608.31

^x p<0.07 * p<0.05 ** p<0.01

Total daily activity level at 25 and 34 weeks gestation were significantly and negatively associated with infant birthweight (Table 10.7). Total daily activity at 16 weeks gestation just missed significance at the $\alpha=0.05$ level ($p<0.09$). Other significant predictors of birthweight included maternal weight pre-pregnancy, educational level, gestational age and sex of the neonate. The direction of each of these relationships was as expected from the literature. A lower birthweight was associated with a lower level of maternal education, a lower weight pre-pregnancy, a shorter gestational length and a female infant sex.

The findings displayed above thus demonstrate a significant negative association between birthweight and total daily activity in low risk pregnant women. This relationship is independent of confounding factors and is particularly evident in the second half of pregnancy. Support for this finding can be found in previous work. Hytten (1984) for example, claims that,

aside from distinct teratogenic exposures, an adverse effect on birthweight is the one of the most plausible mechanisms by which physical activity may impact on fetal health. Moreover, both Manshande et al. (1987) and Alegre et al. (1984) have shown that infant birthweight can be significantly improved by inactivity during the last trimester of pregnancy.

However, as documented in Chapter 1, other research findings have been more equivocal. Rabkin et al. (1990) report on one of the few studies that has measured both occupational and non-occupational activity on a repeated basis through pregnancy. In this instance, data were collected prospectively at 17, 28 and 36 weeks of pregnancy and maternal energy expenditure was estimated from a questionnaire. No association between mean birthweight and energy expenditure could be found, either in terms of occupational activity, domestic activity or a composite measure of the two. Nevertheless, one major criticism of this work may be that estimates of energy expenditure were purely based on the amount and nature of activity performed in the day preceding the participants' interviews. As the present study has demonstrated, different results may be achieved when a more representative measure of activity is obtained.

This accepted however, the findings of the current work cannot automatically be interpreted as evidence of a deleterious effect of daily activity on neonatal outcomes. It is equally possible for example that *inactivity* during pregnancy may be associated with a greater risk of larger (or macrosomic) birthweights. To understand this issue fully, further research on a larger sample is required.

10.6 Chapter Summary

This chapter has considered the impact of maternal daily activity levels on pregnancy outcome. Previous studies have suggested that only extreme forms of activity may have an adverse affect on the outcome of pregnancy (see chapter 1 for a review). However, the findings of the current study suggest that an accumulation of light intensity activity may also exert an effect.

A comparison of study participants with matched controls showed that, for the most part, the sample was not unusual in terms of its pregnancy outcomes. Exceptions to this rule included the fact that one respondent experienced an intrapartum stillbirth. In addition, comparatively high rates of intrauterine growth retardation were observed. These differences accepted, significant and independent associations were observed between total maternal daily activity and several measures of pregnancy outcome. Findings suggested that maternal activity levels at 38 weeks gestation may have had an important impact on labour onset, with more active women being significantly less likely to experience a spontaneous onset of labour.

One possible explanation for this relationship concerned the gestational age of infants at delivery. The vast majority of women who underwent induction of labour in the present study had pregnancies that lasted beyond 40 weeks gestation. Thus, whilst no linear relationship could be observed between maternal activity levels and gestational age per se, it is possible that higher levels of daily activity in late gestation may nonetheless have been associated with a prolongation of pregnancy. Other findings suggested that high levels of maternal daily activity in the earlier stages of pregnancy may significantly reduce the need for an emergency caesarean section. These findings need to be borne in mind when counselling women about the respective benefits and hazards of physical activity in pregnancy.

Given that caesarean section is typically rated as a more severe intervention than induction of labour, one may argue that physical activity during pregnancy should be encouraged. Certainly, caesarean sections are likely to result in a number of undesirable outcomes including higher medical costs for the hospital and longer recovery times for the woman. It is acknowledged however that women's attitudes towards caesarean section may be changing, with increasing numbers electing to undergo this procedure.

Of greater relevance therefore may be the impact of daily activity on infant birthweight. At both 25 and 34 weeks gestation higher levels of maternal daily activity were found to independently reduce infant birthweight. The findings of the current study thus suggest that, even within a limited range of activity levels, women's physical behaviour may impact significantly on fetal health. This observation could have important implications for antenatal

care. Ultimately however, a number of methodological limitations may have influenced the findings of the present study and results must therefore be treated with caution. The main issues surrounding the study's limitations are discussed in detail in Chapter 11.

CHAPTER ELEVEN

Discussion and Conclusions

11.1 Introduction

The work presented in this thesis has examined a number of different issues surrounding the measurement and description of maternal daily activity patterns during low risk pregnancy. An initial review of the literature highlighted a need to examine the patterns of maternal daily activity behaviour in contemporary Western society. Currently, no definitive norms regarding the daily activity levels of low-risk pregnant women exist. It was therefore hoped that a study designed specifically to collect such information would represent the first step in providing baseline data for pregnant women and their health-care providers.

In effect, the research comprised two main parts. *Part One* was dedicated to designing and developing an appropriate activity measure suitable for use in adult women. The decision to design a new measure stemmed from three separate observations. Firstly, that few assessments of integrated daily activity have previously been taken; secondly, that the accuracy of many current measures is ill-defined and thirdly, that concern has been expressed regarding the applicability of current measures to adult females.

Part Two of the research focussed on an assessment of the daily activity levels of British nulliparous women. Interest in this topic arose from the identification of a potential association between maternal physical activity and pregnancy outcome. It was evident that, despite the possibility of a large discrepancy between women's assumed and actual behaviour, there was a lack of information on the integrated daily activity levels of low-risk pregnant women. Indeed, to determine the full impact of pregnancy on women's activity levels much more information was required. To obtain this information, the activity measure that was designed in part one of the research was used to gather data from a sample of healthy British nulliparous women.

This chapter will review the study's results within the context of the research aims stated in Chapter 1. In addition, the implications of the present work are considered and recommendations for future studies are made.

11.2 Research Aim 1:

The Design, Implementation and Evaluation of an Appropriate Method for the Measurement of Daily Physical Activity in Pregnancy

The first aim of the research was to develop a method that could accurately record the daily physical activity patterns of healthy pregnant women. This work entailed a review of current methods, the development of a new activity questionnaire and the use of an ambulatory activity monitor. These techniques were piloted and refined before being used in the main study. The following section discusses the reliability and validity of the measures and considers specific issues regarding participant compliance.

11.2.1 The Validity and Reliability of the Measures in Non-Pregnant Women

Initial studies assessed the accuracy of the self-report measure and the ambulatory activity monitor in healthy, non-pregnant women. These studies involved examining the relative validity and the reliability of the self-report measure as well as establishing the validity of the ankle as a placement site for the activity monitor.

The relative validity of the measures was assessed by comparing them against two existing measures of physical activity (see Chapter 3, section 3.10). A strong correlation was observed between the new activity questionnaire and the modified Baecke questionnaire (Pols et al. 1995). The coefficient that was obtained ($r=0.73$) improved dramatically on those obtained from previous studies. Albanes et al. (1990) reported a correlation of just 0.36 when validating the Minnesota leisure-time survey against the Baecke questionnaire. Similarly, Cauley et al (1987) compared five subjective measures of physical activity in post menopausal women and found the majority of correlations to

be between -0.20 and 0.30 . The validation study also demonstrated a moderate correlation between the modified Baecke questionnaire and the activity monitor ($r=0.66$). Previously Bouten et al. (1996) reported a correlation of 0.58 when comparing movement registration with physical activity levels as assessed by the doubly labelled water method. The results of the validity studies in the present research were therefore extremely encouraging.

The validation studies conducted within the present research only assessed the relative validity of the new techniques. Wareham & Rennie (1998) state that it is not sufficient to compare questionnaires with other subjective instruments since these are likely to have correlated error. However, since the absence of a true gold standard makes the assessment of absolute validity very difficult (Blair et al., 1992), caution should be taken against being critical of this approach. Indeed, according to Washburn et al. (2000) establishing the reliability and validity of physical activity questionnaires is a difficult task without a totally satisfactory solution, not least because there are no objective biological markers that can accurately characterise habitual physical activity. Physical fitness has been used in many studies as a validation standard (Blair et al., 1985; Taylor et al., 1978) but there is a concern that low intensity activity levels might not improve physical fitness. For this reason, some researchers have chosen to use direct observation as a validation tool (Klesges et al., 1990). However, this approach can be so intrusive that it may alter behaviour and bias observations. Similar problems can also occur when measuring energy expenditure by direct or indirect calorimetry (Blair, 1992). Thus, questionnaire validity studies often have little option but to rely on criterion measures of energy expenditure that have been estimated from activity diaries, motion sensors, or dietary records (Paffenbarger et al. 1993; Jacobs et al. 1993).

11.2.2 The Validity of the Measures in Pregnant Women

The activity monitor and self-report questionnaire were subsequently employed on a repeated basis in a sample of low-risk nulliparous women (see Chapter 4, section 4.3.2.7). As pregnancy progressed, correlations between the monitor and self-report data declined.

The level of agreement between the two measures was highest at 12 weeks gestation ($r=0.55$) and lowest at 34 weeks gestation ($r=0.13$). In non-pregnant women, a correlation coefficient of 0.72 had been achieved. Two main explanations for the weaker correlations in late pregnancy can be offered. Firstly there are difficulties involved in measuring the extremely low activity levels of sedentary populations. Secondly, there may be problems involved in using an activity monitor to obtain a representative measure of daily activity in childbearing women.

11.2.2.1 The Feasibility of Measuring Activity in Sedentary Populations

In late pregnancy, the mean daily activity levels of the sample were low, with little variation in maternal activity behaviour. Irrespective of their pre-pregnancy activity levels, women's activity during pregnancy declined to a common baseline and by 38 weeks gestation the mean self-reported activity level of the sample was just 1.31 (S.D. 0.14) METS. This value is below the energy intake of $1.56 \times \text{BMR}$ recommended for non-pregnant women with light activity patterns (FAO/WHO/UNU, 1985). It is therefore likely that the infrequency and intermittency of maternal activity in late pregnancy affected at least one of the activity measures employed in the current study. Westerkerp (1999) for example, states that accelerometers cannot be used to measure static activities since motion sensors are unable to detect the metabolic cost associated with standing, static work and vertical lift. In normal daily life, it is assumed that the effect of static exercise on total level of physical activity is negligible (Westerkerp, 1999). However, in extremely sedentary populations, the time spent in sitting and standing activities may add up to several hours per day.

Bassett et al. (2000) acknowledge similar problems with self-report. These authors document that whilst respondents can recall vigorous and structured exercise with a high degree of accuracy, a lower saliency of sedentary activities may hamper the reliability of an individual's recall. However, several studies suggest that physical activity is a robust behaviour that can be at least be partially characterised by crude methods. Previous research has demonstrated an increased risk of morbidity and mortality in persons with

low activity levels as determined by questionnaire (Paffenbarger et al., 1986; Leon et al., 1987; Morris et al., 1990) and even simple one- or two-item surveys have shown relationships between sedentary activity habits and health (Kaplan et al., 1987). Given that the current study employed interviewer probing to assist in the accurate recall of sedentary activities (Frankfort-Nachmias & Nachmias, 1992; Baranowski, 1988), it is likely that most of the error occurred in the activity monitor data.

11.2.2.2 The Feasibility of Using Activity Monitors in Pregnant Populations

One particular factor that reduced the accuracy of the monitor data in the current study was the fact that compliance with the ambulatory activity monitor varied enormously, both between individuals and between different stages of gestation. At 12 and 16 weeks gestation, the vast majority of women monitored their activity levels for the designated 72-hour period. This allowed daily activity levels on both working and non-working days to be assessed (see section 4. 3.2.7). By 34 weeks gestation however, the number of women providing a full set of data had markedly declined. When those who complied with activity monitors at 25 weeks were compared with those who did not, significant differences in health value and extroversion were observed. Along with educational level and age, health value was also identified as a significant predictor of compliance at 6-8 weeks postpartum.

The link between high levels of participant compliance and high maternal health value suggests that use of the activity monitor may ultimately have depended upon the level of importance that different individuals attributed to the research. It is feasible to suggest for example, that the women who placed a higher value on their health would have been more likely to perform health-related behaviours *before* pregnancy (Lau et al., 1986) and thus also be more interested in assessing their own behaviour *during* pregnancy. It is also possible to conceive how these women may have possessed a greater appreciation of the study's objectives, and a greater belief that they could make a valuable contribution to these aims. These perceptions alone may have been sufficient to maintain their

commitment to an otherwise time-consuming study that necessitated monitoring activity in every aspect of daily life.

Previous research has shown that treatment regimes which must be followed over a long period of time, that are highly complex and that interfere with other desirable behaviours in a person's life, all show lower levels of adherence (Turk & Meichenbaum, 1991). However, the effect of health value on participant compliance is likely to have been particularly evident in the current work given that there was no other financial or material reward for participating in the study. As yet, no previous studies have used activity monitors repeatedly for a period of 9 months. It is therefore difficult to establish whether rewarding participants for their part in the study would have been effective in increasing compliance in the latter stages of the research. Other findings certainly suggested that additional factors also discouraged the use of activity monitors during pregnancy.

At both 38 weeks gestation and 6-8 weeks postpartum, levels of compliance with the activity monitor were raised. This suggested that the low levels of compliance observed in mid gestation were not merely an artefact of conducting longitudinal research, but were also influenced by the women's reproductive status. It is possible that in some individuals, the physical discomforts of pregnancy may have provided sufficient barriers to the monitor's use. When used on the ankle for example, one such discomfort may be the soft tissue swelling or lower leg oedema frequently noted during pregnancy.

However, this effect is unlikely to be prevalent before the third trimester and very few participants reported suffering from this complaint (see Chapter 5, section 5.5.3). Rather, anecdotal comments from the women suggested that their failure to comply with the study protocol had originated almost entirely from a reluctance to use the activity monitor in public. This notion was reflected in the fact that compliance with the activity monitor decreased as levels of extroversion increased.

Such an unwillingness to use the monitor outside the home had not been evident in the pilot study. This suggested that a unique feature of the pregnancy experience might ultimately reduce the viability of using ambulatory activity monitors in childbearing

women. Unger and Crawford (1996) posit that there is a prevailing social encouragement for pregnant women to withdraw from their habitual activities and believe that this expectation often makes them a novelty in public settings. Similarly, Taylor and Langer (1977) illustrate how pregnant women frequently experience avoidance and staring. Such responses can make pregnant women feel uncomfortable and increase their perceptions of social isolation. Many pregnant women may thus be reluctant to wear an activity monitor for fear that it would attract additional attention.

11.2.3 The Implications of Part One of the Research

Part One of the research was concerned with establishing the feasibility of using an activity monitor and a questionnaire to assess the daily activity patterns of pregnant women. According to Montoye et al (1996) assessing physical activity with accelerometers that measure movement in more than one plane has become a viable option not least because they are unobtrusive and lightweight instruments. Moreover, Jacobs (2000) posits that since pregnancy is a state in which the body and physical activity levels may change rapidly, an activity monitor worn for 4-6 days each month may well represent an effective method of measuring physical activity levels during this time. However, the present study has served to identify some unique problems in using activity monitors in pregnant women. These problems emanate from (i) a need to measure low levels of activity in late gestation and (ii) women's reluctance to wear an activity monitor when visibly pregnant. The choice of an appropriate measurement technique may thus depend upon the specific application for which it is intended.

An activity monitor mounted on the wrist undoubtedly remains a feasible method of assessing nocturnal activity patterns. This technique has recently been used to successfully assess the sleep wake patterns of pregnant women (Shinkoda et al., 1999). It is also possible that a continuous record of activity could be obtained in high-risk pregnant women confined to hospital. However, in order to assess the daily activity patterns of healthy pregnant women within the field setting, the only viable option may remain a well-developed and detailed questionnaire.

The interview questionnaire used in the present study was developed specifically for the assessment of daily activity in pregnant women. As such, it represents the only known self-report measure of its kind. Findings from the current study certainly suggested that integrated 24-hour activity levels may be an important influence on pregnancy outcome (see section 11.5). However, many of the questionnaires that have been used previously have been designed primarily to assess the impact of specific occupational activities on fetal health (e.g Berkowitz et al., 1983; Koemeester et al. 1995). The detailed self-report measure that was developed in the current study may therefore be of future value to studies aimed at improving antenatal care (see section 11.6).

11.3 Research Aim 2:

The Impact of Low-Risk Pregnancy on the Daily Activity Levels of British Nulliparous Women

Repeated measures of the respondents' activity patterns across pregnancy revealed several trends, both in overall levels of daily activity and in the various components of this behaviour. Both data from the ambulatory monitor and the new activity questionnaire demonstrated an overall decrease in mean maternal daily activity levels between 25 and 38 weeks gestation. As pregnancy progressed, a significant reduction in the flexible elements of women's occupational activity was observed. Concomitantly, participation in structured sports and exercise ceased and the intensity of other recreational activities, such as walking, was reduced. Increasing amounts of time were spent within the home with significant increases in daytime resting. Mean nocturnal sleep duration also increased. As pregnancy progressed, women reported waking more frequently at night, a finding that led to a decline in perceived sleep quality. The main changes that occurred in maternal daily activity patterns are discussed in greater detail below.

11.3.1 Longitudinal Trends in Maternal Daily Activity Levels

The present study investigated the impact of pregnancy on the daily activity patterns

displayed by a sample of predominately sedentary nulliparous women from Leicestershire. Data from the activity questionnaire showed that the mean physical activity level (PAL) of the study was highest at 16 weeks gestation (1.54 (S.D. 0.18) METS) and lowest at 38 weeks gestation (1.31 (S.D. 0.14) METS). These values compare favourably with values obtained in a previous study of Western pregnant women. Van Raaij et al. (1990) used activity diaries to examine the self-reported activity levels of sedentary Dutch women during pregnancy. In this instance values were found to range from 1.48 (S.D. 0.10) x BMR at 22 weeks gestation to 1.52 (S.D. 0.09) x BMR at 34 weeks gestation.

However, one must acknowledge that the questionnaire assessment of the respondents' daily activity levels relied solely on maternal self-report and as such may be open to memory and recall biases. The peak that was observed in mean daily activity levels could, for example, simply have coincided with a time when women in the study expected to be most active. Nevertheless, the objective data obtained from the ambulatory activity monitors demonstrated a similar trend. Average registered body movement was highest at 16 weeks gestation (186.73 (S.D. 59.43) activity counts/1-min epoch) and lowest at 38 weeks gestation (157.35 (S.D. 69.04) activity counts/1-min epoch). The changes that were observed in the self-reported data were therefore believed to reflect genuine behavioural responses.

Both the self-reported data and the objective activity monitor data demonstrated that the mean daily activity levels of British nulliparous women decline significantly in the latter half of pregnancy. This trend confirms that which may be expected from the literature. Erickson (1967) states that maternal fatigue may become a prominent symptom in late pregnancy and rapid weight gain, joint laxity and shortness of breath may all cause physical discomfort in the third trimester. Maternal anxiety may also rise (e.g. Beck et al., 1980; Areskog et al., 1984; DaCosta et al., 1999). All of these factors are likely to precipitate a change in maternal activity behaviour (McMurray et al., 1993; Wolf & Kissling, 1984; Ogden & Mtandabari, 1997).

The results of the present study certainly suggested that the women's physical and psychological wellbeing declined in the second half of pregnancy. Reported somatic symptoms were lowest during the second trimester, as were scores on the Edinburgh Postnatal Depression Scale and State-Trait Anxiety Inventory (see Chapter 5). In addition, there was direct evidence to suggest that the physical discomforts of pregnancy may have impacted on women's daily activity behaviour. In late pregnancy, physical discomfort was frequently cited as an explanation for increased levels of nocturnal activity. Over four fifths of the sample also reported that their waking activity had declined due to the physical limitations they had experienced during the third trimester. Participation in structured sports and exercise was specifically reported to have been affected by a reduction in physical wellbeing, as was maintenance of the occupational role. Irrespective of when women left paid employment, physical effects were the most popular explanation for ceasing work. Throughout pregnancy, the most prominent physical influence was that of maternal fatigue.

However, the changes that occurred in maternal daily activity levels were, to some extent, also the result of the unique lifestyle characteristics displayed by the study participants. The vast majority of the sample were in paid employment prior to pregnancy, a substantial proportion of whom reported working more than 40 hours a week. Comparisons with Van Raaij et al's (1990) Dutch population suggest that multiparous women who are not in paid employment may be less likely to reduce their activity levels as pregnancy progresses. This difference is likely to reflect the fact that these women do not have occupational demands to relinquish. By caring for other children, their ability to change other forms of activity may also be reduced. Such an observation implies that pregnancy will only impact on maternal activity behaviour if there is scope for it to do so. This conclusion is supported further by the work of Panterbrick (1993). In studying the seasonality of energy expenditure in Rural Nepali women, this author highlighted significant differences in total expenditure between pregnant and non-pregnant individuals during the winter season. All individuals nonetheless sustained very heavy physical effort during the spring and monsoon seasons. These findings clearly

demonstrate how high levels of energy expenditure can be maintained during pregnancy, particularly where lifestyle constraints prevent women from curtailing their activities.

The concept that maternal daily activity levels will only decline if there is an opportunity for them to do so suggests that the nature of the activity performed will have an important influence on women's behavioural responses. The findings of the current study did indeed show pregnancy to have a differential impact on different activity domains.

11.3.2. The Impact of Pregnancy on Maternal Occupational Activity

The mean time of stopping work in the present study was 33.5 (S.D. 5.1) weeks gestation. The stage of pregnancy at which participants chose to leave paid employment was believed to be determined by a complex trade-off between an individual's maternal attitude, her intrinsic job motivation and the level of physical activity demanded by her job. Nonetheless, during the time that they remained at work, many individuals appeared to employ a subtle combination of behaviours in an attempt to minimise the impact of paid employment on both fetal and maternal wellbeing.

The mean occupational activity ratios of women working full-time declined steadily as pregnancy progressed. Mean occupational activity ratios were highest at 16 weeks gestation (2.44 (S.D. 0.59) METS) and lowest at 34 weeks gestation (2.05 (S.D. 0.43) METS). This trend contrasted sharply with that observed in the sample's total daily activity levels. The absence of a second trimester peak in the sample's mean occupational activity ratios suggested that changes in physical wellbeing were unlikely to have been the primary influence on women's working behaviour. Rather, maternal reports suggested that many of the changes were deliberate responses to an underlying awareness of antenatal health advice and perceived risks within the workplace. Specific adaptations that were identified included reducing the length of the working day, increasing the frequency of rest periods, and limiting the performance of optional tasks. Conversely however, the women's gross body movements, their working posture and the activities deemed inherent to their jobs were not significantly altered.

The participants' decision to maintain workplace activities on the one hand yet change the more flexible elements of their job on the other broadly reflects cultural attitudes towards women more generally. Wolkind & Zajicek (1981) state that contemporary Western society places a high value on being a member of the labour force but at the same time it rewards women for removing themselves from the workforce in favour of the maternal role. It is therefore likely that the women's approach to their employment was influenced by a need to perceive themselves both as a responsible mother and as an individual still capable of fulfilling the demands of their occupation.

The smaller changes that women made to their activity patterns, and particularly to their activity during work breaks suggests that they were reluctant to let their pregnancy impact markedly upon their productivity in the workplace. There is evidence within the literature to suggest that working outside the home during pregnancy still needs to be accepted and accommodated by women's employers and colleagues (see Pattison & Gross (1996) for a review). Previously Halpert et al. (1993) identified a trend towards the negative stereotyping of pregnant employees, particularly by male respondents, in which pregnant women were typically regarded as more emotional, irrational and less committed to their jobs than their non-pregnant counterparts. The decision to adapt the more marginal aspects of their work, whilst still maintaining their gross activities, highlights the fact that some pregnant women in the present study may have been fighting similar attitudes.

The notion that women may strive to fulfil their occupational responsibilities during pregnancy is reflected in the fact that almost a quarter of respondents in the current study commenced their maternity leave at a time convenient to their employer. In a previous survey of maternity rights and benefits in Britain (Callender et al., 1997), 35% of workplaces reported problems associated with the taking of maternity leave, the most commonly reported problem being difficulties in covering for an absent employee.

Nonetheless, this observation does not preclude the possibility that women also continued in their occupational role for their own wellbeing. This possibility is supported by the

explanations that some respondents gave for continuing their work until late into the third trimester. Few women reported that they had chosen to remain at work for financial reasons. Rather, many explained that their work provided social contact and a means of avoiding the feelings of boredom and isolation that they believed they would experience if they were at home. Given the positive impact that paid employment can have on an individual's self-esteem (Fallowfield 1990), such a result is not entirely unexpected. Certainly, in a review of literature relating to this topic, Pattison & Gross (1996) conclude that many women view working during pregnancy as a positive experience and face only a few difficulties during this period. The small number of women whose wellbeing is affected by working during pregnancy tend to be those who are at risk from work related stress at other times (Thompson et al. 1997, Pattison & Gross, 1996). This observation suggests that a woman's working activity levels may be determined as much from a need to maintain her own wellbeing as from the influence of social expectation.

11.3.3 The Impact of Pregnancy on Maternal Domestic Activity

The levels of housework that the study participants reported were found to be comparable to those of other Western women and the vast majority of women continued to perform such activities until late into the third trimester. The only factor that caused women to report reduced levels of housework in the earlier stages of pregnancy was physical discomfort. In the latter stages of pregnancy, levels of heavy housework decreased whilst levels of lighter housework increased. Small changes were also made to gardening and D.I.Y activities. Maternal reports once again suggested that adaptations occurred whenever the physical experience of pregnancy hampered an activity or where the respondents perceived an associated health risk. However, unlike mean occupational activity levels, mean overall domestic activity did not change significantly across pregnancy. The mean domestic activity ratio for the sample was 2.45 (S.D. 0.23) METS.

