DEVELOPING A MODEL OF QUALITY OF LIFE FOR PEOPLE WITH CORONARY HEART DISEASE

by

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DEDICATION

To my wife Bing-Leei (Mimi)

my strength and my inspiration

To my sons Jack, Richard and daughter Claire

my joy and my incentive

To all of you,

my happiness and my love

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ABSTRACT

Quality of life (QOL) is an extremely important concept in the promotion of appropriate and successful health care programmes. However, there is a need for conceptual clarity to unravel the complexities of terminology in different medical conditions and the underlying factors that have a direct influence on the quality of life for people with coronary heart disease.

The primary objective of this thesis is to propose a theoretical model which specifies the domains of QOL and the interrelationships among these domains. The objectives of the study are four-fold: (1) To examine whether a cardiac rehabilitation programme has a beneficial effect on cardiac heart disease patients; (2) To evaluate the primary components of generic health-related quality of life assessment tools for people with coronary heart disease; (3) To identify the main factors governing disease-specific health-related quality of life assessment tools amongst patients with coronary heart disease; (4) To examine a variety of conceptual models of QOL and to determine their relevance to cardiac patients.

First, in order to provide conceptual clarity, a comprehensive review of QOL measures was undertaken. Second, data was collected on a cardiac rehabilitation programme in a county hospital using Short Form-36 (SF-36) and Quality of Life for Myocardial Infarction (QLMI) instruments. This data was analysed using a number of techniques including (1)meta-analysis; (2)discriminant analysis; (3)factor analysis and (4)structural equation modelling. Analysing the data in this way enabled the development and clarification of the specific domains of the quality of life model.

Meta-analysis involved pooling the results of several studies, these were then analysed to provide a systematic, quantitative review of the data. The results found that the related studies did not have consistent outcomes to support the

positive effects of a cardiac exercise rehabilitation programme on quality of life in coronary patients.

Findings from the SF-36 indicate that older people with coronary heart disease gain more pain relief than their younger counterparts. After a cardiac exercise rehabilitation programme, statistically significant improvements occurred in physical function, social function, role limitation/physical, energy/vitality, body pain, and change in health-related dimensions of quality of life. The first-order five domains model includes the symptom domain, the restriction domain, the confidence domain, the self-esteem domain and the emotion domain. This model represents an appropriate model of quality of life for people with coronary heart disease compared to the three-domain model and the four-domain model. In terms of the second-order QOL model, the five-domain model also has an adequate fit to the data.

According to the result of structural equation modelling, three models, including the null model, the alternative model I and the alternative model II, did not fit the data perfectly. However, the construct of full latent variable model gradually increased the fit statistics from the null model to the alternative model I and from the null model to alternative model II. Therefore, it can be concluded that the paths and indicators of the three models need to be further adjusted in order to provide a more appropriate model. Nevertheless, this is a first trial to examine a full model of quality of life for people with coronary heart disease using the structural equation analyses. As such, this study provides a new approach to examining the difference between empirical studies and theoretical approaches.

Key words: cardiac rehabilitation programme, quality of life, coronary heart disease, SF-36, QLMI, Structural Equation Modelling, QOL model, meta-analysis, discriminant analysis, factor analysis.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

A NUMBER OF TERMS ARE ABBREVIATED IN THIS THESIS:

		Page
AVR/MVR	Aortic Valve Repair/Replacement; Mitral Valve Repair/Replacement	107
AGFI	Adjusted Goodness-Of-Fit Index	149
AMI	Acute Myocardial Infarction	40
ANOVA	Analysis of Variance	149
BIDS	Bath Information and Data Services	48
CABG	Coronary Artery By-pass Graft Surgery	13
CAD	Coronary Artery Disease	16
CFA	Confirmatory Factor Analysis	68
CFI	Comparative Fit Index	149
CHD	Coronary Heart Disease	1
CHFQ	Chronic Heart Failure Questionnaire	78
CQLI	Cardiac Quality Of Life Index	78
CRL	Coefficient Of Racial Likeness	92
CRP	Cardiac Rehabilitation Programme	1
EFA	Exploratory Factor Analysis	187
GFI	Goodness-Of-Fit Index	148
GHR	General Health Rating	60
HIE	Health Insurance Experiment	87
HRQOL	Health-Related Quality Of Life	22
KMO	The Kaiser-Meyer-Olkin measure	110
LM	Lagrange Multiplier	152
MEDLINE	Medical Literature, Analysis, and Retrieval System Online	48
MHIQ	McMaster Health Index Questionnaire	60
MI	Myocardial Infarction	13
MOS	Medical Outcomes Study	50

		Page
NHP	Nottingham Health Profile	3
NHS	The National Hospital Service	149
NNFI	Non-Normed Fit Index	150
PGWg	Psychological General Well-Being Index	60
POMS	Profile Of Mood States	128
PTCA	Percutaneous Transluminal Coronary Angioplasty	33
QLMI	Quality Of Life After Myocardial Infarction	3
QOL	Quality Of Life	2
QWB	Quality Of Well-Being Questionnaire	128
RMSR	Psychological General Well-Being Index	149
RS	Rating Scale	50
SAQ	Seattle Angina Questionnaire	3
SEIQoL	Schedule For Evaluation of Individual Quality Of Life	58
SEM	Structural Equation Modelling	68
SF-36	Short Form 36 Health Survey Questionnaire	3
SG	Standard Gamble	50
SIP	Sickness Impact Profile	3
SSTAI	Spielberger State Trait Anxiety Inventory	78
TLI	Tucker-Lewis Index	150
TTO	Time Trade-Off	128

CHAPTER 1

INTRODUCTION

1.1 Background

Over the past three decades, the inclusion of physical activity as part of a comprehensive programme of rehabilitation or secondary prevention for patients with a coronary heart disease (CHD) has become generally accepted (Haskell, 1994). Recent studies of patients with coronary heart disease have shown that exercise confers greater benefit (Blair et al., 1989; Dressendorfer et al., 1995; Fletcher, 1998; Tod, Pearson, & McCabe, 1998). In the secondary-care setting, cardiac rehabilitation programmes (CRP) offer an important opportunity to enhance the daily physical activity of patients with cardiac disease (Jolliffe & Taylor, 1998).

Indeed, evidence suggests cardiac rehabilitation and exercise training reduces coronary heart disease risk and improves the quality of life after major cardiac events. In general, cardiac rehabilitation programmes typically include exercise training, educational counselling, stress management training, risk factor modification and vocational guidance (Lavie, Milani, & Littman, 1993; Taylor, 1996; Thompson, 1994).

A cardiac rehabilitation programme provides the patient with an opportunity to lead a healthier lifestyle through appropriate education, counselling, exercise and behaviour change programmes. Cardiac rehabilitation in the U.K. is divided into four phases. Phase I involves the hospital inpatient period (approximately six to fourteen days). Phase II, the early post-discharge period, provides a comprehensive assessment of the cardiac risk, lifestyle advice and psychological interventions. Phase III, the cardiac exercise rehabilitation programme is a supervised outpatient programme (of six to twelve weeks duration). Finally, Phase IV, is an on-going maintenance period (of indefinite duration), supervised essentially through primary health care (NHS Executive, 2000).

The cardiac rehabilitation process normally consists of treatment, observation and assessment. Assessment usually includes areas of sociomedical status as additional outcome criteria and includes ability to function in daily life, productivity, ability to perform in social roles, intellectual capability, emotional stability, and life satisfaction. These multifaceted components, some of which reflect in part the perceptions of the patient, have been collectively termed quality of life (QOL) (Wenger, Nattson, Furberg, & Elinson, 1984).

Quality of life assessment has various levels of conceptualisation and definition. It denotes a wide range of capabilities, limitations, symptoms and psycho-social characteristics that describe an individual's ability to function and to derive satisfaction from a variety of roles. In Patrick and Erickson's (1993) study, their conceptual QOL model includes the primary concepts of impairment, functional status, health perception, and opportunity. Ferrans (1996) stated that conceptual clarity is particularly imperative to ensuring that the various contributors to the cardiac rehabilitation programme can develop individual activities, which comprise a coherent whole with common goals. Thus, quality of life is an extremely important concept in the promotion of appropriate and successful health care programmes.

Arguably, the ideal programme has to address the fact that no two people are the same. Indeed, cardiac patients will have different life experiences, value systems, aspirations and their expectation of what will be required of them will be different. Therefore, the most appropriate QOL model needs to be based upon the adoption of a 'person based' conception which recognises that quality of life depends on the unique experience of life for each person. Clearly, individuals are the only proper judges of their quality of life as people differ in what they value and believe.

The measurement of quality of life can be divided into two categories: generic measures and disease-specific measures. Generic measures offer a general assessment of the health status of an individual and permit comparisons of the health-related quality of life between groups of patients with different conditions. The most frequently used generic instruments of quality of life in heart disease are the Short Form 36 (SF-36); the Nottingham health profile (NHP) and the Sickness Impact Profile (SIP). Disease-specific instruments measure patients with specific conditions such as heart disease, disabilities or mental health. Importantly, disease-specific instruments are more sensitive to detecting change in health status than generic instruments. These instruments are used to monitor progress and often the distribution of resources. The most frequently used disease-specific instruments of quality of life in heart disease are the Quality of Life after Myocardial Infarction Questionnaire (QLMI), the Multidimensional Index of Life Quality (MILQ) and the Seattle Angina Questionnaire (SAQ) (Dempster & Donnelly, 2000; Smith, Avis, & Assmann, 1999).

A cardiac rehabilitation programme offers an important potential source for highlighting the benefits of regular physical activity for people with coronary heat disease. However, although cardiac rehabilitation programmes have the potential to improve physical, mental and social functions, there is currently little evidence to support its efficacy (Beniamini, Rubenstein, Zaichkowsky, & Crim, 1997; Jolliffe & Taylor, 1998; Thompson, Bowman, De Bono, & Hopkins, 1997).

There are a number of other important issues to discuss. Firstly, we need to clarify the generic and disease-specific health-related quality of life concepts. Secondly, there is a need to develop an appropriate QOL model for people with coronary heart disease. Thirdly, cardiac rehabilitation programmes need to be evaluated more critically. These issues are important and require thorough discussion and a more detailed and critical analysis of the literature.

1.2 Statement of Problems/Research Questions

Although 'quality of life' is depicted as something very desirable, the meaning of this concept is seldom specified. All issues relating to the assessment of quality of life need to be considered. To foster this approach, four research questions have been generated. These have to be clarified and examined within a theoretical context. The outcomes from these considerations have to be transformed into a coherent, integrated empirical application. The four questions are as follows:

(1) What domains of the quality of life are appropriate for people with coronary heart disease?

(2) Does a conceptual model of 'health-related quality of life' adequately fit the data?

(3) Are there any demographic differences in the areas addressed by the research?

(4) Does the use of 'health-related quality of life' concepts and its measurement meet the needs of coronary heart disease patients in cardiac rehabilitation programmes?

1.3 Purpose

The primary objective of this thesis was to develop an appropriate model of health-related quality of life for people with coronary heart disease. This primary objective can be expressed in the following four goals:

(1) To identify the main factors governing disease-specific health-related quality of life amongst people with coronary heart disease in a cardiac rehabilitation programme;

(2) To verify a model of health-related quality of life which can predict the direct and indirect effects on the individual cardiac patients;

(3) To examine the generic health-related QOL effects on people with coronary heart disease by their demographic characteristics;

(4) To evaluate whether a cardiac rehabilitation programme has beneficial effects on people with coronary heart disease.

1.4 Hypothesised Conceptual Model of Quality of Life

The definitions of health and quality of life must be broad enough to include the positive aspects of health but narrow enough to distinguish the 'healthy' from the 'sick'. Theoretical concepts of health-related quality of life have been organised using different frameworks or models to express the interrelationships among concepts, i.e. Patrick et al. (1988), Ferrans (1996) and Zhan (1992). One major challenge for developers and users of health-related quality of life measurements is establishing a testable theory of the expected relationships among the different concepts and domains.

Based on a number of conceptual or theoretical models including those proposed by Patrick and Erickson (1993), Ferrans (1996) and Zhan (1992), a revised conceptual model for this study will be proposed (see Figure 3.1, p6). More explanation and discussion of this model will follow in chapters two and three.

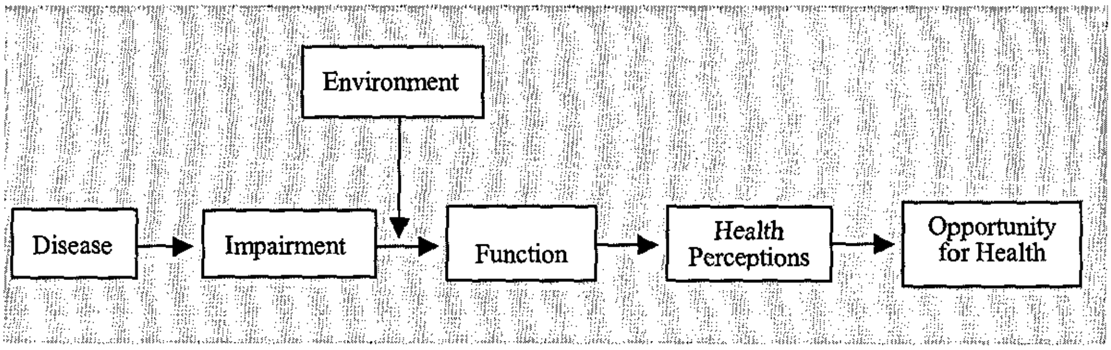


Figure 3.1 Conceptual model of quality of life for people with coronary heart disease

(Revised from Patrick and Erickson's Model, 1993)

1.5 Structure of Thesis

The thesis consists of nine chapters which include the following:

In Chapter 1, the primary purposes and related research problems are presented. Chapter 2 provides an overview and discusses previous studies on 'quality of life' research. This is included a brief summary of the historical development and philosophy of quality of life. In addition, a more detailed explanation of research on the quality of life model, process, outcome and resources. Furthermore, controversial issues relating to quality of life are discussed.

Chapter 3 introduces the theoretical framework for the study. In addition, the developing processes of the quality of life model and the research methodology will be explored. The theoretical model has been revised and these models are separately reported. In particular, three research methods are used to collect data in the study - meta analysis, factor analysis and structural equation modelling. They are described individually and the reasons for using these methods are explained.

In Chapters 4 to 7 four studies of quality of life assessment in cardiac rehabilitation are presented. A meta-analysis is explored in Chapter 4. Generic and specific-disease health-related quality of life are discussed in Chapter 5 and 6. Chapter 7 tests a model of quality of life for people with coronary heart disease.

Chapter 8 contains a discussion of quality of life assessment and the relationships between parameters. Finally, Chapter 9 concludes by presenting a comprehensive view of the findings of quality of life studies, and offers a number of important recommendations. Furthermore, the implications for future quality of life research are considered.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Introduction

The purpose of this chapter is to provide a critical insight into the assessment of cardiac rehabilitation programmes and the concept of health-related 'quality of life'. Initially, consideration is given to historical origins of the concepts of QOL and approaches to cardiac rehabilitation programmes. Second, using an extensive review of literature, the theoretical foundations for health-related 'quality of life' are explored. Third, the key dimensions of the quality of life concept are defined. Finally, a number of health-related quality of life assessment strategies are highlighted.

2.2 Cardiac Rehabilitation Programmes

Cardiac rehabilitation programmes are an essential part of the care pathway for people with coronary heart disease, particularly those with cardiovascular, musculoskeletal, hydroelectrolytic, hematic, respiratory and psychological functions). Indeed, increased knowledge of the benefits of cardiac rehabilitation make nurses better prepared and motivated to include these programmes in coronary intensive care units (ICU, wards and specialized post-hospitalisation centres) (Cabello Fernandez, Navajas Rodriguez de, Soriano Blanco, & Moreno Zorrero, 1999).

2.2.1 Historical Review of Cardiac Rehabilitation Programme

2.2.1.1 Early Beginnings

During the Sixteenth Century, strict bed rest for eight weeks or more, was considered to be an essential component of the medical treatment for coronary patients. However, Herberden in 1772 noted that his patient with angina pectoris was nearly cured after sawing wood for half an hour per day. Eventually, the medical profession recognised enforced bed rest, even for as little as 21 days, could have serious consequences including: muscle wasting, increased calcium excretion and bone demineralisation, reduced blood volume, decreased stroke volume and cardiac output, tachycardia, and diminishing the efficiency of oxygen transport system (Satin et al., 1968).

2.2.1.2 The 1950s and '60s

During this time a number of reports concerning the benefits of early mobilisation and progressively increased activity emerged (Cain, Frasher, & Stivelman, 1961; Newman, Andrews, & Koblish, 1952). From this idea of early mobilisation, a formal inpatient exercise programme was seen as a natural progression. Consequently, a reduction in the amount of time spent in hospital by coronary patients has led to greater emphasis on outpatient training programmes.

There had been a concomitant development in organised cardiac rehabilitation programmes with the general aim of integrating the patients back to their former lifestyle. These programmes had followed differing formats varying in duration, content, time of enrolment and type of patient recruited. Indeed, this variety of studies made it difficult to determine the efficacy of cardiac rehabilitation. In addition, it has been difficult to devise any type of optimal programme (Taylor, 1996).

Cardiac rehabilitation programmes (CRP) began to develop in response to the first seminar that the World Health Organisation European Regional Office held in 1967 on cardiac rehabilitation (Kehl, 1991). Cardiac rehabilitation (CR) has been carried out in a progressively larger number of intensive care and coronary units since the WHO defined it in 1964.

2.2.1.3 The Past 30 Years

During this time there has been a gradual worldwide acceptance of the benefits of exercise for patients with heart disease. This development has been coupled with the steady growth of rehabilitation programmes in most western countries (Thompson et al., 1997). Furthermore, there has also been a shift from exercise-only programmes to multi-factorial intervention. With the later intervention, attention is paid to education and risk factor modification. Stress management has also been increasingly recognised and evaluated (Coats, 1995).

2.2.1.4 The Present Day

Today, it is widely recognised that comprehensive cardiac rehabilitation has many benefits to patients with cardiovascular disease. However, coronary heart disease still remains the leading cause of death in the UK (Thompson et al., 1997). One in four men and one in five women die from the disease. CHD caused over 135,000 deaths in the UK in 1998. The death rate from CHD in the UK is still amongst the highest in the world (British Heart Foundation, 2000).

Thompson et al. (1997) used a short postal questionnaire at 244 centres in England and Wales that admitted patients with cardiac conditions. In total, 199 (81%) of the centres claimed to provide a cardiac rehabilitation service. Of these, 25 were randomly selected as a representative sample and visited in order to obtain detailed information concerning the provision of services. Most 18 (72%) of the centres had commenced their rehabilitation programme within the previous 5 years, usually at the instigation of interested staff. Patient entry to cardiac rehabilitation programmes was restricted; women (who represented only 15% of attenders), elderly people (excluded in 10 (40%) centres), and those with more complex problems, such as angina or heart failure, were under-represented. The central components of all programmes were education and exercise training but there was a wide range in the quantity and quality of service provision. Most 22 (88%) programmes were hospital out-patient based, one (4%) was hospital in-patient based, one (4%) was community-based and one (4%) was home-based. The staffing and funding of programmes were variable, with 7 (28%) having no identified funding.

By making cardiac rehabilitation programmes more responsive to the needs and goals of coronary patients, participation rates and compliance rates should increase with a favourable impact on morbidity, mortality, and quality of life for people with coronary heart diseases. It should be noted that most studies of cardiac rehabilitation have not included a substantial number of women (Carhart & Ades, 1998).

Indeed, the emphasis on CR has varied at different times since its adoption. At present, CR is considered a priority task in the secondary prevention of coronary heart disease and it attempts to offer the patient a healthier and improved quality of life by means of appropriate education, counselling, exercise and behaviour change. In today's health care, there is every reason to make cardiac rehabilitation programmes available to everyone, including older people, women and ethnic minorities.

2.2.2 Definition of Cardiac Rehabilitation Programmes

The World Health Organisation defines cardiac rehabilitation as 'the sum of activities required to influence, favourably, the underlying cause of the disease, as well as to ensure patients the best possible physical, mental and social conditions so that they may, by their own efforts, preserve or resume when lost, as normal a place as possible in the life of the community' (World Health

Organization, 1993). Therefore, the aim of cardiac rehabilitation is to facilitate physical, psychological and emotional recovery and enable patients to achieve and maintain better health and a healthy lifestyle.

The features of cardiac programmes can be categorised as follows:

First, cardiac rehabilitation (CR) is a process of restoring functional abilities of everyday behaviour, which have been degraded by serious cardiovascular events or by surgical procedures to preempt such events (Levy, 1993). Naughton (1992) also emphasised that a cardiac rehabilitation programme is "the process that cardiac patients go through that then restores them to optimal medical, physiological, psychological, social and vocational performance" (p.304-19).

Second, it also attempts to reverse risk factors that have contributed initially to the disease process. CR can encompass not only the means to increase levels of physical activity, psychological and physiological parameters, but also education into CHD and how to reduce other risk factors, for example through diet, counselling, smoking cessation, relaxation and stress management (Coats, 1995).

Third, there are often more specific goals including preventing the harmful effects of prolonged bed rest; controlling risk factors; improving the patient's knowledge of his or her disease, and involving the family in CR, particularly in the last phases. In addition, other goals include: preventing and/or correcting psychological problems such as anxiety and depression; increasing the patient's self-confidence and will to live; improving his or her capacity for physical effort with a programme of aerobic physical exercise; and facilitating familial, occupational and social reinsertion. Furthermore, if these goals are achieved, this may lead to reduced hospital stays and, perhaps morbidity and mortality.

Fourth, cardiac rehabilitation lowers mortality. More importantly, cardiac rehabilitation increases functional capacity and may reduce the likelihood of disability. Oldridge (1991) suggested that cardiac rehabilitation services are worth the patient's costs and efforts and as such, they should be considered an integral component of comprehensive cardiovascular care by cardiologists and primary care physicians. While there is considerable agreement on the roles of exercise testing and training for the three features mentioned earlier, there are also substantiated, and important differences in cardiac rehabilitation services. For example, counselling and risk factor management.

Finally, cardiac rehabilitation aims to restore the patient to an optimum level of recovery and, where possible, to prevent coronary heart disease from progressing.

2.2.3 The Structure of a Cardiac Rehabilitation Programme

There are wide variations in the resources currently available for the rehabilitation of people with coronary heart disease. There is a need for clearer direction of these services. In particular, levels of minimum service provision should be determined. In addition, guidelines are necessary to give a framework for this relatively new and rapidly expanding service.

Patients who have undergone coronary artery by-pass graft surgery (CABG) are obvious candidates for rehabilitation programmes because of the potential for progression of the disease. Such programmes have been shown to foster risk-factor modification, improve quality of life, and prolong survival among post-myocardial infarction (MI) patients. However, the efficacy of these programmes has not been established among patients who have undergone CABG. According to the British Association for Cardiac Rehabilitation (1995) and The National Health Service: NHS Executive (2000) reports, the cardiac rehabilitation programme consists of four phases as shown in Table 2.1

Table 2.1 Four phases of cardiac rehabilitation programme

Phase 1 Before discharge from hospital	• Assessment of physical, psychological and social needs for cardiac rehabilitation • Negotiation of a written individual plan for meeting these identified needs (copies should be given to the patient and the general practitioner) • Initial advice on lifestyle e.g. smoking cessation, physical activity (including sexual activity, diet, alcohol consumption and employment) • Prescription of effective medication and education about its use, benefits and dangers • Involvement of relevant informal career(s) • Provision of information about cardiac support groups • Provision of locally relevant written information about cardiac rehabilitation
Phase 2 Early post-discharge period	• Comprehensive assessment of cardiac risk, including physical, psychological and social needs for cardiac rehabilitation; and a review of the initial plan for meeting these needs • Provision of lifestyle advice and psychological interventions according to the agreed plan from relevant trained therapists who have access to support from a cardiologist • Maintain involvement of relevant informal career(s) • Review involvement with cardiac support groups • Offer resuscitation training for family members
Phase 3 Four weeks after an acute cardiac event	• Structured exercise sessions to meet the assessed needs of individual patients • Maintain access to relevant advice and support from people trained to offer advice about exercise, relaxation, psychological interventions, health promotion and vocational advice
Phase 4 Long-term maintenance of changed behavior	• Long term follow-up in primary care • Offer involvement with local cardiac support groups • Referral to specialist cardiac, behavioral (e.g. exercise, smoking cessation) or psychological services as clinically indicated.