It is possible that the different responses that occurred in the occupational and domestic domains reflected a fundamental difference in the obligatory and volitional nature of these activities. Nevertheless, it is unlikely that many women will view their domestic

tasks as volitional activity (Henderson et al., 1989). Thus, the defining issue was believed to be one of perceived control. Whilst the need to maintain occupational productivity may ultimately limit the amount of control that women can exert over their activity in the workplace, household work is invariably performed only for their families and themselves. They can thus exercise more latitude of choice and decide exactly how and when they will approach this work. Maternal responses certainly suggested that a variety of balancing strategies were necessary to maintain certain behaviour patterns during pregnancy (see section 11.3.3.2)

11.3.3.1 Why Did Women Strive to Maintain Domestic Activities?

The increase in light household work that occurred in the current study was primarily a consequence of the study participants leaving paid employment. Once on maternity leave, women undertook most of the household tasks out of fairness to their partner. They also began preparing their homes specifically for the postpartum period. A similar response has been documented previously. Romito (1993) conducted a qualitative study in France and Italy and showed that, even when women stopped work because of a high-risk pregnancy, they ended up performing much more housework than before. Older children were taken out of nursery and looked after at home, husbands stopped giving the help they had provided when their wives were at work and women made use of the extra time to do all the jobs that they did not usually have time to do.

Findings from the present study revealed that the women who reported doing more housework late in pregnancy received a significantly higher level of social support and typically exhibited a more positive maternal attitude. The tendency to increase domestic behaviour when on maternity leave may therefore not only reflect a general female responsibility to household work (Schor, 1992), but also a unique commitment towards the maternal role. The women's responses highlighted a specific need to ensure that their homes were clean, tidy and hygienic before their babies arrived. The performance of household tasks may thus represent a means by which pregnant women can maintain both a sense of activity and purpose without feeling they have contravened the traditional

paradigm of a responsible mother. Such a notion may help to explain why maternal domestic activity is maintained at a time when occupational activity ratios are being reduced.

11.3.3.2 Strategies Used to Maintain Obligatory Activities

The participants' ability to continue light household tasks until late into the third trimester was aided by the fact that, having given up work, women had more time available to them in which to complete their domestic chores. This meant that they could freely adapt their work-to-rest ratios to accommodate changes in their physical wellbeing. Other strategies that were identified in the current study included pre-planning an activity, prioritising obligatory tasks over volitional pursuits, and monitoring the consequences of any given action.

Such behavioural responses are in part reminiscent of strategies adopted by women in the developing world. Roberts et al. (1982) for example document how pregnant women in rural Gambia reduce their physical activity levels by 25% in the last term of pregnancy through curtailing the time they spend on volitional leisure pursuits but not on obligatory farming (Roberts et al., 1982). Panterbrick (1989) similarly documents how pregnancy and childcare responsibilities make an impact on the time allocated to rest in a group of subsistence farmers. This author shows how despite ill health and a potential conflict between economic and childbearing responsibilities women in rural Nepal manage to sustain levels of physical activity by a combination of behavioural strategies such as the flexibility of labour exchange and the energetically efficient organisation of tasks. These women manage to sustain a remarkable work effort over several consecutive days by punctuating their work with many pauses. Previous research has shown that productivity is indeed raised and fatigue prevented if demanding work is frequently interspersed with small rest periods (Muller, 1953). Thus, whilst women from the developing world constitute an entirely different population in terms of their activity demands and nutritional status, it is interesting to note that Western women may also perceive a need for similar behavioural responses.

As yet, the precise reasons why such adaptations occur in the developed world remains unclear. The prevalence with which the women in the current study reported suffering from fatigue certainly suggested that they may have needed to rely on behaviours that could act as breathers, sustainers or restorers. However, other findings suggested that the women's perceptions of their physical capabilities may themselves have been influenced by social expectation.

At 16 weeks gestation, women who offered a physical explanation for their behaviour were significantly more neurotic and more supported by their partner. Taylor Myers & Grasmick (1990) have previously reported that pregnant women are often stereotyped as invalids, with the expectation that they should be excused certain tasks and not be treated as if they are at fault. An expectation of poorer health during pregnancy, either from the woman herself or from her primary group, may thus lead an individual to focus more closely on changes in her physical wellbeing and use these as justification for changing her daily activity behaviour. Further evidence to suggest that the daily activity behaviour of Western pregnant women may be under a strong cultural influence is discussed in section 11.4.

11.3.4 The Impact of Pregnancy on Recreational Activity

Maternal reports suggested that work and home commitments were ultimately prioritised over leisure activities. However, despite a reduction in the number of hours that women worked during pregnancy, mean recreational activity ratios did not increase. Rather, a decrease in maternal working activity was accompanied by a significant increase in the duration of home-based recreational and resting activities that were reported. Mean overall recreational activity ratios were found to be highest at 25 weeks gestation (1.52 (S.D. 0.24) METS) and lowest at 38 weeks gestation (1.42 (S.D. 0.18) METS).

Overall, only 11% of former exercisers regularly reported continuing with their physical activity programmes during pregnancy. Women who participated in some form of exercise on two occasions or more reported significantly higher levels of activity prior to

pregnancy. This finding suggested that the increased physical effort required to maintain vigorous activities during pregnancy may have been sufficient to discourage activity participation in all but the most committed of women. However, those that continued exercising also demonstrated significantly lower scores on the internal dimension of the FHLC scale. This suggested that the perceived health risks of maternal exertion might also have been an important deterrent. Respondents' own explanations for their changing behaviour certainly supported this opinion.

A similar decline was also observed in the women's social activities with maternal responses once again indicating that the study participants had adapted their behaviour in response to physical limitations and potential risk. Specific health risks that were identified within this context included smoky atmospheres, overcrowded locations and alcohol consumption. In this instance however, some women also expressed concern regarding their changing body shape.

Previously, Davies and Wardle (1994) have argued that, since the role of pregnancy confers respectability to weight gains that would otherwise be unacceptable, stigmatisation of the overweight is likely to be relaxed during pregnancy. However, there is only a limited amount of research evidence to substantiate this view and women of varying sizes frequently receive a considerable amount of lay advice regarding weight gain during pregnancy. This attention leads an increasing number of mothers to express concern both over the amount of weight they gain during pregnancy and the perceived need to lose weight in the postpartum period. It is therefore not surprising to find that, in addition to physical limitations and perceived risk, maternal body image may also impact directly upon women's daily activity levels in pregnancy.

11.4 Research Aim 3:

The Determinants of Maternal Daily Activity Behavior in Low-Risk Pregnancy

Maternal self-reported activity levels pre-pregnancy were found to be associated with a

number of different variables. These included maternal educational level and social class, health value and work duration. Maternal educational level was also found to predict daily activity levels at 34 weeks of pregnancy. Contrary to expectation however, maternal health value did not directly influence activity behaviour at any of five stages of pregnancy. Whilst it was acknowledged that this may partially have been due to a difference in the scales used to measure daily activity levels before and during pregnancy, it was also believed to reflect a generic shift in the women's focus of health.

Respondents' references to the perceived appropriateness of their behaviour suggested that any former benefits of activity to the mother were often outweighed by perceptions of fetal risk. The importance that women attributed to rest during pregnancy was found to be comparable to the importance that they attributed to other well-established health behaviours such as not smoking or abstaining from alcohol consumption.

However, despite this finding, maternal FHLC scores were only found to influence the extent to which women stopped exercising during pregnancy. FHLC scores rarely emerged as a significant predictor of maternal daily activity levels or indeed, as a predictor of the change that occurred in total maternal daily activity levels. This suggests that women's awareness of antenatal health information did not always result in a measurable behavioural change. Such an observation is not unusual. Haslam et al. (1997) for example, state that knowledge of the risks of maternal smoking is unlikely to be a major determinant of actual smoking during pregnancy since there are also many powerful social and psychological factors which can help to maintain an individual's habit (Hilton et al, 1989). The fact that the current study has shown maternal FHLC beliefs to have some influence on women's sporting activity but not on their total daily activity suggests that women's pre-existing social obligations may ultimately have limited the extent to which they could alter other aspects of their behaviour. Such a conclusion thus provides further support for the notion that maternal activity levels may only change during pregnancy if there is an opportunity for them to do so.

Despite the changes that occurred in maternal activity behaviour, the study findings suggested that the women's daily activity levels during low-risk pregnancy remained

under a strong habitual influence. After adjusting for potential confounding variables, one of the strongest and most consistent predictors of maternal activity behaviour during pregnancy was that of maternal activity behaviour *prior* to pregnancy. In particular, women who were employed in more active occupations prior to becoming pregnant reported higher levels of daily activity between 12 and 25 weeks gestation whilst women who reported higher levels of recreational activity pre-pregnancy were significantly more active at 38 weeks gestation. Self-efficacy and extroversion were also identified as significant predictors of daily activity at 38 weeks gestation. In addition, self-efficacy was also a significant predictor of the change that occurred in maternal daily activity levels between 25 and 38 weeks gestation.

Within the general population, previous research has shown that self-efficacy affects health behaviours as varied as abstinence from smoking (Prochaska & Diclemente, 1984), weight control (Strecher et al., 1986) and exercise (Marcus & Owen, 1992). Marlatt & Gordon (1985) suggest that decreased feelings of efficacy will be associated with a period of inactivity and possible feelings of lack of control. These in turn may increase the probability of sustained inactivity. Thus, given that the present work has already demonstrated the importance of perceived control (see section 11.3.3), it is not surprising to find that self-efficacy may influence women's daily activity behaviour during pregnancy. The women who reduced their activity the most were likely to be those individuals who had more difficulty in overcoming the perceived barriers to their physical activity participation.

In the current study, five main barriers to physical activity were identified. These included the physical symptoms of pregnancy, the effect of outside influences, a lack of motivation, a low maternal body image and a lack of time and/or appropriate facilities. Some of these issues have already been discussed. Of relevance is the fact that with the exception of physical symptoms, the vast majority of these barriers were psychosocial in their nature. The evidence for a widespread social discouragement of physical activity in pregnancy was particularly strong. Virtually all participants (96%) indicated that they had been in receipt of advice at least once during the course of their pregnancy, with a

constant source of activity discouragement being that of family, friends and work colleagues. This discouragement often provided women with a welcome excuse for sedentary behaviour. It also served to reinforce women's own perceptions of the health risks associated with physical activity.

The fact that social attitudes may have a particularly strong influence on women's activity behaviour during pregnancy remains in line with recent evidence from an international study. Stahl et al (2000) suggest that the social environment in which a person lives may be a particularly important determinant of their physical activity participation, since non-pregnant individuals who perceive low social support are more than twice as likely to be sedentary than their supported counterparts. This finding strongly suggests that any antenatal advice aimed at helping women to manage activity during pregnancy should not only be aimed at the pregnant woman herself but should also be made available to her partner, her family and friends.

11.5 Research Aim 4:

The Impact of Maternal Daily Activity Levels on Pregnancy Outcome

The present study investigated the impact of integrated daily activity on pregnancy outcome. Past research has suggested that only extreme forms of activity may have an adverse affect on the outcome of pregnancy (see chapter 2 for a review). However, the findings of the current work suggest that an accumulation of light intensity activity may also exert an effect. Higher levels of intrapartum intervention were negatively associated with maternal daily activity levels at 12 weeks, 16 weeks and 34 weeks gestation. Higher levels of maternal daily activity at 38 weeks gestation were positively associated with a greater likelihood of an induction of labour. Higher levels of maternal daily activity at 16 weeks gestation were negatively associated with a lower likelihood of an emergency caesarean section. Total daily activity level at 25 and 34 weeks gestation was independently and negatively associated with infant birthweight.

Previous investigations into the impact of maternal physical activity on fetal health have identified certain occupational activities as the main risk factors for an adverse pregnancy outcome. These factors include prolonged standing, long working hours and heavy lifting. Since the vast majority of women in the present study were employed full-time during pregnancy it is possible that their occupational activity behaviour did indeed have a major influence on their pregnancy outcomes. However, the association between mode of labour onset and maternal daily activity level at 38 weeks gestation suggests that not all the findings can be explained in terms of maternal employment. At this late stage of pregnancy, all but 4 women had ceased paid employment. Participation in both physical exercise and more sedentary social pursuits was also extremely low. Much of the women's physical activity was thus performed within the domestic sphere. Such an observation suggests that concerns may lie less with occupational activity *per se* and more with obligatory activities in general.

The findings of previous studies investigating the relationship between general household work and pregnancy outcome have been equivocal (see Chapter 1, section 1.5.2). Whilst Launer et al (1990) demonstrate a significant association between fetal health and housework, other studies have failed to replicate these findings (e.g. Rabkin et al., 1990; Schramm et al., 1996). As yet however, very few studies have considered the potential association between maternal activity and intrapartum intervention. The vast majority of studies that have investigated this issue have concentrated solely on the effects of volitional exercise (e.g Erdelyi, 1962; Hall and Kaufmann, 1987; Dale et.al., 1982). To date, only one study has examined the potential association between total daily activity and intrapartum intervention (Magann et al, 1996). This study examined the activity patterns of both nulliparous and multiparous women and reported a significant positive relationship between maternal energy expenditure and rates of labour induction.

The findings observed in the present work not only concur with Magann et al.'s (1996) findings but also provide evidence of an interesting association between maternal activity and the course of pregnancy and labour. Compared to women who remain sedentary, women who engage in more daily activity may be less likely to experience a spontaneous

onset of labour but conversely, be more likely to give birth vaginally. Moreover, this relationship may be moderated by the stage of pregnancy at which activity occurs. The findings of the current study suggest that whilst activity in early to mid pregnancy may affect mode of delivery, activity in late pregnancy may influence the mode of labour onset.

Ultimately however these results must be treated with caution since a range of factors other than maternal physical activity behaviour may influence patterns of obstetrical intervention. In particular, variation in the attitudes of different health professionals may directly influence the level and number of interventions that occur (Kleiverda et al., 1997). The reported occurrence of obstetric complications may therefore differ from one area to another. Since all of the women in the current study delivered in the same hospital, geographical variation in levels of obstetrical intervention is likely to be limited. Nonetheless, the possibility that different consultants within this hospital held different attitudes towards obstetrical procedures cannot be dismissed. The women themselves may also have expressed different opinions towards intrapartum intervention. Further study is therefore required before these links can be stated definitively.

Of greater importance to fetal health may be the fact that, even within a limited range of activity levels, maternal physical behaviour can impact significantly on infant birthweight. This variable is one of the most important predictors of infant survival and may also establish the parameters within which individuals will function in later life (Barker et al., 1992; Wadsworth & Kuh, 1997). The effects of inadequate biological development *in utero* may not only be evident in the lives of those affected but also in the lives of their children and their grandchildren (Lumey, 1988).

In the present study, the association of maternal activity with birthweight was disentangled from the effects of other confounding variables such as maternal sociodemographic circumstances, anthropometric characteristics and specific lifestyle behaviours (e.g. smoking). Nonetheless, whilst the analyses controlled for educational level, no adjustment was made for the employment status of the study participants. Since

employed women are known to be healthier than the non-employed, a selection bias cannot be ruled out. Similarly, the effects of specific chemical agents within the working environment cannot be considered. However, as Chapter 7 has already served to demonstrate, the vast majority of women in the current study were not only employed full-time during pregnancy but were also working in predominately non-hazardous occupations. Any bias caused by omitting these variables from the regression models is therefore likely to be small.

The fact that high levels of daily activity may impact negatively on infant birthweight may well justify some social discouragement of maternal physical activity during pregnancy. As yet however, it remains unclear whether daily activity actually has a deleterious effect on birthweight. Rather, it may simply assist in reducing macrosomia and thus the need for assisted or operative delivery. There may also be other advantages to maintaining habitual activity behaviour during pregnancy. For example, much evidence has accumulated to suggest that because of the holistic way in which women view reproduction, the notion of successful childbearing exists as a considerably more complex phenomenon for those individuals that it directly involves. Thus, although in most cases the goals of a live birth and a healthy infant are still paramount, reproductive success for women also appears to necessitate that they have a positive personal experience, one that is judged acceptable in terms of their own social or emotional wellbeing (Oakley, 1993; Scott & Niven, 1996). Several women in the current study suggested that the restrictions that had been placed upon their activity behaviour had caused feelings of boredom and social isolation. As documented in chapter 2, these feelings (along with a loss of an established routine) can be a pre-cursor to maternal depression. Other physical disadvantages to decreasing activity in pregnancy may include a greater gestational weight gain and, even long term maternal weight gain if sedentary behaviour patterns are maintained (Harris, 1997). It is therefore extremely important to ensure that any advice designed to reduce the risk of one adverse condition does not simply increase the risk of experiencing another.

11.6 Study Limitations

The research conducted within this thesis has raised a number of interesting issues. However, in interpreting these findings, a number of methodological limitations must be taken into account.

Firstly, the women who participated in the study were not matched to non-pregnant controls and therefore it is difficult to predict how their activity patterns may have changed if they had not become pregnant. One of the main influences that may be hypothesised to influence adult daily activity behaviour is a change in season. However, in a temperate climate such as that experienced in Britain it is unlikely that variation in weather conditions would produce a significant effect on the activity behaviour of women performing little more than the basic activities of daily life. A previous physical activity survey has reported that the only activities likely to be influenced by changes in local weather conditions are swimming, golf, tennis, fishing and cricket, all of which show an increase during the summer months (ADNFS, 1992). Given that few women reported performing these activities and given also that maternal activity levels decreased as summer approached, it is therefore unlikely that a strong seasonal effect was present. Further studies should nonetheless be taken to verify this assumption.

Secondly, it must be acknowledged that the study sample constituted a relatively small group of women. This accepted, the women participating in the study were of a diverse range of sociodemographic and psychosocial backgrounds. They also reported levels of pre-pregnancy activity that were representative of a wider female population. A slight bias towards higher social classes and higher levels of educational attainment was observed in the current study. However, an analysis of the factors influencing the change in daily activity levels did not reveal any significant effect of maternal sociodemographic circumstances. For this reason, it is still likely that the findings of the present work will reflect many of the ways in which the physical, psychological and social experiences of pregnancy may influence the daily activity patterns of healthy nulliparous women from England.

Thirdly, it must be remembered that the examination of maternal activity patterns within different activity domains relied primarily on self-reported data. It is therefore difficult to ascertain whether or not the activity changes that were reported reflected genuine behavioural responses. However, it was made clear from the start of the study that the research was associated with the hospital and the same degree of confidentiality would apply to these data as to medical data collected within the hospital. At the same time, it was emphasised that the research team was independent of the medical teams dealing with the women. There is some evidence to suggest that subjects are more likely to be frank in talking to outside researchers than if they are questioned by individuals who are providing a service and whom they may not wish to offend (Newson & Newson, 1963). Given that total maternal daily activity levels demonstrated similar trends in both the questionnaire and monitor data, confidence in this approach is high.

In a similar manner, much of the data that was presented was qualitative in its nature. It is therefore difficult to ascertain whether the explanations given by the women reflected true reasons for their behaviour or merely convenient excuses. Ultimately, however, the longitudinal nature of the study served to ensure that respondent bias was limited. Once informed consent had been obtained, data were collected as part of an informal interview that always took place within the women's homes. This approach served two main purposes. Firstly, it meant that rapport was established with participants over a long period of time. Secondly, it means that the interviewer was accepted as a peer group member who not only guaranteed confidentiality but also showed genuine interest in understanding women's experiences. The success of this approach is evident in the fact that respondents did not always find it necessary to answer in a sociably desirable manner. Subsequent analysis of participants' qualitative responses was also rigorous and systematic. Guided by the original research objective, responses were organised in to emergent themes. A second researcher independently checking the analysis ensured reliability.

Finally, the limitations of assessing the relationship between maternal daily activity behaviour and fetal health must be recognised. Some of these were discussed in section

11.5. Of additional concern is the potential bias resulting from a comparatively small sample size and the fact that all assessments of maternal daily activity were based on self-report. Measures of self-report that have evidence of relative validity are undoubtedly of use in studies examining their association with health outcomes. However, absolute amounts of physical activity need to be assessed if research is to define the dose-response relationship between physical activity and fetal health (Haskell, 1994). The fact that the analyses in the present study demonstrated many other associations that were consistent with the literature nonetheless raises confidence in the value of the self-report measure that was used.

11.7 The Implications of Part Two of the Research and Recommendations for Future Work

Western women are currently existing in a society that is placing an increasingly strong emphasis on the value of physical activity participation. At the same time they are also being encouraged to assume increasing responsibility for fetal health. For this reason, maternal physical activity during pregnancy has become an extremely important research focus.

It is clear from the present study that pregnancy is likely to have a significant impact on the daily activity behaviour of healthy, nulliparous women. Although the attendant physical changes of pregnancy can be a potentially strong influence on this behaviour, a number of psychosocial factors may also determine maternal activity at this time. It must be acknowledged however that the cross-sectional analyses presented in the current work cannot establish causality. Whilst an analysis of qualitative data certainly suggested that physical and psychosocial variables may influence women's behaviour during pregnancy, it is also possible that changes in activity may influence the psychosocial aspects of the reproductive experience. Further research is therefore necessary to investigate this issue.

Ultimately, the present work has contributed to such research by providing an invaluable insight into the feasibility of, and inaccuracies in different methods of activity

assessment. There is growing interest in examining the level of physical activity among diverse populations (Sternfeld et al. 1999) and studies such as the one described here are undoubtedly necessary to identify differences in participants' reactivity to different assessment techniques (Warnecke et al. 1997).

In addition, the present study has served to raise several issues regarding the short- and long-term health implications of activity in pregnancy. These findings highlight a need for further studies to assist in the ongoing development of maternity care and the dissemination of effective antenatal advice. At present, prevailing cultural attitudes strongly emphasise the concept of maternal responsibility and often discourage physical activity indiscriminately. However the results of the current study suggest that there may be a number of distinct advantages to maintaining a higher daily activity level during pregnancy. These advantages may not only include an improvement in maternal psychological wellbeing but possibly also a reduced risk of macrosomia and a lower risk of operative delivery. Future studies should therefore be directed towards examining the potential associations between maternal daily activity levels and these outcomes.

In particular, the generalisability of the findings reported in the current study needs to be examined. For statistical purposes, outliers were always excluded from the analyses conducted within the present project. These outliers tended to be more active individuals who are themselves an important population to study. This can be achieved by administering the activity questionnaire to a larger sample of women displaying a wider range of activity behaviours prior to pregnancy. A large prospective study in which women are allocated to high, medium or low activity groups on the basis of their pre-pregnancy activity levels would be particularly valuable in this context.

Whilst the effects of total daily activity levels on pregnancy outcome are undoubtedly important to study, there is also a pressing need for future work to examine the differential effects of volitional and obligatory activities. Whilst current literature suggests that volitional exercise may be safe, the findings of the present study suggest that the maintenance of more obligatory activities may impact adversely on mode of

labour onset. Unfortunately, the present study has also served to demonstrate that women are more likely to maintain their obligatory demands than they are their recreational pursuits. Such a finding highlights the need for more detailed health advice to be developed. This advice must clearly set out the different risks and benefits that are believed to be associated with different forms of activity behaviour so that women can make more informed choices regarding the suitability of their daily activity behaviour.

However, simply being clear on the health consequences of different activities does not necessarily mean that an individual will automatically be able to change her habitual activity pattern. As this research has shown, maternal daily activity levels are only likely to be altered if there is sufficient opportunity for them to do so. This finding indicates that future antenatal care should not only be aimed at providing accurate information but should also offer emotional and practical support to the pregnant woman who may find it difficult to alter an established activity pattern. When fully developed and refined such antenatal interventions may not only help to reduce infant mortality but may also improve maternal psychological wellbeing during the transition to motherhood. The present study obtained a simple measure of participants' activity levels and psychological wellbeing at 6-8 weeks postpartum. However, future work may also consider extending this study to investigate maternal physical and psychological wellbeing at 6 or 12 months postpartum.

In summary, the medical profession is currently having to respond to a strong consumer movement in maternity care and listen to the demands of women for greater participation in the management of their own pregnancies (Oakley, 1993). The present work has gone some way to helping this approach become a viable and successful option. Ultimately, the goal of providing new baseline information is likely to be something that most women want and something from which they and their babies will both be able to benefit.

REFERENCES

- Aaronson LS & Burman ME (1994). Focus on psychometric use of health records in research- Reliability and validity issues. *Res Nurs Health* **17**(1): 67-73.
- Acheson KJ, Campbell IJ, Edholm OG, Miller DS, et al. (1980). The measurement of daily energy expenditure- An evaluation of some techniques. *Am J Clin Nutr* **33**: 1155-1164.
- Affleck G, Tennen H & Rowe J (1991). *Infants in crisis: How parents cope with newborn intensive care and its aftermath*. New York: Springer-Verlag.
- Affonso DD & Arizmendi TG (1986). Disturbances in postpartum adaptation and depressive symptomatology. *Journal of Psychosomatic Obstetrics & Gynaecology* **5**:15-32.
- Ahlborg G, Hogstedt C, Bodin I & Barany S (1989). Pregnancy among working women. *Scandinavian Journal of Work Environment & Health* **15**:227-233.
- Ainsworth BE (2000). Issues in the assessment of physical activity in women. *Res Q Exerc & Sport* **71**(2): 37-42.
- Ainsworth BE, Irwin ML, Addy CL, Whitt MC, et al. (1999). Moderate physical activity patterns of minority women: the cross-cultural activity participation study. *Journal of Women's Health* **8**: 805-813.
- Ainsworth BE, Haskell WL, Leon AS, Jacobs DR, et al. (1993). Compendium of physical activities: Classification of energy costs of human physical activities. *Medicine & Science in Sports & Exercise* **25**:71-80.
- Ainsworth BE, Montoye HJ & Leon AS (1994). Methods of assessing physical activity during leisure and work. In *Physical activity, fitness and health*. Bouchard C, Shephard RJ & Stephens T (Eds.). Champaign IL: Human Kinetics.
- Ainsworth BE, Richardson M, Jacobs DR & Leon AS (1993). Gender differences in physical activity. *Women in Sport & Physical Activity Journal* **2**: 1-16.
- Ajzen I (1985). From intentions to actions: A theory of planned behaviour. In *Action-control: From cognition to behaviour*. Kuhl J & Beckman J (Eds.). Heidelberg, Germany: Springer.