Note: Exercise sessions may be structured in a variety of ways to meet the needs of individual patients. Typically they will be provided to groups, last at least 6 weeks (but normally 12 weeks or more) and comprise at least 3 sessions per week with a minimum of 2 supervised exercise sessions (individual programmers often in a group environment) and 1 session of education and information for patients, partners, careers and family. Some people may benefit from individual sessions and others may prefer to exercise at home (for example, with a self-manual).

The first three phases involve the rehabilitation that occurs within the first few months following heart surgery or a heart attack. Phases I to III are generally managed from what is known as secondary care (World Health Organization, 1993).

In the United Kingdom most cardiac rehabilitation programmes are managed by nurses or physiotherapists with help from a multidisciplinary team, which may include sports scientists or other exercise specialists. The programme is divided into four phases. Phase 1 covers the time in hospital after acute myocardial infarction, and exercise is limited to gradual mobilisation including stair climbing to prepare the patient for discharge. Phase 2 includes the first few weeks at home when the main exercise, usually unsupervised, is a progressive walking programme. Ideally, the patient is sent home with clear written guidance, and supplementary support can be given by telephone contact with the coronary care unit or by direct contact with a primary care team. Phase 3 is the supervised exercise programme, which is the centrepiece of a package of care which includes education, dietary instruction, risk factor monitoring, stress management, and relaxation training. Phase 4 is the long term exercise programme to which it is anticipated most patients will adhere. In practice, more than 50% will drop out of regular vigorous exercise once the supervised programme is completed (Dixhoorn, Duivenvoorden, Staal, & Pool, 1989). A necessary prerequisite to phase 3 is the exercise test (Bethell, 1999).

In Thompson et al.'s (1997) study, a randomised controlled trial was employed to evaluate whether a behavioural and educational cardiac rehabilitation programme was effective in modifying cardiovascular disease risk factors and improving quality of life in a cohort of 86 patients after CABG. Patients were recruited from the cardiac ward of a large teaching hospital and were block-randomised to either an intervention group or routine care. Subjects in the intervention group attended 6 weekly group sessions following hospital discharge, and booster sessions at 8 months and 1 year. They also received a personalised behaviour modification programme based on their baseline risk factors. Risk factor and quality of life measures were recorded at baseline (6 weeks after surgery), 4 months, 8 months, and 1 year. The results indicate few differences between the study groups. However, the intervention group's aerobic capacity (VO_2 max) improved over that of the routine care group. With regard to the quality of life variables, all patients tended to improve steadily over time.

The relatively moderate success of this intervention programme compared with various post-MI studies may be indicative of differences between the treatment needs of patients after acute myocardial infarction and CABG. This indicates that there is a need in post-CABG rehabilitation research to explore these patients' unique treatment needs and investigate a variety of programme strategies to meet them (Thompson & Bowman, 1998).

Carlsson et al. (1997) examined the ability of a secondary prevention programme to improve the lifestyle in myocardial infarction patients aged 50-70 years. Habitual physical activity, food habits, and smoking habits were assessed from questionnaires at admission to hospital and at a one year follow up. The results found that this secondary prevention programme based on a nurse rehabilitator was successful in improving food habits in patients with acute myocardial infarction. Initiating the smoking cessation programme during the hospital stay followed by repeated counselling during follow up might have improved the results. The exercise programme had no advantage in supporting physical activity compared to usual care.

Previous studies have indicated the benefits of cardiac rehabilitation programmes after major coronary artery disease (CAD) events. Maines et al. (1997) studied 591 consecutive patients from two academic institutions before and after completion of a cardiac rehabilitation and exercise training programme. The purpose was to determine the effects of this therapy on exercise capacity, indices of obesity, plasma lipid values, behavioural characteristics, and quality of life parameters. After cardiac rehabilitation, statistically significant improvements occurred in exercise capacity, percent body fat, body mass index, HDL-C, triglycerides, LDL-C/HDL-C, anxiety score, depression score, somatisation score, and in all parameters of quality of life studied. This data further supports the ability of cardiac rehabilitation and exercise training programmes to improve exercise capacity, plasma lipid values, obesity indices, behavioural characteristics, and quality of life parameters in a large cohort of patients who have had major CAD events.

2.2.4 The Contents of a Cardiac Rehabilitation Programme

A cardiac rehabilitation programme can be categorised into the single session that provides only exercise and the multiple session that consists of exercise and lifestyle modification courses.

Most early programmes concentrated on exercise training. However, it is now gradually agreed that a more comprehensive approach should be taken, including secondary prevention, relaxation, education, stress management, and the involvement of close family members in the rehabilitation process. Cardiac rehabilitation should begin at the time of diagnosis of coronary artery disease, or as soon as possible following admission with an acute event (World Health Organization, 1993). In practice, patients are usually recruited to programmes 4-8 weeks post MI and attend for 4-12 weeks (World Health Organization, 1993).

2.2.4.1 Single Session

Exercise training can be beneficial in preventing the development and progression of coronary heart disease. There is epidemiological evidence that increased physical activity is associated with a lower risk of atherosclerotic heart disease (Paffenbarger & Hyde, 1984; Rodriguez-Plaza, Alfieri, & Cubeddu, 1997). In addition, studies have shown a number of benefits from exercise training following MI or coronary artery by-pass graft (CABG) including an 11%-66% increase in maximal functional capacity and greater myocardial contraction (Greenland & Chu, 1988). Both light and heavy exercise have been shown to have beneficial effects on physical performance following MI (Goble et al., 1991). Therefore, the ideal types of exercise to improve cardiovascular fitness are now well characterised. Patients are advised to participate in moderate, rather than high-intensity exercise, sustained for periods of about 20 minutes and repeated regularly (Pell, 1997).

Cardiac rehabilitation programmes have not consistently been shown to improve the psychological well being of their patients. In a study by Beniamini et al. (1997) of 38 cardiac patients (29 men and 9 women) a variety of quality-of-life parameters were assessed before and after they completed either 12 weeks of high-intensity strength training or flexibility training added to their outpatient cardiac rehabilitation aerobic exercise programme.

The strength-trained patients increased their self-efficacy scores for lifting, push-ups, climbing, and jogging, when compared with the flexibility-trained patients. The strength group also had greater improvements in Profile of Mood States (dimensions: total mood disturbance, depression/dejection, and fatigue/inertia) than did the flexibility group. Role emotional health domain scores of Short-Form 36 survey were significantly improved in the strength group when compared with the flexibility group, and the role limitation scores improved in both groups. Increases in strength were associated with enhanced self-efficacy and improved mood and well-being scores. High-intensity strength training added to a cardiac rehabilitation programme of selected patients leads to improvements in quality-of-life parameters. Their data, in conjunction with improvements in strength, strongly support the value of adding high-intensity strength training to cardiac rehabilitation programmes.

Dugmore et al. (1999) examined and evaluated improvements in cardiorespiratory fitness, psychological well-being, quality of life, and vocational status in post-myocardial infarction patients during and after a comprehensive 12-month exercise rehabilitation programme. The results indicated that significant improvements in cardiorespiratory fitness, psychological profiles, and quality of life scores were recorded in the treatment population when compared with their matched controls. Although there were no significant differences in mortality, a larger percentage of the regular exercisers resumed full time employment and they returned to work earlier than the controls. Dugmore et al. (1999) point out that regularly supervised and prolonged aerobic exercise training can improve cardiorespiratory fitness, psychological status, and quality of life. In addition, the trained population had a reduction in morbidity following myocardial infarction, and significant improvement in vocational status over a five year follow up period.

The new programme of rehabilitation is less demanding on cardiac output than standard programmes. Koch et al. (1992) recruited twenty-five patients with chronic heart failure. They were randomised into two groups: a control group with 13 patients and a rehabilitation group of 12 patients. In the control group, 2 did not complete the study (cancer, cardiac transplantation). Tolerance was excellent (heart rate during sessions less than 115 bpm) and all functional parameters improved. Training did not modify the isotopic ejection fraction. The quality of life score increased respectively by 52% (p less than 0.0001 in comparison with the control group) and by 63% (p less than 0.0001); 80% of the patients requested that training be prolonged. The functional improvement obtained by purely peripheral effect had no adverse effect on the heart.

Randomised controlled clinical trials of exercise after myocardial infarction, although difficult to compare, have not shown a reduction in mortality or morbidity (Gulanick, 1991). However, physiological and psychological improvements do occur and these enable patients to improve their quality of life. The effectiveness of exercise programmes is impaired by poor patient compliance. Some characteristics of poor compliers may be identified, but it is safer to assume all participants are potential non-compliers, and to apply compliance-improving strategies within exercise programmes. Oldridge and Jones (1986) have indicated that a number of strategies may be followed at little cost. These include a spouse support programme, a written agreement to participate, self-control techniques including self-monitored exercise testing, and group discussion periods. Unfortunately, compliance with exercise training programmes is poor. Up to 50% of patients drop out of programmes before the end (Pell, 1997). Follow-up studies have reported that less than two thirds of patients attend more that 70% of sessions, and as few as 30% are still exercising after one year (Oldridge, 1988).

2.2.4.2 Multiple Session

The objectives of cardiac rehabilitation are multiple and include lowering mortality, increasing functional capacity, reducing disability and improving quality of life. While there is considerable support for exercise testing and training, there are also substantiated, and important, differences in their recommendations on the cardiac rehabilitation services, such as counselling and risk factor management. The challenge for the 1990's was not only to continue to better define the effectiveness of cardiac rehabilitation services, but more urgently, to deliver effective services most efficiently. This will help physicians to provide optimum care for their patients, improve the likelihood of patients regaining an active and productive life, and should generate a more equitable and accountable reimbursement system for quality health care (Oldridge, 1991).

Cardiac rehabilitation has emerged as an integral part of cardiovascular care and an important and exciting area of rehabilitation. Its future will depend on the maintenance of adequate funding sources, and demonstration that quality of life or cost/benefit assessments justify the continuance of such programmes. Physical activity will remain as the cornerstone of most programmes, but it must be integrated with other risk factor modification programmes. The practitioner of cardiac rehabilitation will need to recognise the appropriate application of risk factor modification (Dafoe, 1990).

Engblom et al. (1992) explored the effect of a three-phase comprehensive rehabilitation programme on the quality of life during the first postoperative year after coronary artery by-pass surgery. They studied 205 male patients randomly allocated into a cardiac rehabilitation (R) and a hospital-based treatment (H) group. The rehabilitation programme included physical exercise, relaxation training, psychological group sessions, dietary advice and discussions about post-operative treatment of coronary disease. There was no difference between R and H groups in the frequency of postoperative complaints, number of hospital admissions and satisfaction of sexual life. An almost significantly greater number of subjects in R group than in H group perceived their health as good 12 months after surgery. The Beck Depression Index score decreased significantly in R group but not in H group during follow-up. A greater increase in 'hobby' activities was observed in R group than in H group. More subjects in R group than in H group considered rehabilitation important for recovery. Patients in H group considered 'support by the spouse and family' as the most important factor, followed by 'subjective mental strength' as the next most important, followed by 'secure income'.

Pell (1997) stated that cardiac rehabilitation provides a means of modifying lifestyle and other risk factors in those presenting with established disease, thereby reducing the risk of subsequent coronary events and deaths. Despite advances in the investigation and treatment of angina and myocardial infarction, and increased knowledge of the factors associated with its development and progression, coronary heart disease remains the leading cause of death and morbidity in the majority of industrialised countries.

In addition to the category of the single and multiple sessions in the cardiac rehabilitation programme, Thompson et al. (1997) found that 23 (92%) of the programmes in England and Wales were hospital-based. Hospitalised patients with coronary heart disease who require rehabilitation are often provided with in-hospital cardiac teaching programmes, which aim to achieve lifestyle modification through health education. The focus of education is mainly concerned with the moderation of risk factors which, if adequately controlled, can assist in reducing patients' morbidity and mortality. These include smoking, hypertension, diabetes, elevated serum cholesterol and obesity.

Coats et al. (1990) studied the effects of physical training on patients who had suffered chronic heart failure. The results indicated that home-based physical training programmes are feasible even in severe chronic heart failure and have a beneficial effect on exercise tolerance, peak oxygen consumption, and symptoms. Unfortunately, home or community based cardiac rehabilitation programmes are not widely established as yet. The aim is to establish home or community based cardiac rehabilitation programmes in order to help people with coronary heart disease to gain long-term health care and a reduction in the mortality of coronary heart disease.

2.3 Health-Related Quality of Life

2.3.1 Quality of Life

Interest in quality of life (QOL) began in the 1960s when a number of sociological studies in the United States investigated life satisfaction (Abbey & Andrews, 1986). In the mid-seventies investigators became interested in the impact of various health states on the population. Quality of life has been measured for many different reasons: (a) to defend or dispute forms of therapy, (b) to choose between therapies, and (c) to identify reductions in life quality resulting from disease or treatment (Goodinson & Singleton, 1989).

Two main types of definitions of QOL are evident in the literature: one pertains to a global measure and the other to Health-Related Quality of Life (HRQOL). The global definition consists of either the patient's subjective well being or a global evaluation of the good or satisfactory character of the person's life. HRQOL means the evaluation of attributes that characterise one's life prior to illness (Padilla, Ferrell, Grant, & Rhiner, 1990).

Although the concept of quality of life is established, it's definition and measurement are neither clear, nor widely accepted. If health care providers are to be able to document effective outcomes resulting from their interventions, they must first develop clear conceptual definitions for the outcomes. After this, measures should be selected that enable these concepts to be examined empirically. A number of issues need to be addressed:

- Clarification of historical and conceptual arguments (factors) in favour of a particular definition of quality of life;
- Distinguishing between different quality of life concepts which are often confused in the literature (symptoms, mood, functional status, and general health status);
- Determining whether quality of life is actually amenable to change as a result of health care interventions.

However, traditional approaches to influencing quality of life may be misdirected. In particular, the relative importance of interventions to clients is often not considered fully (Anderson & Burckhardt, 1999). Clearly, an individual's opinion of 'their' quality of life should be considered and valued.

No one definition of quality of life, which is appropriate for both practice and research has become standard. Hornquist (1982) defined quality of life as the degree of need/satisfaction within the physical, psychological, social, activity, material and structural areas. He described a model in the shape of a spiral expressing the complicated interaction and overlapping that takes place when considering these needs and their satisfaction. He stated that there is no hierarchical order of needs and that needs within the six spheres are given different priority depending on circumstances. Haas (1999) effectively collected a variety of definitions of quality of life as shown in Table 2.2 (p.25).

Many researchers have defined quality of life in a variety of ways, including life satisfaction and the degree to which one has self-esteem, minimal anxiety, and purpose in life. However, for the purpose of this study, the definition proposed by Padilla and Grant (1985) is used. Encompassed within their definition are four main elements of quality of life: performance, personal attitudes and /or affective states, well-being, and support.

There is some agreement that the categories of behaviour affected by health are (1) physical function, (2) social function, (3) emotional function, (4) self-perception of health, and (5) well-being. Categories are sometimes added to examine domains such as pain level, cognitive function, and social opportunities. Health status and health--related quality of life are the terms commonly used for the behavioural dimensions of health (Jette & Downing, 1994).

Ware et al. (1981) briefly outlined a number of reasons for assessing health status. In particular, key reasons included the effectiveness of health care interventions and the improvement of provider decision making. Physical therapists often focus their goals on attained improved health status for their patients, stating desired long-term outcomes in terms of the physical, emotional, and cognitive performance of patients and their abilities to meet role expectations. Moreover, patients suffer their own health-related outcomes relating to morbidity and mortality. In addition, patients also suffer other outcomes concerning a self-perceived level of function, role limitation, sense of well-being, and life satisfaction. The patient's ultimate goal in seeking treatment and adhering to prescribed restorative, palliative, and preventive interventions is improvement in health status.

Table 2.2 Selected definitions of quality of life

Author	Definition
Calman, K.C. (1987)	Satisfaction, contentment, happiness, fulfillment, and the ability to cope … measure the difference, at a particular period of time, between the hopes and expectations of individual and individual's present experience.
Schipper, H., Clinch, J. and Powell, V. (1990)	The functional effect of an illness and its consequent therapy upon a patient, as perceived by the patient. Four broad domains include physical function, psychological state, social, and somatic sensation.
Ferrans, C.E. (1990)	A person's sense of well-being that stems from satisfaction or dissatisfaction with the areas of life that are important to him/her.
World Health Organization (1993)	An individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns ... affected in a complex way by the person's physical health, psychological state, level of independence, social relationships, and their relationships to salient features of their environment.
Meeberg, G.A. (1993)	A feeling of overall life satisfaction, as determined by the mentally alert individual whose life is being evaluated. Other people …must also agree that the individual's living conditions are adequate.
Mount; P.M., and Cohen, SR. (1995)	Subjective well being.
Ferrell, B.R. (1996)	A personal sense of well-being encompassing physical, psychological, social, and spiritual dimensions

Source: Haas, B. K. Clarification and integration of similar quality of life concepts. Image J Nurs Sch. 1999; 31(3):215-20.

The integration of aspects of health-related quality of life (QOL) into diagnosis, therapy and rehabilitation of patients with advanced coronary artery disease (CAD), especially with therapy - resistant angina pectoris, is important for two key reasons. First, restrictions in a patient's QOL often create a number of problems for the treating cardiologist which could be overcome by a more comprehensive psychosocially orientated intervention approach. Second, reduced QOL was shown to have a negative impact on the course of CAD and on survival. Both aspects are discussed with reference to current scientific evidence, including the study on effects of a comprehensive lifestyle change on QOL in CAD patients (Siegrist & Rugulies, 1997).

2.3.2 Theoretical Foundations for Health-Related Quality of Life

Quality of life is of central concern in evaluative research; improved quality of life is probably the most desirable outcome of all health care policies (Tod et al., 1998). However, definitions of quality of life are as numerous and inconsistent as the method of assessing QOL. The lack of a consensus definition of quality of life by means of taxonomy of definitions that emerge from the literature illustrates the point. Farquhar (1995) described and gave examples of four main types of definition which make up the taxonomy: global (type I); component (type II); focused (type III); and combination definitions (type IV). In addition, an outline of factors influencing the definition of quality of life is given and an alternative strategy for both defining and measuring the concept (the use of lay definitions) is suggested.

Rehabilitation professionals understand and respect the specific life goals of people with disabilities. Ultimately, rehabilitation efforts aim to facilitate participation in rehabilitation activities that can promote functional independence and lead to a better life quality. However, it is essential that practitioners and researchers use scientific studies to identify factors that contribute to their client's quality of life. Indeed, consideration should be give to a client's assumptions, perceptions, goals, and values. Both culturally relevant theoretical foundations and measurement methodology are essential for the development of valid and reliable life quality measuring tools for rehabilitation programme evaluation (Tam, 1998).

Two major theories or sets of theories - functionalism and positive well-being - underlie much conceptualisation and measurement of health-related quality of life. These theories are derived from anthropology, psychology, sociology, and other related fields.

2.3.2.1 Related Theories

(1) Functionalism

Functionalism was originally developed by Durkheim and Parsons (1953). According to the functionalist viewpoint, in studying any given society, it emphasised how its various 'parts,' or institutions, combine to give that society continuity over time (Giddens, 1997). Functionalism involves the analysis of social and cultural phenomena in terms of the functions they perform in a sociocultural system. In functionalism, society is viewed as a system of interrelated parts, in which no part can be understood if isolated from the whole (Patrick & Erickson, 1993).

The functionalist theory has significantly influenced the description of states for health indicators and indexes. As a result, descriptions of role functions have been developed in terms of performance and/or capacity. Performance descriptors are the actual behaviours of individuals - 'does not walk freely' or 'walks only with the help of an aid.' Capacity descriptors are the potential abilities of the individual - 'cannot walk freely' or 'can walk only with the help of an aid.' In addition, functionalist definitions of health focus on the 'major' social roles that people perform in societies. These roles encompass work, school, housework, and the independent performance of activities of daily living to care for one's personal needs. Such definitions implicitly operationalise the ideology and culture of our society (Guttmacher, 1983).

(2) Theories of Positive Well-Being and Quality of Life

Many researchers have attempted to define positive health and quality of life, often viewed as concepts and domains located on the upper end of the health-illness continuum. Many of these attempts have been in the mental health field, since mental or psychological well-being constructs are central to the notions of positive health. Models of psychological well-being guide the assessment of quality of life by exploring subjective reactions to life experiences (Diener, 1984).

A person with a chronic disease or impairment might have a high quality of life, avoiding depression and mastering independence or use of personal assistance. A person without disease or impairment might have a low quality of life, being depressed and dissatisfied with his or her situation. Theories of personality, self-concept, and subjective well-being are prominent among the growing number of investigators studying behavioural health or behavioural medicine (Matarazzo, Weiss, Herd, Miller, & Weiss, 1984). These theories are often used to explain health or illness behaviours. Such behaviours, in turn, can be viewed as an intermediate outcome or variable in a causal analysis of health-related quality of life outcomes.

(3) Maslow's Need Theory

Maslow's (1954) hierarchical need theory explains a person's need from a human developmental perspective. Maslow's theory holds two premises. The first premise of his theory is a person's inborn and organised needs. In hierarchy according to their priority and strength, the needs consist of five stages: basic physiological needs; safety and security needs; affections and belongingness needs; esteem needs; and the need for self-realization. Each need is explained as follows:

(a) 'The basic physiological needs' include basic survival needs, such as air, food, and water, which maintain a normal state of the body and blood stream;

(b) `The safety needs' are the needs that ensure survival by protecting oneself against physical harm and deprivation;

(c) The third need, `the affection and belongingness needs' include people's association or companionship for belonging to groups, and for giving and receiving friendship and affections;

(d) The fourth need, `the esteem need' includes the need for a stable and high evaluation of oneself, such as self-respect or self-esteem, derived from the awareness of one's importance to others;

(e) The last and highest need is `the self-actualisation need.' This need includes developing one's potential. In this level, the need refers to one's achievement of one's full potentialities.

The second premise of Maslow's need theory is that only needs not yet satisfied influence behaviour. A person is motivated to satisfy lower-order needs before higher-order needs. When the lower needs such as physiological needs are experienced as deficits, the behaviour is directed toward eliminating such deficits. When the lower needs such as physiological needs are met, a higher need such as safety and security needs - appears. That is, appearance of one need usually rests on the prior satisfaction of another, more pre-potent need (Maslow, 1954, p.370).

Maslow's etic or end-point theory related states of well-being to environmental or ecological systems. In this theory, subjective well-being results when individuals fulfil the needs at their particular levels such as physiological needs, safety needs, love needs, esteem needs, and self-actualisation needs (Maslow, 1943).