References

- Albanes D, Conway JM, Taylor PR, Moe PW, et al. (1990). Validation and comparison of eight physical activity questionnaires. *Epidemiology* **1**: 65-71.
- Alderson M & Yasin S (1966). Measuring habitual leisure-time activity: a questionnaire method suitable for epidemiologic studies. In *Physical activity in health and disease*. Evang K & Lange-Andersen K (Eds.). Baltimore: Williams & Wilkins.
- Alegre A, Rodriguez-Escudero FJ, Cruz E, et al. (1984). Influence of work during pregnancy on fetal weight. *J Reprod Med* **29**: 334-336.
- Allied Dunbar National Fitness Survey (1992). London: Sports Council and Health Education Authority.
- Allison KR, Adlaf EM, Ialomiteanu A & Rehm (1999). Predictors of health risk behaviours among young adults: Analysis of the national population health survey. *Can J Public Health* **90**(2): 85-89.
- American College of Obstetricians & Gynaecologists (1994). *Exercise during pregnancy and the postpartum period*. Washington DC: ACOG Press.
- American College of Obstetricians & Gynaecologists (1985). *Exercise during pregnancy and the postpartum period*. Washington DC: ACOG Press.
- Anderson KLR, Rutenfranz KJ, Masironi R & Seliger V (1978). Habitual activity and health. Copenhagen: *WHO Reg Publ Europ Series* **6**: 105-159.
- Anderson RM, Liu K, Stamler J, Van Horn L, et al (1981). Assessment of individual physical activity level- Intra-individual versus inter-individual variability. *Med Sci Sports Exerc* **13**(2): 100-100.
- Anderson VN, Fleming AS & Steiner M (1994). Mood and the transition to motherhood. *Journal of Reproductive & Infant Psychology*, **12**:69-77.
- Antaki C & Rapley M (1996). 'Quality of life' talk: The liberal paradox of psychological testing. *Discourse Soc* **7**(3): 293-316.
- Areskog B, Uddenberg N & Kiessler B (1984). Postnatal emotional balance in women with and without antenatal fear of childbirth. *Journal of Psychosomatic Research* **28**: 213-220.
- Artal Mittelmark R (1991). Hormonal responses to exercise in pregnancy. In *Exercise in Pregnancy*. Artal Mittelmark R, Wiswell R & Drinkwater B (Eds.). Baltimore: Williams & Wilkins.

References

- Artal R & Buckenmeyer (1995). Exercise during pregnancy and postpartum. *Contemporary Obstetrics & Gynaecology* 40(5): 62-90.
- Artal R, Fortunato V, Welton A, Constantino N, et al. (1995). A comparison of cardiopulmonary adaptations to exercise in pregnancy at sea level and altitude. *American Journal of Obstetrics & Gynaecology* 155:729-733.
- Artal R & Gardin K (1986). Historical perspectives. In *Exercise in Pregnancy*. Artal Mittelmark R & Wiswell RA (Eds.). Baltimore: Williams & Wilkins.
- Artal R & Wiswell RA (Eds.) (1986). *Exercise in Pregnancy*. Baltimore: Williams & Wilkins.
- Artal R, Wiswell RA & Drinkwater B (Eds.) (1991). *Exercise in Pregnancy* (2nd Ed.). Baltimore: Williams & Wilkins.
- Avons P (1984). A method to assess daily energy expenditure accounted for physical activity. In *Human energy metabolism: Physical activity and energy expenditure measurement in epidemiological research based upon direct and indirect calorimetry*. Van Es AJH (Ed.) Euro-Nut. Rep 5:108-110.
- Avons P, Garthwaite P, Davies HL, Murgatroyd PR, et al. (1988). Approaches to estimating physical activity in the community: calorimetric validation of actometers and heart rate monitoring. *Eur J Clin Nutr* 42:185-196.
- Axelsson G, Rylander R & Molin I (1989). Outcome of pregnancy in relation to irregular and inconvenient work schedules. *Br J Ind Med* 46: 393-398.
- Baecke JA, Burema J & Frijters JE (1982). A short questionnaire for the measurement of physical activity in epidemiologic studies. *Am J Clin Nutr* 36: 936-42.
- Baker CW, Carter AS, Cohen LR & Brownkell KD (1999). Eating attitudes and behaviours in pregnancy and postpartum: global stability versus specific transitions. *Ann Behav Med* 21(2): 143-148.
- Baker D & Taylor H (1997). The relationship between condition-specific morbidity, social support and material deprivation in pregnancy and early motherhood. *Soc Sci Med* 45(9): 1325-36.
- Ballinger CB, Kay DSG, Naylor GI & Smith AHW (1982). Some biochemical findings during pregnancy and after delivery in relation to mood change. *Psychological Medicine* 12: 549-556.

References

- Bandura A (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.
- Baranowski T (1988). Validity of self-report of physical activity: An information processing approach. *Res Q Exerc Sport* **59**: 314-327.
- Baranowski T (1985). Methodological issues in self-report of health behaviour. *J School Health* **55**(5): 179-182.
- Baranowski T & de Moor C (2000). How many days was that? Intra-individual variability and physical activity assessment. *Res Q Exerc Sport* **71**(2): S74-S78.
- Baranowski T, Dworkin R, Cieslik CJ, et al. (1984) reliability and validity of children's self-report of aerobic activity: Family health project. *Res Q Exerc Sport* **55**: 309-317.
- Baranowski T, Tsong Y, Hooks P, Cieslik C, et al. (1987). Aerobic physical activity among third to sixth grade children. *Journal of Developmental & Behavioural Pediatrics* **8**(4): 203-206.
- Baratte Beebe KR & Lee K (1999). Sources of midsleep awakenings in childbearing women. *Clin Nurs Res* **8**(4): 386-397.
- Barker DJP (1992). *Fetal and infant origins of adult disease*. London: British Medical Journal Publications.
- Barnes DL, Adair LS. & Popkin BM (1991). Women's physical activity and pregnancy outcome: A longitudinal analysis from the Philippines. *International Journal of Epidemiology*, **20**:162-172.
- Barnett B & Parkey G (1986). Possible determinants, correlates and consequences of high levels of anxiety in primiparous mothers. *Psychological Medicine* **16**:177-185.
- Bartky SL (1988). Foucault, femininity and the modernisation of patriarchal power. In *Feminism and Foucault: Reflections on Resistance*. Diamond I & Quinby I (Eds.). Boston: Northeastern University Press.
- Bassett DR (2000). Validity and reliability issues in objective monitoring of physical activity. *Res Q Exerc Sport* **71**(2): 30-36.
- Beck N, Siegel L, Davidson W, Kormeier J, et al. (1980). Predictions of pregnancy outcome: Maternal preparation, anxiety and attitudinal sets. *Psychosomatic Research* **24**: 343.

References

- Bell R. & O'Neill M (1994). Exercise and pregnancy: A review. *Birth* **21**(2): 85-95.
- Benefice E, Simondon K & Malina RM (1996). Physical activity patterns and anthropometric changes in Senegalese women observed over a complete seasonal cycle. *Am J Human Biol* **8**: 251-261.
- Benson P, Little BC, Talbert DG, Dewhurst J, et al. (1987). Foetal heart rate and maternal emotional state. *British Journal of Medical Psychology* **60**:151-154.
- Bentler PM & Abramson PR (1981). The science of sex research-some methodological considerations. *Arch Sex Behav* **10**(3): 225-251.
- Berg G, Hammer M, Moller-Nielsen J, Linden U, et al. (1988). Low back pain during pregnancy. *Obstet Gynaecol* **71**: 71-75.
- Bergant A, Nguyen T, Moser R & Ulmer H (1998). Prevalence of depressive disorders in early puerperium. *Gynakol Geburtshilfliche Rundsch* **38**(4): 232-7.
- Berkowitz GS, Kelsey JL, Holford TR, et al. (1983). Physical activity and the risk of spontaneous preterm delivery. *Journal of Reproductive Medicine* **28**:581-8.
- Berryman JC, Thorpe KJ & Windridge KC (1995). *Older mothers: Conception, pregnancy and birth after 35*. London: Pandora.
- Bhattacharya A, McCutcheon EP, Shvartz E & Greenleaf JE (1980). Body acceleration distribution and O₂ uptake during running and jumping. *J Appl Physiol* **49**: 881-887.
- Biddle SJH (1997). Current trends in sport and exercise psychology research. *The Psychologist* **10**(2): 63-69.
- Biddle SJH & Mutrie N (1991). *Psychology of physical activity and exercise: A health-related perspective*. London: Springer-Verlag.
- Blair SN (1992). Assessment of physical activity in clinical and epidemiological research. *Health Psychology (Suppl 11)*: 48
- Blair SN (1984). How to assess exercise habits and physical fitness. In *Behavioural Health: A handbook of health enhancement and disease prevention*. Matarazzo JD, Weiss SM & Herd JA (Eds.). New York: Wiley.
- Blair SN, Haskell WL, Ho P et al. (1985). Assessment of physical activity by seven day recall in a community survey and controlled experiments. *Am J Epidemiol* **122**: 794-804.

References

- Blair, SN, Kohl HW, Gordon NF & Paffenbarger RS. (1992). How much physical activity is good for health? *Annual Review of Public Health* **13**: 99-126.
- Blumenthal JA, Emery CF, Madden DJ, George LK, et al. (1989). Cardiovascular and behavioural effects of aerobic exercise training in healthy older men and women. *Journal of Gerontology* **44**: M147-157.
- Bolton HL, Hughes PM, Turton P & Sedgewick P (1998). Incidence and demographic correlates of depressive symptoms during pregnancy in an inner London population. *J Psychosom Obstet Gynaecol* **19**(4): 202-209.
- Booth M (2000). Assessment of physical activity: An international perspective. *Res Q Exerc Sport* **71**(2): 114-120.
- Bordo S (1990). Reading the slender body. In *Body politics: Women and the discourses of science*. Jacobs M, Keller EF & Shuttleworth S (Eds.) New York: Routledge.
- Botkin C & Driscoll CE (1991). Maternal aerobic exercise: Newborn effects. *Fam Pract Res J* **11**: 387-393.
- Bouchard C (1983). A method to assess energy expenditure in children and adults. *Am J Clin Nutr* **37**: 461-467.
- Bouten CV, Verboeket-Van De Venne WP, Westerterp KR, Verduin M et al. (1996). Daily physical activity assessment: Comparison between movement registration and doubly labelled water. *J Appl Physiol* **81**: 1019-1026.
- Bouten CV, Westerterp KR, Verduin M & Janssen JD (1994a). Evaluation of a triaxial accelerometer for the assessment of daily physical activity. In *Dynamic analysis using body fixed sensors*. Veltink PH & van Lummel RC (Eds.). The Hague: McRoberts.
- Bouten CV, Westerterp KR, Verduin M & Janssen JD (1994b). Assessment of energy expenditure for physical activity using a triaxial accelerometer. *Med Sci Sports Exerc* **26**:1516-1523.
- Brannen J (1994). Sociological definitions of the family-employment relationship in the United Kingdom. In *Cross-national research papers no. 2 : The family-employment relationship*. Letablier MT & Hantrais L (Eds.). ESRC:CNAF.
- Brannen J & Moss P (1988). *New mothers at work*. London: Unwin Hyman.
- Breen D (1975). *The Birth of a First Child*. London: Tavistock Publications.

References

- Brett KM, Strogatz DS & Savitz DA (1997). Employment, job strain, and preterm delivery among women in North Carolina. *Am J Public Health* **87**(2): 199-204.
- Bribring GL (1959). Some considerations of the psychological processes in pregnancy. *Psychoanalytic Study of the Child*, **14**:113-21.
- Brill PA & Cooper KH (1993). Physical exercise and mental health. *Phi Kappa Phi Journal* **73**(1): 44-45.
- Brines J (1994). Economic dependency, gender and the division of labour at home. *Am J Soc* **100**: 652-688.
- Brooke OG, Anderson HR, Bland JM, et al. (1989). Effects on birthweight of smoking, alcohol, caffeine, socio-economic factors and psychosocial stress. *BMJ* **298**:795-801.
- Brown A, Smolensky M, D'Alonzo G, Redmond D, et al. (1990). Circadian rhythm in human activity objectively quantified by actigraphy. *Prog Clin Biol Res* **341A**: 77.
- Brown GW, Bifulco A & Andrews B (1990). Self-esteem and depression 3: Etiologic issues. *Social Psychiatry and Psychiatric Epidemiology* **25**(5): 235-243.
- Brown JD & Lawton M (1986). Stress and wellbeing in adolescence- the moderating role of physical exercise. *Journal of Human Stress* **12**(3): 125-131.
- Brown S, Lumley, J, Small R & Astbury J (1994). *Missing voices: the experience of motherhood*. Oxford: Oxford University Press.
- Bruess C & Richardson G (1995). *Decisions for Health (4th Ed.)*. Dubuque, IA: Wm C Brown Communications.
- Cale, L (1993.) Monitoring physical activity in children. Loughborough University, Leicestershire, UK, PhD thesis.
- Calfas KJ & Taylor WC (1994). Effects of physical activity on psychological variables in adolescents. *Paediatric Exercise Science* **6**: 406-423.
- Calganeri M, Bird HA & Wright V (1982). Changes in joint laxity occurring during pregnancy. *Annals of Rheumatic Disease* **41**:126-128.
- Callender C, Milward N, Lissenburgh S & Forth J (1997). *Maternity rights and benefits in Britain. Department of Social Security Research Report No. 67*. London: HMSO.

References

- Calnan M (1989). Control over health and patterns of health-related behaviour. *Social Science & Medicine* **29**: 131-136.
- Canada Fitness Survey (1983). *Fitness and Lifestyle in Canada*. Ottawa, Canada.
- Cannell C & Kahn R (1968). Interviewing. In *Handbook of Social Psychology, Vol II*. Lindzey G & Aronson E (eds.). Reading, Massachusetts: Addison-Wesley.
- Capeless EL & Clapp JF (1989). Cardiovascular changes in early phase of pregnancy. *American Journal of Obstetrics & Gynaecology* **161**: 1449-1453.
- Caplan G (1960). Emotional implications of pregnancy and influences on family relationships. In *The Healthy Child*. Stuart HC & Prugh DG (Eds.). Cambridge: Harvard.
- Cardinal BJ (1997). Effects of behavioural monitoring on physical activity and psychosocial determinants of exercise behaviour. *Social Behaviour & Personality* **25**(1): 13-18.
- Carlson B & Petti K (1989). Health locus of control and participation in physical activity. *American Journal of Health Promotion* **3**: 32-37.
- Caspersen CJ (1989). Physical activity epidemiology: Concepts, methods and applications to exercise. *Exerc Sport Sci Rev* **17**: 423-473.
- Cauley JA, Laporte RE, Black Sandler R, Orchard TJ, et al. (1987). Comparison of methods to measure physical activity in postmenopausal women. *Am J Clin Nutr* **45**: 14-22.
- Ceesay SM, Prentice AM, Day KC, Murgatroyd PR, et al. (1989). The use of heart rate monitoring in the estimation of energy expenditure: A validation study using indirect whole body calorimetry. *Br J Nutr* **61**: 175-186.
- Cefalo RC & Moos MK (1988). *Preconceptional health promotion: A practical guide*. Rockville, MD: Aspen Publications.
- Chamberlain R (1975). Birthweight and length of gestation. In *British Births 1970*. The Steering Committee of the British Births Survey (Eds.) London: William Heinemann Medical Books Ltd.
- Chan K (1977). Individual differences in reactions to stress and their personality and situational determinants: Some implications for community mental health. *Social Science & Medicine* **11**: 89-103.

References

- Chapin, FS (1974) Human activity patterns in the city. London: Wiley-Interscience.
- Chapman HA, Hobfoll SE & Ritter C (1997). Partners' stress underestimations lead to women's distress: A study of pregnant inner city women. *J Pers Soc Psychol* **73**(2): 418-25.
- Chapple PA & Furneaux WD (1964). Changes of personality in pregnancy and labour. *Proc Roy Soc Med* **57**:260-261.
- Clapp JF (1998). *Exercising through your pregnancy*. Champaign (IL): Human Kinetics.
- Clapp JF (1991). The changing thermal response to endurance exercise during pregnancy. *American Journal of Obstetrics & Gynaecology* **165**: 1684-1689.
- Clapp JF (1990). The course of labour after endurance exercise. *American Journal of Obstetrics & Gynaecology* **163**:1799-805.
- Clapp JF (1989). The effects of maternal exercise on early pregnancy outcome. *American Journal of Obstetrics & Gynaecology* **161**:1453-7.
- Clapp JF (1980). Acute exercise stress in the pregnant ewe. *American Journal of Obstetrics & Gynaecology* **136**:489-94.
- Clapp JF & Capeless EL (1991). The changing glycemic response to exercise during pregnancy. *Am J Obstet Gynaecol* **165**: 1678-1683.
- Clapp JF & Capeless EL (1991). The VO_{2max} of recreational athletes before and after pregnancy. *Medicine and Science in Sports & Exercise* **23**: 1128-1133.
- Clapp JF & Capeless EL (1990). Neonatal morphometrics after endurance exercise during pregnancy. *Am J Obstet Gynaecol* **163**: 1805-1811.
- Clapp JF & Dickstein S (1984). Endurance exercise and pregnancy outcome. *Medicine & Science in Sports & Exercise* **16**: 556-62.
- Clapp JF & Rizk KH (1992). Effect of recreational exercise on mid trimester placental growth. *American Journal of Obstetrics & Gynaecology* **167**: 1518-1521.
- Clapp JF, Wesley M & Sleamaker RH (1987). Thermoregulatory and metabolic responses to jogging prior to and during pregnancy. *Med Sci Sports Exerc* **19**: 124-130.
- Clark M & Ogden J (1999). The impact of pregnancy on eating behaviour and aspects of weight concern. *Int J Obes Relat Metab Disord* **23**: 18-24.

References

- Clement S, Wilson J & Sikorski J. (1999). The development of an intrapartum intervention score based on women's experiences. *Journal of Reproductive & Infant Psychology* 17: 53-62.
- Coblner WG (1965). Some maternal attitudes towards conception. *Ment Hyg* 49:4-10.
- Coggan AR, Kohrt WM, Sina RJ, Bier DM, et al. (1990). Endurance training decreases glucose turnover and oxidation during moderate intensity exercise in men. *J Appl Physiology* 68: 990-996.
- Cohen GC, Prior JC, Vigna Y, et al. (1989). Intense exercise during the first two trimesters of unapparent pregnancy. *Physician Sports Medicine* 17: 87-94.
- Cohen MB (1973). Personal identity and sexual identity. In *Psychoanalysis and Women*. Miller JB (Ed.) Harmondsworth: Penguin.
- Colburn TR, Smith BM, Guarini JJ & Simmons NN (1976). An ambulatory activity monitor with solid state memory. *Instrum Soc Am BM*, 76322: 117-122.
- Coolican H (1994). *Research methods and statistics in psychology*. (2nd Ed). London: Hodder & Stoughton.
- Condon JT (1987). Psychological and physical symptoms during pregnancy: A comparison of male and female expectant parents. *Journal of Reproductive & Infant Psychology* 5:207-213.
- Coutts A (1998). The minor problems of pregnancy: A review. *Prof Care Mother Child* 8(4): 95-97.
- Cox JL, Holden JM & Sagovsky R (1987). Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *British Journal of Psychiatry* 150: 782-786.
- Cnattingus S, Haglund B & Merrick O (1988). Cigarette smoking as a risk factor for late fetal and early neonatal death. *British Medical Journal* 297: 258-261.
- Crandon AJ (1979). Maternal anxiety and neonatal wellbeing. *J Psychomatic Res* 20:207-210.
- Crews DJ (1993). Self-regulation strategies in sport and exercise. In *Handbook of research on sport psychology*. Singer RN, Murphey M & Tennant LK (Eds.). New York: McMillan.

References

- Crews DJ & Landers DM (1987). A meta-analytic review of aerobic fitness and reactivity to psychosocial stressors. *Med Sci Sports Exerc* **19**: S114-120.
- Croonen F & Binkhorst RA (1974). Oxygen uptake calculated from expiratory volume and oxygen analysis only. *Ergonomics* **17**: 113-117.
- Curtis M (1986). *The psycho-physiologic effects of bed rest on at-risk pregnant women: A pilot study*. University of Wisconsin, Madison, WI, Thesis.
- DaCosta D, Larouche J, Dritsa M & Brender W (1999). Variations in stress levels over the course of pregnancy: factors associated with elevated hassles, state anxiety and pregnancy-specific stress. *Journal of Psychosomatic Research* **47**(6): 609-21.
- Dale E, Mullinax KM & Bryan DH (1982). Exercise during pregnancy: Effects on the fetus. *Canadian Journal of Applied Sports Science* **7**: 98-103.
- DaSilva VA, Moraes Santos AR, Carvalho MS, Martins ML, et al. (1998). Prenatal and postnatal depression among low-income Brazilian women. *Braz J Med Biol Res* **31**(6): 799-804.
- Dauncey MJ & James WPT (1979). Assessment of the heart rate method for determining energy expenditure in man using a whole body calorimeter. *Br J Nutr* **42**:1-13.
- David RJ (1980). The quality and completeness of birthweight and gestational age data in computerised birth files. *AJPH* **70**: 964-973.
- Davies K & Wardle J (1994). Body Image & Dieting in Pregnancy. *J Psychosom Res* **38**: 787-799.
- Davies PSW (1992). Developments in the assessment of physical activity. In *Physical activity and health*. N.Norgan (Ed.). Cambridge: Cambridge University Press.
- Dean K (1991). Relationships between knowledge and belief variables and health maintenance behaviours in a Danish population over 45 years of age. *Journal of Ageing & Health* **3**: 386-406.
- Deater Deckard K, Pickering K, Dunn DF & Golding J (1998). Family structure and depressive symptoms in men preceding and following the birth of a child. *Am J Psychiatry* **155**(6): 818-823.
- Department of Health (1991). Dietary reference values for food energy and nutrition for the UK. *Report on Health & Social Subjects No. 41*. London: HMSO.

References

- Derosis HA & Pellegrino VY (1982). *The book of hope: How women can overcome depression*. New York: Macmillan.
- DeSwiet M (1991). The respiratory system. In *Clinical Physiology in Obstetrics*. Ilytten F & Chamberlain G (Eds.). London: Blackwell Scientific.
- Deutsch H (1974). *The Psychology of Women*. New York: Grune and Stratton.
- Dewey KG & McCrory MA (1994). Effects of dieting and physical activity on pregnancy and lactation. *American Journal of Clinical Nutrition*, **59**(Suppl):446S-53S.
- Devine CM, Bove CF & Olson CM (2000). Continuity and change in women's weight orientations and lifestyle practices through pregnancy and the postpartum period: The influence of life course trajectories and transitional events. *Soc Sci Med* **50**(4): 567-582.
- Dey I (1993). *Qualitative data analysis*. London: Routledge.
- DfEE (1997). *Statistics on women and men in education, training and employment*. London: DfEE.
- Dibblee L & Graham TE (1983). A longitudinal study of changes in aerobic fitness, body composition and energy intake in primigravid patients. *American Journal of Obstetrics & Gynaecology*, **147**: 908-14.
- Dickinson JE, Godfrey M & Evans SF (1997). Antenatal patterns of uterine activity in low-risk women: A longitudinal study. *Aus NZ J Obstet Gynaecol* **37**(2): 149-152.
- Dimitrovsky L, Lev S, & Itskowitz R (1998). Relationship of maternal and general self-acceptance to pre- and postpartum affective experience. *J Psychol*, **132**(5): 507-16.
- Dishman RK (1982). Compliance/adherence in health-related exercise. *Health Psychol* **1**: 237-267.
- Dishman RK & Sallis JF (1994). Determinants and Interventions for Physical Activity and Exercise. In *Physical Activity, Fitness and Health*. Bouchard C, Shephard RJ & Stephens T (Eds.). Champaign, IL: Human Kinetics.
- Dishman RK, Sallis JF & Orenstein D (1985). The determinants of physical activity and exercise. *Public Health Rep* **100**: 158-171.
- Dishman RK & Steindhardt M (1988). Reliability and concurrent validity for a seven day recall of physical activity in college students. *Med Sci Sports Exerc* **20**: 14-25.

References

- Durak EP, Jovanic-Peterson L & Peterson CM (1990). Comparative evaluation of uterine response to exercise on five aerobic machines. *American Journal of Obstetrics & Gynaecology* **162**: 754-6.
- Durant RH, Baranowski T, Davis H, Rhodes T, et al. (1993). Reliability and variability of indicators of heart-rate monitoring in 3- 4- or 5- year old children. *Med Sci Sports & Exerc* **25**: 389-395.
- Durham RF (1998). Strategies women engage in when managing preterm labour at home. *Journal of Perinatology* **18**(1): 61-64.
- Durnin JVGA (1992). Physical activity levels past and present. In *Physical activity and health*. N.Norgan (Ed.). Cambridge: Cambridge University Press.
- Durnin JVGA & Passmore R (1967). *Energy, work and leisure*. London: Heinemann Educational Books.
- Duvekot JJ, Cheriex EC, Pieters FA, Menheere PP, et al. (1993). Early pregnancy changes in hemodynamics and volume homeostasis are consecutive adjustments triggered by a primary fall in vascular tone. *American Journal of Obstetrics & Gynaecology* **169**:1382-1392.
- Dye TD, Knox KL, Artal R, Aubrey RH, et al. (1997). Physical activity, obesity and diabetes in pregnancy. *Am J Epidemiol* **146**(11) 961-965.
- Edholm OG (1966). The assessment of habitual activity. In *Physical activity in health and disease*. Evang K & Andersen KL (Eds.) Oslo: Universitets Forlaget.
- Edwards MJ (1986). Hyperthermia as a teratogen: a review of experimental studies. *Teratogenesis Carcinog Mutagen* **6**: 563-82.
- Ehlers CL, Frank E & Kupfer DJ (1988). Social zeitgebers and biological rhythms. *Arch Gen Psychiatry* **45**: 948-952.
- El Khoury N, Karam EG & Melhem NM (1999). Depression and pregnancy. *J Med Liban* **47**(3): 169-74.
- Elliot SA, Anderson M, Brough DI, Watson JP, et al. (1984). Relationship between obstetric outcome and psychological measures in pregnancy and the postpartum year. *Journal of Reproductive & Infant Psychology* **2**: 18-32.
- Elliot SA, Rugg, AJ, Watson JP, & Brough DI (1983). Mood changes during pregnancy and after the birth of a child. *British Journal of Clinical Psychology* **22**: 295-308.