Even though the need theory is often cited in relation to quality of life research, little empirical evidence exists linking the constructs derived from this theory to health and quality of life. Along the lines of Maslow's theories, important needs include material, physical, psychological, social, and spiritual well-being as well as a sense of satisfaction with one's opportunity for access to the total environment, education and training, and employment. Little is known about the relationship of need satisfaction to other health-related quality of life outcomes.

Concepts of subjective well-being, however, are clearly consistent with the notion that quality of life can be defined as the performance of social roles and activities that people want to perform as well as the degree of satisfaction derived from performing them. The desire to become all that one is capable of becoming appears universal. Functionalism and theories of positive well-being are not the only theoretical examinations of what people mean by health and quality of life. Anthropologists, sociologists, and qualitative researchers from many different fields repeatedly discover that health and illness have particular meanings in different cultures, ethnic groups, and population groups within and outside a single country (Patrick & Erickson, 1993).

2.3.2.2 Related Conceptual Models

(1) Patrick and Erickson's Model

There are five broad health-related quality of life concepts: opportunity, health perceptions, functional states, impairments, and death or duration of life. This model is arranged with the concept and indicators of death and survival at the bottom and concepts, domains, and indicators of opportunity at the top as though placed on the value continuum from the least desirable to the most desirable (see Figure 2.1). Individual domains and indicators, however, cannot be easily located hierarchically on the value continuum of health-related quality of life ranging from minimal to maximal. Different levels of symptom severity may cover the entire range of the continuum. Combinations of domains and indicators, such as physical function and health perceptions, interact and can be considered as different levels of health-related quality of life. For example, minor symptoms may not affect psychological or social function, although major impairments and symptoms may cause profound psychological and social dysfunction. Perceived satisfaction with health may be low even though physical, psychological, and social function are high.

A health intervention such as a health promotion programme for older adults might affect both aspects of psychological function. Affective attitudes and behaviours are further subdivided into indicators of distress and happiness, because these positive and negative aspects of affect have been shown to be distinct from each other. Cognitive function is divided into general alertness,

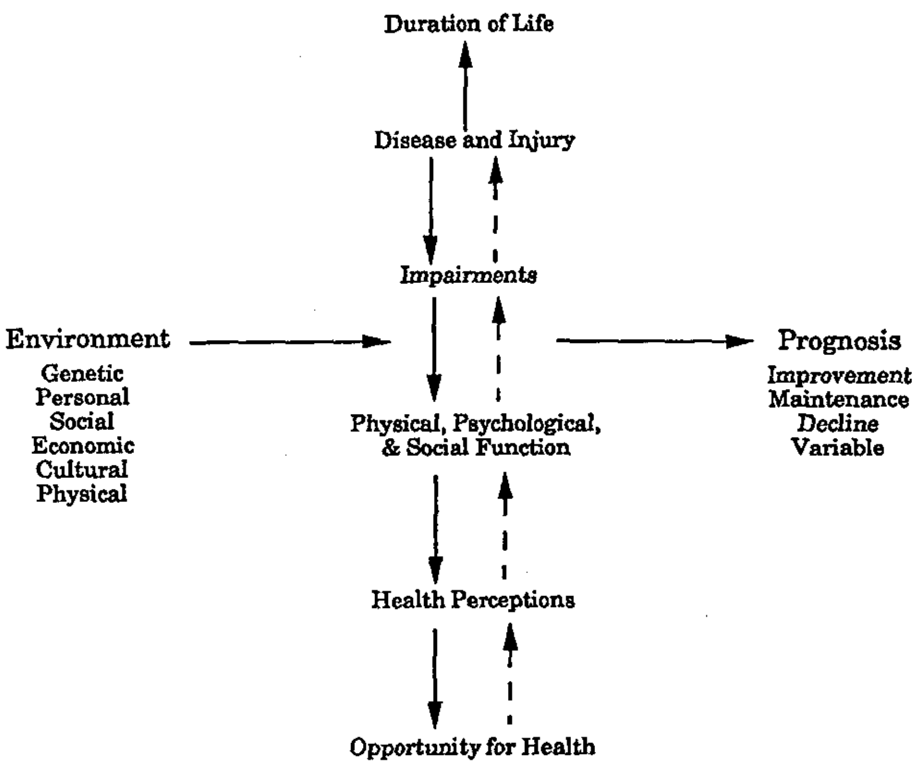


Figure 2.1 Theoretical relationships among health-related quality of life concepts.

Note: The solid arrows indicate a causal direction from disease through impairments to functional status, perceptions, and opportunity for health. This causal pathway is not a linear sequence; one may be impaired but not dysfunctional as with a cosmetic disfigurement. Disfigurement may, however, cause a lower perceived health status and reduced opportunity because of stigma. Thus, the sequence may be interrupted or incomplete. The dashed arrows indicate that this causal sequence may be reversed, e.g., reduced health perceptions may affect function. Disease and all its consequences are shown to influence duration of life. Source: Patrick and Bergner (1990)(1) Patrick and Erickson's conceptual relationship framework disorientation, and problems in reasoning. Reasoning problems would be those tasks included in a mental status examination. In a health promotion programme evaluation and assessment of the psychological function might involve affective attitudes and behaviours and cognitive functions as well as all indicators of these domains. Investigators planning primary data collection must choose those concepts, domains, and indicators that fit their assessment objective, health decision or problem, and resources.

(2) Ferrans Model

Conceptual clarity is extremely important. Differences in meaning can lead to profound differences in outcomes for research, clinical practice and the allocation of health care resources. In this research, Ferrans conceptual model of quality of life is developed based on the adoption of an individualistic ideology. This ideology recognises that quality of life depends on the unique experience of life for each person. Consistent with this ideology, quality of life is defined in terms of satisfaction with the aspects of life that is important to the individual. The model was developed using a qualitative methodology. Factor analysis of patient data was used to cluster related elements into domains of quality of life. The resulting model identifies four domains of quality of life: health and functioning, psychological/spiritual, social and economic, and family (see Figure 2.2). Subsequent cross-cultural work with African Americans and Mexican Americans has provided evidence that these elements of the model appropriately reflect quality of life for segments of the population not sampled in the original work. The Ferrans and Powers Quality of Life Index were developed using this model as its basis (Ferrans, 1996).

Bliley and Ferrans (1993) studied forty patients undergoing percutaneous transluminal coronary angioplasty (PTCA): data was collected from medical records, structured interviews, and mailed questionnaires. Perceived quality of life was assessed by using the Ferrans and Powers Quality of Life Index. Health-related quality of life was assessed in terms of cardiac symptoms, tolerance of physical activity, exercise capacity, perceived general health, return

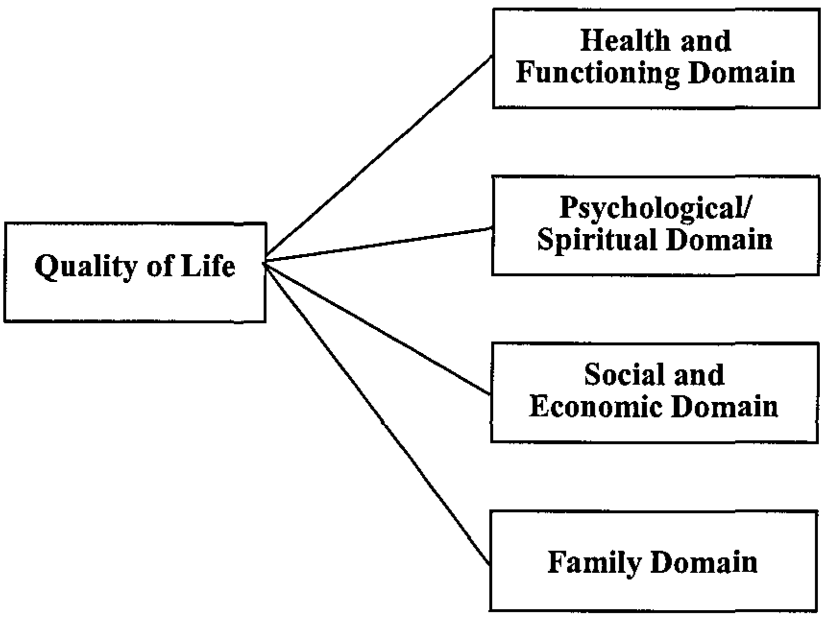


Figure 2.2 Ferrans conceptual model of quality of life
(Source: Ferrans, C. E. Development of a conceptual model of quality of life. Sch Inq Nurs Pract. 1996; 10(3): 293-304.)

to work, and lifestyle changes. The results show that perceived quality of life increased significantly due to increased satisfaction with health and functioning rather than change in other areas of life. Significant improvements were found in (1) cardiac symptoms (decreased incidence of chest pain and frequency of cardiac symptoms), (2) tolerance of physical activity (decrease in symptoms with activity, increase in distance able to walk, and decrease in interference with recreational activities because of symptoms), (3) treadmill tests and (4) perceived general health.

(3) Zanh's Model

Zhan (1992) defined quality of life as the degree to which a person's life experiences are satisfying. This concept is both multi-dimensional and context-related since human experiences are dynamic and complex. The conceptual model mainly includes personal background, social situation, culture, environment, health-related factors and age influence a person's perceptions of meaning and quality of life. Meaning arises from the transaction between the person and the environment. Therefore, quality of life cannot be measured purely by either an objective approach or a subjective approach. There are four important dimensions essential for an assessment of QOL: (a) life satisfaction; (b) self-concept; (c) health and functioning; and (d) socio-economic factors (see Figure 2.3, p. 35).

2.3.3 Conceptualisation of the Domains of Quality of Life

The domains of quality of life are defined in diverse ways depending on a researcher's approach. Based on Patrick and Erickson's conceptual model (1973) and related literature, the primary concepts of quality of life can be divided into health perceptions, functional status, impairment and opportunity. These are described in more detail in the following sections.

2.3.3.1 Health Perceptions

The concept of health perceptions implies that quality of life is a mixture of the individual's objective resources, behaviour, and affection, and of his or her subjective satisfaction with those resources, behaviours, and affection. Satisfaction is a measure of the extent to which an individual's needs or aspirations are fulfilled. Only a person with a need can experience the satisfaction of having that need met (Hornquist, 1982). Meanwhile, Najman and Levine (1981) stated that the satisfaction derived from activities, relationships, moods, or other states of being is a pivotal concept in health-related quality of life. The level of satisfaction illuminates how people behave, make choices,

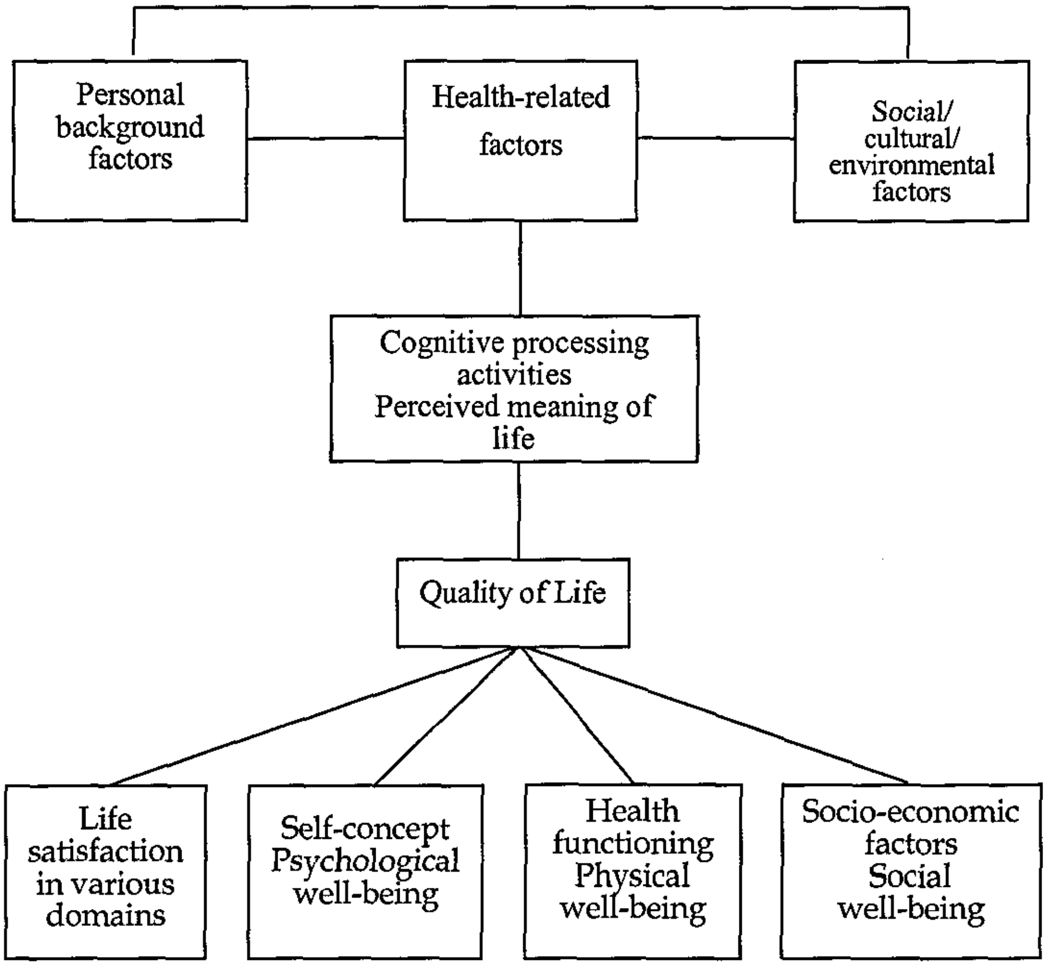


Figure 2.3 Zanh's conceptual model of quality of life
(Source: Zhan, L. Quality of life: conceptual and measurement issues. J Adv Nurs. 1992; 17(7): 795-800.)

communicate with professionals, follow treatment regimens, or accept the inevitable.

Researchers agree that the major needs of life include material, physical, psychological, social, and spiritual well-being. The individual must have a sense of satisfaction with personal access to the total environment, education, training, and employment. Little is known about the relationship of need satisfaction to other health-related quality of life outcomes. Some evidence suggests that lower levels of functional status are not necessarily correlated to lower levels of satisfaction (Patrick et al., 1988).

Campbell (1981) stated that there is no doubt that happiness and satisfaction have both commonalities and differences. According to Campbell (1981), satisfaction involves 'an act of judgment' and happiness involves the 'spontaneous lift-of-the-spirits'.

All three concepts have been distinguished by Stones and Kozma (1980): life satisfaction is 'gratification of an appropriate proportion of the major goals of life', happiness is 'an activity or state in the sphere of feelings', and morale is 'a moral condition as regards discipline and confidence'.

While these conceptual differences can be debated at length (George & Bearon, 1980), satisfaction can be viewed as a discrete and important domain of health-related quality of life. Satisfaction with health, however, has been a general health status concept proposed in several previous classifications of health outcome variables (Starfield, 1974).

Szalai (1980) points out that when someone asks, "How are you?" he or she is, in effect, asking for a personal judgment on your quality of life. Clearly, subjective judgments relating to life quality are made every day. This emphasises the saliency and importance of the concept of health perceptions, although how these overall evaluative judgments are made is not fully understood. For example, one person's evaluation may vary in different life situations; likewise, two people may evaluate a similar life situation in vastly different ways. Subjective judgments, however, capture both the personal evaluative nature of health and the more positive aspects of the quality of life.

2.3.3.2 Functional Status

Assessing the functional status of patients is becoming increasingly important in the evaluation of patient' outcomes following clinical interventions and in the quality assurance of the cardiac rehabilitation programmes. However, no current functional status measure quantifies all of the important domains affected by coronary artery disease.

A large number of measurement efforts focused on functioning in the physical, mental, and social areas of life. Ware (1987) recommends including physical, mental, social, and perceptual health measures in assessment efforts as a minimum standard for health measures claiming to be comprehensive.

(1) Physical Function

Inadequate physical activity is one of the most prevalent risk factors for ill-health in western industrialised societies (Jolliffe & Taylor, 1998). Therefore, physical function is crucially important for assessing the impact of chronic disease and for evaluating rapidly emerging technologies and their effects on the course and outcome of chronic diseases such as kidney ailments, chronic respiratory conditions, and cardiovascular disease. Measures of physical function can be classified into two domains: activity restrictions and fitness.

Physical function is usually used by general practitioners in obtaining a patient's healthy status or listening to accounts of the patient's problems so as to find appropriate treatment. In general, these disabilities include body movement (e.g., difficulty in walking or bending over), limitations in mobility (e.g., having to stay in bed or not being able to drive a car or use public transportation), or interference with self-care activities (e.g., bathing, dressing, or eating without assistance). The capacity to perform daily routines and tasks determines personal independence, a widely shared value in our society. Reduced ability to carry out these activities of daily living is also among the most frequently measured concepts of health and well-being in population studies (Katz & Akpom, 1976).

Fitness measures appraise muscular strength, cardiovascular endurance, flexibility, agility and the nature of physical activity. Fitness is prominent in health promotion efforts to improve the performance of activity with vigour and without excessive fatigue and further, it is increasingly used as a measure of health-related quality of life. Individual measures of fitness include such items as the ability to run the length of a football field, or the speed with which one can walk ten yards.

Measures of physical fitness are difficult to be relevant across entire populations as different norms apply to different age, sex, and disease groups. What defines physical fitness for a group of people disabled by coronary heart disease, for example, differs from that for non-disabled persons. By and large, physical activity measures such as those based on the work of Paffenbarger et al. (1986) are currently being developed to study the health effects of physical activity.

Bethell (1999) stated that exercise training increases aerobic fitness by both central and peripheral effects in normal subjects. Centrally, stroke volume, ejection fraction and rate, and force of contraction of the left ventricle increase in response to exercise. The heart beats more slowly and empties more completely with a greater reserve and higher potential cardiac output. There is also a reduction in central sympathetic tone and increase in red cell mass. Peripherally, there is a more efficient distribution of blood to the working muscles, and these muscles extract a greater percentage of the oxygen from their blood supply, so a lower blood flow is required to fuel any level of exertion. The same amount of activity can be performed for a lower blood flow and a lower cardiac output. These peripheral effects are specific to the muscles that have been trained.

Exercise has been the centre-piece of most cardiac rehabilitation programmes. It deserves this place as it contributes to both of the two aims of this treatment, to return the patient to good health as rapidly as is safe and to reduce to a minimum the risk of recurrence of the cardiac illness. However, there are considerable problems in providing exercise-based rehabilitation to all who need it or may benefit from it. In the United Kingdom probably less than 20% of eligible patients take part in cardiac rehabilitation programmes. A lack of funding is one undoubted reason for this low take-up. In addition, patient decision making to join the programme and adhere to the course may also influence attitude and participation in cardiac rehabilitation programmes (Bethell, 1999).

Worcester et al. (1993) explored whether a group programme of light exercise could improve quality of life in patients after acute myocardial infarction to the same extent as a high intensity exercise training programme. Physical working capacity based on metabolic equivalents achieved from treadmill exercise tests at entry, after 11 weeks and one year. Quality of life is based on self-report scores of anxiety, depression, and well-being, and interview assessments of activities and psychosocial adjustment at entry, after four months, and one year. The effects on quality of life of a low cost programme of light exercise are similar to those obtained from a high intensity exercise training programme (Ades, Huang, & Weaver, 1992).

(2) Psychological Function

The domains of psychological function mainly include two aspects: affective indicators (happiness, distress, morale, or positive affect) and cognitive aspects (alertness, confusion, or impaired thought and concentration). Both the affective and cognitive domains of health-related quality of life are crucial components as they are influenced significantly by disease processes and treatment and, in a reversal of causal direction, they may affect disease and treatment (Patrick & Erickson, 1993).

Cardiac rehabilitation programmes increasingly attempt to improve both quantity and quality of life (QOL). Documenting QOL changes requires appropriate instruments, and interpreting QOL data requires an understanding of the factors that influence such reports. Engebretson et al. (1999) assessed QOL among 77 patients before and after participation in a 12-wk phase II cardiac rehabilitation programme. Individual psychological differences in trait anxiety and defensiveness were also assessed. The sample was 76.6% male, 70.1% married, and had a mean age of 58.8 yr. QOL reports were strongly and differentially influenced by individual differences in trait anxiety, such that patients reporting high trait anxiety displayed poorer QOL than those low in trait anxiety. More specifically, trait anxiety influenced reports most strongly, functional aspects moderately, and physical aspects of QOL reported the least. Defensiveness was unrelated to QOL reports. The 17% of participants who voluntarily left the rehabilitation programme prematurely were characterised as younger, having better self-perceived health, having a less severe cardiac history, and being high in both trait anxiety and defensiveness.

Oldridge et al. (1991) investigated the impact of a brief period of cardiac rehabilitation, initiated within 6 weeks of acute myocardial infarction (AMI), on both disease- specific and generic health-related quality of life, exercise tolerance and return to work after AMI. With a stratified, parallel group design, 201 low-risk patients with evidence of depression or anxiety, or both, after AMI, were randomised to either an 8-week programme of exercise conditioning and behavioural counselling or to conventional care. Although the differences were small, significantly greater improvement was seen in rehabilitation group patients at 8 weeks in the emotions dimension of a new disease-specific, health-related Quality of Life Questionnaire, in their state of anxiety and in exercise tolerance. All measures of health-related quality of life in both groups improved significantly over the 12 month follow-up period.

A randomised trial using controls tested whether psycho-social rehabilitation of acute myocardial infarction (MI) patients would significantly improve their return to work rate. The trial also assessed the importance of various psychological, social, occupational, socio-demographic, and medical factors in facilitating or impeding rapid return to work. The findings suggest that rehabilitation programmes intervening on multiple levels (psychological, social, occupational, and physical) may best meet the needs of chronically ill cardiac patients. Results indicate that implementing measures addressing the patient's general psycho-social adjustment to MI may improve existing programmes (Burgess et al., 1987).

(a) Affective Functioning

Psychological distress and well-being have been usefully distinguished in theory (Veit & Ware, 1982). The relationship between positive and negative indicators, however, is not quite clarified. Numerous scales have been developed to measure psychological dysfunction and distress, particularly depression and anxiety (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961).

The findings from the Medical Outcomes Study (Wells et al., 1989) indicate that patients with either current depressive disorder or depressive symptoms tend to have lower physical, social, and role functioning. They also have lower perceived health and greater pain than patients with no chronic conditions. These findings underscore the importance of assessing depression, even when depressive disorder is not present. Depressive symptoms and chronic medical conditions interact, resulting in poor functional status.

Numerous attempts have been made to measure happiness or the more positive aspects of affective function (Bradburn, 1969). Striking differences exist in comparing the response distributions from different countries. Ratings of happiness tend to be lower in developing countries than in industrialised nations: happiness is the highest in the Netherlands and lowest in India (Ouweneel & Veenhoven, 1989). Explanations for these differences include cultural bias, that is, the questions have different meanings in different countries. Variation in social quality concerning questions reflecting real differences in the life quality in different nations may also be important.

(b) Cognitive Functioning

Cognitive functioning is also a major component of psychological well-being. For example, advanced congestive heart failure may decrease cerebral blood flow and metabolism, thereby producing confusion and difficulty in judgment or reasoning. Clinicians may observe impaired thought and concentration in many patients, particularly elderly ones, because of a wide variety of cerebral processes or therapies. Memory and the ability to carry out intellectual tasks are of great importance to many people. The loss of cognitive function because of a treatment or disease can produce great psychological distress (Patrick et al., 1988).

Mental functioning can be assessed using unstructured (mental-status examinations) administered by clinicians, semi-structured interviews that permit scores to be derived from responses of the subjects and observations of the interviewer, self-completed questionnaires, observer ratings, and formal psychological tests (Kane & Kane, 1981).