References

- Ellis MI, Seedholm BB & Wright V (1985). Forces in women 36 weeks pregnant and four weeks after delivery. *Engineering Medicine* **14**: 95-99.
- Epstein S & Katz L (1992). Coping ability, stress, productive load and symptoms. *Journal of Personality & Social Psychology* **62**: 813-25.
- Epstein S & Meier P (1989). Constructive thinking: A broad coping variable with scientific components. *Journal of Personality & Social Psychology* **57**: 332-350.
- Erdelyi GJ (1962). Gynaecological survey of female athletes. *Journal of Sports Medicine & Physical Fitness* **2**:174-9.
- Erickson (1967). Method for frequent assessment of symptomology during pregnancy. *Psychological Reports* **20**: 447-450.
- Erkkola R (1976). The physical work capacity of the expectant mother and its effect on pregnancy, labour and the newborn. *International Journal of Gynaecology & Obstetrics* **14**: 153-9.
- Eysenck HJ (1959). *Manual of the Maudsley Personality Inventory*. London: University of London Press.
- Eysenck SBG (1962). The validity of a personality questionnaire as determined by the method of nominated groups. *Life Sciences* **1**: 13-18.
- Eysenck HJ & Eysenck SBG (1975). *Manual for the Eysenck Personality Inventory*. London: Hodder & Stoughton.
- Eysenck SBG & Eysenck HJ (1963). The validity of questionnaires and rating assessments of extroversion and neuroticism and their factorial validity. *Brit J Psychol* **54**: 51062.
- Fairburn CG & Welch SL (1990). The impact of pregnancy on eating habits and attitudes to shape and weight. *International Journal of Eating Disorders* **9**(2): 153-160.
- Fallowfield L (1990). *The quality of life*. London: Souvenir Press.
- FAO/WHO/UNU (1985). *Energy and protein requirements*. WHO technical report series 724. Geneva: WHO.
- Farmer ME, Locke BZ, Moscicki EK, Dannenberg AL, et al. (1988). Physical activity and depressive symptoms- The NHANES-I epidemiologic follow up study. *Am J Epidemiol* **128**(6): 1340-1351.

References

- Fasting K & Gronningsaeter H (1986). Unemployment, trait anxiety and physical exercise. *Scand J Sports Sci* **8**: 99-103.
- Federick J & Adelstein P (1978). Factors associated with low birthweight of infants delivered at term. *Br J Obstet Gynaecol* **85**: 1-7.
- Feksi A, Harris B, Walker RF, Riad-Fahmy D, et al. (1984). 'Maternity blues' and hormone levels in saliva. *Journal of Affective Disorders* **6**:351-355.
- Ferri E. (Ed.) (1993). *Life at 33: The 5th follow-up of the National Child Development Study*. London: National Children's Bureau & City University.
- Ferri E. & Smith K. (1996). *Parenting in the 1990s*. London: Family Policy Studies Centre & Joseph Rowntree Foundation.
- Fielding D & Bosanko C (1984). Psychological aspects of the menstruum and premenstruum. In *Psychology and Gynaecological problems*. Broome A & Wallace L (Eds.). London: Tavistock.
- Fishbein M & Azjen I (1975). *Belief, attitude, intention and behaviour: An introduction to theory and research*. Reading, MA: Addison-Wesley.
- Fisher (1985). *Development and structure of the body image*. Hillsdale, NJ: Erlbaum.
- Fleming AS, Ruble DN, Flett GL & Shaul DL (1988). Postpartum adjustment in first time mothers: effects of mood on maternal responsiveness. *Developmental Psychology* **24**: 71-81.
- Ford ES, Merrit RK, Heath GW, Powell KE, et al. (1991). Physical activity behaviours in lower and higher socio-economic status populations. *Am J Epidemiol* **133**: 1246-1256.
- Fortier I, Marcoux S & Brisson J (1995). Maternal work during pregnancy and the risk of delivering a small for gestational age or preterm infant. *Scand J Work Environ Health* **21**(6): 412-418.
- Foster FG, McPartland RJ & Kupfer DJ (1978). Motion sensors in medicine: A report on reliability and validation. *Journal of Inter-American Medicine* **3**: 4-8.
- Fox ME, Harris RE & Brekken A (1977). The active duty military pregnancy: a new high-risk category. *American Journal of Obstetrics & Gynaecology*, **129**: 705.
- Frankfort-Nachmias C & Nachmias D (1992). *Research methods in the social sciences*. London: Edward Arnold.

References

- Freedson PS (1989). Field monitoring of physical activity in children. *Paediatric Exercise Science* **1**: 8-18.
- Gabbe SG, Niebyl JR & Simpson JL (1991). *Pocket companion to Obstetrics: Normal and problem pregnancies* (3rd Edition). New York: Churchill Livingstone.
- Gard PR, Handley SL, Parsons AD & Waldron G (1986). A multivariate investigation of postpartum mood disturbance. *British Journal of Psychiatry* **148**: 567-575.
- Garrow JS (1974). *Energy balance and obesity in man*. Amsterdam: Elsevier.
- Gayle R, Montoye HJ & Philpot J (1977). Accuracy of pedometers for measuring distance walked. *Research Quarterly* **48**: 632-636.
- Ghosh P, Bitsanis D, Crawford MA, Poston L (2000). Adult offspring of rates fed a diet high in saturated fat during pregnancy demonstrate vascular abnormalities. *Journal of Physiology* **525**: 8.
- Gillberg C & Gillberg IC (1983). Infantile autism- A total population study of reduced optimality in the prenatal, perinatal and neonatal period. *Journal of Autism & Developmental Disorders* **13**(2): 153-166.
- Glendinning M & Millar N (1985). *Women and poverty in Britain*. Sussex: Wheatsheaf
- Gleve K (1987). Rethinking feminist attitudes towards motherhood. *Feminist Review* **25**: 38-45.
- Godin G (1994). Theories of reasoned action and planned behaviour: usefulness for exercise promotion. *Med Sci Sports Exerc* **26**(11): 1391-4.
- Godin G & Shephard RJ (1985). A simple method to assess Exercise behaviour in the community. *Canadian Journal of Applied Sports Science* **10**: 141-146.
- Godin G, Valois P & Lepage L (1993). The pattern of influence of perceived behavioural control upon exercising behaviour: an application of Azjen's theory of planned behaviour. *J Behav Med* **16**: 81-102.
- Goldstein H (1977). Smoking in pregnancy: Some notes on the statistical controversy. *Br J Prev Soc Med* **31**: 13-17.
- Goldstein H (1971). Factors influencing the height of seven year old children- Results from the National Child Development Study. *Human Biology* **43**: 92-111.
- Gollnick PD (1985). Metabolism of substrates: energy substrate metabolism during exercise and as modified by training. *Federation proceedings* **44**: 353-357.

References

- Gondola J & Tuckman B (1982). Psychological mood states in 'average' marathon runners. *Perceptual & Motor Skills* **55**: 1295-1300.
- Gotlib IH, Whiffen VE, Mount JH, Milne K, et al. (1989). Prevalence rates and demographic characteristics associated with depression in pregnancy and the postpartum. *Journal of Consulting & Clinical Psychology* **57**: 269-274.
- Gotlib IH, Whiffen VE, Wallace PM & Mount JH (1991). Prospective investigation of postpartum depression: Factors involved in onset and recovery. *Journal of Abnormal Psychology* **100**: 122-132.
- Graham H (1987) Women's smoking and family health. *Social Science & Medicine* **25**: 45-56.
- Graham H and Oakley A (1986). Competing ideologies of reproduction: Medical and maternal perspectives on pregnancy. In *Concepts of health, illness and disease*. Currer C & Stacey M (Eds.). Oxford: Berg.
- Green JM (1990). *Is the baby alright and other worries*. Paper presented at the 10th Anniversary Conference of the Society for Reproductive & Infant Psychology, Cambridge, England.
- Green JM, Coupland VA & Kitzinger JV (1988). *Great expectations: A prospective study of women's expectations and experiences of childbirth*. Cambridge: Centre for Family Research.
- Greenshields W, Hulme H, & Oliver S (1993). *The perineum in childbirth: a survey of women's experiences and midwives practices*. London: National Childbirth Trust.
- Gross H & Pattison HM (1995). Cognitive failure during pregnancy. *Journal of Reproductive & Infant Psychology* **13**: 17-32.
- Grossman FK, Eichler LS & Winickoff SA (1980). *Pregnancy, birth and parenthood: Adaptation of mothers, fathers and infants*. San Francisco: Jossey-Bass.
- Gruber JJ (1986). Physical activity and self-esteem development in children: a meta-analysis. In *Effects of physical activity in children*. Stull GA & Eckert HM (Eds.). Champaign, IL Human Kinetics.
- Grunebaum A., Minkoff H. & Blake D (1987). Pregnancy among obstetricians: A comparison of births before, during and after residency. *American Journal of Obstetrics & Gynaecology*, **157**:79.

References

- Guildford JP (1956). *Fundamental statistics in psychology and education* (4th Ed.). New York: McGraw Hill.
- Hall DC & Kaufmann DA (1987). Effects of aerobic and strength conditioning on pregnancy outcomes. *American Journal of Obstetrics & Gynaecology* **157**: 1199-203.
- Hall DE & Mohr AJ (1933). Prenatal attitudes of primiparae. *Ment Hyg* **17**: 226-234.
- Hall MH, Chng PK & MacGillivray I (1980). Is routine antenatal care worthwhile? *Lancet* **2**: 78-80.
- Halpert JA, Wilson ML & Hickman JL (1993). Pregnancy as a source of bias in performance appraisals. *Journal of Organizational Behaviour* **14**: 649-663.
- Halverson CF, Kohnstamm GA & Martin RP (1994). The developing structure of temperament and personality from infancy to adulthood. Hills dale, NJ: Erlbaum.
- Hansen OE & Maggio M (1960). Static work and heart rate. *Einsehe Arbeitphysiol* **18**: 242-247.
- Harris HE (1997). *The influence of pregnancy on long-term changes in maternal body weight*. University of Greenwich, London, UK, PhD Thesis.
- Harris HE & Ellison GTH (1997). Retrospective estimation of prepregnant body weight. *Annals of Human Biology* **24**: 272 (Abstract).
- Harris HE, Ellison GTH, Holliday M & Lucassen E (1997). Methodological considerations in the design of an obstetric database abstracted from medical records. *Meth Infom Med* **36**: 191-200.
- Harris R (1979). Cultural differences in body perception during pregnancy. *British Journal of Medical Psychology* **52**: 347-352.
- Harris K & Campbell E (1999). The plans in unplanned pregnancy: Secondary gain and the partnership. *Br J Med Psychol* **72**: 105-120.
- Hartikainen-Sorri AL & Sorri M (1989). Occupational and socio-medical factors in preterm birth. *Obstet Gynaecol* **74**: 13-16.
- Haskell WL (1994). Health consequences of physical activity: understanding and challenges regarding dose response. *Med Sci Sports Exerc* **26**: 649-660.
- Haslam C (1999). Maternal factors, obstetric history and smoking stage of change. *Journal of Public Health Medicine* **21**(2): 185-191.

References

- Haslam C, Draper ES & Goyder E (1997). The pregnant smoker: social and psychological influences. *J Public Health Med* **19**: 187-192.
- Hatch EE & Bracken MB (1993). Association of delayed conception with caffeine consumption. *Am J Epidemiol* **138**: 1082-1092.
- Hatch MC, Shu X-O, McLean DE, Levin B, et al. (1993). Maternal exercise during pregnancy, physical fitness and fetal growth. *Am J Epidemiol* **137**: 1105-1114.
- Hauth JC, Gilstrap LC & Brekken AL (1983). The effect of 17-alpha-hydroxyprogesterone caproate on pregnancy outcome in an active-duty military population. *Am J Obstet Gynaecol* **146**: 187-190.
- Hebert JR, Clemow L, Pbert L, Ockene IS, et al. (1995). Social desirability bias in dietary self-report may compromise the validity of dietary intake measures. *Int J Epidemiol* **24**(2): 389.
- Heckman JD & Sassard R (1994). Musculoskeletal considerations in pregnancy. *J Bone Joint Surg* **76-A**: 1720-1730.
- Hemminki E & Gissler M (1996). Birth by younger and older mothers in a population with late and regulated childbearing: Finland 1991. *Acta Obstetricia Gynecologica Scandinavica* **75**: 19-27.
- Henderson KA, Bialeschki MD, Shaw SM & Freysingewr VJ (1989). *A leisure of one's own- A feminist perspective on women's leisure*. State college PA: Venture Publishing.
- Hendrick V, Altshuler L, Cohen L & Stowe Z (1998). Evaluation of mental health and depression during pregnancy: Position paper. *Psychopharmacol Bull* **34**(3): 297-9.
- Henriksen TB, Hedegaard M, Secher NJ & Wilcox AJ (1995). Standing at work and preterm delivery. *British Journal of Obstetrics & Gynaecology* **102**: 198-206.
- Hensley LD, Ainsworth BE & Ansorge CJ (1993). Assessment of physical activity-Professional accountability in promoting active lifestyles. *Journal of Physical Education, Recreation & Dance* **64**(1): 56-64.
- Hickey CA, Cliver SP, Mulvihill FX, et al. (1995). Employment related stress and preterm delivery: A contextual examination. *Public Health Reports* **110**: 410-418.
- Higher Education Research Institute (1993). *The American freshman: National norms*. Los Angeles: UCLA Press.

References

- Hofer MA (1984). Relationships as regulators: A psychobiologic perspective on bereavement. *Psychosom Med* **46**: 183-197.
- Hogan J (1989). Personality correlates of physical fitness. *Journal of Personality & Social Psychology* **56**: 284-288.
- Hogue CJR, Buehler JW, Struss LT, Smith JC, et al. (1987). Overview of the National Infant Mortality Surveillance (NIMS) Project: Design, methods, results. *Pub Health Rep* **102**: 126-138.
- Homer CJ, Beresford SA, James SA, Siegel E, et al. (1990). Work related physical exertion and risk of preterm low birthweight delivery. *Paediatric and Perinatal Epidemiology* **4**: 161-174.
- Hurst JC & Strousse F (1938). The origin of emotional factors in normal pregnant women. *Am J Med Sci* **196**: 95-99.
- Hutchinson PL (1981). Metabolic and circulatory responses to running during pregnancy. *Physician Sports Medicine* **9**: 55-61.
- Hytten FE (1984). The effect of work on placental function and fetal growth. In *Pregnant women at work*. Chamberlain G (Ed.). London: Royal Society of Medicine.
- Ismail AJ, Barany JW & Smith CB (1971). Relationship between mechanical force and physiological cost during gait in adult man. In *Biomechanics*. Cooper JM (Ed.). Chicago, IL: Athletic Institute.
- Jackson MA, Gott P, Lye SJ, Knox, et al. (1995). The effect of maternal aerobic exercise on human placental development: Placental volumetric composition and surface areas. *Placenta* **16**: 179-191.
- Jacobs DR (2000). Comment on issues in the assessment of physical activity in women. *Res Q Exerc Sport* **71**(2): 43-46.
- Jacobs DR, Ainsworth BE, Hartman TJ & Leon (1993). A simultaneous evaluation of 10 commonly used physical activity questionnaires. *Med Sci Sports Exerc* **25**: 81-89.
- Jacobs DR, Hahn LP, Haskell WL, Pirie P & Sidney S (1989). Reliability and validity of a short physical activity history: CARDIA and the Minnesota Heart Health Program. *J Cardiopulm Rehab* **9**: 448-459.
- Jaffee L, Lutter JM, Rex J, Hawkes C, et al. (1999). Incentives and barriers to physical activity for working women. *American Journal of Health Promotion* **13**: 215-218.

References

- Janz KF (1994). Validation of the CSA accelerometer for assessing children's physical activity. *Med Sci Sports Exerc* **26**: 369-375.
- Jarrachi-Zadek A, Kane FJ, Van de Castle RI, Lachenbruch PA, et al. (1969). Emotional and cognitive changes in pregnancy and early puerperium. *Brit J Psychiat* **115**: 797-805.
- Jarrett JC & Spellacy WN (1983). Jogging during pregnancy: An improved outcome? *Obstet Gyneacol* **61**: 705-709.
- Jarski RW & Trippet DL (1990). The risks and benefits of exercise during pregnancy. *Journal of Family Practice* **30**: 185-89.
- Jenkin W & Tiggemann M (1997). Psychological effects of weight retained after pregnancy. *Women & Health* **25**: 89-98.
- Jobber D & Saunders J (1989). The prediction of industrial mail-survey response rates. *Journal of the Operational Research Society* **40**(10): 839-847.
- Johnson CA, Corrigan SA, Dubbert PM & Gramling SE (1990). Perceived barriers to exercise and weight control practices in community women. *Women & Health* **16**: 177-191.
- Johnson SR, Kolberg BH, Varner MW & Railsback D (1987). Maternal obesity in pregnancy. *Surg Gynaecol Obstet* **164**: 431-437.
- Jones KL, Chernoff FG & Kelly CD (1984). Outcome of pregnancy in women who 'binge' drink during the first trimester of pregnancy. *Clinical Research* **32**:114A.
- Juster T & Stafford F (1991). The allocation of time: Empirical findings, behavioural models and problems of measurement. *Journal of Economic Literature* **29**: 471-522.
- Kalkwarf HJ, Haas JD, Belko AZ, Roach RC, et al. (1989). Accuracy of heart rate monitoring and activity diaries for estimating energy expenditure. *Am J Clin Nutr* **49**: 37-43.
- Kannel WB & Sorlie PS (1979). Some health benefits of physical activity: The Framingham study. *Arch Intern Med* **139**: 857-861.
- Kardel KR & Kase T (1998). Training in pregnant women- Effects on fetal development and birth. *Am J Obstet Gynaecol* **178**(2) 280-286.

References

- Karzel RP & Friedman MC (1991). Orthopaedic injuries in pregnancy. In *Exercise in pregnancy*. Artal RA, Wiswell RA & Drinkwater BL (Eds.). Baltimore: Williams & Wilkins.
- Katch FI & McArdle WD (1977). *Nutrition, weight control and exercise*. Boston: Houghton Mifflin.
- Katz VL, Jenkins T, Haley L & Bowes WA (1991). Catecholamine levels in pregnant physicians and nurses: A pilot study of stress and pregnancy. *Obstetrics & Gynaecology* 77:338-342.
- Kay S & Purves IN (1996). Medical records and other stories: A narratological framework. *Meth Inform Med* 35: 72-87.
- Kay T (1995). *Women and sport: A review of research*. London: Sports Council.
- Keith L & Luke B (1991). The association between women's work, working conditions and adverse pregnancy outcomes: A review of the literature and directions for future research. *Women's Health Inst* 1: 113-119.
- Kemper HCG & Verschur R (1977). Validity and reliability of pedometers in habitual activity research. *Eur J Appl Physiol* 37: 71-82.
- Kendzierski D (1990). Exercise self-schemata: Cognitive and behavioural correlates. *Health Psychol* 9: 69-82.
- Kennerley H & Gath G (1989). Maternity blues: Detection and measurement by questionnaire. *British Journal of Psychiatry* 155: 356-362.
- Kern I (1982). An endless joy: The culture of motherhood over 35. *Papers in the Social Sciences* 2: 43-56.
- King AC, Blair SN, Bild D, et al. (1992). Determinants of physical activity and interventions in adults. *Med Sci Sports Exerc* 24(Suppl): S221-S236.
- King AC, Taylor CB & Haskell WL (1993). The effects of differing intensities and formats of twelve months of exercise training on psychological outcomes in older adults. *Health Psychol* 12(4):292-300.
- Kitzinger C & Perkins R (1993). *Changing our minds*. London: Women's Press.
- Kitzinger S (1995). *Ourselves as mothers*. New York: Addison Wesley.

References

- Klebanoff MA, Shiono PH & Carey JC (1990a). The effect of physical activity during pregnancy on preterm delivery and birthweight. *Obstetrics & Gynaecology*, **163**:1450-6.
- Klebanoff MA, Shiono PH & Rhoads GG (1990). Outcomes of pregnancy in a national sample of resident physicians. *New England Journal of Medicine* **323**:1040-1045.
- Klein H, Potter HW & Dyke RB (1950). *Anxiety in Pregnancy and Childbirth*. New York: Harper & Row.
- Klein PD et al. (1984). Calorimetric validation of the doubly labelled water method for estimation of energy expenditure in man. *Hum Nutr Clin Nutr* **38C**: 95-106.
- Kleinman JC, Pierre MB, Madans JH, et al. (1988). The effects of maternal smoking on fetal and infant mortality. *Am J Epidemiol* **127**:46-55
- Kleiverda G, Paarlberg KM & Buitendijk SE (1997). Pregnancy, work conditions and obstetric outcomes: methodological issues reviewed for further research. *Journal of Reproductive & Infant Psychology* **15**: 281-286.
- Klesges RC, Eck LH, Mellon MW, Fulliton W, et al. (1990). The accuracy of self-reports of physical activity. *Med Sci Sports Exerc* **22**: 690-697.
- Koemeester AP, Broerson J PJ & Treffers PE (1995). Physical work load and gestational age at delivery. *Occupational & Environmental Medicine* **52**:313-315.
- Kohl HW, Blair SN, Paffenbarger RS, Macera CA & Kronenfeld JJ (1988). A mail survey of physical activity habits as related to measured physical fitness. *Am J Epidemiol* **127**: 1228-1239.
- Korcok M (1981). Pregnant jogger: What a record! *JAMA* **246**:201.
- Koumentaki A, Anthony FW, Poston L & Wheeler T (2000). Effects of dietary protein restriction on isolated small artery function in female rats. *Journal of Physiology* **525**: 20.
- Kramer MS (1991). The aetiology and prevention of low birth weight: Current knowledge and priorities for future research. In *Advances in the prevention of low birthweight: An international symposium*. Washington DC: National Center for Education & Maternal & Child Health.
- Kriska AM & Caspersen CJ (1997). A collection of physical activity questionnaires for health related research. *Med Sci Sports Exerc* **29**: S1-S205.

References

- Kriska AM, Knowler WC & Laporte RE, et al. (1990). Development of questionnaire to examine relationship of physical activity and diabetes in Pima Indians. *Diabetes Care* **13**: 401-411.
- Kulpa FJ, White BM & Visscher R (1987). Aerobic exercise in pregnancy. *American Journal of Obstetrics & Gynaecology* **156**:1395-403.
- Kumar R & Robson KM (1984). A prospective study of emotional disorders in childbearing women. *British Journal of Psychiatry* **144**: 35-57.
- Kumar R & Robson KM (1978) Neurotic disturbance during pregnancy and the puerperium; preliminary report of a prospective survey of 119 primiparae. *In Mental illness in pregnancy and the puerperium*. Sandler M (Ed.). Oxford: Oxford University Press.
- Kumar R, Robson KM & Smith AMR (1984). Development of a self-administered questionnaire to measure maternal adjustment and maternal attitudes during pregnancy and after delivery. *J Psychosom Res* **28**(1): 43-51.
- Labs S & Wurtele SK (1986). Fetal health locus of control scale: development and validation. *Journal of Consulting & Clinical Psychology* **54**(6): 814-819.
- Lamb KL & Brodie DA (1990). The assessment of physical activity by leisure-time physical activity questionnaires. *Sports Med* **10**(3): 159-180.
- Lane A, Keville R, Morris M, Kinsella A, et al. (1997). Postnatal depression and elation among mothers and their partners: prevalence and predictors. *Br J Psychiatry* **171**: 550-5.
- Laporte RE, Cauley JA, Kinsey C, Corbett W, et al. (1982). The epidemiology of physical activity in children, college students, middle aged men, menopausal females and monkeys. *Journal of Chronic Diseases* **352**: 787-795.
- Laporte RE, Huller LH, Kupfer FJ, McPartland RJ, et al. (1979). An objective measure of physical activity for epidemiologic research. *Am J Epidemiol* **109**: 158-168.
- Laporte RE, Montoye HJ & Caspersen CJ (1985). Assessment of physical activity in epidemiologic research: Problems and prospects. *Public Health Rep* **100**: 131-146.
- Lau RR, Hartman KA & Ware JE (1986). Health as a value: Methodological and theoretical considerations. *Health Psychology* **5**(1): 25-43.

References

- Launer LJ, Villar J, Kestler E, de Onis M (1990). The effect of maternal work in fetal growth and duration of pregnancy: A prospective study. *British Journal of Obstetrics & Gynaecology* **97**: 62-70.
- Lauter S (1926). Zur Genese der Fettsucht. *Dtsch Arch Klin* **150**: 315-365.
- Lee KA, Zaffke ME & McEnany G (2000). Parity and sleep patterns during and after pregnancy. *Obstet Gynaecol* **95**(1): 14-18.
- Leifer M (1980). *Psychological effects of motherhood: A study of first pregnancy*. New York: Praeger.
- Lemke MR (1999). Motor signs of depression. *Nervenarzt* **70**(7): 600-612.
- Lemke MR, Broderick A & Hartmann W (1998). Motor activity and subjective findings in depressed patients. *Fortschur Neurol Psychiatr* **66**(1): 43-48.
- Lemke MR, Broderick A, Zeitelberger M & Hartmann W (1997). Motor activity and daily variation of symptom intensity in depressed patients. *Neuropsychobiology* **36**(2): 57-61.
- Leon AS, Cornett J, Jacobs DR et al. (1987). Leisure-time physical activity levels and risk and risk of coronary heart disease and death: The Multiple Risk Factor Intervention Trial. *JAMA* **258**: 2388-2395.
- Lewinsohn PM & Hoberman HM (1982). Depression. In *International Handbook of Behaviour Modification & Therapy*. Bellack AS, Hersen M & Kazdin AE (Eds.). New York: Plenum Press.
- Lewis S, Klee H. & Jackson M. (1995). Illicit drug users' experiences of pregnancy: An exploratory study. *Journal of Reproductive & Infant Psychology* **13**: 219-227.
- Li R, Deurenberg P & Hautvast JGAJ (1993). A critical evaluation of heart rate monitoring to assess energy expenditure in individuals. *Am J Clin Nutr* **58**: 602-607.
- Lifson N, Gordon GB & McClintock R (1955). Measurement of total carbon dioxide by means of D₂O¹⁸. *J Appl Physiol* **7**:704.
- Loesch JG & Greenburg NH (1962). Areas of conflict observed during pregnancy. *Am J Orthopsychiat* **32**: 624-636.
- Lokey EA, Tran ZV, Wells CL, et al. (1991). Effects of physical exercise on pregnancy outcomes: a meta-analytic review. *Med Sci Sports Exerc* **23**: 1234-1239.