The relationship between affective and cognitive measures of psychological well-being is not well understood. In older adults, cognitive and affective function may be particularly hard to distinguish, because the two constructs overlap. The relationship between cognitive and social function may also be difficult to separate operationally, because both mental status and social function are products of the environment. Thus, measures of affective and cognitive function are commonly used in conjunction with measures of social functioning or well-being (Patrick et al., 1988).

(3) Social Function

Social well-being in its broadest sense can be both a component and a determinant of a person's quality of life, which has been operationalised in diverse ways. It is difficult to provide an exact operational definition for the social domain without evaluating the individual's external environment. In a broader view, social well-being can be derived from individual perceptions, motivations, attitudes, and behaviours and from circumstances external to the individual. These may include aspects of quality of life that may or may not be related to health, such as community life, physical environment, transportation, and financial resources (Patrick & Erickson, 1993).

Social well-being can also be defined in reference to social relationships. Thoits (1982) notes the following: quantity of connections (number of people in the network), quality (having people one feels close to or can trust), utilization (actually spending time with people), meaning (the importance of social relationships), availability (having people or animals there when needed), and satisfaction. Little consistency exists in the way these concepts have been measured and interpreted by different researchers and analysts (Bruhn & Philips, 1984).

Patrick and Erickson (1993) stated that despite this conceptual confusion, social function remains an important concept in assessing health-related quality of life. There are four types of social functioning - limitations in usual social roles, social integration, social contact, and intimacy. These important domains are described below.

(1) Limitations in usual roles or major activity: social role identification and major activity are classified according to a person's participation in daily activities in the workplace, in the household, or at school. The usual social roles such as holding a job, going to school, parenting, managing a house, engaging in leisure pursuits, or maintaining relationships with friends are important to most people. Active participation in the community through membership in social, civic, political, or religious organisations is highly important to quality of life. Social participation may also confer a high degree of emotional well-being, particularly for people who do not have close family or friendship ties.

(2) Social integration: social ties provide psychosocial and instrumental support to people with disabilities, which may be particularly important influences on survival, on recovery, on the course of disease, and on other health outcomes (Kasl, 1983). Therefore, social support is a predictor of social well-being, along with other aspects of health-related quality of life.

(3) Social contact: the frequency of visits with friends or relatives, the number of meetings and community activities attended, or types of social interaction are another recognised component of social well-being (Donald & Ware, 1982). Social isolation and feelings of loneliness are particularly important for seriously ill persons. The social isolation items consist of five statements concerning contact, social relationships, intimacy, loneliness, and feelings of boredom. Family support programmes such as transplant groups and individual counselling are interventions designed to address the social isolation of seriously impaired persons.

(4) Intimacy: some people in an individual's network may provide a feeling of closeness and trust. Such intimacy can be an important determinant of emotional well-being in patients facing serious illness or death. Sexual function and dysfunction are also important concepts of social functioning.

Westin et al. (1997) assessed quality of life in patients after acute myocardial infarction (AMI), coronary artery by-pass grafting surgery (CABG) and percutaneous transluminal coronary angioplasty (PTCA) as compared with healthy controls. Self-administered questionnaires were completed 1 month and 1 year after the event. Quality of life in the dimensions of: (1) perceived general health, (2) thoracic pain, (3) breathlessness, (4) feeling of arrhythmia, (5) anxiety, (6) depression, (7) self-esteem, (8) experience of social life, and (9) sex life were included in the questionnaire.

The findings of Westin et al. (1997) indicated that the patients differed from the controls in both psychological and somatic aspects of QOL after 1 month. Furthermore, 1 month after the event AMI patients experienced more anxiety ($P = 0.001$) than CABG patients, whilst CABG patients experienced a poorer sex life ($P < 0.001$) than AMI patients. Quality of life is considerably affected in patients following a cardiac event, especially during the initial recovery phase. Although substantial improvement in quality of life occurs over time, the persistence of residual distress at 1-year follow-up is a challenge for clinicians concerned with the full rehabilitation of the cardiac patient.

2.3.3.3 Impairment

People with severe physical, mental, or emotional impairments are frequently restricted in their work. They may engage in meaningful activity, learn, and attend to daily activities possibly within a supported environment (Patrick et al., 1988). The concept of impairment includes the most familiar category of morbidity, for example, the number of sick persons or cases of disease in relationship to a specific population. Thus, impairment is at the centre of the professional appraisal of the presence or absence of abnormalities within the individual. These abnormalities may be present at birth or acquired later through pathologic processes or injury. Six impairment components can be distinguished: symptom or subjective complaints, signs, self-reports of disease, physiological measures, tissue alterations, and diagnoses (Patrick et al., 1988). The relative emphasis placed on each type depends on the health decision under investigation, on the assessment objectives and on how the evidence is obtained.

2.3.3.4 Opportunity

Opportunity is integral to many definitions of life quality, this is defined as the potential for an optimal state for health or "being all that one can be." (Patrick & Erickson, 1993, p.103). Calman (1987) suggests that quality of life is the difference between the hopes and expectations of the individual and individual's present experience. In other words, quality of life is an assessment of potential for growth or improvement.

2.4 Measurement of Health-Related Quality of Life

All measurement processes include assumptions about the nature and value of the constructs used in the measurement, yet the role of theory in developing health-related quality of life measures and in interpreting data is often neglected (Patrick & Guttmacher, 1983). In fact, theory guides implicitly or explicitly the selection of content and the measurement process. Even though users and analysts may not identify a particular theory or set of theories in selecting the concepts and domains to be included in the measurement of health-related life quality, the choice itself reflects the investigator's ideological and cultural notions and those of the society in which he or she lives.

The measurement operations used to assign numbers to concepts and domains of health-related quality of life also reflect theoretical assumptions. Measurement theories differ on how the nature of the phenomena under investigation is perceived and on how numbers are assigned to constructs using specific rules. As a result of these theoretical differences in conceptualisation and measurement, different measurement strategies and instruments may yield different data and conclusions. Consequently, patients, providers, analysts and decision makers make different conclusions and take different actions.

O'Connor et al. (1989) for example published a meta-analysis of randomised trials of cardiac rehabilitation that included an exercise component following myocardial infarction. The meta-analysis was performed because small numbers of subjects in previously published trials had perpetuated questions about the value of cardiac rehabilitation in terms of reduction in total and cardiovascular mortality, sudden death, and fatal and nonfatal reinfarctions.

These trials had examined outcomes based on the traditional biomedical definition of health as the absence of pathology. Most importantly, inclusion of health status measures in these trials could have provided a very different assessment of the value of the intervention.

In measuring health-related quality of life, analysts use constructs or theoretical ideas based on observations of what we cannot observe directly. Different kinds of health-related quality of life constructs are domains that distinguish different ideas or concepts into groups. Finally, the measurement operations result in a set of indicators of these constructs that reveal the presence, absence or degree of health-related quality of life.

Quality of life assessment is increasingly acknowledged as an important component in selecting optimal health interventions for persons with cardiovascular disease. Dempster and Donnelly (2000) suggested that a major aspect of service evaluation and development is the assessment of the nature and extent to which an intervention or treatment impacts on a patient's illness or condition as well as on their quality of life. They also noted that instruments designed to measure health-related quality of life (HRQOL) could be divided into two categories - generic or disease-specific:

- Generic measures provide a broad assessment of the health status of an individual and allow comparisons of HRQOL between groups of patients with different conditions. Often, these instruments are used to monitor progress and to assist in the distribution of resources.

- Disease-specific instruments are designed to measure HRQOL by tapping those areas of life which may be affected by a specific condition or illness. These instruments are narrow in focus.

These diseases specific instruments have a number of advantages over their generic counterparts. Firstly, disease-specific instruments comprise domains or areas which are related closely to the areas of life explored by clinicians.

Secondly, disease-specific instruments tend to be more sensitive to detecting change in health status than generic instruments.

Valenti et al. (1996) reported the use of an improved self-administered questionnaire for assessing quality of life (QOL) after acute myocardial infarction. The modified questionnaire significantly increased the proportion of patients able to answer all questions from 84%-92%. The additional questions in the improved questionnaire increased the total variance explained by the Emotional, Physical and Social QOL factors from 65.8%-66.5%. Internal consistency and construct validity were assessed and found to be high. Overall, the result found that this improved questionnaire was easy to administer and that it possesses desirable properties of validity and reliability.

Many studies claim that cardiac outpatients have the same perception of what comprises quality of life as do their health care providers (Arvan, 1988; Fletcher, 1998; Jette & Downing, 1994; McGirr, Rukhom, Salmoni, O'Sullivan, & Koren, 1990). However, in Woodend et al.'s (1997) survey, the result indicated that the list of items was compiled from all quality of life measures and quality of life research. Staff members, cardiac out-patients and family members were asked what they considered important to the patients' quality of life by rating the relative importance of each item on the list. Of the top ten items ranked by patients, only three items appeared on the staff top ten list, and five on the family, member's list. The patients, in contrast with staff and family chose aspects of QOL that reflected the positive aspects of life. These differences were more marked in the physical, psychological, and activity domains than in the social domain. Therefore, QOL measures developed from the perspective of primary caregivers do not accurately reflect the thinking of the patients.

Dempster and Donnelly (2000) used MEDLINE and BIDS to search for research papers which contained a report of at least one of the three most common generic instruments or at least one of the five disease-specific instruments used with ischaemic heart disease patients. Evidence for the validity, reliability, and sensitivity of these instruments was critically appraised. It was found that of the three generic measures - the Nottingham Health Profile, Sickness Impact Profile, and Short Form 36 (SF-36) - the SF-36 appears to offer the most reliable, valid, and sensitive assessment of quality of life (Brazier et al., 1992; Smith, Taylor, & Mitchell, 2000). However, a few of the SF-36 subscales lacked a sufficient degree of sensitivity to detect change in a patient's clinical condition. Therefore, according to the evidence, the quality of life after myocardial infarction questionnaire should be used rather than the Seattle angina questionnaire, the quality of life index cardiac version, the angina pectoris quality of life questionnaire, and the summary index.

Overall, research on disease-specific measures is limited compared to the number of studies which have investigated generic measures. An assessment of the quality of life of people with coronary heart disease should comprise a disease-specific measure in addition to a generic measure. The SF-36 and the quality of life after myocardial infarction questionnaire (version 2) are the most appropriate currently available generic and disease-specific measures of health -related quality of life, respectively. Further research into the measurement of health-related quality of life of people with ischaemic heart disease is required in order to address the problems (such as lack of sensitivity to detect change) identified by this review.

2.4.1 Generic Measures

2.4.1.1 Medical Outcomes Study 36-Item Short Form Health Survey

The SF-36 is a short questionnaire with 36 items which measure eight multi-item variables: physical functioning (10 items), social functioning (2 items), role limitations due to physical problems (4 items), role limitations due to emotional problems (3 items), mental health (5 items), energy and vitality (4 items), pain (2 items), and general perception of health (5 items). There is a further unsealed single item on changes in respondents' health over the past year. For each variable item scores are coded, summed, and transformed on to a scale from 0 (worst possible health state measured by the questionnaire) to 100 (best possible health state). Minor modifications to the wording of six items on the SF-36 (see Appendix 1) were made to make it acceptable to British subjects. The changes are similar to those reported in the Sheffield study (Brazier et al., 1992).

Past studies suggest that the Medical Outcomes Study (MOS) SF36 is a useful instrument for assessing health outcomes. Although it is being promoted for use in general practice, it is important first to examine its reliability in this setting. In particular, Lin and Ward (1998) used a consecutive sample of 64 adult patients. The patients were asked to complete on separate occasions identical questionnaires containing the (MOS) SF36. A 66% response rate was achieved for both Time 1 and Time 2 surveys. This resulted in 64 paired questionnaires with high completion rates (95-100%). The results demonstrated high internal consistency for both tests (Cronbach's $\alpha > 0.87$). The reliability coefficients ranged from 0.59 to 0.89 across scales. This study provides support for the psychometric stability of the (MOS) SF36 as a quality of life measure for patients in general practice. However, a larger study is required to establish much needed normative ranges for self-administered instruments in general practice.

Lalonde et al. (1999) conducted a cross-sectional survey (n = 878) to compare the psychometric properties of three preference-based and one nonpreference-based health-related quality of life measures among healthy subjects, with and without treatment for dyslipidemia and/or hypertension and patients with coronary heart disease (CHD). All measures were stable over a 3 to 6 week period. Compared to the Time Trade-off (TTO) and the Standard Gamble (SG), the Rating Scale (RS) was the best correlation with the SF-36 Health Survey.

In contrast to the SF-36 General Health Perception (GHP), the SF-36 Physical Component scale and the RS, the TTO and SG were less able to discriminate CHD patients with various levels of physical disability. Only the SF-36 GHP subscale and the RS were able to differentiate healthy participants from participants receiving dyslipidemia and/or hypertension treatment. Neither the SF-36 Physical nor the Mental Component scales were able to discriminate these two groups. Overall, these results suggest that unlike the RS, the TTO and the SG, as administered in this study, they may not be sufficiently sensitive to measure the impact of primary cardiovascular disease prevention strategies on the health-related quality of life of the participants.

The goal of health care for individuals with chronic disease is the improvement of function and well-being. The individual's perception of his or her quality of life may be the best indicator of the achievement of this goal. Measurement of self-perceived quality of life, or health status, is not a routine component of evaluation. Jette and Downing (1994) conducted research to investigate the health status of individuals upon entry into a cardiac rehabilitation programme and to demonstrate the use of a comprehensive, generic health status measure in this group. They recruited 789 men and women participating in one of 13 cardiac rehabilitation programmes in the state of Massachusetts. As part of a large database, subjects completed a 36 item generic questionnaire, Short Form 36 (SF-36), which examines eight health concepts. Scores range from 0% to 100%; a higher score is consistent with better health status. Mean uncontrolled scores ranged from 26.6 to 70.8. Mean scores adjusted for sex, age, and education ranged from 27.1 to 70.9. In light of previously published data using a similar 20-item scale, Jette and Downing's (1994) results show that cardiac disease is associated with reductions in health-related quality of life. Health status measurement provides information that can supplement the usual measures of impairment in patients with cardiovascular disease. The findings of this study contribute to the understanding of the health status of individuals who enrol in cardiac rehabilitation programmes. The health status instrument used in this study has potential as a useful and practical measurement tool for use in the clinical setting.

2.4.1.2 Sickness Impact Profile Study

Bergner et al. (1981) modified the Sickness Impact Profile (SIP) which is a behaviourally based measure of health status. The SIP contains 136 items in 12 categories. The relationship between the SIP and criterion measures was moderate to high and in the direction hypothesised. A technique for describing and assessing similarities and differences among groups was developed using profile and pattern analysis.

The SIP comprises of 136 items grouped into 12 scales: sleep and rest, eating, work, home management, recreation and pastimes, ambulation, mobility, body care and movement, social interaction, alertness behaviour, emotional behaviour, and communication.

Dempster and Donnelly (2000) used cluster and factor analytical techniques. Three of these categories were further aggregated into a physical dimension (ambulation, mobility, and body care and movement) and four others into a psychosocial dimension (social interaction, alertness behaviour, emotional behaviour, and communication). The other five dimensions cannot be grouped in a coherent manner but an overall score for the SIP can be obtained. The author also indicated that the total SIP score appear to be responsive to changes in patients' health status after surgery but were not responsive to changes over time post-MI. The available evidence suggests that the SIP should not be separated into 12 scales but should be used to obtain a total score or scores for the physical and psychosocial dimensions when used in either discriminative or evaluative studies among patients with ischaemic heart disease.

2.4.1.3 Nottingham Health Profile

The instrument of the NHP is divided into two parts: the first part, requires a 'yes' or 'no' response to 38 statements. These are grouped into six scales: mobility, pain, energy, sleep, emotional reactions, and social isolation. In the second part, NHP investigates the effects of health on seven areas of daily life:

(1) work, (2) looking after the home, (3) social life, (4) home life, (5) sex life, (6) interests and hobbies, (7) holidays. The NHP is brief and can be administered quickly because of the limited response choices.

Rehabilitation is an important part of the treatment of patients with ischemic heart disease. Therefore, many patients undergoing coronary artery by-pass surgery (CABS) also participate in cardiac rehabilitation programmes. Engblom et al. (1997) investigated whether rehabilitation influences quality of life and work status after CABG. The Nottingham Health Profile also measures perceived distress. A cardiac rehabilitation programme in conjunction with usual medical care after CABG may induce a perception of improved health. The influence on return to work is limited.

Lukkarinen and Hentinen (1997) assessed quality of life with the Nottingham Health Profile among patients with coronary heart disease. The patients who participated in this study were seriously ill, as nearly half of them had three or more stenosed coronary arteries. There were more male patients in the by-pass surgery group and female patients in the angioplasty group. The quality of life was evaluated using the Nottingham Health Profile (NHP) instrument in relation to an age and sex-matched general population, the background factors and the severity of the coronary disease.

The health-related quality of life of coronary patients before the invasive procedures was significantly poorer on all the six dimensions than the quality of life in an age and sex-matched general population. The most obvious differences were seen on the following dimensions: energy, pain, emotional reactions, sleep and physical mobility. The smallest differences occurred in social isolation. Both males and females had the lowest value for energy and social isolation in the youngest age group (35-54 years). The index values of emotional reactions in the two youngest groups were significantly higher among females than males, which reflects poor quality of life.

The women in the age group between 35-54 years found the manifestation of a serious disease extremely hard to face. The research findings clearly suggest that while choosing the mode of treatment, the patient's quality of life should be considered along with the clinical severity of the disease, especially in the case of young women. From the societal and social points of view, the patient's symptoms and quality of life are even more important than the objective medical outcome. In clinical decision-making, the goal is to integrate the results of health-related quality of life assessments with clinical decisions, and this underlines the need to evaluate whether the treatment given is congruent with the patient's quality of life. On the basis of the present findings, the NHP instrument seems to be applicable to quality of life measurements among coronary patients. It does not, however, necessarily give an accurate and conclusive view of an individual's overall quality of life.

In summary, the NHP may be used to track large changes in health status such as pre- to post- cardiac surgery but does not appear to be sensitive to smaller changes within groups. In particular, some scales, such as emotion, appear to have weak validity.

2.4.1.4 Comparison Among Generic Measures of Quality of Life

As an evaluative tool in the field of heart disease, the mental health and general health scales do not appear to be responsive to change, and the role emotional and role physical scales are prone to ceiling effects. These scales may not measure specific changes that a patient with heart disease experiences as his/her condition improves or deteriorates. Therefore, results obtained from these four scales should be interpreted with caution.

In terms of assessing whether or not patients have a severe health problem, the NHP is a useful survey tool to use. However, as already indicated, it does not provide a comprehensive measure of health-related quality of life.

The first part of the NHP has been used in many studies and the result of the second part has relatively little psychometric work. Dempster and Donnelly (2000) pointed out that the ability of the NHP scales to discriminate between the clinical classes of angina is inconsistent. This inconsistency may be because the clinical classification systems are not highly regarded as criterion measures. In addition, results are also inconsistent regarding the ability of the NHP to discriminate between people with heart disease and healthy people.

2.4.2 Disease-Specific Measures

2.4.2.1 Quality of Life After Myocardial Infarction Questionnaire

The 26 items on the QLMI questionnaire are grouped into five domains: symptoms, restriction, confidence, self-esteem, and emotion. Recently, assessments of the psychometric properties and a refinement of the content of the QLMI have been conducted. The refined questionnaire (comprising the QLMI with two original questions removed and three new questions added) is known as the QLMI-2 and groups 27 items into three domains: emotional, physical, and social. The QLMI-2 appears to have better psychometric properties than the original QLMI, as the domains of the QLMI-2 have higher internal consistency estimates and are based on factor analysis. However, the evaluative properties of the QLMI-2 have yet to be investigated. Most of the QLMI domains have a moderate to strong evaluative dimension, submitting high estimates of test-retest reliability and moderate to high responsiveness indices. As there is little difference in the content of the QLMI and the QLMI-2, it is likely that the QLMI-2 would be at least equally as useful as the QLMI in evaluative studies (Dempster & Donnelly, 2000).

2.4.2.2 Multidimensional Index of Life Quality

Avis et al. (1996) set out to design a multidimensional measure of health-related quality of life appropriate for patients with cardiovascular disease that was psychometrically sound, brief, and easy to administer. Qualitative interviews conducted with healthy subjects and patients with cardiovascular diseases identified nine major quality of life domains. Based on the responses of 129 cardiovascular disease patients recruited from hospitals and clinics, a criteria-based approach was used to select 35 questionnaire items that best tapped these domains.

Psychometric properties of the Multidimensional Index of Life Quality (MILQ) were tested with a sample of 348 patients with various cardiovascular diseases. Cronbach's alpha was 0.76 or higher for eight of the nine MILQ domains. Test-retest reliability coefficients were 0.73 or greater in all but two domains. Individual domain scores as well as a weighted overall quality of life index were correlated highly with self-assessed health and the number of heart-related symptoms. These results give rise to the conclusion that the MILQ is a psychometrically reliable and valid instrument for measuring quality of life in patients with cardiovascular diseases.

Lim et al. (1993) modified the Quality-of-Life after the Myocardial Infarction (QLMI) questionnaire developed by Oldridge (1988) and used a self-administered mode to patients with suspected acute myocardial infarction (AMI) in a randomised controlled trial of secondary prevention. Acceptability of the questionnaire was good, with 93% of responders answering all items. Factor analysis suggested three quality-of-life (QOL) dimensions: emotional, physical and social. These differed somewhat from the dimensions proposed by Oldridge and colleagues (Oldridge & Jones, 1986).

However, a sensitivity analysis showed relative invariance of results to weighting schemes. Scores on the three dimensions were responsive to differences between the treatment groups, and demonstrated construct validity based on associations between the measured QOL and variables expected to affect QOL. The researchers concluded that the QLMI questionnaire has the potential as an instrument for assessing QOL in post-AMI patients and that it can be successfully self-administered.

Hillers et al. (1994) developed a questionnaire to measure health-related quality of life for patients after myocardial infarction (MI). In a cross-sectional survey, 63 patients identified the most frequently occurring and important problems following acute myocardial infarction. The QLMI instrument was developed on the basis of these most frequent and important problems. The QLMI was administered, along with instruments measuring health utilities, social function, and emotional function, in a randomised trial of rehabilitation versus conventional care.

The most frequent and important problems fell into areas of symptoms, restriction, confidence, self-esteem, and emotions, each of which is represented in the 26-item QLMI. Effect sizes of the overall QLMI in differentiating between rehabilitation and control groups, and in detecting improvement over 12 months were comparable or larger than any other instrument. The QLMI demonstrates a high degree of reliability, and is more responsive than other questionnaires. Relations between the QLMI and other measures provide moderate to strong evidence of its validity in discriminating between patients following AMI according to their health-related quality of life, and in measuring changes in health-related quality of life over time.

2.4.3 Other Instruments of Quality of Life

Many measures of quality of life present patients with predetermined lists of questions that may or may not be relevant to the individual patient. Hickey et al. (1996) used the SEIQoL-DW, which is derived from the schedule for evaluation of individual quality of life (SEIQoL). The measure allows respondents to nominate the areas of life which are most important, rate their level of functioning or satisfaction with each, and indicate the relative importance of each to their overall quality of life. Given its practicality and brevity, the measure should prove particularly useful in clinical situations where patient generated data on quality of life is important.