References

- Long BC & van Stavel R (1995). Effects of exercise training on anxiety: a meta-analysis. *Journal of Applied Sport Psychology* **7**: 167-189.
- Lotgering FK, Gilbert RD & Longo LD (1985). Maternal and fetal responses to exercise during pregnancy. *Physiology Review* **65**:1-36.
- Lotgering FK, Gilbert RD & Longo LD (1984). The interactions of exercise and pregnancy: A review. *American Journal of Obstetrics & Gynaecology*, **149**: 550-68.
- Lotgering FK, Gilbert RD & Longo LD (1983). Exercise responses in pregnant sheep. Oxygen consumption, uterine blood flow and blood volume. *Journal of Applied Physiology* **55**: 834-41.
- Lotgering FK, van Dorn MB, Struijk PC, Pool J, et al. (1991). Maximal aerobic exercise in pregnant women: Heart rate, O₂ consumption, CO₂ production and ventilation. *Journal of Applied Physiology* **70**: 1016-1023.
- Loudon (1992). *Death in childbirth: An international study of maternal care and maternal mortality 1800-1950*. Oxford: Oxford University Press.
- Luke B, Mamelle N, Keith L, et al. (1995). The association between occupational factors and preterm birth; a United States nurses study. *Am J Obstet Gynaecol* **173**: 849-862.
- Lumey H (1988). *Obstetric performance of women after in utero exposure to the Dutch famine (1944-45)*. Columbia University, New York, PhD thesis.
- MacIntyre S (1978). Some notes on record taking and making in an antenatal clinic. *Sociologic Rev* **26**: 595-611.
- McAuley E, Courneya KS & Rudolph DL (1994) Enhancing exercise adherence in middle-aged males and females. *Prev Med* **23**: 498-506.
- McCann IL & Holmes DS (1984). Influence of aerobics on depression. *Journal of Personality & Social Psychology* **46**: 1142-1147.
- McColl E (1994). Questionnaire design and construction. *Nurse Researcher* **1**: 112-121.
- McConnell OL & Datson PG (1961). Body image changes in pregnancy. *Journal of Projective Techniques* **25**: 451-456.
- McDonald AD, McDonald JC, Armstrong B, et al. (1988). Prematurity and work in pregnancy. *British Journal of Industrial Medicine* **46**: 196-9.

References

- McDonald DG & Hogdon JA (1991). *Psychological effects of aerobic fitness training: Research and theory*. New York: Springer-Verlag.
- McKenzie TL (1991). Observation measures of children's physical activity. *Journal of School Health* **61**: 224-227.
- McKenzie TL & Carlson BR (1989). Systematic observation and computer technology. In *Analysing Physical Education and Sport Instruction*. Darst P, Zakrajsek D & Macini (Eds.). Champaign, IL: Human Kinetics.
- McMurray RG, Mottola MF, Wolfe LA., Artal R, et al. (1993). Recent advances in understanding maternal and fetal responses to exercise. *Medicine & Science in Sports & Exercise* **25**(12): 1305-1321.
- McPartland RJ, Kupfer DJ, Foster FG, Reisler KL, et al. (1975). Objective measurement of human motor activity. *Biotelemetry* **2**: 317-323.
- McRae S (1991). *Maternity rights in Britain*. London: Policy Studies Institute.
- McWilliams E (2000). *Development of a questionnaire to measure perceived support during pregnancy and its relation to coping strategies and outcome*. Loughborough University, Leicestershire, UK, PhD Thesis.
- McWilliams E (1994). The association of perceived support with birthweights and obstetric complications: Piloting prospective identification and the effects of counselling. *Journal of Reproductive & Infant Psychology* **12**: 115-122.
- Mackey MC & Coster Schultz MA (1992). Women's views of the preterm labour experience. *Clin Nurs Res* **1**(4): 366-384.
- Magann EF, Evans SF & Newnham JP (1996). Employment, exertion and pregnancy outcome: Assessment by kilocalories expended each day. *Am J Obstet Gynaecol* **175**: 182-187.
- Magann EF & Nolan TE (1991). Pregnancy outcome in an active duty population. *Obstet Gynaecol* **78**: 391-393.
- Maloni JA (1996). Bed rest and high-risk pregnancy. *Nursing Clinics of North America* **31**(2): 313-325.
- Maloni J, Chance B, Zhang C, et al. (1993). Physical and psychosocial effects of antepartum hospital bed rest. *Nurs Res* **42**: 197.

References

- Mamelle N, Laumon B & Lazar P (1984). Prematurity and occupational activity during pregnancy. *American Journal of Epidemiology* **119**: 309.
- Mamelle N & Munoz F (1987). Occupational working conditions and preterm birth: A reliable scoring system. *American Journal of Epidemiology* **126**: 150.
- Manshande JP, Eeckels R, Manshande-Desmet V, et al. (1987). Rest versus heavy work during the last weeks of pregnancy. *Br J Obstet Gynaecol* **94**: 1059-67.
- Marcoux S, Brisson J & Fabia J (1989). The effect of leisure-time physical activity on the risk of pre-eclampsia and gestational hypertension. *J Epidemiol Community Health* **43**: 147-152.
- Marcus BH, Eaton CA, Rossi JS, et al. (1994). Self-efficacy, decision making and stages of change: An integrative model of physical exercise. *J Appl Social Psychol* **24**: 489-508.
- Marcus BH, King TK, Clark MM, Pinto B et al. (1996). Theories and techniques for promoting physical activity behaviours. *Sports Med.* **22**(5): 321-331.
- Marcus BH & Owen N (1992). Motivational readiness, self-efficacy and decision-making for exercise. *Journal of Applied Social Psychology* **22**(1): 3-16.
- Markens S, Browner CH & Press N (1997). Feeding the fetus: On interrogating the notion of maternal fetal conflict. *Feminist Studies* **23**(2): 351-73.
- Marlatt GA & Gordon J (1985). *Relapse prevention*. New York: Guildford Press.
- Mead D (1994). Personal experiences of designing questionnaires. *Nurse Researcher* **1**: 158-166.
- Meares R, Grimwade J, Bickley M & Wood C (1972). Pregnancy and neuroticism. *Med J Aust March*: 517-520.
- Meijer GAL, Westerterp KR, Koper H & ten Hoor F (1989). Assessment of energy expenditure by recording heart rate and body acceleration. *Med Sci Sports Exerc* **21**: 343-347.
- Meijer GAL, Westerterp KR, Verhoeven FM, Koper HB, et al. (1991). Methods to assess physical activity with special reference to motion sensors and accelerometers. *IEEE Trans Bio-Med Eng* **38**: 221-229.
- Melanson EL & Freedson PS (1996). Physical activity assessment : A review of methods. *Critical Reviews in Food Science & Nutrition* **36**: 385-396.

References

- Mercer RT (1986). *First time motherhood experiences from teens to forties*. New York: Springer.
- Mercer RT & Ferketich SL (1988). Stress and social support as predictors of anxiety and depression during pregnancy. *Advances in Nursing Science* **10**: 26-39.
- Miller DJ, Freedson PS & Kline GM (1994). Comparison of activity levels using the Caltrac accelerometer and five questionnaires. *Med Sci Sports Exerc* **26**: 376-382.
- Miller DI & Nelson RC (1973). *Biomechanics of sport*. Philadelphia: Lea & Febiger.
- Miller PM & Lloyd C (1991). Social support and its interactions with personality and childhood. *Social Psychiatry & Psychiatric Epidemiology* **26**: 171-177.
- Miller NH, Katz VL & Cefalo RC (1989). Pregnancies among physicians A historical cohort study. *Journal of Reproductive Medicine* **34**: 790-796.
- Misra DP, Strobino DM, Stashhinko EE, Nagey DA, et al. (1998). Effects of physical activity on preterm birth. *Am J Epidemiol* **147**(7): 628-35.
- Monahan P & DeJoseph J (1991). The woman with preterm labour at home: A descriptive analysis. *Journal of Perinatal & Neonatal Nursing* **4**: 12-21.
- Montoye HJ (1975). *Physical activity and health: An epidemiologic study of an entire community*. Englewood Cliffs, NJ: Prentice Hall.
- Montoye HJ (1971). Estimation of habitual physical activity by questionnaire and interview. *Am J Clin Nutr* **24**: 1113-1118.
- Montoye HJ, Kemper HCG, Saris WHM & Washburn RA (Eds.) (1996). *Measuring physical activity and energy expenditure*. Champaign, IL: Human Kinetics.
- Montoye HJ & Taylor HL (1984). Measurement of physical activity in population studies: A review. *Human Biology* **56**: 195-216.
- Montoye HJ, Washburn R, Servais S, Ertl A, et al. (1983). Estimation of energy expenditure by a portable accelerometer. *Med Sci Sports Exerc* **15**: 403-407.
- Morgan WP & Goldston SE (Eds.) (1987). *Exercise and Mental Health*. Washington, DC: Hemisphere.
- Morgan WP & Pollock ML (1977). Psychologic characterisation of the elite distance runner. *Annals of the New York Academy of Science* **301**: 382-403.
- Morris L (1990). *The Workings of the Household*. Cambridge: Polity Press.

References

- Morris JRW (1973). Accelerometry- A technique for the measurement of human body movements. *J Biomech* **6**: 729-736.
- Morris JN, Clyton DG, Everitt MG, Semmence AM, et al. (1990). Exercise in leisure-time: coronary attack and death rates. *Br Heart J* **63**: 325-334.
- Morris JN & Hardman AE (1997). Walking to health. *Sports Med* **23**(5): 306-332.
- Moser C & Kalton G (1971). *Survey methods in social investigation (2nd Ed.)*. London: Heinemann.
- Moses J, Steptoe A, Matthews A & Edwards S (1989). The effects of Exercise training on mental wellbeing in the normal population: A controlled trial. *Journal of Psychosomatic Research* **33**: 47-61.
- Moss N & Carver K (1993). Pregnant women at work: Sociodemographic perspectives. *American Journal of Industrial Medicine* **23**: 541-557.
- Mulcare JA, Ayres S & Allen J (1999). *Measuring physical activity in persons with chronic physical, psychological or cognitive disabilities*. Paper presented at the American College of Sports Medicine Annual Meeting, Seattle, WA.
- Muller EA (1953). Physiological basis of rest pauses in heavy work. *Quarterly Journal of Experimental Physiology* **38**: 205-215.
- Murphy JF, Newcombe R, Dauncey M, Garcia J, et al. (1984). Employment in pregnancy: Prevalence, maternal characteristics, perinatal outcome. *Lancet* **1**: 1163-1166.
- Naeye RL & Peters EC (1982). Working during pregnancy: Effects on the fetus. *Paediatrics* **69**: 724-9.
- Nash FW (1973). Maternal education and attitudes – 100 first maternities. *Hlth Soc Ser J* **83**: 2363-2364.
- National Centre for Health Statistics (1985). *Vital Health Stat 10 (163)*. Health Promotion and Disease Prevention. Washington DC: US Government Printing Office.
- Nemeck MA (1990). Health beliefs and breast self-examination among black women. *Health Values* **14**: 41-52.
- Newman P & Smith A (1997). *Social focus on families*. Pullinger J & Summerfield C (Eds.). London: Stationery Office.

References

- Newson J & Newson E (1963). *Infant care in an urban community*. London: George Allen & Unwin.
- Newton RW & Hunt LP (1984). Psychosocial stress in pregnancy and its relation to low birthweight. *BMJ* **288**: 1191-1194.
- Nicholls & Grieve (1992). Posture, performance and discomfort in pregnancy. *Applied Ergonomics* **23**: 128-132.
- Nichols JF, Morgan CG, Chabot LE, Sallis JF, et al. (2000). Assessment of physical activity with the computer Science and Applications Inc Accelerometer: Laboratory versus field validation. *Res Q Exerc Sport* **71**(1): 36-43.
- Nichols JF, Morgan CG, Sarkin JA, Sallis JF, et al. (1999). Validity, reliability and calibration of the Tritrac accelerometer as a measure of physical activity. *Med Sci Sports Exerc* **31**: 908-912.
- Nicholson P (1988). *The social psychology of 'postnatal depression.'* Unpublished doctoral dissertation, London School of Economics, London.
- Nilsson A & Almgren P (1970). Parental emotional adjustment. *Acta Psychiatrica Scandinavia (Suppl.)*: 220
- Norgan (1992). *Physical activity and health*. Cambridge: Cambridge University Press.
- Norman P (1990). Health locus of control beliefs and preventive health behaviours. *Journal of the Institute of Health Education* **28**: 113-117.
- Norr KL, Block CR, Charles A, Meyering S, et al. (1977). Explaining pain and enjoyment in childbirth. *Journal of Health & Social Behaviour* **18**: 260-275.
- Norris R, Carroll D & Cochrane R (1990). The effects of aerobic and anaerobic training on fitness, blood pressure and psychological stress and wellbeing. *J Psychosom Res* **34**(4): 367-375.
- North TC, McCullagh P & Tran ZV (1990). Effect of exercise on depression. *Exercise & Sports Sciences Reviews* **18**: 379-415.
- Nott PN, Franklin M, Armitage C & Gelder MG (1976). Hormonal changes and mood in the puerperium. *British journal of Psychiatry* **128**: 379-383.
- Nurminen T, Lusa S, Ilmarinen J & Kurppa K (1989). Physical workload fetal development and course of pregnancy. *Scandinavian Journal of Work Environment & Health* **15**: 404-414.

References

- O'Brien B & Naber S (1992). Nausea and vomiting during pregnancy: Effects on the quality of women's lives. *Birth* **19**: 3138-3143.
- O'Connell JK & Price JH (1982). Health locus of control of physical fitness program participants. *Perceptual & Motor Skills* **55**: 925-926.
- O'Hara MW (1986). Social support life events and depression during pregnancy and the puerperium. *Archives of General Psychiatry* **43**: 569-573.
- O'Hara MW, Rehm LP & Campbell SB (1983). Postpartum depression :A role for social network and life stress variables. *Journal of Nervous and Mental Disease* **171**: 336-341.
- O'Hara MW, Rehm LP & Campbell SB (1982). Predicting depressive symptomatology: Cognitive behavioural models and postpartum depression. *Journal of Abnormal Psychology* **93**: 158-171.
- O'Hara MW, Schlechte JA, Lewis DA & Varner MW (1991). Controlled prospective study of postpartum mood disorders: Psychological environmental and hormonal variables. *Journal of Abnormal Psychology* **100**: 63-73.
- O'Hara MW, Zekoski EM, Phillips LH & Wright EJ (1990). Controlled prospective study of postpartum mood disorders: Comparisons of childbearing and non-childbearing women. *Journal of Abnormal Psychology* **99**: 3-15.
- Oakley A. (1993). *Essays on women, medicine and health*. Edinburgh: Edinburgh University Press.
- Oakley A (1989). Smoking in pregnancy: Smokescreen or risk factor? Toward a materialist analysis. *Sociology of Health & Illness* **11**: 311-32.
- Oakley A (1984). *The captured womb: A history of the medical care of pregnant women*. Oxford: Blackwell.
- Oakley A (1981). Normal motherhood: An exercise in self-control? In *Controlling women: The normal and the deviant*. Hutter B & Williams G (Eds.). London: Croom Helm.
- Oakley A (1980). *Women confined – Towards a sociology of childbirth*. Oxford: Martin Robertson.
- Oakley A & Rajan L (1990). Obstetric technology and maternal emotional wellbeing: a further research note. *Journal of Reproductive & Infant Psychology* **8**: 45-55.

References

- Oakley A, Rajan L & Grant A (1990). Social support and pregnancy outcome. *British Journal of Obstetrics & Gynaecology* **97**: 155-162.
- Ogden J & Mtandabari T (1997). Examination stress and changes in mood and health-related behaviours. *Psychology & Health* **12**(2): 289-299.
- Oldridge NB & Jones NL (1983). Improving patient compliance in cardiac rehabilitation: Effects of written agreement and self-monitoring. *Journal of Cardiac Rehabilitation* **3**: 257-262.
- Olds DL, Henderson CR & Tatelbaum R (1994). Intellectual impairment in children of women who smoke cigarettes. *Paediatrics* **93**: 221-227.
- Olds DL, Henderson CR, Tatelbaum R & Chamberlain R (1986). Improving the delivery of prenatal care and outcomes of pregnancy: A randomised trial of nurse home visitation. *Paediatrics* **77**(1): 16-28.
- Oloff M & Aboud FE (1991). Predicting postpartum dysphoria in primiparous mothers: Roles of perceived parenting self-efficacy and self-esteem. *Journal of Cognitive Psychotherapy* **5**: 3-14.
- OPCS (1999). Population Trends. London: HMSO.
- OPEC (1996). *Social portrait of Europe* (2nd Ed). Luxembourg: Office for Official Publications of the European Communities.
- Oppenheim AN (1992). *Questionnaire design, interviewing and attitude measurement* (2nd Ed.) London: Pinter Publishers Ltd.
- Ostgaard HC, Zetherstrom G, Roos-Hansson E & Svanberg B (1994). Reduction of back and posterior pelvic pain in pregnancy. *Spine* **19**: 894-900.
- Owen L, McNeill A & Callum C (1998). Trends in smoking during pregnancy in England 1992-1997: Quota sampling surveys. *BMJ* **317**: 728-730.
- Paffenbarger RS, Blair SN, Lee IM & Hyde RT (1993). Measurement of physical activity to assess health effects in free living populations. *Med Sci Sports Exerc* **25**: 60-70.
- Paffenbarger RS, Hyde RT, Wing AL, et al. (1986). Physical activity, all cause mortality, and longevity of college alumni. *N Engl J Med* **314**: 605-13.
- Paffenbarger RS, Wing AL & Hyde RT (1978). Physical activity as an index of heart attack risk in college alumni. *Am J Epidemiol* **108**: 161-175.

- Palta M, Prineas R, Berman R & Hannan P (1982). Comparison of self-reported and measured height and weight. *Am J Epidemiol* **115**: 223-230.
- Panterbrick C (1993). Seasonality of energy-expenditure during pregnancy and lactation for rural Nepali women. *Am J Clin Nutr* **57**(5): 620-628.
- Panterbrick C (1989). Motherhood and subsistence work- the Tamang of rural Nepal. *Human Ecology* **17**: 205-228.
- Pappas GP, Golin S & Meyer DL (1990). Reducing symptoms of depression with exercise. *Psychosomatics* **31**:112-3.
- Park CL, Moore PJ, Turner RA & Adler NE (1997). The roles of constructive thinking and optimism in psychological and behavioural adjustment during pregnancy. *Journal of Personality & Social Psychology* **73**(3):584-592.
- Passmore R & Durnin J (1955). Human energy expenditure. *Physiology Reviews* **35**: 801-840.
- Patterson SM, Krantz DS, Montgomery LG , Deuster PA, et al. (1993). Automated physical activity monitoring: Validation and comparison with physiological and self-report measures. *Psychophysiol* **30**: 296-305.
- Pattison H & Gross H (1996). Pregnancy, work and women's wellbeing: A review. *Work & Stress* **10**: 72-87.
- Pattison HM & Moyse KI (1995). The effects of suitability for current role on the psychological wellbeing of employed and non-employed mothers. *Journal of Reproductive & Infant Psychology* **13**:229-236.
- Paykel ES, Emms EM, Fletcher J & Rassaby ES (1980). Life events and social support in puerperal depression. *British Journal of Psychiatry* **136**: 339-346.
- Payne PR, Wheeler EF & Salvosa CB (1971). Prediction of daily energy expenditure from average pulse rate. *Am J Clin Nutr* **24**:1164-1170.
- Peoples-Sheps MD, Siegel E, Suchindran CM, et al. (1991). Characteristics of maternal employment during pregnancy: Effects on low birth weight. *American Journal of Public Health* **81**: 1007-1012.
- Pertuzzello SJ, Landers DM, Hatfield BD, Kubitz KA, et al. (1991). A meta-analysis on the anxiety reducing effects of acute and chronic exercise: Outcomes and mechanisms. *Sports Medicine* **11**: 143-182.

References

- Phelan ST (1988). Pregnancy during residency- obstetric complications. *Obstetrics & Gynaecology* **72**: 431-436.
- Phillips JT, Pruitt LA & King AC (1996). Lifestyle activity. Current recommendations. *Sports Med* **22**(1): 107.
- Phoenix A (1991). *Young mothers*. Oxford: Polity Press.
- Pitt B (1968). Atypical depression following childbirth. *British Journal of Psychiatry* **114**: 1325-1335.
- Pivarnik JM, Ayers AN, Mauer MB, Cotton DB, et al. (1993). Effects of maternal aerobic fitness on cardiorespiratory responses to exercise. *Medicine & Science in Sports & Exercise* **25**: 993-998.
- Pivarnik JM, Mauer MB, Ayres AN, Kirshon B, et al. (1994). Effect of chronic exercise on blood volume expansion and hematologic indices during pregnancy. *Obstetrics & Gynaecology* **83**: 265-269.
- Piyasil (1998). Anxiety and depression in teenage mothers: A comparative study. *J Med Assoc Thai* **81**(2): 125-9.
- Pols MA, Peeters PHM, Bueno-De-Mesquita BH, Ocke MC, et al. (1995). Validity and repeatability of a modified baecke questionnaire on physical activity. *Int J Epidemiol* **24**: 381-388.
- Pomerance JJ, Gluck L & Lynch VA (1974). Physical fitness in pregnancy: Its effect on pregnancy outcome. *American Journal of Obstetrics & Gynaecology* **119**: 867-76.
- Powell KE, Thompson PD, Caspersen CJ & Kendrick JS (1987). Physical activity and the incidence of coronary heart disease. *Annu Rev Public Health* **8**: 253-287.
- Prentice AM, Coward WA & Whitehead RG (1984). *Measurement of energy expenditure by the doubly-labelled water method*. Nestle Foundation Report. Vevey, Switzerland: Nestle.
- Pritchard CW & Teo Mfphm PYK (1994). Preterm birth, low birthweight and the stressfulness of the household role for pregnant women. *Social Science & Medicine* **38**: 89-96.
- Prochaska JO & DiClemente CC (1984). *The transtheoretical approach: Crossing traditional boundaries of therapy*. Homewood, IL: Dow Jones Irwin.

References

- Prochaska JO & DiClemente CC (1982). Transtheoretical therapy: Toward a more integrative model of change. *Psychotherapy Research & Practice* **19**: 276-288.
- Puska P, Berg M-A & Peltoniemi J (1993). *Health behaviour among a Finnish adult population*. Helsinki: National Public Health Institute, Department of Epidemiology and Health Promotion.
- Quinton D, Rutter M & Rowland O (1976). An evaluation of an interview assessment of marriage *Psychol Med* **6**: 577-586.
- Rabinowitz S, Melamed S, Weisberg E, Tal D, et al. (1992). Personal determinants of leisure-time exercise activities. *Perceptual & Motor Skills* **75**: 779-784.
- Rabkin CS, Anderson HR, Bland JM, Brooke OG, et al. (1990). Maternal activity and birthweight: a prospective population-based study. *American Journal of Epidemiology* **131**: 522-531.
- Radke AO (1958). Man's new environment: Vehicle vibration. *Mech Eng* **80**: 38-41.
- Raglin JS (1990). Exercise and mental health: Beneficial and detrimental effects. *Sports Med* **9**: 323-329.
- Ramirez G, Grimes RM, Annegers JF, Davis BR, et al. (1990). Occupational physical activity and other risk factors for preterm birth among US army primigravidas. *American Journal of Public Health* **80**: 728-729.
- Rauramo I, Andersson B & Laatikainen T (1982). Stress hormones and placental steroids in physical activity during pregnancy. *British Journal of Obstetrics & Gynaecology* **89**: 921-925.
- Rauramo I & Forss M (1988). Effect of exercise on maternal hemodynamics and placental blood flow in healthy women. *Acta Obstetrica Gynecologica Scandinavica* **67**: 21-25.
- Reading AE (1983). The influence of maternal anxiety on the course and outcome of pregnancy: A review. *Health Psychology* **2**: 187-202.
- Redmond DP & Hegge FW (1985). Observations on the design and specification of a wrist-worn human activity monitoring system. *Behaviour, Research Methods, Instruments & Computers* **17**: 659-669.
- Registrar General's Classification of Occupations (1970). London: HMSO.