Spertus et al. (1995) studied the validity, reproducibility and responsiveness of the Seattle Angina Questionnaire, a 19-item self-administered questionnaire measuring five dimensions of coronary artery disease: (1) physical limitation, (2) anginal stability, (3) anginal frequency, (4) treatment satisfaction and (5) disease perception. All five scales correlated significantly with other measures of diagnosis and patient function. The questionnaire responses of patients with stable coronary artery disease did not change over three months. These results demonstrate that the Seattle Angina Questionnaire is a valid and reliable instrument that measures five clinically important dimensions of health in patients with coronary artery disease. Indeed, it is sensitive to clinical change and therefore is a valuable measure of outcome in cardiovascular research.

2.5 Concluding Remarks

A cardiac rehabilitation programme provides appropriate education, counselling, exercise and behaviour change in order to improve a patient's quality of life and health status. Many researchers have defined quality of life in a variety of ways, including life satisfaction and the degree to which one has self-esteem, minimal anxiety, and purpose in life. There are some agreements from previous studies that the categories of behaviour affected by health are (1) physical function, (2) social function, (3) emotional function, (4) self-perception of health, and (5) well-being. In addition, in Patrick and Erickson's (1993) study, the conceptual model includes the primary concepts of impairment, functional status, health perception, and opportunity.

The measurement of health-related quality of life (HRQOL) can be divided into two categories - generic or disease-specific. Generic measures provide a broad assessment of the health status of an individual and allow comparisons of HRQOL between groups of patients with different conditions such as the instruments of SF-36, SIP and NHP. Disease-specific instruments are designed to measure HRQOL by tapping those areas of life which may be affected by a specific condition or illness such as QLMI, SAQ. The summarised contents of these instruments for health-related quality of life are shown in Table 2.3.

Table 2.3 Contents of the instruments for health-related quality of life

Instrument	Domains Examined	Length	Administrator
Sickness Impact Profile (SIP)	Physical: ambulation, mobility, body care Psychosocial: social interaction, communication, alertness, emotional behaviour Other: sleep/rest, eating, work, home management, recreational pastimes	136 items	Self or interviewer (30 min)
Nottingham Health Profile (NHP)	Six domains of experience: pain; physical mobility, sleep, emotional reactions, energy, social isolation Seven domains of daily life: employment, household work, relationships, personal life, sex, hobbies, vacations	45 items	Self-administered (10 min)
Short Form 36 Survey (SF-36)	Nine domains of physical functioning, social functioning, role limitations due to physical problems, role limitations due to motional problems, mental health, energy/fatigue, bodily pain, and general health perception	36 items	Self-administered (10 min)
MacNew Quality of Life after Myocardial Infarction(QLMI)	Three domains:emotional, physical and social including Frustrated, Worthless, Confident, Down in the dumps, Relaxed, Worn Out, Happy with Personal Life, Restless, Short of Breath, Tearful, More Dependent, Social Activities, Others/less Confidence in you, Chest Pain, Lack Self-Confidence, Aching Legs, Sports/Exercise Limited, Frightened, Dizzy/Lightheaded, Restricted or Limited, Unsure about Exercise, Overprotective Family, Burden on Others, Excluded, Unable to socialize, Physically Restricted, Sexual Intercourse.	27 items	Self administered (15 min)
McMaster Health Index Questionnaire(MHIQ)	Physical: mobility, self-care, communication, and global physical functioning Social: general well-being, work/social role performance, social support and participation, and global social function Emotional: self-esteem, findings about personal relationships and the future, critical life events, and global emotional functioning	59 items	Self administered (20 min)
Psychological General Well-being Index (PGWg)	Six dimensions: freedom from bodily distress, life satisfaction, sense of vitality, cheerful vs. distressed, relaxed vs. anxious, self-control	22 items	Self or interviewer (12 min)
General Health Rating Index (GHR)	Six dimensions: past, present, and future perceptions of health; health-related worry and concern; resistance vs. susceptibility to illness; tendency to view illness as a part of life	29 items	Self or interviewer (7 min)
Quality of Well-being Scale (QWB)	Measures actual performance and preference: self-care, mobility, institutionalisation, social activities, reports of symptoms and problems (including mental)	50 items	Trained interviewer (12 min)

CHAPTER 3

FRAMEWORK AND METHODOLOGY

3.1 Introduction

This chapter discusses in detail the theoretical framework used in the thesis and the research methods used in the empirical studies that accompany the theoretical development.

The chapter is divided into two main sections. First, section 3.2 describes the developing process of the theoretical framework for the quality of life research. In addition, a rationale for a theoretical model in the quality of life research is discussed, this includes consideration of the model development. Second, section 3.3 describes the general research methods used in order to complete the data collection in this research project. Particular attention is paid to meta-analysis, inferential statistics, structural equation modelling and the use of questionnaires. Furthermore, the implications of using each research method are discussed.

3.2 Theoretical Framework

The theoretical foundations for the conceptualisation and measurement of health-related quality of life provide the base from which specific concepts, domains, and indicators could be examined. It is important that these theoretical origins of the notions of quality of life be studied and recognised. Indeed, these origins provide many of the implicit assumptions behind the data obtained from different evaluations and interpretation of the data. The development of an instrument is associated with the conceptual theories and measurement traditions on which it is based (Patrick & Erickson, 1993).

The role of theory in developing health-related quality of life assessments and in interpreting data is crucial given that theory guides implicitly or explicitly the selection of content and the evaluation processes. Patrick and Erickson (1993) also believe major measurement theories govern the rules for assigning numbers to the constructs used in creating indicators which include health states based on the different concepts and domains of health-related quality of life.

Without the foundations of theory, it is very difficult to use instruments in collecting and analysing health-related quality of life data and interpreting relationships among different health-related quality of life concepts. In addition, many cultural, political and social processes influence the meaning and measurement of health-related quality of life. It is important to consider these influences in order to understand how respondents react to health-related quality of life questions and to analyse data in a manner consistent with measurement assumptions.

Theoretical relationships between disease and functional status are not difficult to specify. However, relationships between quality of life measures of attitudes or behaviours (feelings of positive well-being and activities of daily living) are often difficult to predict. For example, emotional well-being might well improve with advancing age. A variety of social theories have been invoked to help specify the interrelationships among different indicators of health-related quality of life (Patrick & Erickson, 1993).

The principal theoretical bases for defining health and life quality states are the functionalist theory from sociology and anthropology (Giddens, 1997) and theories of positive well-being and quality of life from psychology (Diener, 1984). Although these are not the only theories of health and quality of life that have been invoked, they are the principal ones used in developing, applying, and analysing the predominant measures of health-related quality of life. Patrick and Erickson (1993) emphasised the idea that no single theory appears sufficient to encompass the myriad concepts or operations involved in defining and measuring health-related quality of life.

Based on the above related theories, Patrick and Erickson (1993) developed a conceptual framework of theoretical relationships on health-related quality of life. All the concepts and domains are not only used in the global definition of health-related quality of life but also identify indicators for each domain and illustrate how these indicators are used in developing measures and in assessing quality of life. The five concepts are defined further by domains, which are states, attitudes, behaviours, perceptions, other spheres of action and thought in health-related quality of life. The five broad health-related quality of life concepts are (1) opportunity, (2) health perceptions, (3) functional states, (4) impairments, and (5) death or duration of life domains of these concepts, and proposed indicators or measures of the concepts and domains. Patrick and Erickson's (1994) entire conceptual model contains the five concepts, eighteen domains, and multiple indicators. For precisely identifying the pathway of the QOL model, the conceptual model needs to be simplified in order to clarify the model of quality of life.

As previously stated, conceptual clarity is extremely important, because differences in meaning can lead to profound differences in outcomes for research, clinical practice and allocation of health care resources. The Ferrans (1996) conceptual model of quality of life is based on the adoption of an individualistic ideology, which recognises that quality of life depends on the unique experience of life for each person. The model identifies four domains of quality of life: health and functioning, psychological/spiritual, social and economic, and family (Ferrans, 1996). Another conceptual model, was developed by Zhan (1992), in which four domains of quality of life are defined: life satisfaction, self-concept, health and functioning, and socio-economic factors. Other investigators have proposed different classes of outcome variables (Bergner, 1985; Patrick & Elinson, 1984; Ware, 1984). These models appropriately reflect quality of life for contributing to a better understanding of the impact of illness and treatment on quality of life.

3.2.1 Development of a Model of Quality of Life for Coronary Heart Disease

In terms of disease-specific quality of life measures, the Quality of Life after Myocardial Infarction (QLMI) questionnaire is a useful instrument of quality of life for people with coronary heart disease. Lim 's (1993) and Hiller's (1994) respectively explored the domains of quality of life for cardiac patients by using the QLMI questionnaire. Lim's research found three domains and Hiller's result found five domains in the quality of life survey. Hiller's (1994) reported that three domains are more comprehensive structures for measuring people with coronary heart disease. Through the combination of related theories and conceptual models or concepts, this study needs to develop a comprehensive model of quality of life for people with coronary heart disease.

The definition of 'quality of life' is very broad; indeed it is particularly difficult to generate a definition which is all encompassing. Patrick and Erickson (1993) propose the core concepts and domains of health-related 'quality of life'. The hypothesised conceptual model as shown in Figure 3.1 derives from the theoretical perspectives discussed in previous section and Chapter 2. Cultural, social, psychological, and biomedical perspectives have implicitly or explicitly prompted many researchers to develop measures of these concepts.

Figure 3.1 depicts a hypothesised conceptual model of health-related quality of life for cardiac patients in a simple linear progression from disease and impairment to quality of life. The concepts are bounded by environmental determinants that influence disease and its consequences in health-related quality of life. The disease includes coronary heart disease: Myocardial Infarction (MI), Percutaneous Transluminal Coronary Angioplasty (PTCA), Coronary Artery By-pass Graft Surgery (CABG) and other surgery. The environment factor contains genetic, personal, social, economic, cultural and physical dimensions. The World Health Organisation (1980) trial classification of the consequences of disease in terms of impairments, disabilities, and handicaps is a similar conception. Figure 3.1 also indicates the causal chain that permits testing the variable course of coronary heart disease, which may cause impairments to become permanent and lead to changes in quality of life.

Therefore, for developing an appropriate QOL model and evaluating the cardiac rehabilitation programme for people with coronary heart disease, the hypothesised conceptual model of quality of life is based on Patrick and Erickson's (1993) conceptual model. This model includes a number of relevant concepts such as impairment, function status, health perceptions and opportunity for health (see Figure 3.1).

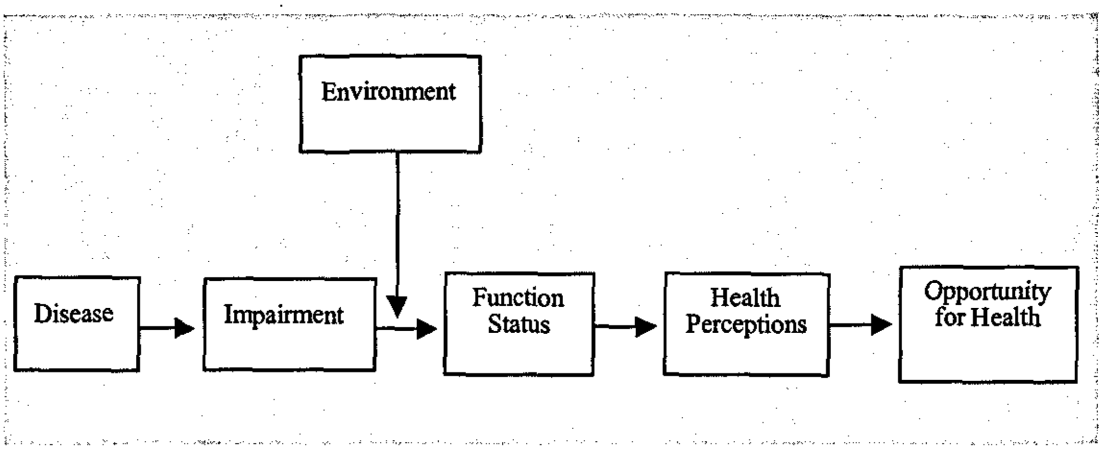


Figure 3.1 Conceptual model of quality of life for people with coronary heart disease

Note: Revised from Patrick and Erickson's Model (1993)

3.2.2 Measurement of Quality of Life

Based on the hypothesised conceptual model in Figure 3.1, the empirical study consisted of three approaches to identify, analyse and test for this model. First, in order to realise the full process from disease to quality of life and evaluate the outcomes of a cardiac rehabilitation programme, meta-analysis was used in the first study. This facilitated the integration of the concepts of quality of life and the process medical treatment. In addition, observation were made for four months in a local hospital in order to understand the procedures and medical treatments associated with the cardiac rehabilitation programme. These visits enabled a greater insight to be gained of a number of the concepts proposed by Patrick and Erickson (1993). In particular, the assessment of quality of life were examined including disease -> impairment -> functions status -> health perception -> opportunity (see Figure 3.1, p.65).

Second, the measurement of quality of life is divided into generic and disease-specific measures (see Figure 3.2). The second part of the study clarified the domains and indicators between generic and disease-specific measures. In addition, consideration was given to whether quality of life is affected by environment factors. Thus, the discriminant analysis, t-test and factor analysis was applied as a statistical tool.

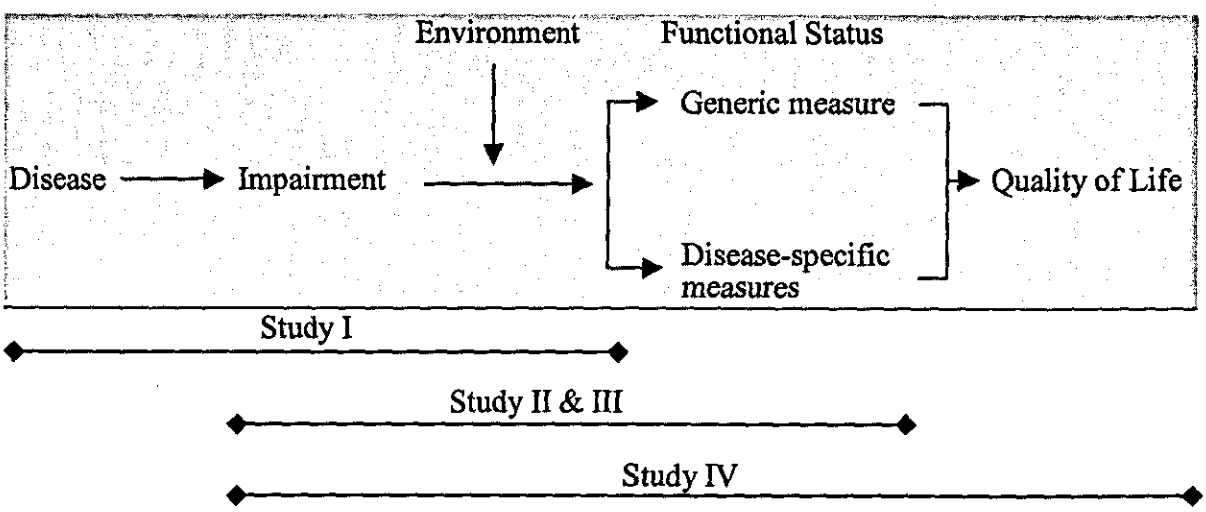


Figure 3.2 The process of measurement of quality of life for people with coronary heart disease

Third, the main objectives and related issues of the thesis (see Table 3.1) are to test a model of quality of life for cardiac patients and to explore what are real components as primary domains and indicators. An effective statistical method, structural equation modelling, can clearly establish causal components between domains and indicators. Thus, a number of domains in the quality of life need

Table 3.1 The main, sub objectives and issues of this thesis

Studies	Main Objectives	Sub-Objectives and Issues
Study I (Chapter 6)	To identify the main factors governing disease-specific health-related quality of life amongst people with coronary heart disease in a cardiac rehabilitation programme;	(1) To examine the validity and reliability of a QLMI instrument in order to establish an appropriate model of QOL for cardiac patients; (2) To compare the differentials of QOL for people with coronary heart disease between entering and completing a cardiac rehabilitation programme.
Study II (Chapter 7)	To verify a model of health-related quality of life which can predict the direct and indirect effects on the individual cardiac patients;	(1) To compare conceptual models which specify the domains of QOL for cardiac patients and the interrelationships among those domains; (2) To examine a theoretical model of QOL and to ascertain whether it is a valid model.
Study III (Chapter 5)	To examine the generic health-related QOL effects on people with coronary heart disease by their demographic characteristics;	(1) Depending on the gender ratio, males have a higher score than females in quality of life when involved in a cardiac exercise rehabilitation programme; (2) The older age group (over 65) have a higher score than younger age group (under 55) in quality of life whilst involved in a cardiac exercise rehabilitation programme; (3) From the disease type of coronary heart disease, CABG patients have a higher score than the other heart diseases in quality of life when involved in a cardiac exercise rehabilitation programme; (4) After six weeks of a cardiac rehabilitation programme, cardiac patients achieve a higher score on quality of life measures than before entering the cardiac exercise rehabilitation programme.
Study IV (Chapter 4)	To evaluate whether a cardiac rehabilitation programme has beneficial effects on people with coronary heart disease.	To estimate the effects of exercise treatment on quality of life in order to compare it with other treatments.

to be examined thoroughly in order to develop an appropriate QOL model for people with coronary heart disease.

3.3 General Methods

This section will introduce the statistical methods for the empirical study and the procedures of measuring quality of life as shown on Figure 3.2 (p.66). Given the different research approaches used in each study, consideration should be given to the method and how this relates to the conceptual model of quality of life for people with coronary heart disease. The literature proposed and relating to quality of life and cardiac rehabilitation programmes were extracted in the first study, this required a suitable statistical method in order to enable consistent results to be generated. Meanwhile, the exploratory factor analysis and discriminant analysis were used to identify and classify latent variable on the QOL model. In addition, a theoretical model needed to identify each domain that fitted into the model. Thus, a powerful statistical method, Confirmatory Factor Analysis (CFA) and Structural Equation Modelling (SEM), conforms with the purpose of this study. The following sections will introduce these research approaches in more detail.

3.3.1 Meta-Analysis

Meta-analysis, or quantitative review, utilises statistical procedures to combine two or more empirical studies relating one variable to another. It combines outcomes of various studies to determine the effect (if any) one variable has on another, on an across-study basis. For instance, all of the subjects in each of the reviewed studies are placed into a single study experimental design, resulting in the additional inferential power that this large number of subjects allows. Furthermore, meta-analytic techniques do not preclude the incorporation of theoretical subtleties.

Berlin and Colditz (1990) apply the techniques of meta-analysis to data extracted from the published literature by Powell (1987). Its purpose is to make formal quantitative statements and to explore features of study design that influence the observed relation between physical activity and coronary heart disease risk.

3.3.2 Inferential Statistics

There are two measures of evaluating quality of life: the Short Form 36 (generic) and the Quality of Life after Myocardial Infarction (disease-specific) measure. Initially, this study intends to understand generic quality of life whether affected by environment factors. Thus, using paired t-test and discriminant analysis to classify between independent and dependent variables (see Chapter 5). Secondly, a number of researchers define the domains of disease-specific QOF in a different ways, even though they use the same questionnaire, such as Lim et al.'s (1993) and Hillers et al. 's (1994) findings. Thus, factor analysis is used to identify the appropriate domains of disease-specific disease (see Chapter 6).

3.3.2.1 Discriminant Analysis

The key to understanding discriminant analysis is to consider the definition of the word. This technique can precisely explain what are the best ways to discriminate between different groups of people or objects.

Discriminant function analysis is used to determine which variables discriminate between two or more naturally occurring groups. For example, an educational researcher may want to investigate which variables discriminate between high school graduates who decide (1) to go to college, (2) to attend a trade or professional school, or (3) to seek no further training or education. For that purpose the researcher could collect data on numerous variables prior to students' graduation. After graduation, most students will naturally fall into one of the three categories. Discriminant Analysis could then be used to determine which variable(s) are the best predictors of students' subsequent educational choice. A medical researcher may record different variables relating to patients' backgrounds in order to learn which variables best predict whether a patient is likely to recover completely (group 1), partially (group 2), or not at all (group 3). A biologist could record different characteristics of similar types (groups) of flowers, and then perform a discriminant function analysis to determine the set of characteristics that allows for the best discrimination between the types.

3.3.2.2 Factor Analysis

Factor analysis is a grouping technique that assists the understanding of concepts. The single most distinctive characteristic of factor analysis is its data-reduction capability. Given an array of correlation coefficients for a set of variables, factor-analytic techniques enable us to see whether some underlying pattern of relationships exists such that the data may be 'rearranged' or 'reduced' to a smaller set of factors or components that may be taken as source variables accounting for the observed interrelations in the data (Kim, 1975). In other words, it examines inter-relationships among large numbers of variables and disentangles those relationships to identify clusters of variables that are closely linked together (Burns & Grove, 1997). It tests the validity of ideas about item types in order to decide which items should be included. The purpose of factor analysis is to reduce a set of data so it may be easily described and used.

3.3.3 Structural Equation Modelling

Structural equation modelling (SEM) is a statistical methodology that takes a confirmatory (i.e., hypothesis-testing) approach to the multivariate analysis of a structural theory bearing on some phenomenon. This theory represents 'causal' processes that generate observations on multiple variables (Bentler, 1988; Fornell, 1982). The term structural equation modelling conveys two important aspects of the procedure: (a) that the causal processes under study are represented by a series of structural (i.e., regression) equations, and (b) that these structural relations can be modelled pictorially to enable a clearer conceptualisation of the theory under study. The hypothesised model can then be tested statistically in a simultaneous analysis of the entire system of variables to determine the extent to which it is consistent with the data. If goodness-of-fit is adequate, the model argues for the plausibility of postulated relations among variables. If it is inadequate, the tenability of such relations is rejected.

Several aspects of SEM set it apart from the older generation of multivariate procedures (Fornell, 1982). First, it takes a confirmatory, rather than an exploratory approach to the data analysis (although aspects of the latter can be addressed). Furthermore, by demanding that the pattern of intervariable relations be specified a priori, SEM lends itself well to the analysis of data for inferential purposes. By contrast, most other multivariate procedures are essentially descriptive by nature (e.g., exploratory factor analysis), so that hypothesis testing becomes difficult, if not impossible. Second, whereas traditional multivariate procedures are incapable of either assessing or correcting for measurement error, SEM provides explicit estimates of these parameters. Finally, whereas data analyses using the former methods are based on observed measurements only, those using SEM procedures can incorporate both unobserved (i.e. latent) and observed variables (Garson, 2000).

Given these highly desirable characteristics of SEM, it has become a popular methodology for non-experimental research, where methods for testing theories are not well developed and ethical considerations make experimental design unfeasible (Bentler, 1980). Structural equation modelling can be utilised very effectively to address numerous research problems involving nonexperimental research.

The aim of structural equation modelling is to explain the structure or pattern among a set of latent variables, each measured by one or more (fallible) indicators. Structural equation modelling is predominantly confirmatory in nature and compares the covariance matrix implied by the specified model with the (actual) covariance matrix based on the empirical data. The aim of ordinary linear regression is to explain how an observable (dependent) variable depends on a number of manifest indicators.

"Unlike exploratory factor analysis which is guided by intuitive and ad hoc rules, structural equation modelling casts factor analysis in the tradition of hypothesis testing, with explicit tests of both the overall quality of the factor solution and the specific parameters composing the model" (Byrne, 1994, p.3-22).