References

- Reiff GG, Montoye HJ, Remington RDE, Napier JA, et al. (1967). Assessment of physical activity by questionnaire and interview. *Journal of Sports Medicine & Physical Fitness* **7**: 135-142.
- Renfrew JW, Pettigrew KD & Rapoport SI (1987). Motor activity and sleep duration as a function of age in healthy men. *Phys Behav* **41**: 627-634.
- Report of the Royal College of Physicians (1991). *Medical aspects of exercise benefits and risks*. The Royal College of Physicians of London.
- Revelli A, Durando A & Massobrio M (1992). Exercise and pregnancy: A review of maternal and fetal effects. *Obstet Gynaecol Surv* **47**(6): 355-367.
- Rice PL & Fort IL (1991). The relationship of maternal exercise on labour, delivery and health of the newborn. *Journal of Sports Medicine & Physiology* **31**: 95-9.
- Riddle PK (1980). Attitudes, beliefs, behavioural intentions and behaviours of men and women towards regular jogging. *Res Q Exerc Sport* **51**: 663-674.
- Rikli RE (2000). Reliability, validity and methodological issues in assessing physical activity in older adults. *Res Q Exerc Sport* **71**(2): 89-96.
- Roberts MF, Wenger CB, Stolwijk JAJ & Nadel ER (1977). Skin blood flow and sweating changes following exercise training and heat acclimation. *Journal of Applied Physiology* **43**: 133-137.
- Roberts SB, Paul AA, Cole TJ & Whitehead RG (1982). Seasonal changes in activity, birthweight and lactational performance in rural Gambian women. *Transactions of the Royal Society of Tropical Medicine & Hygiene* **76**: 668-678.
- Romito P (1996). The costs of motherhood in women's lives. Paper presented to the International Conference, 'The Cost of Children', Bologna, Italy.
- Romito P (1993). The practice of protective legislation for pregnant workers in Italy. *Women's Studies International Forum* **16**: 581-590.
- Rose NC, Haddow JE, Palomake GE & Knight GJ (1991). Self-rated physical activity level during the second trimester and pregnancy outcome. *Obstetrics & Gynaecology* **78**:1078.
- Rosenstock IM (1966). Why people use health services. *Millbank Memorial Fund Quarterly* **44**: 94-124.

References

- Rosenthal AN & Paterson Brown S (1998). Is there an incremental rise in the risk of obstetric intervention with increasing maternal age? *Br J Obstet Gynaecol* **105**(10): 1064-1069.
- Rossi A (1968). Transition to parenthood *J Marr Fam* **30**: 26-39.
- Roth DL & Holmes DS (1987). Influence of aerobic exercise training and relaxation training on physical and psychological health following stressful life events. *Psychosom Med* **49**(4): 355-365.
- Rowell LB (1974). Human cardiovascular adjustments to exercise and thermal stress. *Physiology Review* **54**: 75-149.
- Royal College of General Practitioners (1998). *Emma's diary. A week by week guide to your pregnancy (Autumn/Winter 1998/99)*. Maidenhead, Berkshire: Lifestyle Marketing.
- Ruhling RO, Cameron J & Sibley L (1981). Maintaining aerobic fitness while jogging through a pregnancy: A case study (abstract). *Med Sci Sports Exerc* **13**: 93.
- Ryan EA, O'Sullivan MJ & Skyler JS (1985). Insulin action during pregnancy: Studies with the euglycemic clamp technique. *Diabetes* **34**: 380-389.
- Sacks MH (1993). Exercise for stress control. In *Mind body medicine*. Goleman D & Gurin J (Eds.). New York: Consumer Reports Books.
- Sadeh A (1994). Assessment of intervention for infant night waking: parental reports and activity-based home monitoring. *J Consult Clin Psychol* **62**: 63-68.
- Sadeh A, Hauri PJ, Kripke DF & Lavie P (1995). The role of actigraphy in the evaluation of sleep disorders. *Sleep* **18**: 288.
- Sadler S (1992). What it's really like to be pregnant. *Professional Care of Mother & Child* **Feb**: 48
- Sady SP & Carpenter MW (1989). Aerobic exercise during pregnancy: Special considerations. *Sports Med* **7**: 357-75.
- Sallis JF (1991). Self-report measures of children's physical activity. *Journal of School Health* **61**(5): 215-219.
- Sallis JF, Haskell WL, Fortmann SP, Vranizan CB et al. (1986). Predictors of adoption and maintenance of physical activity in a community sample. *Prev Med* **15**: 331-341.

References

- Sallis JF, Haskell WL, Wood PD, Fortmann SP, et al. (1985). Physical activity assessment in the five city project. *Am J Epidemiol* **121**: 91-106.
- Sallis J & Hovell M (1990). Determinants of exercise behaviour. *Exerc & Sports Sci Rev* **18**: 307-330.
- Sallis J, Hovell M, Hofstetter C & Barrington E (1992). Explanation of vigorous physical activity during two years using social learning variables. *Soc Sci Med* **34**: 25-32.
- Sallis JF, Hovell MF, Hofstetter CR, Faucher P, et al. (1989). A multivariate study of determinants of vigorous exercise in a community sample. *Preventive Medicine* **18**: 30-34.
- Sallis JF & Owen N (1997). Ecological Models. In *Health behaviour and health education* (2nd Ed.). Glanz K, Lewis FM & Rimer BK (Eds.). San Francisco, CA: Jossey-Bass.
- Sallis JF, Patterson TL, Buono MJ, Atkins CJ, et al. (1988). Aggregation of physical activity habits in Mexican American families. *J Behav Med* **11**: 31-41.
- Sallis JF & Saelens BE (2000). Assessment of physical activity by self-report: Status, limitations and future directions. *Res Q Exerc & Sport* **71**(2): 1-14.
- Saltin B & Rowell LB (1980). Functional adaptations to physical activity and inactivity. *Federation Proceedings* **39**: 1506-1513.
- Sanjose S, Roman E & Beral V (1991). Low birthweight and preterm delivery, Scotland 1981-1984: Effects of parents' occupation. *Lancet* **338**: 428-431.
- Santos Perez M, Lerma Soriano A & Ruiz Plaza JM (1998). Fathers' experiences during their wives' pregnancy. *Rev Enferm* **21**: 18-19.
- Saris WHM (1985). The assessment and evaluation of daily physical activity in children. A review. *Acta Paediatr Scand* **318**: 37-48.
- Saris WHM & Binkhorst RA (1977). The use of the pedometer and actometer in studying daily physical activity in man. Part I: Reliability of pedometer and actometer. *Eur J Appl Physiol* **37**: 219-228.
- Saris WHM & Binkhorst RA (1977). The use of the pedometer and actometer in studying daily physical activity in man. Part II: Validity of pedometer and actometer. *Eur J Appl Physiol* **37**: 229-235.

References

- Saurel-Cubizolles MJ & Kaminski M (1987). Pregnant women's working conditions and their changes during pregnancy: A national study in France. *British Journal of Industrial Medicine* **44**: 236-243.
- Saurel-Cubizolles MJ, Kaminski M, Llado-arkhipoff J, et al. (1985). Pregnancy and its outcome among hospital personnel according to occupation and working conditions. *Journal of Epidemiology & Community Health* **39**: 1229-1234.
- Saurel-Cubizolles MJ, Subtil D & Kaminski M (1991). Is preterm delivery still related to physical working conditions in pregnancy? *Journal of Epidemiology & Community Health* **45**: 29-34.
- Savitz DA, Whelan EA, Rowland AS, et al. (1990). Maternal employment and reproductive risk factors. *American Journal of Epidemiology* **132**: 933.
- Schauberger CW, Rooney BL, Goldsmith L, Shenton D, et al. (1996). Peripheral joint laxity increases in pregnancy but does not correlate with serum relaxin levels. *American Journal of Obstetrics and Gynaecology* **174**: 667-671.
- Schieve LA, Cogswell ME & Scanlon KS (1999). Maternal weight gain and preterm delivery: Differential effects by body mass index. *Epidemiol* **10**(2): 141-147.
- Schifter DB & Ajzen I (1985). Intention, perceived control and weight loss: an application of the theory of planned behaviour. *Journal of Personality & Social Psychology* **49**: 843-851.
- Schneider KTM, Bollinger A & Huch A (1984). The oscillating 'vena cava syndrome' during quiet standing: An unexpected observation in later pregnancy. *Br J Obstet Gynecol* **91**: 766-780.
- Schoeller DA (1983). Energy expenditure from doubly labelled water: some fundamental considerations in humans. *Am J Clin Nutr* **38**: 999-1005.
- Schoeller DA, Ravussion E, Schutz Y, Acheson KJ, et al. (1986). Energy expenditure by doubly labelled water: Validations in humans and proposed calculation. *Regulatory Integrative Comp. Physiol* **19**: R823-R830.
- Schoeller DA & Van Santen E (1982). Measurement of energy expenditure in humans by doubly labelled water method. *J Appl Physiol* **53**: 955-959.
- Schor JB (1992). *The overworked American*. New York: Harper Collins.

References

- Schramm WF, Stockbauer JW & Hoffman HJ (1996). Exercise, employment, other daily activities and adverse pregnancy outcomes. *Am J Epidemiol* **143**: 211-218.
- Schulman JL & Reisman JM (1959). An objective measure of hyperactivity. *Am J Ment Defic* **64**: 455-456.
- Schutz Y, Froidevaux F & Jequier E (1988). Estimation of 24h energy expenditure by a portable accelerometer. *Proc Nutr Soc* **47**: 23A.
- Schwarz RW (1985). Pregnancy in physicians: Characteristics and complications. *Obstetrics & Gynaecology* **66**: 672-676.
- Schwarzer R (1993). *Measurement of perceived self-efficacy: psychometric scales for cross cultural research*. Berlin: Freie Universitat.
- Schwarzer R (Ed.) (1992). *Self-efficacy: Thought control of action*. Washington DC: Hemisphere.
- Scott G & Niven C (1996). Pregnancy: A bio-psycho-social event. In *Conception, pregnancy and birth*. Niven CA & Walker A (Eds.). Oxford: Butterworth-Heinemann.
- Scale JL, Rumpler WV, Conway JM et al. (1990). Comparison of doubly labelled water, intake balance, and direct calorimetry and indirect calorimetry methods for measuring energy expenditure in adult men. *Am J Clin Nutr* **52**(1): 66-71.
- Sensible Drinking (1995). *The report of an Inter-Departmental working group*.
- Shapiro S, Weinblatt E, Frank CW & Sager RV (1965). The H.I.P. study of incidence and prognosis of coronary heart disease: preliminary findings on incidence of myocardial infarction and angina. *J Chronic Dis* **18**: 527-558.
- Shaw SM (1991). Dereifying family leisure: An examination of women's and men's everyday experiences and perceptions of family time. *Leisure Sciences* **14**: 271-286.
- Shephard RJ & Montelpare W (1988). Geriatric benefits of exercise as an adult. *J Gerontol* **43**(4): M86-M90.
- Sherr L (1995). Obstetrics. In *Health psychology processes and applications* (2nd Ed). Broome A & Llewelyn S (Eds.). London: Chapman and Hall. pp. 307-328.

References

- Shinkoda H, Matsumoto K & Park YM(1999). Changes in the sleep-wake cycle during the period from late pregnancy to puerperium identified through the wrist actigraph and sleep logs. *Psychiatry Clin Neurosci* **53**(2): 133-135.
- Sibley L, Ruhling RO, Cameron-Foster J, et al. (1981). Swimming and physical fitness during pregnancy. *Journal of Nursing & Midwifery* **32**: 277-90.
- Simpson JL (1993). Are physical activity and employment related to preterm birth and low birth weight? *American Journal of Obstetrics & Gynaecology* **168**:1231-8.
- Sinclair (1990). Subjective assessment. In *Evaluation of Human Work*. Wilson JR & Corlett EN (Eds.). London: Taylor & Francis.
- Sjogren B (1997). Reasons for anxiety about childbirth in 100 pregnant women. *J Psychosom Obstet Gynaecol* **18**(4): 266-72.
- Slenker SE, Price JH & O'Connell JK (1985). Health locus of control of joggers and nonexercisers. *Perceptual & Motor Skills* **61**: 323-328.
- Smith IK, Lancaster CJ, Delbene VE & Fleming GA (1990). The relationship between medical students' locus of control and promotion of breast self-examination. *Medical Education* **24**: 164-170.
- Spielberger CD (1983). *State-Trait Anxiety Inventory: A comprehensive bibliography*. Palo Alto, CA: Consulting Psychologists Press.
- Spielberger CD, Gorsuch R & Lushene R (1970). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.
- Spink KS (1992). Relation of anxiety about social physique to location of participation in physical activity. *Perceptual & Motor Skills* **74**: 1075-1078.
- Spirito A, Ruggiero L, Coustan D, McGarvey S, et al. (1992). Mood state of women with diabetes during pregnancy. *Journal of Reproductive & Infant Psychology* **10**: 29-38.
- Stahl T, Rutten A, Nutbeam D, Bauman A, et al. (2001). The importance of the social environment for physically active lifestyle- Results from an international study. *Soc Sci Med* **52**: 1-10.
- Stein A & Fairburn CG (1996). Eating habits and attitudes in the postpartum period. *Psychosom Med* **58**: 321-325.

References

- Stein ZA, Susser MW & Hatch MC (1986). Working during pregnancy: Physical and Psychosocial Strain. *Occupational Medicine: State of the Art reviews* 1(3): 405-409.
- Steinberg SI & Bellavence F (1999). Characteristics and treatment of women with antenatal and postpartum depression. *Int J Psychiatry Med* 29(2): 209-33.
- Steiner M (1998). Perinatal mood disorders: Position paper. *Psychopharmacology Bulletin* 34(3): 301-306.
- Steinhardt MA & Dishman RK (1989). Reliability and validity of expected outcomes and barriers for habitual physical activity. *J Occup Environ Med* 31(6): 536-546.
- Stephens T (1988). Physical activity and mental health in the United States and Canada: evidence from four population surveys. *Prev Med* 17: 35-47.
- Stephens T & Craig CL (1990). *The wellbeing of Canadians: Highlights of the 1988 Campbell's survey*. Ottawa, ON: Canadian Fitness & Lifestyle Research Institute.
- Steptoe A (1992). Physical activity and psychological wellbeing. In *Physical activity and health*. N.Norgan (Ed.). Cambridge: Cambridge University Press.
- Stern MJ (1982). The National Exercise and Heart Disease Project: Long term psychosocial outcome. *Archives of Internal Medicine* 142: 1093-1097.
- Sternfeld B (1997). Physical activity and pregnancy outcome. Review and recommendations. *Sports Medicine* 23(1): 33-47.
- Sternfeld B, Ainsworth B & Quesenberry CP (1999). Physical activity patterns in a diverse population of women. *Preventive Medicine* 28: 313-323.
- Sternfeld B, Quesenberry CPJ & Eskenazi B (1995). Exercise during pregnancy and pregnancy outcome. *Med Sci Sports Exerc* 27: 634-640.
- Stetson BA, Rahn JM, Dubbert PM, et al. (1997). Prospective evaluation of the effects of stress on exercise adherence in community residing women. *Health Psychol* 16(6): 515-520.
- Stevens-Simon C, McAnarney ER, Coulter (1986). How accurately do pregnant adolescents estimate their weight prior to pregnancy? *J Adol Healthcare* 7: 250-254.

References

- Stevens-Simon C, Roghmann KJ, McAnarney ER (1992). Relationship of self-reported pre-pregnant weight and weight gain during pregnancy to maternal body habitus and age. *JADA* **92**: 85-86.
- Stewart AL (1982). The reliability and validity of self-reported weight and height. *J Chron Dis* **35**: 295-309.
- Stewart DW & Shamdasani PN (1990). *Focus groups: Theory and practice*. Newbury Park: Sage.
- Stokols D (1992). Establishing and maintaining healthy environments: toward a social ecology of health promotion. *Am Psychol* **47**(1): 6-22.
- Strang VR & Sullivan PL (1985). Body image attitudes during pregnancy and the postpartum period. *Journal of Obstetric, Gynaecologic and Neonatal Nursing* **14**: 332-337.
- Strecher VJ, Devellis BM, Becker MH, et al. (1986). The role of self-efficacy in achieving health behaviour change. *Health Educ Quart* **13**(1): 73-91.
- Streissguth AP, Barr HM & Sampson PD (1990). Moderate prenatal alcohol exposure: Effects on child IQ and learning problems at age 7 1/2 years. *Alcoholism: Clinical & Experimental Research*.
- Strickland BR (1978). Internal-external expectancies and health-related behaviours. *Journal of Consulting and Clinical Psychology* **46**: 1192-1211.
- Stunkard A (1960). A method of studying physical activity in man. *Am J Clin Nutr* **8**: 595-601.
- Stunkard AJ & Albaum JM (1981). The accuracy of self-reported weights. *Am J Clin Nutr* **34**: 1593-1599.
- Sugawara M, Toda MA, Shima S, Mukai T et al. (1997). Pre-menstrual mood changes and maternal mental health in pregnancy and the postpartum period. *J Clin Psychol* **53**(3): 225-32.
- Sugihara K & Kobayashi T (1998). Sleep behaviour of pregnant women using sleep logs. *Psychiatry Clin Neurosci* **52**(2): 201-202.
- Suiono S, Simpanen AL, Olkkonen VM, et al. (1976). Effects of the left lateral recumbent position compared with the supine and upright positions on placental blood flow in normal late pregnancy. *Annals of Clinical Research* **8**:22.

References

- Tafari N, Naeye RL & Gobeze A (1980). Effects of maternal undernutrition and heavy physical work during pregnancy on birth weight. *British Journal of Obstetrics & Gynaecology* **87**: 222-226.
- Tankersley CG, Nicholas WC, Deaver DR, Mitka D, et al. (1992). Estrogen replacement in middle-aged women: Thermoregulatory responses to exercise in the heat. *Journal of Applied Physiology* **73**:1238-1245.
- Taylor Myers S & Grasmick HG (1990). The social rights and responsibilities of pregnant women: An application of Parson's Sick Role Model. *Journal of Applied Behavioural Science* **26**: 157-172.
- Taylor HL, Jacobs DR, Shucker B, et al. (1978). A questionnaire for the assessment of leisure time physical activities. *J Chronic Dis* **31**: 741-755.
- Taylor SE & Langer EJ (1977). Pregnancy: A social stigma. *Sex Roles* **3**: 27-35.
- Teitelman AM, Welch LS, Hellenbrand KG & Bracken MB (1990). Effect of maternal work capacity on preterm birth and low birth weight. *American Journal of Epidemiology* **131**: 104-113.
- Terry DJ, Mayocchi L & Hynes GJ (1996). Depressive symptomatology in new mothers: A stress and coping perspective. *Journal of Abnormal Psychology* **105**(2): 220-231.
- Tessler R & Mechanic D (1978). Psychological distress and perceived health status. *Journal of Health & Social Behaviour* **19**: 254-262.
- Timm J & Henderson R (1994). *The effect of bed rest on muscle strength and weight in the pregnant woman: A pilot study*. Presented at the 18th Annual Research Conference, Midwest Nursing Research Society. Milwaukee.
- Timmers T (1993). Is the computer-based patient record an analog or a model of the patient? *Meth Inform Med* **32**: 108.
- Thomas JR, Landers DM, Salazar W, Etnier J, et al. (1994). Exercise and cognitive function. In *Physical activity, fitness and health*. Bouchard C, Shephard RJ & Stephens T (Eds.). Champaign IL: Human Kinetics.
- Thompson JE, Walsh LV & Merkatz IR (1990). The history of prenatal care: Cultural, social and medical contexts. In *New perspectives on prenatal care*. Merkatz IR & Thompson JE (Eds.). New York: Elsevier.

References

- Thompson LJ (1942). Attitudes of primiparae as observed in a prenatal clinic. *Ment Hyg* **26**: 243-256.
- Thompson LM Murphy P, O'Hara J & Wallymead A (1997). Levels of daily hassles and uplifts in employed and non-employed pregnant women. *Journal of Reproductive & Infant Psychology* **15**: 271-280.
- Thorpe K (1993). A study of the use of the Edinburgh postnatal depression scale with parent groups outside the postpartum period. *Journal of Reproductive and Infant Psychology* **11**: 119-125.
- Torun B (1983). Inaccuracy of applying energy expenditure rates of adults to children. *Am J Nutr* **38**: 813-814.
- Touwen BC, Huisjes HJ, Jurgens-van der Zee AD, Bierman-van Eedenburg ME, et al. (1980). Obstetrical condition and neonatal neurological morbidity. An analysis with the help of the optimality concept. *Early Human Development* **4**: 207-28.
- Tuntiseranee P, Geater A, Chongsuvivatwong V & Kor Anantakul O (1998). The effect of heavy maternal workload on fetal growth retardation and preterm delivery. A study among southern Thai women. *J Occup Environ Med* **40**(11): 1013-1021.
- Turk DC & Meichenbaum D (1991). Adherence to self-care regimens: The patient's perspective. In *Handbook of clinical psychology in medical settings*. Rozensky RH, Sweet JJ & Tovian SM (Eds.). New York: Plenum.
- Twenge JM (1997). Attitudes towards women 1970-1995. A meta-analysis. *Psychology of Women Quarterly* **21**: 37-51.
- Tryon WW (1991). *Activity measurement in psychology and medicine*. New York: Plenum.
- Tyron WW & Williams R (1996). Fully proportional actigraphy: A new instrument. *Behaviour Research Methods* **28**: 392-403.
- Unger R & Crawford M (1996). *Women and Gender: A Feminist Psychology* (2nd Ed.). New York: McGraw-Hill Inc.
- U.S. Bureau of the Census (1990). *Current population reports: Work and family patterns of American women. Series p-23 No. 165*. Washington DC: US Government Printing Office.

References

- U.S. DHHS (1996). *Physical activity and health: A report of the Surgeon General*. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control & Prevention, National Center for Chronic Disease Prevention & Health Promotion.
- Ussher J (1989). *The psychology of the female body*. London: Routledge.
- Van Hilten JJ, Braat EAM, Van Der Velde EA, Middlekoop HAM, et al. (1993a). Ambulatory activity monitoring during sleep: An evaluation of internight and intrasubject variability in healthy persons aged 50-98. *Sleep* **16**: 146-150.
- Van Hilten JJ, Middlekoop HAM, Kuiper SIR, Kramer CGS, et al. (1993b). Where to record motor activity: an evaluation of commonly used sites of placement for activity monitors. *Electroencephalogr Clin Neurophysiol* **89**: 359-362.
- Van Raaij JMA, Schonk CM, Vermaat-Miedema SH, Peek MEM, et al (1990). Energy cost of physical activity throughout pregnancy and the first year postpartum in Dutch women with sedentary lifestyles. *Am J Clin Nutr* **52**: 234-239.
- Van der Lei J (1991). Use and abuse of computer-stored medical records. *Meth Inform Med* **30**: 79-80.
- Vance S (1985). An exploratory study of the relationships of psychosocial life stress and medical risk to the course and outcome of pregnancy. *Dissertation Abstracts International* **46**(9-B): 3243.
- Varassi G, Bazzano C & Edwards WT (1989). Effects of physical activity on maternal plasma B-endorphin levels and perception of labour pain. *Am J Obstet Gynecol* **180**: 707-712.
- Veale D & Le Fevre K (1988). Aerobic exercise in the adjunctive treatment of depression: a randomised controlled trial. In *Sport, health, psychology and exercise symposium*. London: Sports Council.
- Wadsworth MEJ & Kuh DJL (1997). Childhood influences on adult health: A review of recent work from the British 1946 national birth cohort study, the MRC National survey of Health and Development. *Paediatr Perin Epidemiol* **11**: 2-20.
- Walker LO (1997). Weight and weight-related distress after childbirth: relationships to stress, social support and depressive symptoms. *J Holist Nurs* **15**(4): 389-405.

References

- Walker LO, Cooney AT & Riggs MW (1999). Psychosocial and demographic factors related to health behaviours in the first trimester. *J Obstet Gynecol Neonatal Nurs* **28**(6): 606-614.
- Wallace AM, Boyer DB & Dan A (1986). Aerobic exercise, maternal self esteem and physical discomforts during pregnancy. *J Nurse Midwifery* **31**: 255-262.
- Wallace AM & Engstrom JL (1987). The effects of aerobic exercise on the pregnant woman, fetus and pregnancy outcome: *A review*. *J Nurse Midwifery* **32**(5): 277-290.
- Wallston BS & Wallston KA (1978). Locus of control and health: A review of the literature. *Health Education Monographs* **6**:107-117.
- Wallston KA & Wallston BS (1981). Health locus of control scales. In *Research with the locus of control construct*. Lefcourt H (Ed.). New York: Academic Press.
- Warde A & Hetherington K (1993). A changing domestic division of labour? Issues of measurement and interpretation. *Work, Employment and Society* **7**(1): 23-45.
- Wareham NJ & Rennie KL (1998). The assessment of physical activity in individuals and populations. Why try to be more precise about how physical activity is assessed? *International Journal of Obesity* **22**(Suppl 2): S30-S38.
- Warnecke RB, Johson TP, Chaves N, Sudman S, et al. (1997). Improving question wording in surveys of culturally diverse populations. *Annals of Epidemiol* **7**: 334-342.
- Washburn R, Chin MK & Montoye HJ (1980). Accuracy of pedometer in walking and running. *Res Q Exerc & Sport* **31**: 693-702.
- Washburn RA, Heath GW & Jackson AW (2000). Reliability and validity issues concerning large scale surveillance of physical activity. *Res Q Exerc Sport* **71**(2): 104-113.
- Washburn RA & Laporte RE (1988). Assessment of walking behaviour: Effect of speed and monitor position on two objective physical activity monitors. *Res Q Exerc Sport* **59**: 83-85.
- Washburn RA & Montoye HJ (1986). The assessment of physical activity by questionnaire. *Am J Epidemiol* **123**: 563-576.

References

- Waterlow JC (1990). Mechanisms of adaptation to low energy intakes. In *Diet and disease*. Harrison GA & Waterlow JC (Eds.). Cambridge: Cambridge University Press.
- Watson JP, Elliot SA, Rugg AJ & Brough DI (1984). Psychiatric disorder in pregnancy and the first postnatal year. *British J of Psychiatry* **144**: 453-462.
- Weber J & Wertheim EH (1989). Relationships of self-monitoring, special attention, body fat percent and self-motivation to attendance at a community gymnasium. *Journal of Sport & Exercise Psychology* **11**: 105-114.
- Webster JB, Krpik DJ, Messin S, Mullaney DJ, et al. (1982). An activity-based sleep monitor system for ambulatory use. *Sleep* **5**: 389-399.
- Weinmann J (1981). *An outline of psychology as applied to medicine*. Bristol: Wright.
- Welk GJ & Corbin CB (1995). The validity of the tritrac-R3D activity monitor for the assessment of physical activity in children. *Res Q Exerc Sport* **66**: 202-209.
- Weller I & Corey P (1988). The impact of excluding non-leisure energy expenditure on the relation between physical activity and mortality in women. *Epidemiology* **9**: 632-635.
- Westerkerp KR (1999). Physical activity assessment with accelerometers. *International Journal of Obesity* **23**(Suppl 3): S45-S49.
- Wever RA (1985). Man in temporal isolation: Basic principles of the circadian system. In *Hours of work: temporal factors in work scheduling*. Folkard S & Monk TH (Eds.). New York: John Wiley & Sons Inc.
- Wheatley S (1998). Psychosocial support in pregnancy. In *Psychological perspectives on pregnancy and childbirth*. Clement S (Ed.). Edinburgh: Churchill Livingstone.
- Whiffen VE (1988). Vulnerability to postpartum depression: A prospective multivariate study. *Journal of Abnormal Psychology* **151**: 329-339.
- Whitmarsh A. (1995). *Social Focus on Women*. Church J & Summerfield C (Eds.). London: HMSO.
- Wilbur J, Naftzger-Kang L, Miller am, Chandler P, et al. (1999). Women's occupations, energy expenditure and cardiovascular risk factors. *Journal of Women's Health* **8**: 377-387.

- Wilcox AJ (1993). Birthweight and perinatal mortality: The effect of maternal smoking. *Am J Epidemiol* **137**: 1098-1103.
- Wildschut HIJ, Harker LM & Riddoch CJ (1993). The potential value of a short questionnaire for the assessment of habitual physical activity in pregnancy. *J Psychosom Obstet Gynaecol* **14**: 17-29.
- Wiles R (1994). I'm not fat I'm pregnant. In *Women and Health*. Wilkinson S & Kitzinger C. (Eds.) Taylor & Francis.
- Wilhelmson I, Sanne H, Elmfeldt D, Tibbin B, et al. (1975). A controlled trial of physical training after myocardial infarction. *Prev Med* **4**: 491-508.
- Wilkie JR (1981). The trend towards delayed parenthood. *Journal of Marriage & the Family* **43**: 583-591.
- Williams E, Klesges RC, Hanson CL & Eck LH (1989). A prospective study of the reliability and convergent validity of three physical activity measures in a field research trial. *J Clin Epidemiol* **42**: 1161-1170.
- Williams RL, Creasey RK & Cunningham GC (1982). Fetal growth and perinatal viability in California. *Obstetrics & Gynaecology* **59**: 624-632.
- Wolf TM & Kissling GE (1984). Changes in lifestyle characteristics, health and mood of freshman medical students. *Journal of Medical Education* **59**: 806-814.
- Wolfe LA, Ohtake PJ, George KP et al. (1990). Aerobic training effects on exercise hemodynamics during pregnancy (Abstract). *Med Sci Sports Exerc* **22**: S28.
- Wolkind S & Zajicek E (1981). *Pregnancy: A Psychological and Social Study*. London: Academic Press.
- Wong SC & McKenzie DC (1987). Cardiorespiratory fitness during pregnancy and its effect on outcome. *International Journal of Sports Medicine* **8**: 79-83.
- Wong SF & Ho LC (1998). Labour outcome of low-risk multiparas of 40 years and older: A case-control study. *Aust NZ J Obstet Gynaecol* **38**(4): 388-390.
- Wong TC, Webster JG, Montoye HJ & Washburn R (1981). A portable accelerometer device for measuring human energy expenditure. *IEEE Trans. Biomed. Eng* **28**: 467-471.
- Woo GM (1997). Daily demands during pregnancy. *Annals of Behavioural Medicine* **19**(4): 385-398.

References

- Woollett A & Phoenix A (1991). Psychological views of mothering. In *Motherhood, meanings, practices and ideologies*. Phoenix A, Woollett A & Lloyd E (Eds.). London: Sage.
- Younger JA (1991). A model of parenting stress. *Research in Nursing & Health* **14**: 197-204.
- Zaharieva E (1972). Olympic participation by women. *JAMA* **221**: 992-995.
- Zaidise I, Artal R & Bessman SP (1986). Fuel metabolism in pregnancy. In *Exercise in pregnancy*. Artal R & Wiswell RA (Eds.). Baltimore: Williams & Wilkins.
- Zajicek E (1981). The experience of being pregnant. In *Pregnancy: A psychological and social study*. Wolkind S & Zajicek E (Eds.). London: Academic Press.
- Zajicek E (1979). Self perceptions during pregnancy and early motherhood. In *Woman sex-role stereotyping*. Harnett O, Boden G & Fuller H (Eds.). London: Tavistock Publications.
- Zarnow T (1995). The twenty-four hour workout. *Ladies Home Journal* **112**: 60-65.
- Zuckerman BS, Frank DA, Hingson R, Morelock S, et al. (1986). Impact of maternal work outside the home during pregnancy on neonatal outcome. *Paediatrics* **77**: 459-64.

APPENDICES

A.1 Parent Information Sheet Accompanying Study Consent Form

LEICESTER ROYAL INFIRMARY

The P.R.A.M. Scheme Pregnancy Related Activity Monitoring

At the Leicester Royal Infirmary Maternity Hospital we are carrying out the P.R.A.M. study to find out more about women's health and wellbeing during and after pregnancy.

➤ Why are we doing this study?

Different people have different routines. We want to find out about the things that women do when they are pregnant and the range of activities that they perform.

The results of this work will hopefully be of great help to those women who plan to have children in the future. It also gives us a chance to talk to you about the experience you are having and the way in which you might be feeling.

➤ Why am I being given this information sheet now?

We especially want to know about first time mothers-to-be and would like you to think about participating in our study. *All* women who are having their first baby at Leicester Royal Infirmary are being invited to take part.

➤ How does the P.R.A.M. study work?

If you agree to take part in this study Penny Clarke, a PhD research student, will ask you to help her fill out a questionnaire. Penny will ask you about the type of things you do at work or at home and about any hobby or sport that you may do.

All the information she collects is confidential and is only being used for research purposes. Your name will not be needed.

The whole questionnaire takes about 10 minutes to do. You may be given the opportunity to complete it after your clinic appointment today or you may wish to arrange another time that would suit you better.

➤ What happens then?

If you stay in the study you will be visited at home on five occasions and asked to wear a small activity monitor for a period of three days each time. Penny will also speak to you a bit more about the kind of things you have been doing.

The visits will take place in the 16th, 25th, 34th and 38th week of your pregnancy and at about 8 weeks after you have had your baby. Our researcher will do all she can to arrange her visits at a time convenient to you.

➤ What happens if I decide not to take part in this study?

We would be very grateful if you could help us but if you do not wish to do so this will not affect your usual care in the hospital. You can withdraw from the study at any time without giving a reason.

Thank you for your time. If you would like more information or think that you may like to take part in our study please ask your midwife to introduce you to Penny.

A.2 New Activity Questionnaire

The P.R.A.M. Scheme Pregnancy Related Activity Monitoring

CURRENT ACTIVITY (VISIT 1)

Name: Code No:

Hosp. No: Consultant:

Date of Birth: / / Interview No: Date:

Location: Interview Recorded? Tape No:

M. Height:m P. Height:m

Pre-Preg. Weight: Current Weight:kg

READ OUT:

Thank you for agreeing to take the time to help in this study.

People in general have different routines and different behaviour patterns and I would like to take this opportunity to ask you some questions about your daily activities and lifestyle.

It is not an examination and you are not being judged in any way. In fact, there are no right or wrong answers. I am simply trying to find out how women feel during pregnancy and the different types of activities that they might perform.

I will read out the questions and mark your answers as we go along.

All the information you give is in the strictest confidence.

1. BACKGROUND INFORMATION.

First of all I would like to ask you some general questions about your pregnancy and your health. Some of the questions may seem a bit personal but nobody will see any of your answers except me. Your name is not used at any stage.

1. Could you first tell me how many weeks into your pregnancy you are?
• Include the week we are in now.

2. And do you know what date your baby is due?

D	D	M	M	Y	Y

3. Do you have any other children?
• If yes, enter how many.

4. And have you ever been pregnant before? YES / NO
↓
• If yes, Would you be able to tell me anything about what happened?
• (Probe: length of pregnancy, reasons for loss)

5. Would you say that this (current) pregnancy was planned? Yes, definitely
Yes, a little bit
No, not at all

6. Before you became pregnant, did you ever suffer from PMT (pre-menstrual tension)? Almost Always
Sometimes
Never

7. And before becoming pregnant, would you have described yourself as

or a smoker a non-smoker ⇒ Roughly, how many cigarettes did you smoke in a day?

8. How would you describe yourself at the moment?

or a smoker a non-smoker ⇒ Roughly, how many cigarettes do you smoke in a day now?

9. What about drinking, before becoming pregnant would you have described yourself as

or a regular drinker
an occasional drinker
a non-drinker

10. And how would you describe yourself now?

or a regular drinker
an occasional drinker
a non-drinker

[CARD 1]

11. At the moment, how often do you think you have a drink of the sort shown in group A?

12. And would you be able to put a figure on how much you have each time?

• Repeat for groups B & C

	GROUP A	GROUP B	GROUP C
How often?			
How much?	pints	glasses	measures

13. Are there any other alcoholic drinks that you have at the moment that we have not mentioned?

YES / NO

DRINK ⇒			
How often do you have this drink at the moment?			
And how much do you normally have each time?			

14. Could I ask how many cups of coffee you normally drank a day before you became pregnant?

• Repeat for tea & cola drinks

Coffee
(cups)

Tea
(cups)

Cola
(330ml cans/cups)

15. Have any of these amounts changed at all?

YES / NO



• If yes, So how many cups of **** do you drink in a day now?

16. Do you think that your eating habits have changed in any way since you became pregnant? YES / NO

- If yes, In what way(s) in particular?
- (Probe:, particular foods, more/less overall, is change deliberate, is change resisted?)

.....

.....

.....

.....

[CARD 2]

17. Are you currently, or have you ever, visited your doctor or received treatment for any of the things shown on this card:

	PAST	PRESENT
Stress or anxiety	<div></div>	<div></div>
Depression	<div></div>	<div></div>
An eating disorder	<div></div>	<div></div>
A drinking problem	<div></div>	<div></div>
An addiction	<div></div>	<div></div>

18. Have you ever taken any drugs or medicines not prescribed by a doctor? YES / NO

- If yes, Can you tell me any more about this?

.....

.....

19. And are you currently taking any drugs or medicines not prescribed by a doctor? YES / NO

- If yes, Can you tell me any more about this?

.....

.....

20. Do you think that you will be going to any antenatal classes during this pregnancy?

YES / NO

21. But can I just check that you haven't been to any so far?

YES / NO

- If yes, How many have you been to?

- Could you tell me anything about why you went?

.....

.....

.....

2. DAILY ACTIVITY.

I'd like to move on now and ask you some questions about your daily activities, any work you might have done and so on. Can I just check that you are still happy to carry on?

*We are mostly interested in the things you have done in the past week, that is, over the last seven days. For you this includes everything from last **** right up until to yesterday.*

22. Did you work in paid employment at any time during this period? YES / NO
(Q31)

23. Are you currently seeking work at all? YES / NO

24. Were you employed when you became pregnant? YES / NO
(Q29)

25. Can I ask how many weeks into your pregnancy you stopped working?

26. And what were your main reasons for stopping work at this time?
.....
.....
.....
.....
.....

IF REASONS ARE PREGNANCY RELATED:

27. Was the decision to stop work at this time largely made by you or by somebody else?

Me	<div></div>	
Somebody else	<div></div>	⇒ Who?
Me & Somebody else	<div></div>	⇒ Who else?

EVERYBODY

28. If it had been possible, do you think you would have preferred to stop work at a different point in your pregnancy? YES / NO

↓
• If yes, When would this have been?
.....
.....
.....

(Q71)

29. If you don't mind, could you tell me how long it has been since you were last employed?

I have never worked (Q71)

years months weeks

30. Would you say that the idea of trying for a baby had any influence on your decision to give up work at this time?

Yes, a lot

Yes, a little bit

No, not at all.

I'm not sure

(Q71)

3: EMPLOYMENT.

31. What is your main occupation?

32. Can I just check if you are or self employed an employee

33. Do you normally have to do shift work in this job? YES / NO

34. And do you normally work night shifts in this job? YES / NO

35. Have you been involved in any shift work as part of this job in the last seven days? YES / NO

36. Are you exposed to any fumes or chemicals in your work? YES / NO

37. And is your work associated with any vibrations? YES / NO



• If yes, Would you describe these as or slight moderate severe

38. Thinking of the last seven days only, so that's from ***** up until yesterday, could you tell me roughly what times you started and finished work each day?

- Please do not include any time spent travelling to or from the workplace
- Note a.m. or p.m.

	LAST WEEK						
	M	T	W	Th	F	S	Su
Started work							
Finished work							

39. Are these your regular working hours? YES / NO

40. And/But, do you consider the times at which you started and finished work last week to be typical of the hours you are working at the moment? YES / NO
(Q43)

41. Could you tell me how many hours a week you should have worked?

42. And can I ask what happened to make last week different?
.....
.....
.....
.....
.....

[CARD 3]

43. In the last 7 days at work how often do you think you have.....

	Never	< 1/2	1/2	> 1/2	Always
.. Sat down	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.. Stood up	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
..Walked about	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.. Stood & lifted heavy things	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
..Walked & carried heavy things	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.. Drove a vehicle	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

• Probe, And what type of vehicle did you drive?
(CHECK TOTAL=1)

[CARD 4]

44. At the moment how often do you...

	Never	Not often	Quite often	Always
.. Bend or stoop at work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.. Kneel down at work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
.. Squat at work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

45. Do you think that your pregnancy influences the way you behave at work at the moment?

.....

.....

.....

.....

.....

.....

46. In terms of physical effort generally how demanding have you found your last week's work to be?

Very demanding
Fairly demanding
Not very demanding

<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

47. At the moment do you get any type of break when you are at work?

YES / NO



- If yes, Tell me a little bit more about this.

Do you have any:	About how many do you have each day?	On average, how long does each one last?	And can you describe to me what you do during this time at the moment?
Lunch or meal breaks		mins	
Coffee breaks		mins	
Other deliberate breaks		mins	

48. Is this how it has always been?

YES / NO



- If no, How and why is it different now?

49. How do you normally travel to work?

- On foot
- By bicycle
- By car / truck - as the driver
- as a passenger
- By motorcycle / moped - as the driver
- as a passenger
- By train / bus
- I usually work from home

Other

50. Thinking of the last seven days only, so that's from ***** up until yesterday, could tell me exactly how you travelled to work each day?

	How many days did you travel this way?	How long did this journey usually take you? (mins)	Were you picked up from home?	So how did you usually get to your pick-up point?	And how long did it normally take you to reach this point?
On foot			X	X	X
By bicycle			X	X	X
By car / truck - as the driver			X	X	X
- as a passenger					
By motorcycle / moped - as the driver			X	X	X
- as a passenger					
By train / bus					
I worked from home		X	X	X	X
Other:					
.....					

51. Do you ever have to climb a flight of stairs at work? YES / NO (Q.55)

52. And are you climbing these as frequently as you have always done? YES / NO

53. If we say one flight of stairs equals 10 steps, roughly how many flights a day do you climb at work at the moment?

54. And, at the moment, do you ever run up these stairs?

rarely or never

sometimes

often

55. Do you ever have to climb a ladder at work? YES / NO (Q57)

56. About how many times a day do you think you do this at the moment?

[CARD 5]

Could you please look at the card I'm showing you now and use it to answer the following questions.

	Yes, always	Yes, mostly	Sometimes	Not often	Never
57. Do you enjoy the various activities you perform in your job?					
58. Do you find it difficult trying to combine family and job commitments?					
59. Do you enjoy the company of your colleagues?					
60. Do you find that your job interferes with the needs of your family?					
61. Do your employers praise good work?					
62. Would you really like to stay at home and take care of your family on a full time basis?					
63. Do you find your job very challenging?					
64. Do you often feel isolated in your job?					
65. Do you enjoy earning your own salary?					
66. Do your employers make unrealistic demands on you?					
67. Are there good opportunities for promotion?					
68. Are your daily job activities very boring?					
69. Is it very noisy where you work?					

TOTAL =

70. I'd like to end this section by asking you whether or not you hope to start work again after you have had your baby?

YES / NO



- If yes, How soon after your baby is born do you think you will return to work?

years months weeks

Don't know

4: VOLUNTEER/ ADDITIONAL WORK

71. Have you worked in any other job or worked as a volunteer in the last seven days?

- Yes, another job
- Yes, as a volunteer
- Yes, both
- No, neither

(Q99)

During the last week you say that you have worked in a second job or as a volunteer.

72. Could you please tell me what your job title is in this role?

.....

73. Can I just check if you are

- self employed / your own boss
- or an employee / junior worker

74. Do you normally have to do shift work in this job?

YES / NO

75. And do you normally work night shifts in this job?

YES / NO

76. Have you been involved in any shift work as part of this job in the last seven days?

YES / NO

77. Are you exposed to any fumes or chemicals in this work?

YES / NO

78. And is this work associated with any vibrations?

YES / NO

- ↓
- If yes, Would you describe these as

- slight
- or moderate
- severe

Remember we are still talking about a second job or some volunteer work that you have done.

79. Thinking of the last seven days only, so that's from ***** up until yesterday, could you tell me roughly what times you started and finished this work each day?

- Please do not include any time spent travelling to or from the workplace
- Note a.m. or p.m.

	LAST WEEK						
	M	T	W	Th	F	S	Su
Started work							
Finished work							

80. Are these your regular working hours for this job?

YES / NO

81. And/But, do you consider the times at which you started and finished last week to be typical of the hours you do in this job at the moment?

YES / NO
(Q 84)

82. Could you tell me how many hours a week you should have worked?

83. And can I ask what happened to make last week different?

[CARD 6]

We are still talking about your second job or some volunteer work that you have done.

84. In the last 7 days in this work, how often do you think you have.....

	Never	< 1/2	1/2	> 1/2	Always
.. Sat down	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
.. Stood up	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
..Walked about	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
.. Stood & lifted heavy things	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
..Walked & carried heavy things	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
.. Drove a vehicle	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>

● Probe, And what type of vehicle did you drive?

(CHECK TOTAL=1)

[CARD 7]

85. At the moment how often do you...

	Never	Not often	Quite often	Always
.. Bend or stoop in this job	<div></div>	<div></div>	<div></div>	<div></div>
.. Kneel down in this job	<div></div>	<div></div>	<div></div>	<div></div>
.. Squat in this job	<div></div>	<div></div>	<div></div>	<div></div>

86. Do you think that your pregnancy influences the way you behave in this job at the moment?

91. Thinking of the last seven days only, so that's from ***** up until yesterday, could tell me exactly how you travelled to work each day?

	How many days did you travel this way?	How long did this journey usually take you? (mins)	Were you picked up from home?	So how did you usually get to your pick-up point?	And how long did it normally take you to reach this point?
On foot			X	X	X
By bicycle			X	X	X
By car / truck - as the driver			X	X	X
- as a passenger					
By motorcycle / moped - as the driver			X	X	X
- as a passenger					
By train / bus					
I worked from home		X	X	X	X
Other:					
.....					

92. Do you ever have to climb a flight of stairs when you are doing this work? YES / NO (Q 96)

93. And are you climbing these as frequently as you always have done? YES / NO

94. If we say one flight of stairs equals 10 steps, roughly how many flights a day do you climb at work at the moment?

95. And, at the moment, do you ever run up these stairs?

rarely or never
sometimes
often

96. Do you ever have to climb a ladder in this work? YES / NO (Q98)

97. About how many times a day do you think you do this at the moment?

98. Can I just check if you have a third job or any further voluntary commitments? YES / NO (COMPLETE EXTRA SECTIONS)

5: STUDY

99. In the last seven days have you been involved in any type of study or ongoing educational course?

YES / NO
(Q124)

During the last week you say that you have been studying.

100. Could you tell me what course it is you are following?

- (Probe: level & subject)

101. Is this course

Full time

Part time

102. And does it include any type of practical work?

YES / NO

⇓

- If yes, What kind of practical tasks does it usually involve?

103. Are you exposed to any fumes or chemicals in the course of your study?

YES / NO

104. And is the work you do on this course associated with any vibrations?

YES / NO

⇓

- If yes, Would you describe these as

slight

moderate

severe

or

Remember that we are still talking about some studying that you have done.

105. Thinking of the last seven days only, so that's from ***** up until yesterday, could you tell me roughly what times you started and finished studying each day?

- Please do not include any time spent travelling to or from the study place
- Note a.m. or p.m.

	LAST WEEK						
	M	T	W	Th	F	S	Su
Started work							
Finished work							

106.Are these your regular hours of study?

YES / NO

107.And/But, do you consider the times at which you started and finished studying last week to be typical of the hours you do at the moment?

YES / NO
(Q 110)

108.Could you tell me how many hours a week you should have studied?

109.And can I ask what happened to make last week different?

[CARD 8]

110.During the times that you have been studying in the last 7 days how often do you think you have.....

	Never	< ½	½	> ½	Always
.. Sat down	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
.. Stood up	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
..Walked about	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
.. Stood & lifted heavy things	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
..Walked & carried heavy things	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>
.. Drove a vehicle	<div></div>	<div></div>	<div></div>	<div></div>	<div></div>

• Probe, And what type of vehicle did you drive?

(CHECK TOTAL=1)

[CARD 9]

111.At the moment how often do you

	Never	Not often	Quite often	Always
.. Bend or stoop whilst studying	<div></div>	<div></div>	<div></div>	<div></div>
.. Kneel down whilst studying	<div></div>	<div></div>	<div></div>	<div></div>
.. Squat whilst studying	<div></div>	<div></div>	<div></div>	<div></div>

112.At the moment, do you think that your pregnancy influences the way you behave when you are studying?

113. In terms of physical effort generally how demanding have you found your last week of study to be?

Very demanding
Fairly demanding
Not very demanding

114. At the moment do you get any type of break during the times that you are studying?

YES / NO

⇓

- *If yes, Tell me a little bit more about this.*

Did you have any:	About how many did you have each day?	On average, how long did each one last?	Can you describe to me what you do during this time at the moment?
Lunch or meal breaks		mins	
Coffee breaks		mins	
Other deliberate breaks		mins	

115. Is that the way it has always been?

YES / NO

↓

- *If no, How and why is it different now?*

.....

.....

.....

.....

.....

116. How do you normally travel to your place of study?

On foot
By bicycle
By car / truck – as the driver
 - as a passenger
By motorcycle / moped – as the driver
 - as a passenger
By train / bus
I usually work from home

Other

117. Thinking of the last seven days only, so that's from ***** up until yesterday, could tell me exactly how you travelled to your place of study each day?

	How many days did you travel this way?	How long did this journey usually take you? (mins)	Were you picked up from home?	So how did you usually get to your pick-up point?	And how long did it normally take you to reach this point?
On foot			X	X	X
By bicycle			X	X	X
By car / truck - as the driver			X	X	X
- as a passenger					
By motorcycle / moped – as the driver			X	X	X
- as a passenger					
By train / bus					
I studied from home		X	X	X	X
Other:					
.....					

118. Do you ever have to climb a flight of stairs at your place of study? YES / NO (Q122)

119. And are you climbing these as frequently as you always have done? YES / NO

120. If we say one flight of stairs equals 10 steps, roughly how many flights a day do you climb there at the moment?

121. And, at the moment, do you ever run up these stairs?

rarely or never
sometimes
often

122. Do you ever have to climb a ladder when you are studying? YES / NO (Q124)

123. About how many times a day do you think you do this at the moment?

6: HOME BASED ACTIVITIES.

Now we need to turn a bit more to what happens at home.

124. Have you been involved in any household duties in the last 7 days?

YES (Q 125) / NO

⇓

● *If no, Are you normally responsible for these tasks?*

YES / NO (Q147)

↓

● *If yes, What were your main reasons for not doing the household tasks last week?*

(Q147)

[CARD 10] *Some types of housework tend to be heavier than others. This next card gives you a few examples of heavy and light housework. It does not include everything, the examples given there are just meant to guide you.*

125. Using the card as a guide, do you think you have done any heavy housework in the last 7 days? YES / NO
(O127)

 \Downarrow


● **If yes, How many days last week did you do this heavy housework?**

□

126. And if you think back to the day that you most recently did some heavy housework roughly how long in total do you think you spent on it?

- *Do not to include any time spent on lighter housework or any breaks that were taken.*

Hours



Minutes

127. Have you done any lighter housework in the last 7 days?

YES / NO
(Q129)


⇓

• *If yes, About how many days last week did you do some lighter housework*


1

128. And on the day you most recently did some light housework, roughly how long in total did you spend doing it?

- Do not include any time spent on heavier housework or any breaks that were taken



Hours



Minutes

129. Do you think that you are doing the same amount of household work as normal?

Yes

No, more

No, less

⇓

• If no, Why is this?

.....

.....

.....

.....

130. Are you putting the same amount of effort into your housework as you usually do?

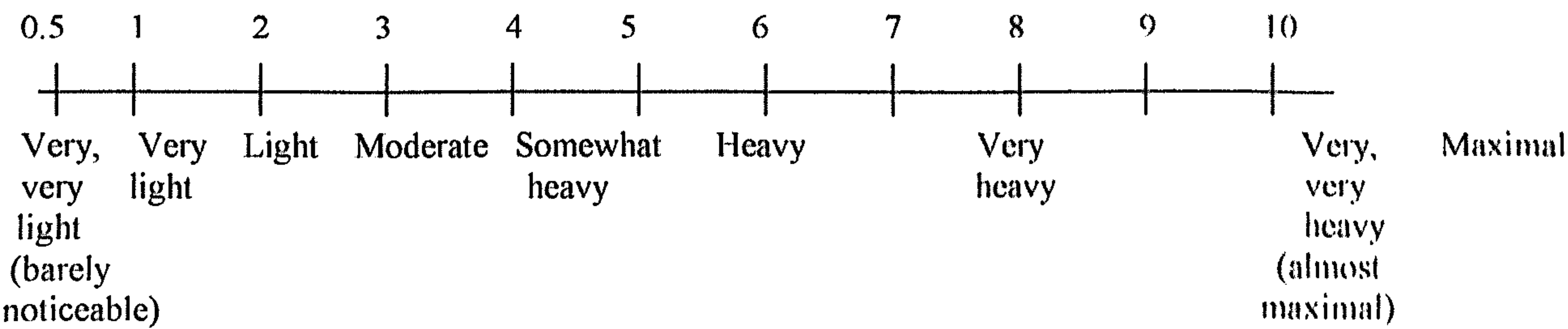
Yes

No, more

No, less

[CARD 11]

131. Using this scale how would you rate the degree of effort you have put into your housework in the last 7 days?



132. Do you ever take a short rest break when you are doing the housework?

Always

Most times

Sometimes

Not often

Never

(Q135)

(Q135)

133. About how often do you give yourself a break at the moment?

134. Have you always done this?

YES / NO

⇓

• If No, probe how, when and why it has changed.