3.3.4 The Use of Questionnaires

There are two questionnaires: the Short Form 36 (SF-36, see Appendix 1); the Quality of Life after Myocardial Infarction (QLMI, see Appendix 3) which are used as the primary instruments in this study. The psychometric evidence suggests that the SF-36 is the best available generic measure of HRQoL among people with ischaemic heart disease. The SF-36 is the shortest of the three generic measures reviewed, which makes it more acceptable to patients, clinicians, and service providers (Dempster & Donnelly, 2000). The report from McHorney et al. (1994) suggests that the MOS SF-36 Health Survey was used to evaluate data completeness and quality, test scaling assumptions, and estimate internal-consistency reliability for the eight scales constructed from. Analyses were conducted among 3,445 patients. Reliability coefficients ranged from a low of 0.65 to a high of 0.94 (median = 0.85) and varied somewhat across patient subgroups. Thus, SF-36 is an appropriate instrument for the generic measure of quality of life.

The MacNew QLMI is a self-administered, condition-specific, health-related quality of life instrument that is valid, reliable, and responsive (Heller, Knapp, Valenti, & Dobson, 1993; Lim et al., 1993; Valenti, Lim, Heller, & Knapp, 1996).

In addition, Avis et al. (1996) developed a multidimensional measure of health-related quality of life appropriate for patients with cardiovascular disease that was psychometrically sound, brief, and easy to administer. Cronbach's alpha was 0.76 or higher for eight of the nine MILQ domains. Test-retest reliability coefficients were 0.73 or greater in all but two domains. The Multidimensional Index of Life Quality is a psychometrically reliable and valid instrument for measuring quality of life in patients with cardiovascular diseases.

The above instruments have a high reliability and validity and have been authorised by the developer for the use of each questionnaire in this study (see Appendix 2).

3.4 Concluding Remarks

The purpose of this thesis is to focus on finding an appropriate model of quality of life for people with coronary heart disease. The statistical techniques and questionnaires enabled the researcher to identify and classify the domains of quality of life. Four main statistical methods (meta-analysis, discriminant analysis, factor analysis and structural equation modelling) have been applied in this study, aimed at exploring related factors that affect the model in the macrocosmic aspect and to identify whether each indicator adapts the domains of quality of life in microcosmic aspect. Based on theoretical background and previous studies, a strict structural design and tools were used to establish a suitable model for people with coronary heart disease. More importantly, these findings will assist patients to receive high quality of life and enhance the quality of medical treatment delivered.

CHAPTER 4

EFFECTS OF A CARDIAC REHABILITATION EXERCISE PROGRAMME ON QUALITY OF LIFE IN CORONARY PATIENTS: A META-ANALYSIS

4.1 Introduction

One of the key objectives of cardiac rehabilitation is to improve the quality of life (that is, by facilitating familial, occupational and social reinsertion) by such means as preventing and/or correcting psychological problems, increasing the patient's self-confidence and will to live, and improving his or her capacity for physical effort, by way of a programme of aerobic physical exercise. By achieving these goals, morbidity and mortality should be reduced and, perhaps the incidence of hospital readmission (Cabello Fernandez et al., 1999).

Quality of life is being increasingly considered as an expected outcome of cardiac rehabilitation programmes. Cardiologists have always believed that the components of quality of life are important to their patients. However, they are often sceptical about attempts to quantify them. Currently, a measurement for quality of life is increasingly being required and used in evaluative research and the planning of rehabilitation services. Thoroughly planned measures have reliability and validity equal to any physiological or pathological index (Mayou & Bryant, 1993). However, few instruments exist that reflect a multidimensional concept of quality of life including disease-specific items. This instrument needs to identify the effects on quality of life of a cardiac exercise rehabilitation programme.

The purpose of this meta-analysis is to estimate the effect of exercise treatment on quality of life in order to compare it with other treatments. In addition, meta-analysis explores the outcome of quality of life in cardiac exercise rehabilitation programmes.

4.2 Method

In this study, meta-analysis, a quantitative method for summarising existing studies, is defined as an analysis of analyses: that is, pooled results of several studies are analysed to provide a systematic, quantitative review of their data. In the preliminary examination of the literature, a computer search using the key words 'quality of life' and 'cardiac rehabilitation programme' was conducted. Approximately 120 previous studies were associated with the keywords in the database of MEDLINE (Medical Literature, Analysis, and Retrieval System Online) and BIDS (Bath Information and Data Services). Inclusion criteria of this study include: (a) the primary research study was published in peer-reviewed journals; (b) they provided treatment for coronary patients, such as patients after first myocardial infarction or with stable angina pectoris or patients after by pass or valve operation; (c) medical examinations, including work capacity, were performed before and after the exercise programme; (d) intensity or duration of exercise was designed to induce physical training effects; (e) patients were only exposed to an exercise treatment, whilst studies that combined exercise with psychotherapy or counselling were excluded; (f) quality of life of the patients was measured with validated questionnaires or psychiatric interview techniques.

Three different study designs can be distinguished: (a) the pre-post design without a control group compares a patient group before and after an exercise programme; (b) the pre-post-design with a control group compares gains in the exercise group with a sedentary control group; (c) the pre-post-design with different treatment groups applies different exercise programmes and compares the induced effects with a sedentary control group.

4.2.1 Statistical Treatment

For studies using pre-post-design with a control group, effect size was calculated using the formula: $d=(M_t - M_c) / SD_p$, where M_t= mean gain of the exercise treatment group, M_c= mean gain of the sedentary control group, and SD_p = pooled standard deviation of the two groups (Johnson, 1989). The pooled standard deviation was chosen because, in the long run, it gives a better estimate of the population standard deviation than other methods if the assumption of equal variances is reasonable (Hedges & Olkin, 1985; Rosenthal, 1984). If means or standard deviations were not reported, effect size was calculated from the t value or corresponding significance level according to methods described by (Glass, McGaw, & Smith, 1981; Rosenthal, 1984).

In a similar way, effect size was calculated for studies using pre-post-design without a control group. In none of the studies was the standard deviation of the pre-post-difference reported, so effect sizes had to be estimated using the reported t value or using the significance level according to methods described by Glass et al. (1981) and Rosenthal (1984). If the proportion of improved vs. deteriorated patient groups after treatment were reported, effect size was estimated according to Cohen (1977).

In studies using pre-post-design with different treatment groups, only differences between the control group and the group with the most intense and supervised exercise programme were compared. Some studies with more than one treatment group reported effects separately for each group without comparing between groups. These studies were treated like pre-post-studies without a control group.

If a study used more than one measure for quality of life, the results with the highest effect size were considered for the meta-analysis. If results were reported as being non-significant, the effect size was calculated assuming a significance level of $p = .05$ in favour of exercise programmes. This appeared justified because some studies indicate such non-significant tendencies. To get an unbiased estimator, effect sizes were corrected for the degree of freedom of the significance test used in the study, as suggested by Hedges and Olkin (1985).

Effect sizes were estimated under the assumption of perfect reliability. Confidence intervals for estimated effect sizes were calculated according to formulas used for studies with control groups as detailed by Hedges and Olkin (1985). Relationships between effect size and design features were analysed by SPSS (1999b).

A summary table, made up of variables such as study number, sample size, correlation coefficient, and p value, was established to calculate the effect size of each outcome variable. A computer programme 'D-STAT' was used for data analysis. Correlation coefficients or p values were used to determine the unweighted effect size (g). Based on sample size and unweighted effect size, every outcome variable was examined for its homogeneity between studies. Outliers of the variable were eliminated to achieve a homogenous state ($p > .05$) Then, weighted effect size (*d*) of each variable was determined (Johnson, 1989).

4.3 Results

Methodological characteristics of the 11 primary studies are shown in Table 4.1. Using Kendall's *tau* coefficient (Howell, 1997), the relationship between methodological characteristics and the effect sizes was checked. The effect sizes in studies on quality of life were not related to methodological characteristics such as duration of the exercise training, publication year or use of a control group.

Table 4.1 Methodological characteristics of studies included in meta-analysis of the effects of exercise programme on quality of life

Study	Type of design	Duration	Follow-up	N	Psychological assessment
1. Hung(1984)	With control	2-6w	4w	Nt=85 Nc=66	MOS SF-36
2. Engebbretson (1999)	W/O control	12w	No	49	MOS SF-36
3. Rukholm (1994)	W/O control	12w	2w	146	CQLI
4. Lavie and Milani (1995a)	With control	12w	No	Nt=31 Nc=120	MOS SF-36
5. Beniamini (1997)	W/O control	12w	12m	18	MOS SF-36
6. Finlayson (1997)	W/O control	4m	12m	224	SSTAI IPAI
7.Kavanagh (1996)	With control	12w	12m	Nt=21 Nc=9	CHFQ
8.Maines (1997)	W/O control	6w	No	283	MOS SF-36
9.Berkhuysen (1999)	W/O control	6w	No	58	MOS SF-36
10.Lavie and Milani (1997)	W/O control	6w	No	112	MOS SF-36
11.Loose (1995)	With control	6w	No	Nt=8 Nc=71	SIP

KEY

CHFQ	The Chronic Heart Failure Questionnaire
CQLI	Cardiac Quality of Life Index
MOS SF-36	Medical Outcome Study Short-Form General Health Survey
SIP	Sickness Impact Profile
SSTAI	The Spielberger State Trait Anxiety Inventory

The meta-analysis showed an average effect size of exercise programmes on quality of life in coronary patients of *d* mean = .27 (see Table 4.2). Using the weighted integration method (Hedges & Olkin, 1985), the effect size was significantly larger than zero (P< .01). The confidence interval, in which the population effect size lies within a probability of 95 percent, was estimated for quality of life from .21 to .34. If the confidence interval (CI) includes zero (0.00), the value indicating exactly no difference, it may be concluded that across all studies there is no relationship between the independent and dependent variable (Johnson, 1989). According to Cohen (1988), average effect sizes have to be evaluated as less than medium (defined as d= .50) for quality of life.

Table 4.2 Effect size and related information of the outcome variables

Study	*d*	95% CI	r	p
1	-0.81	-1.15 / -0.48	-0.38	0.00
2	+0.38	-0.02 / +0.78	+0.19	0.06
3	-0.48	-0.83 / -0.14	-0.24	0.00
4	-0.38	-0.77 / +0.02	-0.19	0.02
5	+0.66	+0.42 / +0.90	+0.31	0.00
6	+0.00	-0.12 / +0.12	+0.00	1.00
7	+0.21	-0.20 / +0.61	+0.10	0.29
8	+0.88	+0.71 / +1.05	+0.40	0.00
9	+0.36	+0.22 / +0.50	+0.18	0.00
10	+0.77	+0.50 / +1.04	+0.36	0.00
11	+0.45	-0.29 / +1.18	+0.22	0.05
Overall	+0.27	+0.21 / +0.34	+0.13	0.00

4.4 Discussion

Coronary heart disease remains the most common cause of death in Western society and the highest rates in the world are found in the U.K. (NHS Executive, 2000). Cardiac rehabilitation aims to restore the patient to an optimum level of recovery, and where possible, to prevent coronary heart disease from progressing (Egan, 1999). Exercise programmes are extensively used in cardiac prevention and rehabilitation. While they are mainly designed for cardiological reasons, the question of how they affect patients' physical capacities and quality of life is raised. Eleven studies on the effects on quality of life were included in this meta-analysis. The effect size of exercise programmes was not systematically related to the duration of the programmes indicating that the effects that exercise training can have upon quality of life are probably not enhanced by prolonging programmes.

Furthermore, the effect sizes of exercise programmes were not associated with the publication year of studies. One might suspect that because of changes in attitude toward exercise over the last 20 years, it was more difficult to find sedentary control groups, or to find sedentary patients prior to the start of the exercise programme (Kugler, Seelbach, & Kruskemper, 1994).

Pell (1997) pointed out that when assessing rehabilitation programmes for chronic diseases, it is insufficient to consider outcomes in terms of mortality and morbidity. Quality of life must be considered and studies applying generic quality of life instruments have generally shown no significant benefit following rehabilitation (Burgess et al., 1987; Ott et al., 1983; Stern & Cleary, 1982). The present study supports Pell's (1997) viewpoint that the effect of exercise programmes were not fully explained by the quality of life in the cardiac rehabilitation programme. Therefore, the finding of this meta-analysis is that the related studies could not have consistent outcomes to support the positive effects of cardiac exercise rehabilitation programme on quality of life in coronary patients.

Examining the study quality is an important step before a meta-analysis is discussed because quality may influence study outcomes (Brown & Hedges, 1994). In general, journal reports had large sample sizes and often reported significant results in the expected direction. In addition, publication bias in favour of significant findings should be considered. This factor may have artificially inflated the journal effect size (Broome, Lillis, & Smith, 1989). Therefore, further rigorous synthesis including fugitive research reports should address more precise relations with quality of life.

Although meta-analysis for research integration cannot take the place of primary studies to address causal relations, it may provide useful guidelines for the direction of new primary research. Future study should focus on the synthesis to test a causal model and to explain interrelations among significant outcome variables of quality of life.

CHAPTER 5

HEALTH-RELATED QUALITY OF LIFE ASSESSMENT: GENERIC MEASURES-SF36

5.1 Introduction

The Short Form 36 (SF-36) questionnaire (Ware & Sherbourne, 1992a) (see Appendix 1) was developed from the Medical Outcome Survey (MOS) by excluding some of the health concepts included in the full-length MOS scale (Tarlov et al., 1989). Notably, SF-36 was developed in response to patient demand for a shorter and more user-friendly measurement tool. The SF-36 has been used for a range of different illnesses including patients undergoing cardiac rehabilitation (Jette & Downing, 1994; Lavie & Milani, 1995; Ware, 1993).

The SF-36 is a widely used generic health status measure which uses eight scales: physical functioning, social functioning, role limitations caused by physical problems, role limitations caused by emotional problems, mental health, energy/vitality, bodily pain, and general health. In addition, the SF-36 incorporates a self-assessment measure of health change over the past year (Ware & Sherbourne, 1992a).

McHorney et al. (1993) believe the SF-36 has demonstrated construct validity through factor analysis in a study with patients in a variety of conditions. Furthermore, it has been established that the different scales in the SF-36 have internal consistency (Brazier et al., 1992; Jenkinson, Wright, & Coulter, 1993; Kurtin, Davies, Meyer, DeGiacomo, & Kantz, 1992).

Although the SF-36 appears to have strong psychometric properties, further research is required in order to investigate its sensitivity to change in the patient population. However, it must be recognised that every patient population has its own specific qualities, consequently results found in one population may not transfer to another. Indeed, one or both of the instruments may be population sensitive.

Brezinka et al. (1998) studied gender differences in psychosocial profile at entry into cardiac rehabilitation. The study consisted of 109 and 122 female patients matched for age with a diagnosis of myocardial infarction, coronary artery by-pass grafting, or coronary angioplasty, they were assessed at entry into a multidisciplinary outpatient rehabilitation programme. The results concluded that there were no significant differences between genders at programme entry for age, coronary risk factors, coronary incident, or medication. Interestingly, women reported significantly lower perceived exercise tolerance and significantly more functional and psychosomatic complaints. Furthermore, women were significantly more anxious and scored significantly higher on social inhibition and vital exhaustion than men. These attributes reported by women may help to explain their higher drop-out and lower adherence rates in cardiac rehabilitation.

Carhart and Ades (1998) stated that comprehensive cardiac rehabilitation has substantial benefits for patients with cardiovascular disease. If cardiac rehabilitation programmes are made more responsive to the needs and goals of female coronary patients, then their participation and compliance rates should increase. Indeed, this increased responsiveness may result in a favourable impact on morbidity, mortality, and quality of life for women with cardiovascular diseases.

Recent research from Cherubini et al. (1998) relating to the world population indicates that people over the age of 65 constitute a growing proportion of the population. This trend is evident in both western and in developing countries. In particular, a unique feature of this group is the high prevalence of cardiovascular diseases. Clearly, this will negatively affect the quality of life and life expectancy of these older people. The benefits of physical activity have been demonstrated both in healthy and chronically ill elderly subjects, while the risks have been found to be modest. Besides, Lavie and Milani (1995b) considered that elderly patients had greater improvements than younger patients in exercise capacity and mental health after cardiac rehabilitation. They go on to suggest that elderly patients with CAD should be routinely referred to and vigorously encouraged to pursue formal outpatient cardiac rehabilitation and exercise training programmes after major CAD events.

Westin et al. (1997) assessed quality of life in patients after acute myocardial infarction (AMI), coronary artery by-pass grafting surgery (CABG) and percutaneous transluminal coronary angioplasty (PTCA) compared with healthy controls. The study recruited 296 AMI, 99 CABG, 18 PTCA patients and 88 randomly selected healthy controls. 349 patients completed the entire programme. Quality of life was assessed in the following dimensions: perceived general health, thoracic pain, breathlessness, feeling of arrhythmia, anxiety, depression, self-esteem, experience of social life and sex life. The results show patients differed from controls in both psychological and somatic aspects of QOL after 1 month. Furthermore, 1 month after the event AMI patients experienced more anxiety ($P = 0.001$) than CABG patients, whilst CABG patients experienced a poorer sex life ($P < 0.001$) than AMI patients. Clearly, quality of life is considerably affected in patients following a cardiac event, particularly during the initial recovery phase.

Oldridge and Jones (1986) studied the preventive use of exercise rehabilitation after myocardial infarction. The results show physiological and psychological improvements occur that enable patients to improve their quality of life. However, the effectiveness of exercise programmes is impaired by poor patient compliance. Some characteristics of poor compliers may be identified, but it is safer to assume all participants are potential non-compliers. Therefore, exercise programmes should always have compliance-improving strategies.

The purposes of this chapter are to understand the differences in the patient's quality of life between pre and post rehabilitation programme. In addition, this chapter also uses discriminant analysis to clarify whether the perception of 'quality of life' might be changed by gender, age and disease types of patients within a 6 week cardiac exercise rehabilitation programme.

From the review of previous studies in the field and according to the purposes of this chapter, there are a number of issues which need to be identified, and examined and tested in this research:

(1) Depending on the gender ratio, males have a higher score than females in quality of life when involved in a cardiac exercise rehabilitation programme.

(2) The older age group (over 65) have a higher score than younger age group (under 55) in quality of life whilst involved in a cardiac exercise rehabilitation programme.

(3) From the disease type of coronary heart disease, CABG patients have a higher score than the other heart diseases in quality of life when involved in a cardiac exercise rehabilitation programme.

(4) After six weeks of a cardiac rehabilitation programme, cardiac patients achieve a higher score on quality of life measures than before entering the cardiac exercise rehabilitation programme.

5.2 Method

5.2.1 Subjects

Data was generated by the subjects using the SF-36 instrument in a standardised manner on consecutive patients enrolled on a cardiac rehabilitation programme. Data collection took place from September 1998 to February 1999. Patients were accepted on a cardiac exercise rehabilitation programme based on referral from their physicians. Twenty-four percent of the subjects were referred by their physicians for cardiac rehabilitation with a diagnosis of myocardial infarction (MI), 54% had undergone coronary artery by-pass graft (CABG) surgery, and 19% had undergone angioplasty or other surgery. Sixty-three subjects agreed to participate. 81% of the subjects were men, and 19% were women (see Table 5.1). The average age of the entire sample was 61.21 (SD=8.41). Age variable divided into three groups: A group - under 55 years old; B group - between 56 and 64; C group - above 65 years old.

Table 5.1 The demographic of SF-36 generic health-related quality of life

		Frequency	Percent
Gender	Male	51	81.0
	Female	12	19.0
Event	CABG	34	54.0
	MI	17	27.0
	Angioplasty/ other surgery	12	19.0
Age	Under 55 yrs	22	34.9
	56-64 yrs	20	31.7
	Over 65 yrs	21	33.3

Note: CABG: coronary artery by-pass graft; MI: myocardial infarction.

5.2.2 Procedure

Extensive data were collected from all subjects when they entered the cardiac rehabilitation programme and upon completion of the programme. The data included demographic information, exercise tolerance test data, psychological profile and medication information. As part of the data collection process, the 36-item short-form Medical Outcomes Study questionnaire (SF-36) was completed independently by the subjects involved in this study. It should be noted that the developers of the SF-36 agreed to the questionnaire's use in this research (see also Appendix 2)

5.2.3 Instrument

The SF-36 evolved from a number of instruments that have been used to measure health status. In particular, the Health Insurance Experiment (HIE), and Medical Outcomes Study (MOS) are most relevant. The Health Insurance Experiment (HIE) research was undertaken to determine the best possible method for measuring a broad array of functional and health status concepts and to compare the outcomes of different methods of delivering care. This work resulted in the publication of an eight volume set of RAND technical reports and the essence of this work has been summarised elsewhere (Brook et al., 1983; Ware et al., 1986). The Medical Outcomes Study (MOS) developed and refined measures of health status, and was a large scale test of the feasibility of self-administered patient questionnaires and generic scales in the assessment of the outcomes of medical care (Ware & Sherbourne, 1992b; Tarlov et al., 1989).

The MOS was a two-year observational study designed to help understand how specific aspects of the American health care system affect the outcomes of medical care. The investigators studied a number of tracer conditions (e.g. depression, hypertension, coronary heart disease) and repeatedly assessed the health status of these patients during the two years of the study. The distinctive feature of both the HIE and the MOS was the decision to collect patient assessed outcomes, rather than to rely solely on laboratory tests and other clinical measures. It is from these many studies from the American health care system that the 'short-form' questionnaires developed, and are gaining increasing popularity both in America and England (Jenkinson et al., 1993).

Examples of scale items are presented in Table 5.2. The SF-36 measures eight health concepts that make up a multidimensional scale: physical functioning (10 items), social functioning (2 items), role limitations due to physical problems (4 items), role limitations due to emotional problems (3 items), mental health (5 items), energy/fatigue (4 items), bodily pain (2 items), and general health perception (5 items). A single item evaluates the patient's perception of change in health over the past year, but is not included in the scoring.

Table 5.2 Brief Contents of Short Form 36 Items

Scale	Item	Response Choices
Physical function	Does your health limit you in walking several blocks? If so, how much?	3 choices ranging from limited a lot to not limited at all
Social function	How much of the time during the last 4 weeks or since hospital discharge has your health limited your social activities?	6 choices ranging from all of the time to none of the time
Role limitation Physical	During the past 4 weeks or since hospital discharge, have you accomplished less than you would like as a result of your physical health?	Yes or no
Emotional	During the past 4 weeks or since hospital discharge, have you cut down on the amount of time you spend on work or other activities as a result of emotional problems?	Yes or no
Mental health	How much of the time during the past 4 weeks have or since hospital discharge have you felt calm and peaceful?	6 choices ranging from all of the time to none of the time
Energy/fatigue	How much of the time during the past 4 weeks or since hospital discharge did you feel full of vigour?	6 choices ranging from all of the time to none of the time
Bodily pain	How much bodily pain have you had during the past 4 weeks or since hospital discharge?	5 choices ranging from none to very severe
General health	I am as healthy as anybody I know.	5 choices ranging from definitely true to definitely false

Source: Jenkinson, C.; Layte, R.; Wright, L., and Coulter, A. The U.K. SF-36: an analysis and interpretation manual. Oxford, UK: Health Services Research Unit/Department of Public Health and Primary Care, University of Oxford; 1996.

The questionnaire can be completed in less than 10 minutes. Standardised multi choices allow the patient to indicate the extent of various limitations due to his or her health; the degree of energy, fatigue, and emotional ability; and his or her perception of health and change in health. The patients are asked to describe their perceptions and behaviours in the past month.

Scores on each of the dimensions are obtained by summing item responses. A scoring algorithm is then used to transform these raw scores into a scale from 0 (poor health) to 100 (good health). A higher score indicates better health. Table 5.3 provides information on the number of items in each of the eight dimensions and a guide to the interpretation of scores from the SF-36. Missing scores for individual items are estimated using the average score across other items in the scale. The usefulness, validity, and reliability of the instrument and its precursors have been reported by Lin and Ward (1998), Brazier et al. (1992) and McHorney et al. (1994), for use with patients with mild to severe chronic medical and psychiatric problems.

Table 5.3 A guide to the interpretation of scores on the SF-36 survey

	Meanings of Scores	
Dimension (no. of items)	Low Scores	High Scores
Physical Functioning (10)	Limited a lot in performing activities including bathing and dressing	Performs all types of physical activities without limitations due to health
Social Functioning (2)	Extreme and frequent interference with normal social activities due to physical and emotional problems	Performs normal social activities without interference due to physical or emotional problems
Role Limitations due to physical problems (4)	Problems with work or other daily activities as a result of physical health	No problems with work or other daily activities due to physical health
Role Limitations due to emotional problems (3)	Problems with work or other daily activities as a result of emotional problems	No problems with work or other daily activities as a result of emotional problems
General Mental Health (5)	Feelings of nervousness and depression all of the time	Feels peaceful, happy and calm all of the time
Energy/Vitality (4)	Feels tired and worn down all the time	Feels full of energy all the time
Bodily Pain (2)	Severe and limiting bodily pain	No pain or limitations due to pain
General Health Perceptions (5)	Believes personal health is poor and likely to get worse	Believes personal health is excellent

Source: Ware, John E. and Sherbourne, Cathy Donald. The MOS 36-item short-form health survey (SF-36). Medical Care. 1992; 30(6): 473-483.

5.2.4 Data Analysis

Discriminant analysis assists in the analysis of the differences between the groups and/or provides us with a means to assign (classify) any case into the groups which it most closely resembles (Klecka, 1980, p.8). Huberty (1989) stated that discriminant analysis (DA) includes a set of response variables and a set of one or more groupings or nominally scaled variables. Klecka (1980) outlined the basic prerequisites for conducting a discriminant analysis stating, 'two or more groups exist which we presume differ on several variables and that those variables can be measured at the interval or ratio level.' There is no limit to the types of variables that can be employed. However, the unlimited nature of the variable can lead to difficulties with interpretation (Nunnally & Bernstein, 1994).

As Huberty's (1989) description and Klecka's (1980) prerequisites in the above paragraph imply, discriminant analysis has two sets of techniques based on the purpose of the analysis: predictive discriminant analysis and descriptive discriminant analysis. "When groups of units are known in advance and the purpose of the research is either to describe group differences (DDA) or to predict group membership (PDA) on the basis of response variable measures, discriminant analysis techniques are appropriate" (Huberty, 1994, p. 25-26). Alternatively, Stevens (Stevens, 1996, p. 261) described the distinction between PDA and DDA in the following way: "in predictive discriminant analysis the focus is on classifying subjects into one of several groups, whereas in descriptive discriminant analysis the focus is on revealing major differences among the groups".

The ideas associated with discriminant analysis can be traced back to the 1920s and work completed by Karl Pearson and others on intergroup distances, e.g., coefficient of racial likeness (CRL), (Huberty, 1994). In the 1930s, Fisher translated multivariate intergroup distance into a linear combination of variables to aid in intergroup discrimination. Methodologists from Harvard

University contributed much to the interest in application of discriminant analysis in education and psychology in the 1950's and 1960's (Huberty, 1994). Klecka (1980) provided several historical references that deal mostly with early applications of DA.

Predictive discriminant analysis (PDA), or 'classification' as it is sometimes called, generally includes "a set of predictor variables and one criterion variable, the latter being a grouping variable with two or more levels, that is, there are two or more groups" (Huberty & Barton, 1989, p.158,). Predictive discriminant analysis is similar to multiple regression analysis except that PDA is used when the criterion variable is categorical and nominally scaled. DDA includes a collection of techniques involving two or more criterion variables and a set of one or more grouping variables, each with two or more levels, whose effects are assessed through MANOVA.

According to Kerlinger and Pedhazur (1973, p. 337) "the discriminant function is a regression equation with a dependent variable that represents group membership." The aforementioned relationship between multiple regression and descriptive discriminant analysis is clearly illustrated in the two-group, or dichotomous grouping variable case, i.e. regression and DDA yield the same results. Thus, discriminant analysis helps to differentiate between or to predict group membership while regression analysis predicts a certain level of result.

In addition, a paired t-test was applied to derive the significance of the difference at $p<0.01$ between pre and post rehabilitation programme. Data were expressed as the mean and standard deviation (SD). In order to assimilate the data in this study the SPSS statistics package was used (SPSS Inc., 1999a).

5.3 Results

Descriptive statistics for the SF-36 are in Table 5.4. Analysis using t-test statistical methods to evaluate patient's QOL between before and after a cardiac rehabilitation programme are presented in Table 5.5. The post-test mean scores on the SF-36 dimensions are generally higher than the pre-test, which indicates patients can improve their quality of life after a cardiac exercise rehabilitation programme.

Table 5.4 Mean & SD on the pre-post measure of SF-36 QOL survey

		PRE		POST	
Dimensions	N	Mean	SD	Mean	SD
Physical functioning	63	63.62	19.52	77.69	17.12
Social functioning	63	62.96	22.93	76.54	17.64
Role limitation physical	59	26.69	37.68	53.28	42.44
Role limitation emotional	60	62.78	42.12	76.44	35.87
Mental health	63	72.54	17.47	78.50	17.28
Energy/vitality	63	52.72	19.22	64.27	18.35
Pain dimension	63	65.43	20.65	77.96	18.93
Health perceptions	61	61.46	18.56	65.00	20.66
Total	56	61.10	14.92	71.07	15.15

Table 5.5 Paired t-test on eight dimensions of SF-36 QOL survey

Dimensions	t	df	Sig. (2-tailed)
Physical functioning	-4.30*	62	0.00
Social functioning	-3.73*	62	0.00
Role limitation physical	-3.62*	59	0.00
Role limitation emotional	-1.89	58	0.06
Mental health	-1.92	62	0.06
Energy/vitality	-3.44*	62	0.00
Pain dimension	-3.53*	62	0.00
Health perceptions	-1.00	60	0.32
Total	-3.52*	61	0.00

There are significant differences ($p < .01$) on five dimensions: physical functioning, social functioning, role limitation physical, energy/vitality and pain. Only three dimensions (role limitation emotional, mental health and health perceptions) do not reach a significant statistical level.

The most distinguishable differences among these dimensions are shown in Figure 5.1. When the patients had coronary heart disease in phase one of the rehabilitation process they had to stay in hospital for two weeks. The patients needed to go back home in phase two, for two weeks. They were allowed to undertake very light exercise at home. During these weeks, the hospital staff visited the patients several times in order to gain a greater understanding of their recovery situation. In phase three, patients went back to hospital to attend a cardiac rehabilitation programme.

The courses of CRP include physical training, mental consultation, medical education, i.e. changing lifestyle, diet behaviour, nutrition undertaken and related topics of preventing coronary heart disease. In this study, all of the patients were treated in the cardiac rehabilitation programme for six weeks at a

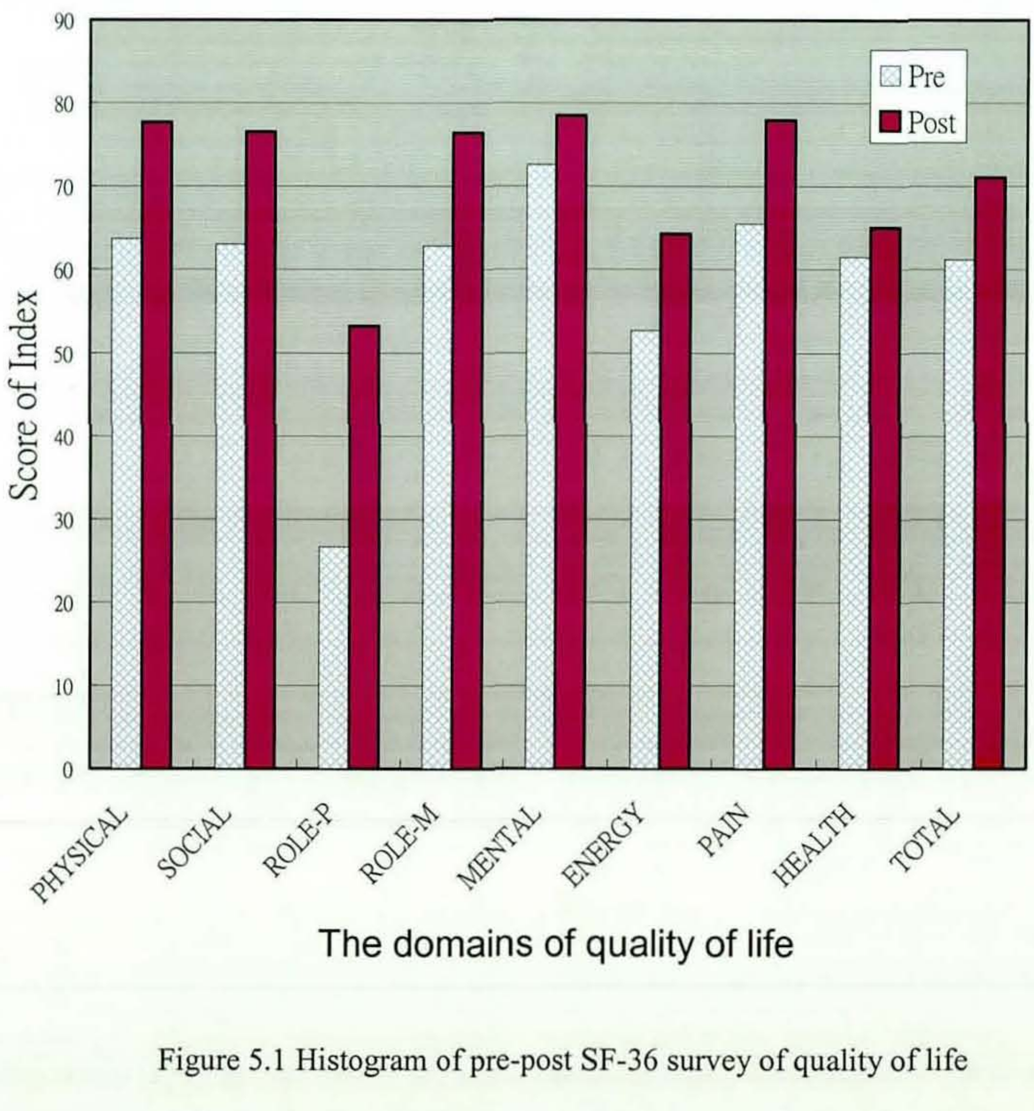


Figure 5.1 Histogram of pre-post SF-36 survey of quality of life

local hospital. This requirement was based upon research results which suggest patients attending a cardiac rehabilitation programme can get a higher score for quality of life than patients who stay at home or do not care about the rehabilitation process (British Association for Cardiac Rehabilitation, 1995). In terms of the patients in this research, they have improved in aspects of physiological, psychological and social status. Generally, the score of quality of life indicated a statistically significant difference (see Table 5.5, p.95) between before and after a cardiac rehabilitation programme.

The discriminant analysis method (see p.69) was applied to the data. The questionnaire of quality of life contains eight dimensions as dependent variables and three groups of age are as independent variables. Potentially, the score for quality of life may be different for the three age groups. Therefore, the discriminant analysis was used to analyse the difference between the groups and/or provide a means to classify any case into the groups which it most closely resembles (Klecka, 1980, p9).

The average score of quality of life, shown in Table 5.6 has obvious differences between pain, mental and energy/vitality dimensions. Moreover, Table 5.7 (see p.99) presents standardised canonical discriminant function coefficients and structure matrix. On the two functions listed in Table 5.7, it appears that the pain dimension provides the greatest amount of explanatory power on the first function and correspondingly the social function on the second function. The group centroids have shown a significant distance between group A and C as shown Figure 5.2 (see p.100). Thus, the parameter of pain has much explanatory power in explaining the first function. Conversely, the pain factor could affect the score of quality of life between group A (under 55 years) and C (over 65 years).

Table 5.6 Mean & SD of age groups on SF-36 QOL survey

Dimensions	Age					
	A group Under 55 yrs		B group 56-64 yrs		C group Over 65 yrs	
	M	SD	M	SD	M	SD
Physical Function	71.25	20.21	69.50	17.84	72.04	18.20
Social Function	44.44	7.03	49.44	9.86	42.39	7.57
Role Limitation Physical	42.19	41.55	32.50	41.44	37.04	43.51
Role Limitation Emotional	79.17	31.91	61.67	46.23	71.60	36.64
Mental Health	72.25	17.37	73.20	19.69	79.41	17.46
Energy/Vitality	53.13	21.36	58.50	21.77	62.04	20.77
Pain	45.14	12.48	45.00	7.63	52.26	7.43
Health Perceptions	60.75	8.66	61.85	9.38	59.04	10.55

Table 5.7 Different age groups of cardiac patients on discriminant analysis

Groups (N=63)	Discriminant Functions	
Age	Group Centroids	
	Fun. 1	Fun. 2
Under 55 yrs	-.702	-.556
Between 55-64 yrs	-.340	.604
Over 65 yrs	.668	-.118
	Structure Matrix	
	Fun. 1	Fun. 2
Pain Dimension	.645	-.215
Mental Health Dimension	.303	-.050
Energy/Vitality Dimension	.263	.136
Health Perceptions Dimension	-.177	.153
Social Function Dimension	-.388	.644
Role Limitation Emotional	-.020	-.382
Role Limitation Physical	-.029	-.188
Physical Function Dimension	.063	-.101

* FUN1 through 2: Chi-square=28.608, df=16, p<.05.

**FUN2: Chi-square=10.785, df=7, p>.05.

In addition, the independent variable i.e. gender and disease types have also been examined in discriminant analysis. There were no significant differences among these variables with the eight dimensions of health-related quality of life.

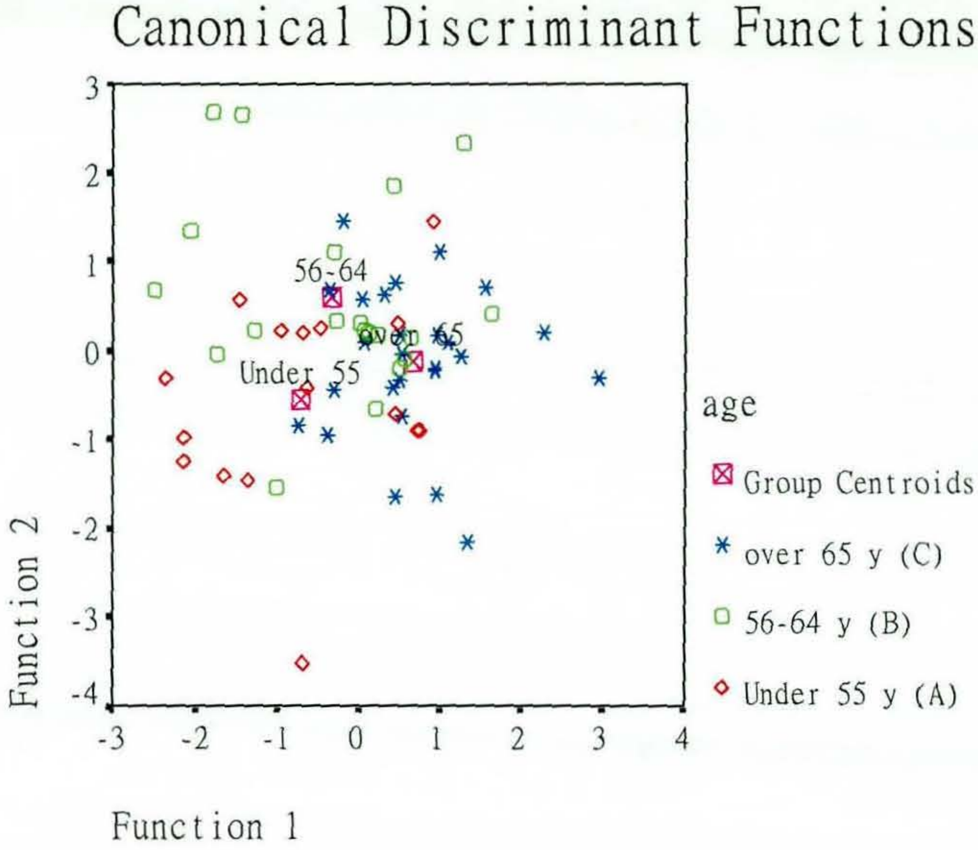


Figure 5.2 Scatter plot of canonical discriminant functions on SF-36 scores by age group.

5.4 Discussion

The purpose of this study was to examine the patient's quality of life using the SF-36 questionnaire when administered to participants in a cardiac rehabilitation programme. The SF-36 is scored in such a way that a high score indicates a better health state. The results of the study support the findings of others who view the SF-36 in a positive light and who consider it to be a sound instrument for measuring change in QOL (Crockett, Cranston, Moss, & Alpers, 1996; Prieto, Alonso, Ferrer, & Anto, 1997; VanderZee, Sanderman, & Heyink, 1996). The SF-36 appears to be a useful instrument when measuring QOL in cardiac rehabilitation.

Jette and Downing (1994) recruited 789 men and women participating in one of 13 cardiac rehabilitation programmes in the state of Massachusetts. Subjects completed a 36 item generic questionnaire, Short Form 36 (SF-36) which examines eight health concepts. Scores range from 0% to 100%; a higher score is consistent with better health status. Their results show that after adjusting for sex, age, and education, cardiac disease is associated with reductions in health-related quality of life. Therefore, the authors considered that the health status instrument (SF-36) used in their study has the potential to be a useful, practical measurement tool for assessing clinical processes in cardiac rehabilitation programmes.

According to the ratio of gender, the male's score of quality of life is mostly higher than the female's. Recent findings from Lukkarinen and Hentinen (1997) indicated that women in general, and especially younger women, have a poorer quality of life than men. However, it should be noted that more men than women were referred for by-pass surgery. Nevertheless, there is no obvious difference between male and female quality of life in this study.

Similarly, Jette and Downing (1994) studied the health status of individuals entering a cardiac rehabilitation programme as measured by the medical outcomes study 36-item short-form survey. The findings of their study are: the demographic variable, i.e. sex and age, were not significantly different within the domains of the SF-36. Gender difference, including the structure of physical, exercise capacity, behaviour characteristics, coronary risk factors and quality of life may cause different results. Moreover, women were not extensively encouraged to participate in cardiac rehabilitation and exercise training programmes (Lavie & Milani, 1995a).

Lukkarinen and Hentinen (1997) point out that the health-related quality of life of coronary patients before the invasive procedures was significantly poorer on all the six dimensions than the quality of life in an age and sex matched general population. The most obvious differences were seen on the following dimensions: energy, pain, emotional reactions, sleep and physical mobility. Although there are slight differences between the Nottingham Hospital Profile (NHP) and the SF-36, some dimensions are linked together, for example, energy, emotion and physical mobility. Correspondingly, the results of this study indicated that patients also had poor quality of life before entering a cardiac rehabilitation programme.

The results show that patients with cardiac disease are most disabled or limited in their performance of roles by physical problems. The modal score was the lowest possible score for the scale. The subjects were limited in the kind of activities they could perform, they had to reduce the amount of time spent on activities and had difficulty performing the activities that they took on. This finding may be a reflection of physical restrictions placed on patients by their health care providers following a cardiac event or procedure, or they may reflect self-imposed or family imposed restrictions based upon anxiety or lack of information concerning safe types of activities.

On the basis of the present findings, patients entering cardiac rehabilitation programmes can also be expected to experience a considerable lack of energy or feelings of fatigue. For example, answers to items on the SF-36 suggested that our patients felt worn out and tired. These findings indicate the need for attention to the psychological needs of patients on cardiac rehabilitation programmes. The findings also support the view that patients may need assistance with learning how to pace daily activities (Beniamini, Rubenstein, Zaichkowsky, & Crim, 1997; Cozen & Pass, 1998; Haley, McHorney, & Ware, 1994; Johnson, 1989; Oldridge et al., 1991).

Most patients referred for cardiac rehabilitation have stable angina and are well controlled with medication or have had procedures such as CABG and angioplasty that are designed to reduce or eliminate anginal pain. The findings demonstrate that different age groups can be affected by the main factor of pain dimension.

The findings also compare with those of Stewart et al. 's (1989) study. They included patients with chronic diseases such as myocardial infarction, congestive heart failure, and angina. The subjects with myocardial infarction demonstrated significant deviations in scores on physical, social, and role function and health perceptions as compared with the patients without chronic diseases. These findings concur with our findings that patients were most limited in carrying out roles due to physical functional limitation.

5.5 Conclusion

From a social point of view, the patient's symptoms and quality of life are even more important than the objective medical outcome. In clinical decision-making, the goal is to integrate the results of health-related quality of life assessments with clinical decisions. This decision-making underlines the need to evaluate whether the treatment given is congruent with the patient's quality of life.

The findings concerning the health status of patients entering cardiac rehabilitation programmes are consistent with this study. In terms of the ratio of gender, there is no difference between male and female. Findings indicate older people with coronary heart disease gain more pain relief than their younger counterparts. In relation to the types of treatment, the patients with CABG have a higher score of quality of life than the other treatment.

After a cardiac rehabilitation programme, statistically significant improvements occurred in physical function, social function, role limitation/physical, energy/vitality, bodily pain, and change in health-related dimensions of quality of life. Importantly, this data further supports the proposition that cardiac rehabilitation and exercise training programmes improve quality of life in coronary artery disease patients. Therefore, the SF-36 should be considered an appropriate instrument when measuring generic health-related QOL in cardiac rehabilitation. Furthermore, research must continue into the evaluation of the QOL in cardiac rehabilitation programmes, with the aim of establishing a more accurate assessment of QOL.

CHAPTER 6

HEALTH-RELATED QUALITY OF LIFE ASSESSMENT: DISEASE-SPECIFIC MEASURES-QLMI

6.1 Introduction

Cardiovascular disease is currently the major cause of death in the UK and other developed countries. Indeed, it is of growing concern in many developing countries (Mark et al., 1994; Sophie, Carole, Mike, & British Heart Foundation, 1999). Health-related quality of life can be assessed using disease-specific or generic measures. Using generic measures enables a wide variety of domains to be investigated. Therefore, anticipated and unpredictable treatment effects and adverse effects can be assessed. However, the major limitation of these instruments is that it does not examine treatment or adverse effects in detail.

Disease-specific instruments focus on the problems of a defined population at a specific point in a disease process. The key strength of this instrument is that it addresses treatment and adverse effects in detail. There has been a noticeable shift in recent years towards a focus on disease-specific quality of life (QOL) as the primary outcome measure in studies of cardiovascular disease. In particular, there appears to be a demand for reliable, sensitive and validated questionnaires which measure QOL following coronary heart disease (CHD), which can be used in a patient self-administered mode. While disease-specific instruments cannot be used to compare populations with different illnesses or problems, they have an important role in elucidating areas of health-related quality of life impairment in patient groups of special interest (Guyatt, Veldhuyzen Van Zanten, Feeny, & Patrick, 1989).

Most QOL questionnaires comprise multiple items. Besides problems of interpretation, analysis of each item separately raises methodological problems because of multiple comparisons. Developers of questionnaires typically aggregate items into a small number of conceptually meaningful Quality of Life dimensions (Guyatt et al., 1989; Oldridge et al., 1991). Often QOL dimensions are defined intuitively in a manner considered meaningful by the investigators (Cleary, Greenfield, & McNeil, 1991; Guyatt et al., 1989) or identified via a data analytic technique such as factor analysis (Fletcher, Hunt, & Bulpitt, 1987).