.....

.....

.....

.....

.....

FOR NON-EMPLOYED MOTHERS ONLY

[CARD 12]

Could you please look at the card I'm showing you now and use it to answer the following questions.

	Yes, always	Yes, mostly	Sometimes	Not often	Never
135. Do you enjoy housework					
136. Do you find it difficult trying to combine housework with other family activities?					
137. Do you enjoy the contact you have with other people in your role as a full time homemaker					
138. Do you find that housework interferes with the needs of your family?					
139. Do your family praise the work you do around the home?					
140. Would you really like to be employed?					
141. Do you find working around the home can be very creative?					
142. Do you feel isolated in your role as a full time homemaker?					
143. Do you enjoy setting your own standards and routines for household chores?					
144. Do your family make unrealistic demands on you?					
145. Do you value the individual freedom being a full time homemaker allows?					
146. Do you find working around the house is very boring?					

TOTAL =

FOR EVERYBODY

147. Have you spent any time shopping for food or household goods in the last seven days? YES / NO

148. How often do you go out for this kind of shopping at the moment?

Never / less than once a week
Once a week
2-4 times a week
Every day

(Q151)

149. Could you tell me roughly how much time in total you think you have spent shopping for food or household goods in the last 7 days?

Do not include any time spent travelling.

HoursMinutes

150. Thinking about the shop or supermarket that you used the most last week, how did you usually travel there?

		How long did this journey normally take you? (mins)	Were you picked up from home?	So how did you usually get to your pick-up point?	And how long did it normally take you to reach this point?
On foot			X	X	X
By bicycle			X	X	X
By car / truck - as the driver - as a passenger			X	X	X
By motorcycle / moped - as the driver - as a passenger			X	X	X
By train / bus					
Other:					

151. Is this what you have always done? YES / NO

- ↓
- If No, probe how, when and why it has changed.

.....

.....

.....

.....

152. Have you done any gardening in the last 7 days? YES / NO (Q157)

[CARD 13] Like housework, some kinds of gardening are heavier than others. This next card gives you a few examples of heavy and light gardening. It does not include everything, it is just meant to guide you.

153. Do you think any of the gardening you did last week would be classed as heavy gardening? YES / NO (Q155)

- ↓
- If yes, On how many days last week did you do some heavy gardening?

154. And if you think back to the day that you most recently did some heavy gardening roughly how long in total did you spend doing it?

- Do not to include any time spent on lighter gardening or any breaks that were taken

HoursMinutes

155. Have you done any lighter gardening in the last 7 days? YES / NO (Q 157)

• If yes, About how many days last week did you do some lighter gardening?

156. And on the day you most recently did some light gardening, roughly how long in total did you spend doing it?

• Do not include any time spent on heavier gardening or any breaks that were taken

Hours Minutes

157. Did you do much gardening before you were pregnant? YES / NO

IF YES OR IF AMOUNT OF GARDENING HAS CHANGED:

158. Do you think that being pregnant has any influence on the sort of gardening work that you do or do not do at the moment?

• If yes, In what way?

.....

.....

.....

159. Have you done any DIY or car maintenance work in the last 7 days? YES / NO (Q162)

[CARD 14] This next card gives you a few examples of heavy DIY and car maintenance work but it does not include everything. It is only meant as a guide.

160. Using the card as a guide, do you think that you have done any heavy DIY or car maintenance work in the last week?

• If yes, How many days last week did you do this?

161. And thinking only of the day that you most recently did some heavy DIY or car maintenance work, how long in total do you think you spent doing it?

• Do not to include any breaks that were taken

Hours Minutes

162. Did you do much DIY/car maintenance work before you were pregnant? YES / NO

IF YES OR IF AMOUNT OF WORK HAS CHANGED:

163. Do you think that being pregnant has any influence on the sort of DIY/car maintenance work that you do or do not do at the moment? YES / NO

- ↓
- If yes, In what way?
-
-
-
-

[CARD 15] Moving on to some other things that you may or may not have done in the last week,

Thinking only of the last 7 days, could you tell me how much time on average you think you have spent ...

	None	<15mins/day	15-30mins/day	>30mins	⇒ How long?
164... Physically carrying an infant	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
165... Pushing a child in a pram, pushchair or wheelchair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
166... Playing physical games with a child	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
167... Lifting a disabled adult	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
168... Pushing an adult in a wheelchair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

169. Do you ever have to climb a flight of stairs when you are at home? YES / NO (Q173)

170. And are you climbing these as frequently as you always have done? YES / NO

171. If we say one flight of stairs is 10 steps, roughly how many flights a day do you think you climb up at home at the moment?

172. And, at the moment, do you ever run up these stairs?

rarely or never
sometimes
often

7: LEISURE AND RECREATION

I'd like to move on now and ask you about the kinds of activities that you do when you are not busy elsewhere, the sorts of things you do in between working or doing the housework for example.

[CARD 16] Thinking back over your free time at home in the last 7 days, how often do you think you

	Never	< 1/2	1/2	> 1/2	Always
173.Sat down to watch TV	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
174.Sat down to read	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
175.Sat down to do any other leisure time activity	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

• Can you tell me what this was?

	Never	< 1/2	1/2	> 1/2	Always
176.Stood up to do a leisure time activity	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

• Can you tell me what this was?

177.And when you have time to yourself, how often do you think you walk around your home?

	Never	1/4	1/2	3/4	Always
	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

(CHECK TOTAL=1)

178.Have you done any outside walks for pleasure in the last 7 days?

YES / NO
(Q182)

⇓

• If yes, Were any of these walks of two miles or more? These are long continuous walks that would usually take at least 40 minutes.

YES / NO
(Q180)

• If yes, About how many?

179.So, on the most recent occasion that you did one of these long walks about how long did you actually spend walking?

<input type="text"/>	Hours	<input type="text"/>	Minutes
----------------------	-------	----------------------	---------

180.Have you done any walks in the last 7 days that have lasted between 1 & 2 miles? This would usually be walking that lasted for about 20-30 minutes.

YES / NO

⇓

• If yes, About how many?

181.And in the last week, have you done any shorter walks which lasted for at least 5 minutes YES / NO

- ↓
- If yes, About how many?

182.What about cycling, have you done any cycling in your leisure time in the last 7 days? YES / NO
Do not include stationery cycling carried out at a gym or on a home exercise bike. (Q191)

183.Did this include any cycle racing, mountain biking on mountain trails or any other kind of fast, energetic cycling? YES / NO
(Q186)

- ↓
- If yes, What exactly did you do?

mountain biking
racing
both
- Other

184.And altogether, how many times in the last week have you done this sort of fast energetic cycling?

185.If we take the most recent occasion you did some fast, energetic cycling, about how long in total did you spend doing it? Hours Minutes

186.Did you do any ordinary cycle rides in the last week? YES / NO
(Q191)

187.And did any of these last for 30 minutes or more? YES / NO
(Q189)

- ↓
- If yes, About how many?

188.So on the most recent occasion that you did one of these long cycle rides about how long in total did you actually spend cycling? Hours Minutes

189.Have you done any cycle rides in the last seven days that have lasted between 10 & 30 minutes? YES / NO
↓

- If yes, About how many?

190. And still thinking about your leisure time in the last week, have you done any shorter cycle rides which lasted for at least 5 minutes?

YES / NO

⇓

- If yes, About how many?

191. Did you do any outside running or jogging in your leisure time last week?

YES / NO
(Q196)

192. Did any of these runs last for 30 minutes or more?

YES / NO
(Q194)

⇓

- If yes, About how many?

193. So on the most recent occasion that you did one of these long runs about how long in total did you actually spend running?

Hours

Minutes

194. Have you done any runs in the last seven days that have lasted between 10 & 30 minutes?

YES / NO

⇓

- If yes, About how many?

195. And still thinking about your leisure time in the last week, have you done any shorter runs that lasted for at least 5 minutes?

YES / NO

⇓

- If yes, About how many?

196. Are you a member of a gym or fitness suite at the moment?

YES / NO

197. And did you go to a gym or fitness suite any time last week?

YES / NO
(Q199)

⇓

198. If no, have you been to the gym at all since you have been pregnant?

YES / NO
(Q204)

⇓

- How frequently have you been going?

⇓

- Is that how often you would go to the gym normally?

Yes
No, more
No, less

⇓

- If no, Why is this?

.....
.....

199. About how many times did you go the gym last week?

200. Thinking only about the last time you went to a gym or health club

Did you use:	YES	NO	How long did you use it for? (mins)	And roughly how much effort did you put in?			
An exercise bike or cycling machine				L	M	H	D/N
A rowing machine				L	M	H	D/N
A treadmill or running machine				L	M	H	D/N

201. Did you use any other equipment or do anything else while you were there?

YES / NO

- ⇓
- If yes,

Last time you were at the gym did you do any....	YES	NO	How long did you do this for?
Light weightlifting			
Heavy weight lifting / Power lifting / Body building			
Push ups pull ups, sit ups etc			
Light exercises e.g. back exercises			
Exercise on a stair or step machine			
Sitting in a whirlpool / jacuzzi			
Other (please specify)			

202. Do you think that the visit that you have just described to me is fairly typical of what you used to do at the gym before you were pregnant?

YES / NO

- ⇓
- If no, How & why is it different?

.....

.....

.....

.....

203. And/but, is it fairly typical of what you tend to do at the moment?

YES / NO
(Q204)

- ⇓
- If no, How & why is it different?

.....

.....

.....

.....

204. Thinking back over the last 7 days again, so that's from ***** up until yesterday, did you do any of the activities shown on this card?

Activity	YES	NO	On how many occasions?	& On average how long did each occasion last?
Keep fit / Aerobics (High Impact)				
Keep fit / Aerobics (Low Impact)				
Yoga				
Swimming (fast laps)				
Swimming (slow laps)				
Swimming (leisure)				
Water aerobics				
Snooker, pool, billiards				
Ten pin bowling, skittles				
Darts				
Tennis (at a competitive / high level)				
Tennis (social / low level)				
Squash (at a competitive / high level)				
Squash (social / low level)				
Badminton (at a competitive / high level)				
Badminton (social / low level)				

205. Do you regularly play any individual or team sports that we have not mentioned? YES / NO (Q206)

- ↓
- If yes,

What sport(s) do you play?	How many times did you play last week?	How long did you usually play each time? ▪ Do <u>not</u> include any time spent travelling or changing.	And did you usually play	
			Competitively	Socially

[CARD 18] The card I'm giving you know shows some other popular activities.

206. Could tell me if you have done any of these things in the last 7 days?

In the last seven days have you	YES	NO	How many times in the last week?	Average length of time on each occasion?	Main activity during this time
Visited family or friends					
Had friends or family visit me					
Went to a pub or social club					
Visited cinema or theatre					
Went shopping for pleasure					
Went to a restaurant					
Attended a sports event as a supporter					

207. Did you attend any other sort of social event, meeting or group in the last week ? YES / NO

- ⇓
• If yes,

Event / meeting attended.	No. of times you went last week	Average length of time on each occasion • Do <u>not</u> include any time spent travelling	Main activity during this time

208. Do you think that your leisure activities have changed in any way since you have been pregnant? YES / NO

- ⇓
• If yes, How & why?

.....

.....

.....

.....

.....

.....

8: SLEEPING & RESTING

I wonder if we could just move on now and talk a little bit about your resting and sleeping patterns over the last week.

209.Over the last week did you generally sleep

extremely well
very well
fairly well
rather badly
extremely badly

210.Can you remember what time you woke up yesterday?

.....

211.And did you get out of bed straight way?

YES / NO
(Q 212)

↓

• If no, So what time did you get out of bed?

.....

212.Could you tell me what time you went to bed that night?

.....

213.And did you turn the light out straight away?

YES / NO
(Q 214)

↓

• If no, So what time did you turn the light out?

.....

214.Would you say that the sleeping pattern you have just described was typical of most other nights last week?

YES / NO

↓

• If no, Could you describe what would have been a more typical sleeping pattern for you last week?

I usually went to bed at		I usually woke up at	
I usually turned the light out at		I got out of bed at	

215.At the moment, how much does the quality of your sleep vary from one night to the next?

Very much
Moderately
Slightly
Not much
Not at all

216.Do you wake up in the night at all?

YES / NO
(Q219)

↓

• If yes, On average at the moment, how many times do you wake up per night?

Hardly ever
Once or twice
No more than 5 times
5-10 times
More than 10 times

217. When you wake up during the night, how long does it usually take you to go back to sleep?

- Less than 10 minutes
- 10-30 minutes
- 30-60 minutes
- Over 60 minutes

218. And what do you most commonly do while you are awake?

- Lay in bed
- Sit
- Stand
- Walk about
- Go to the toilet

Other

219. Were there any nights in the last week when you had much less sleep than usual?

YES / NO
(Q221)

- If yes, How many?

--

- Can you give me any reasons for this?

.....

.....

.....

.....

220. Roughly how long in total were you awake on these nights?

--

Hours

--

Minutes

220b. And what did you generally do while you were awake?

221. Could I ask you if you shared a bedroom last week?

- Always
- Sometimes
- Never

222. And did you share a bed last week?

- Always
- Regularly
- Sometimes
- Never

223. What size of bed did you sleep in last week?

- Single
- Double
- King size

224. Do you nap during the day at all at the moment?

YES / NO

(Q228)

↓

↓

• If yes, Have you always done this?

YES / NO

225. On how many days last week did you take a nap?

226. And about how many naps did you have each day?

227. On average, how long did you normally nap for each time

Hours

Minutes

228. Do you ever lie down to rest but not to sleep?

YES / NO

(Q232)

↓

↓

• If yes, Have you always done this?

YES / NO

229. On how many days last week did you lie down to rest?

230. And about how many times a day did you do this?

231. On average, how long did you normally rest for each time?

Hours

Minutes

In this next bit I'm going to have to ask you something a little bit embarrassing. You do not have to answer but it would really help me to get an overall picture of how active you've been. At the end of the day, the answers you give me will simply be coded and added to all the other sections we've already completed.

Would you be prepared to answer four short questions concerning your sexual activity? We can go through them together or if you'd prefer I can give you a separate sheet that you can fill out by yourself.

YES / NO

(Q237)

232. Do you think your pregnancy has affected your sex life at all?

YES / NO

233. So would you say that your sexual activity has recently

increased

decreased

stayed about the same

234. I really need to ask you if you were involved in any sexual intercourse last week?

YES / NO

235. If you don't mind would you be able to tell me roughly how often this was?

236. And would you be able to say roughly how long it lasted for each time?

440

9 GENERAL INFORMATION

We're nearly there. All I need to do now is just ask you a few general questions.

237. Firstly, is there anything else you did last week that you do not feel we have covered? YES / NO

- *If yes, Please tell me more about this.*
- *(Probe: what did, how many times, how long each time.)*

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

238. Do you think that you tend to behave any different physically now that you know you are pregnant? YES / NO

- *If yes, How & why?*
- *(Probe whether deliberate or forced)*

.....

.....

.....

.....

.....

.....

.....

.....

239. Overall at the moment, do you think that you are generally

more physically active than you were before you became pregnant
less physically active than you were before you became pregnant
just as active as you have always been.

(Q241)

240. Where do you think most of this change has occurred?

241. In the weeks leading up to your baby’s birth do you think that you will generally be

- More physically active than you are now
- Less physically active than you are now
- Just as active as you are now

242. Do your close family and friends encourage or discourage you to be physically active at the moment, or do they do neither?

- They encourage me a lot
- They encourage me a little
- They discourage me a little
- They discourage me a lot
- They do neither
- I do not have any close family or friends

243. Have any books or magazines that you’ve read given you any advice on physical activity during pregnancy?

- Yes, books
- Yes, magazines (antenatal)
- Yes, magazines (other)
- No, none
- I haven’t read any

⇒ Which ones?

• If yes, Can you remember what they told you?

244. And what about your doctor or midwife? Have they or any other health professional given you any advice on physical activity during pregnancy?

YES / NO

• If yes, what have they said to you?

245. Have you been given advice on physical activity during pregnancy from anywhere or anybody else?

YES / NO

• If yes, Would you mind expanding a little on what you were told?

246. Overall then, how much do you try to follow the advice that you have been given on physical activity?

A lot

Quite A lot

A little

Not at all

No advice given

247. If had been possible, would you have really liked to have done a different level of activity to that which you did last week?

Yes, I would really have liked to do more
Yes, I would really have liked to do less
No, I was happy with the amount that I did

(Q249)

• If yes, So what were the main reason why this was not possible?

248. How hard do you think it would be for you to be less/more active than you are at the moment?

Virtually impossible

Very hard

Quite hard

Quite easy

Very easy

249. Over the last week generally, how energetic have you felt?

very energetic

quite energetic

lacking in energy

250. And how often have you felt tired?

Never

Sometimes

Regularly

Always

251. Have you felt ill at any time in the last week?

Never

Sometimes

Regularly

Always

(Q253)

252. Do you think this was pregnancy related?

YES / NO

253. Have you been to the doctor with any concerns or worries about your pregnancy?

YES / NO

↓

- If yes, Can you tell me any more about this?

.....

.....

254. Have you experienced any medical problems or complications with your pregnancy?

YES / NO

↓

- If yes, Can you tell me any more about this?

.....

.....

255. Could I just ask you to tell me what your usual pace of walking is at the moment?

Casual or strolling (*less than 2 mph*)

Average or normal (*2-3 mph*)

Fairly brisk (*3-4 mph*)

Brisk or striding (*more than 4 mph*)

256. And finally, if you had needed to get a bus or train at any time last week how often do you think you would have been willing to run to catch it?

Always

Sometimes

Never

SECTION J - PERSONAL DETAILS

As a matter of routine we collect some background information on our interviewees. If I give you this card would you mind just telling me the letter of your answer.

257. To which population group do you consider you belong?

A. White	
B. Black-Caribbean	
C. Black-African	
D. Black-Other	
E. Indian	
F. Pakistani	
G. Bangladeshi	
H. Chinese	
I. Other	

258. And which of the categories best describes your marital status?

A. Married / Cohabiting	
B. Single	
C. Divorced / Separated	
D. Widowed	

259. Where do you live?

A. Whole house or bungalow (detached)	
B. Whole house or bungalow (semi-detached)	
C. Whole house or bungalow (terraced/end of terrace)	
D. Flat or maisonette - in a block with a lift	
E. - in a block without a lift	
F. Part of a house or bungalow	
G. Part of a flat or maisonette - with a lift	
H. - without lift	
I. Dwelling within business premises	
J. Caravan / houseboat	
K. Other	

260. Is your home

A. Mortgaged / Owned by you	
B. Rented by you	
C. A Council / Housing Association Property	

261. How many people live in your home at the moment?

262. Do you have any of the qualifications shown on this card?

YES / NO



- If yes, Could you tell me which ones?

	Interviewee	H. of Household
CSE Grades 2-5		
CSE Grade 1		
GCE 'O' level		
School Certificate		
Scottish (SCE) Lower		
City & Guilds Craft/Ordinary Level		
GCSE		
GCE 'A' Level/ 'S' Level		
Higher Certificate		
Matriculation		
Scottish (SCE) Higher		
Overseas School Leaving Exam/ Certificate		
ONC/OND/ City & Guilds Advanced/ Final Level		
HNC/ HND/ City & Guilds Full Technological Certificate		
RSA / Other Clerical and Commercial		
Teachers Training Qualification		
Nursing Qualification		
Professional Qualification (membership awarded by a professional institute)		
Degree, including higher degree		
Other work-related qualifications/certificate		
Other (please specify)		

263. Who do you consider to be the head of your household?

Myself		My partner		My partner & I together	
My mother/father		Another			

264. Using the same card as before, could you please tell me the highest qualification that your **** possesses.

265. What is his (her) main occupation?

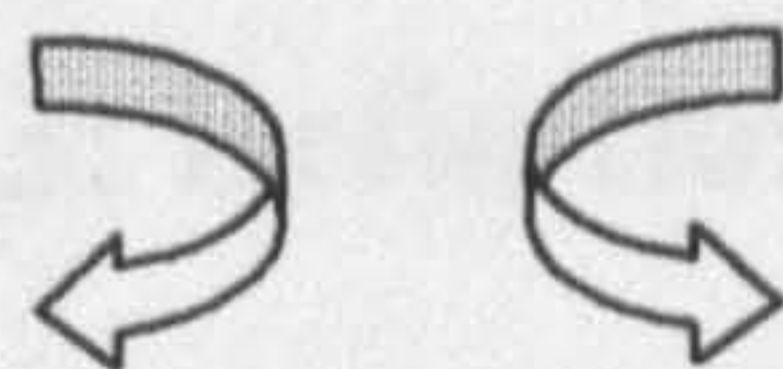
- If he is not working at the moment, enter details of their last job.

.....

.....

269. Is (was) he

self employed / an employee



Does (did) he/she employ any other people?

Yes – under 25
Yes – 25 or more
No

Are (were) they a

manager
foreman/supervisor
another employee



How many employees work (worked) in this establishment?

Under 25
25 or more

YOU HAVE FINISHED THE QUESTIONNAIRE
THANK YOU FOR TAKING THE TIME TO COMPLETE THIS SURVEY

A.3: Definitions Used in the Activity Questionnaire

A3.1 Alcohol Consumption (Q11)

<u>GROUP A</u>	<u>GROUP B</u>	<u>GROUP C</u>
Beer	Wine	Spirits <i>e.g.</i>
Lager	Sherry	Gin
Shandy	Champagne	Rum
Stout	Port	Whisky
Cider	Cinzano	Brandy
(Bottles,	Babycham	Vodka
cans,	Vermouth	Liqueurs
draught)	Dubonnet	Advocaat
	Martini <i>etc.</i>	

A3.2 Domestic Activities (Q125-128)

HEAVY HOUSEWORK

Scrubbing / polishing floors by hand (*on knees*)
 Washing a lot of clothes by hand
 Spring cleaning (*moving furniture etc.*)
 Washing windows
 Vigorous Hoovering
 Mopping or sweeping large areas
 Carrying heavy rubbish bags or boxes
 (*Or anything similar to this*)

HEAVY GARDENING

Digging / clearing rough ground
 Carrying / loading / stacking / chopping wood
 Mowing large areas with a hand mower
 Cutting shrubs & trees by hand
 Vigorous weeding, hoeing or raking
 (*Or anything similar to this*)

DIY AND CAR MAINTENANCE WORK

Carpentry
 Plastering large areas
 Painting / wall papering
 Laying / removing carpet
 Car washing and polishing by hand
 (*Or anything similar to this*)

LIGHT HOUSEWORK

Tidying up / Dusting
 Washing by machine
 Ironing
 Cooking
 Serving food / washing dishes
 Clearing the table
 (*Or anything similar to this*)

LIGHT GARDENING

Weeding flower boxes
 Small scale greenhouse work
 Watering / seeding the lawn
 Mowing with a riding mower
 Tidying up
 (*Or anything similar to this*)

A.4 Parent Information Sheet Accompanying Activity Monitor Consent Form



LEICESTER ROYAL INFIRMARY

The P.R.A.M. Scheme

Pregnancy Related Activity Monitoring

PARENT INFORMATION SHEET

Thank you for joining the P.R.A.M. scheme and helping us with our research. The aim of our study is to find out more about women's health and wellbeing during and after pregnancy. We are particularly interested in movement during pregnancy and the way in which this might relate to how a mother-to-be is feeling.

➤ ***Why am I being asked to wear an activity monitor?***

Portable activity monitors have been shown to be one of the most accurate and efficient ways of measuring bodily movement. They silently record all the activity that a person performs over a number of days. Information is stored in the monitor until it can be downloaded to a computer.

➤ ***Will my monitor be uncomfortable to wear?***

No bigger than the size of a wristwatch, your activity monitor can be worn around the ankle without discomfort. **It causes no side effects to you and will not harm your baby.**

➤ ***Are activity monitors only used during pregnancy?***

Just because a woman wears an activity monitor it does not necessarily mean she is pregnant. Similar devices have been used widely in studies of sleep disturbance and have also been used to look at the activity patterns of children. Other people who have worn activity monitors include rheumatoid arthritis sufferers, fitness enthusiasts and healthy individuals from the general population.

➤ ***Is there anything else I need to know?***

The value of each monitor is £500. Please try not to lose it or throw it away.

Your monitor is designed to be splashproof but you **must** remove it before bathing and showering, swimming or using a sauna.

We would like you to wear your monitor on your ankle for at least 72 hours (3 consecutive days). Always remember to press the marker button whenever you take off, or put on, your monitor. The marker button looks like a small circle and can be found on the front of the watch.

A.5 Postpartum Activity Summary Sheet

The P.R.A.M. Scheme

Pregnancy Related Activity Monitoring

ACTIVITY SUMMARY

NAME..... CODE NO.....

SUMMARY DAY..... SUMMARY DATE.....

This morning I woke up at..... and got out of bed at.....

Today I:

The times I did this between were:

Went to work

Did some housework

Rode a bicycle

Rode a motorbike/moped

Drove a car/van

Walked somewhere

Played a sport/

Took some physical exercise*

* The type of sport/ exercise that I did was

The other things I did today were:

The times I did this between were:

This evening I went to bed at and turned the light out at.....