At this point, there are three controversial issues that need to be clarified and the purpose of this chapter is to address these issues. First, the definition of domains of quality of life is unclear because researchers have defined the domains in different ways, with diverse meanings (Hillers et al., 1994; Lim et al., 1993; Valenti, Lim, Heller, & Knapp, 1996). It is essential to construct and build an appropriate model or domains of QOL for coronary heart disease patients.

Second, although the questionnaire of Quality of Life after Myocardial Infarction (QLMI) is an acceptable instrument for coronary heart disease patients (Smith et al., 2000), it needs to confirm its validity and reliability. The third issue is to evaluate the cardiac rehabilitation programme, and to help those patients to get a higher score for quality of life by means of a cardiac rehabilitation programme.

The purposes of this chapter are:

(1) To examine the validity and reliability of a QLMI instrument in order to build up an appropriate model of QOL for cardiac patients;

(2) To compare the differentials of QOL for people with coronary heart disease between entering and completing a cardiac rehabilitation programme.

To address the research questions raised, the following issues are examined:

(1) An appropriate model of QOL must include the domains of physical, emotional and social.

(2) The construct of validity and reliability of QLMI has to satisfy the rigours of formal statistical methods.

(3) The patients will get higher scores after completing a six-week cardiac rehabilitation programmes.

6.2 Method

6.2.1 Subjects

In the first part of the study, one hundred and forty-one consecutive patients (115 male; 26 female) were administered the QLMI at the commencement of a cardiac rehabilitation programme. Factor analysis was used to determine the domains of quality-of-life. Fifty-two patients, who fully completed the cardiac rehabilitation programme, were selected for the second part of the study. This study consists of a comparison of the QOL questionnaire between entering and completing the cardiac rehabilitation programme.

Ages of participants ranged from 25 to 82 years (mean = 62). The participants had begun the cardiac rehabilitation programme after experiencing one of two broadly defined events: surgery (n = 112) including CABG, AVR/MVR, transplant; or non-surgery (n = 29) covering PTCA, MI and cardiac failure (see Table 6.1). Data collection took place from September 1998 to March 1999 at a local hospital.

Table 6.1 The demographic of QLMI health-related quality of life

		Frequency	Percent
Gender	Male	115	81.6
	Female	26	18.4
Event	Surgery	112	79.4
	Non-surgery	29	20.6

6.2.2 Instrument

The MacNew Quality of Life after Myocardial Infarction Questionnaire (QLMI-2), a modification of the original QLMI, is a self-administered, condition-specific, health-related quality of life instrument that is valid, reliable, and responsive, and is simpler to administer than the original QLMI (Heller, Knapp, Valenti, & Dobson, 1993; Lim et al., 1993; Valenti, Lim, Heller, & Knapp, 1996). The refined questionnaire (comprising the QLMI with two original questions removed and three new questions added) is known as the QLMI-2 and groups 27 items into three domains: emotional, physical, and social.

6.2.2.1 Description of QLMI Questionnaire

The Quality of Life after Myocardial Infarction Questionnaire (QLMI) was originally developed at McMaster University, Canada. The initial QLMI is a valid, reliable, and responsive interviewer-administered questionnaire for disease-specific health-related quality of life (Oldridge et al., 1991; Hillers et al., 1994). This questionnaire contains 26 items, which are categorised into five domains: symptoms, restriction, confidence, self esteem, and emotion.

The MacNew QLMQ (QLMI-2) appears to have better psychometric properties than the original QLMI, as the domains of the QLMI-2 have higher internal consistency estimates and are based on factor analysis. Although there is little difference in the contents of the QLMI and the QLMI-2, it is likely that the QLMI-2 would be at least equally as useful as the QLMI in evaluative studies.

Dempster and Donnelly (2000) pointed out that one of the best disease-specific measures appears to be the QLMI-2. In the light of the current evidence, a more detailed psychometric analysis of the QLMI-2 has been conducted, when compared to the Seattle Angina Questionnaire (SAQ) (Dougherty, Dewhurst, Nichol, & Spertus, 1998). According to the findings of Dempster and Donnelly (2000), it is the recommended choice of disease-specific health-related QOL measurement instrument, for use with patients who have ischaemic heart disease.

The questionnaire of QLMI is widely recognised as having validity and reliability and it is also a popular instrument for evaluating quality of life for people with coronary heart disease. In light of this research evidence and clinical experience, this study has adopted the MacNew QLMI questionnaire as its measurement instrument (see Appendix 3). The developers of the QLMI agreed to the questionnaire being used in this study (see Appendix 2).

6.2.3 Data Analysis

The treatment of the demographic data consisted of measures of central tendency for the interval data utilizing the mean and standard deviation of age. The nominal data describing gender and disease events was represented by percentages and frequency measurements (Munro, 1997).

The first research question to be addressed was 'construct validity' which extracts effective factors from indicators of instruments through exploratory factor analysis. When using factor analysis, three decisions need to be made. The first decision involves whether factor analysis is appropriate for the data. The second decision relates to the number of factors which should be used. The final decision was related to which variables are important for which factors. Table 6.2 summarises some possible answers to these questions.

Table 6.2 Some criteria in factor analysis

Criteria	Comments
Factor loading (Smyth & Yarandi, 1996)	Factor loading <0.35 needs to be eliminated. Factor loading ≥ 0.4 are highlighted (i.e., 0. 4 is the cut-off point)
Eigenvalue (Hair, Anderson, Tatham, & Black, 1998)	For Principal Component Analysis only those values with an eigenvalue of greater than one are considered to be significant.
KMO (MSA) (Kaiser & Rice, 1974)	An index for comparing the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients (Norusis, 1994, p52). MSA < 0. 50 is unacceptable.

An exploratory principal components factor analysis with the varimax rotation was used to determine the allocation of items in the QLMI questionnaire to the underlying QOL domains. The varimax rotation maximizes the loading on one factor and minimizes the loadings on all others (Ferketich & Muller, 1990). Items with individual factor loadings of at least 0.40 were selected for retention of a factor (Smyth & Yarandi, 1996). Factors with an eigenvalue of one or greater determined the number of factors to be extracted. The interpretation of the results was in relationship to the conceptual framework and the assumption of reconstructing an appropriate model of QOL for people with coronary heart disease.

Exploratory factor analysis is a data simplification technique and is used to determine the (few) underlying dimensions of a large set of intercorrelated variables (Bryman, 1999). Factor analysis attempts to identify factors which are independent from each other in order to promote an understanding of the structure of the specific content area (Green P.E., Tull D.S., & Albaum G., 1988).

It was expected that factor analysis would show there were no dispersing components but that these were linked together by a few underlying factors.

The second research question addressing internal consistency reliability was established using a Cronbach's alpha coefficient. A Cronbach's alpha coefficient of 0.70 was considered a sufficient indicator of reliability of the QLMI based on (Nunnally & Bernstein, 1994).

A paired t-test was applied to derive the significance of the difference at $p<0.01$ between pre and post rehabilitation programme. The data was represented by the mean and standard deviation (SD). The data from the questionnaire of QLMI was entered into a SPSS-PC data file and treated as interval/nominal data.

6.3 Results

6.3.1 Domains of Quality of Life

The aim of the first research question was to identify constructs that unite a set of characteristics of health-related QOL for coronary heart disease as a means of determining appropriate domains using a factor analysis approach. A principal components factor analysis using a varimax rotation was performed on 141 participant scores.

The initial step was to compute a correlation matrix for the twenty-seven items. Where there were no significant correlations between these items, it would not be appropriate to conduct a factor analysis. The correlation matrix for these items in the quality of life after myocardial infarction is presented in Table 6.3. All but one (Question 27) of the items is significantly correlated at less than the 0.05 level, either positively or negatively, with one another (Question 16). This finding suggests that the domains of QOL may constitute one or more factors.

Exploratory factor analysis was performed using the guidelines described in the previous section (see Section 6.2.3) for KMO, eigenvalues, and factor loadings. The principal components analysis extracts clusters of intercorrelated variables that account for variance in the observed variables. Previously set acceptance criteria included eigenvalues greater than 1.0 and retention of individual factor loading of 0.40 or higher. The individual factor loading of at least 0.40 for retention of an item is recommended (Smyth & Yarandi, 1996). Factors with an eigenvalue of 1, or greater determined the number of factors to be extracted. The smallest number of factors is desirable for reasons of parsimony.

Table 6.3 Correlation matrices for items of QLMI questionnaire

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27
Q1	1.000																										
Q2	.658	1.000																									
Q3	.504	.652	1.000																								
Q4	.743	.757	.636	1.000																							
Q5	.697	.639	.680	.727	1.000																						
Q6	.605	.623	.554	.651	.541	1.000																					
Q7	.675	.666	.633	.705	.683	.542	1.000																				
Q8	.656	.555	.618	.676	.717	.520	.626	1.000																			
Q9	.341	.389	.386	.423	.323	.479	.281	.352	1.000																		
Q10	.546	.614	.549	.666	.591	.417	.593	.535	.175	1.000																	
Q11	.382	.397	.503	.406	.465	.459	.341	.400	.332	.335	1.000																
Q12	.490	.496	.553	.572	.461	.642	.472	.397	.487	.342	.481	1.000															
Q13	.465	.572	.563	.525	.586	.376	.510	.411	.306	.486	.421	.425	1.000														
Q14	.306	.387	.336	.387	.320	.393	.293	.299	.396	.231	.330	.418	.292	1.000													
Q15	.487	.670	.645	.666	.642	.546	.590	.549	.326	.601	.488	.469	.626	.432	1.000												
Q16	.294	.506	.320	.445	.279	.446	.249	.248	.389	.241	.235	.320	.329	.190	.382	1.000											
Q17	.414	.411	.422	.465	.364	.492	.364	.331	.349	.188	.493	.555	.354	.450	.465	.265	1.000										
Q18	.566	.649	.626	.656	.625	.473	.586	.649	.269	.665	.421	.453	.575	.412	.726	.289	.396	1.000									
Q19	.262	.323	.372	.314	.314	.322	.316	.396	.404	.165	.281	.394	.240	.297	.348	.234	.293	.366	1.000								
Q20	.527	.438	.487	.514	.473	.501	.405	.487	.474	.262	.479	.593	.461	.436	.498	.165	.760	.445	.366	1.000							
Q21	.428	.417	.491	.482	.439	.485	.432	.530	.407	.274	.459	.474	.455	.386	.521	.164	.568	.486	.337	.620	1.000						
Q22	.327	.273	.227	.340	.321	.228	.243	.330	.287	.158	.333	.254	.314	.130	.271	.272	.177	.323	.230	.195	.377	1.000					
Q23	.600	.710	.608	.687	.567	.567	.556	.489	.375	.486	.454	.565	.529	.415	.600	.402	.428	.542	.327	.459	.462	.386	1.000				
Q24	.463	.392	.493	.597	.510	.476	.416	.403	.370	.269	.447	.621	.479	.302	.460	.314	.523	.392	.335	.595	.521	.297	.492	1.000			
Q25	.506	.471	.561	.622	.555	.561	.454	.474	.420	.338	.421	.704	.414	.393	.488	.287	.496	.461	.440	.587	.527	.238	.494	.722	1.000		
Q26	.420	.423	.477	.467	.419	.486	.367	.400	.430	.234	.538	.536	.381	.512	.512	.265	.764	.443	.373	.784	.581	.263	.478	.541	.563	1.000	
Q27	.218	.213	.223	.212	.213	.250	.084	.130	.095	-.002	.295	.287	.164	.280	.243	.072	.233	.146	.138	.233	.323	.197	.204	.270	.289	.308	1.000

An orthogonal rotation is based on the assumption that the factors are uncorrelated and thus the independence of the factors is maintained (Polit-O'Hara, 1999). Varimax rotation is an orthogonal rotation that maximizes the variance of the loading within factors across variables. The most frequently used rotation is the varimax rotation, which maximizes the loading of one factor and minimizes the loading on all. The advantage of the varimax is that the extracted factors have a greater number of items that load only on those factors (Ferketich & Muller, 1990).

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is an index for comparing the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients (Norusis, 1994, p52). A small value for KMO means that a factor analysis of the variables may not be appropriate, because correlations between pairs of variables cannot be explained by the other variables. Kaiser (1974) characterises KMO values in the 0.90's as 'marvellous', in the 0.80's as 'meritorious', in the 0.70's as 'middling', in the 0.60's as 'mediocre', in the 0.50's as 'miserable', and below 0.5 as 'unacceptable'. The KMO value obtained from analysing the data for QLMI survey is 0.93. This shows that the data set collected from 141 cardiac patients can be used for factor analysis.

In order to decide how many factors should be used this study followed the general rule of existing factors if eigenvalues are greater than one. The item loadings on the initial four principal components and the eigenvalues greater than one for the QLMI questionnaire in this study are listed in Table 6.4.

Table 6.4 Item loadings on first four principal components: factor matrix

Variables	Factor 1	Factor 2	Factor 3	Factor 4
1. Frustrated	***.76***	-.23	-.05	-.01
2. Worthless	***.79***	-.30	.14	-.06
3. Confident	***.79***	-.15	-.08	-.03
4. Down in the dumps	***.85***	-.24	.06	-.06
5. Relaxed	***.79***	-.29	-.14	.07
6. Worn Out	***.75***	.03	.20	-.16
7. Happy with Personal Life	***.74***	-.36	-.11	-.11
8. Restless	***.73***	-.25	-.12	.03
9. Short of Breath	***.55***	.26	***.46***	-.16
10. Tearful	***.62***	-.55	-.15	-.10
11. More Dependent	***.63***	.20	-.09	.25
12. Social Activities	***.74***	.26	.12	-.13
13. Others/less Confidence in you	***.68***	-.17	-.06	.17
14. Chest Pain	***.54***	.27	-.04	-.13
15. Lack Self-Confidence	***.79***	-.17	-.10	.05
16. Aching Legs	***.46***	-.08	***.69***	-.03
17. Sports/Exercise Limited	***.66***	***.47***	-.17	-.17
18. Frightened	***.76***	-.29	-.16	.04
19. Dizzy/Lightheaded	***.49***	.18	.22	-.07
20. Restricted or Limited	***.73***	***.42***	-.23	-.18
21. Unsure about Exercise	***.69***	.28	-.19	.19
22. Overprotective Family	***.42***	.01	.30	***.68***
23. Burden on Others	***.77***	-.11	.15	.07
24. Excluded	***.70***	.27	.01	.03
25. Unable to Socialise	***.74***	.24	.02	-.10
26. Physically Restricted	***.70***	***.48***	-.15	-.07
27. Sexual Intercourse	.32	.33	-.13	***.52***

Note: the score is marked as the value greater than 0.40.

To obtain a clear picture of the factors extracted for an appropriate model of QOL, Figure 6.1 shows the scree plot of the eigenvalues for each factor of QLMI scale. The graphical scree test was proposed by Cattell (1966). In this method, a graph is drawn of the descending variance accounted for by the factors initially extracted. The plot typically shows a break between the steep slope of the initial factors and the gentle one of the later factors. The term `scree', in fact, is a geological one for describing the debris found at the bottom of a rocky slope and implies that these factors are not very important. The factors to be retained are those which lie before the point at which the eigenvalues seem to level off. This occurs after the first two factors in this case, both of which, incidentally, have eigenvalues of greater than one. In other words, both criteria suggest the same number of factors in this example. The choice of criterion may depend on the size of the average communalities and the number of variables and subjects (Bryman, 1999,p282).

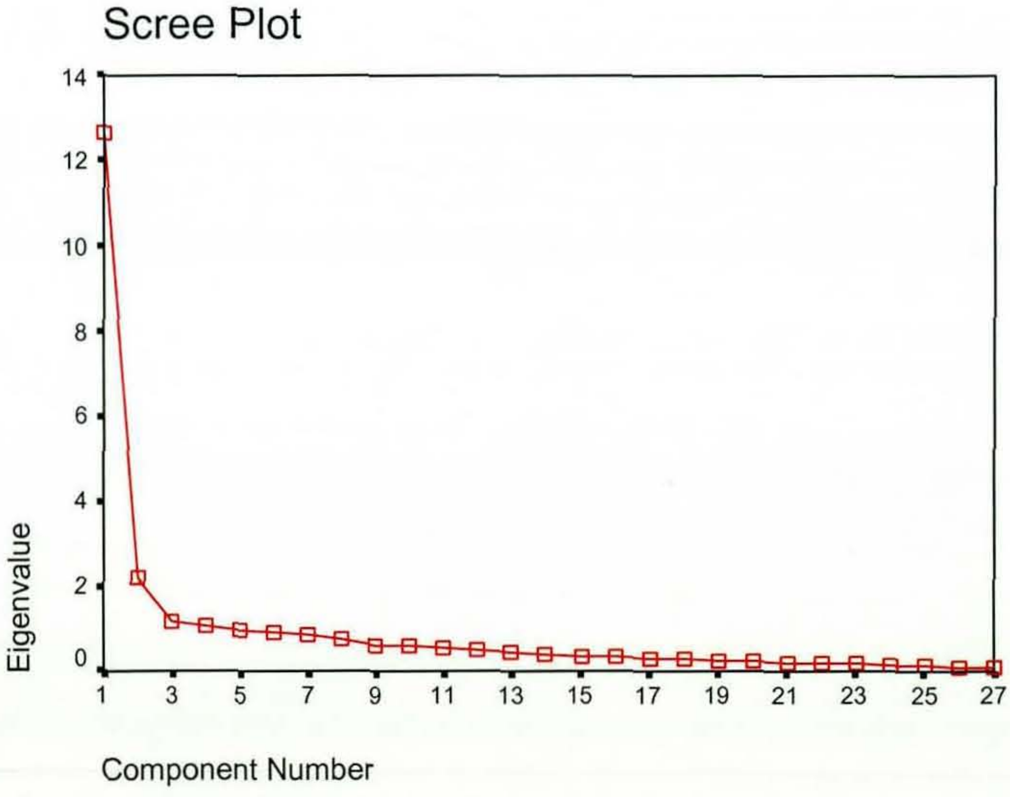


Figure 6.1 Scree test of eigenvalues for the QLMI scale

The four factors accounted for 63.5% of the variance for the sample and the results of the factor analysis for all the variables relating to the QLMI questionnaire are summarised in Table 6.5, which indicates the value of eigenvalues and total variance explained that the disease-specific for cardiac patients should be simplified into four factors. The four factors were identified as: Emotion issues (factor 1), Physical/restrictions issues (factor 2), Symptoms issues (factor 3) and Social/Family issues (factor 4).

Table 6.5 Initial principal components factor analysis of QLMI scores-total variance explained.

Component	Eigenvalue	% of Variance	Cumulative %
Factor 1	12.668	46.920	46.920
Factor 2	2.213	8.197	55.117
Factor 3	1.207	4.471	59.588
Factor 4	1.071	3.965	63.553
Total			63.553%

Table 6.6 examines the variables that were loaded onto another factor of greater than 0.40 to analyse the proper placement of the variable: In Emotion issues (factor 1), thirteen variables loaded with values greater than 0.48, and represented a status of emotional condition. 'Worn-out' loaded onto Emotion issues (factor 1) at 0.48, Physical/restrictions issues (factor 2) at 0.45 and Symptoms issues (factor 3) at 0.44 possibly indicating a multiple nature of the variable related to emotional, physical/restrictions and sympton issues. However, this item was retained in Factor 1 because the attribution of this item was close to emotional factor and loading was greater than other domains.

In Physical/restrictions issues (factor 2), eleven variables loaded with values greater than 0.43 and represented an inability to perform activities of daily living or physical effects of disease or treatment of disease. Three variables loaded onto other factors at greater than 0.40. 'Worn-out' and 'Short of breath' loaded onto Physical/restrictions issues (factor 2). 'More independent' loaded onto Social/Family issues (factor 4) possibly due to the need for more support from family. Although item 11 with loading 0.41 at factor 4 is slightly less than a loading of 0.47 at Factor 2, it was shifted into Factor 4 because item 11 of attribution was more clear than Factor 2.

In Symptoms issues (factor 3), there are three variables loaded with values greater than 0.44, and represented responses resulting from the disabilities experienced by cardiac patients. Item 9 'Short of breath' alone loaded at 0.43 onto Physical/restrictions issues (factor 2), this may be due to the unrelieved pain or the perception of an overall lack of support in the area of Physical/restrictions issues. This item with a loading of 0.64 clearly belonged with Factor 3. In Social/Family issues (factor 4), three variables loaded with values greater than 0.41, and representing difficulties related to family interactions and communication. The conclusion from this statistical result is that this question 19 does not place any factors on this scale.

The internal consistency reliability of the QLMI at the 0.7 level indicated it was sufficient for the QOL instruments for people with coronary heart disease. This question was tested by using a Cronbach's alpha to determine internal consistency reliability. The standardized reliability coefficient, based on the 27-items total for the QLMI, was 0.95. Consequently, the QLMI was found to have strong internal consistency reliability. Nunnally and Bernstein (1994) has indicated 0.7 to be an acceptable reliability coefficient but lower thresholds are sometimes used in the literature. This suggested that each of the items equally affect variation in the total score and any deletion would only slightly alter the above reported reliability.

Table 6.6 Item loadings on orthogonal rotated factors of QLMI score

Variables	Factor 1	Factor 2	Factor 3	Factor 4
Factor1-Emotion				
Tearful (10)	.85			
Relaxed (5)	.79			
Happy with Personal Life (7)	.79			
Frightened (18)	.77			
Down in the dumps (4)	.76			
Worthless (2)	.74			
Restless (8)	.72			
Lack Self-Confidence (15)	.70			
Frustrated (1)	.70			
Confident (3)	.68			
Others/less Confidence in you (13)	.60			
Burden on Others (23)	.59			
Worn Out (6)	.48	.45	.44	
Factor2-Physical/restrictions				
Restricted or Limited (20)		.84		
Sports/Exercise Limited (17)		.82		
Physically Restricted (26)		.81		
Unable to Socialise (25)		.63		
Social Activities (12)		.63		
Unsure about Exercise (21)		.60		
Excluded (24)		.59		
Chest Pain (14)		.56		
More Dependent (11)		.47		.41
Factor3-Symptom				
Short of Breath (9)		.43	.64	
Aching Legs (16)			.79	
Factor4-Social/Family				
Overprotective Family (22)				.76
Sexual Intercourse (27)				.62
Dizzy/Lightheaded (19)				

Note: 1. Extraction Method: Principal Component Analysis.Rotation Method: Varimax with Kaiser Normalization.
2. (): Items number.

6.3.2 Comparison between Entering and Completing CRP

The paired-samples t test is used to determine if the mean of a sample is similar to that of the population or to analyse the results of experiments when the same person or animal is observed under two different conditions, or studies involved a pair of subjects (or measurements) that are matched in some way. A paired design allows the detection of true differences when they exit. Paired design is not restricted to situations in which the same person or object is measured under two different conditions, but the important consideration is that the two members of a pair are matched in some way (Norusis, 1999).

This study is the 'pre and post' design. When fifty-two patients are measured entering and completing a cardiac rehabilitation programme, observed differences in the components of quality of life are more easily attributable to outcomes of cardiac rehabilitation. The results of descriptive statistics between entering and completing a cardiac rehabilitation programme were presented in Table 6.7 for physical, emotional and social dimensions of QOL. Table 6.1 (see p.108) shows the cardiac patients who participated in the cardiac rehabilitation programme for six weeks. There are significant differences between pre and post investigation on the QLMI questionnaire (see Table 6.8 and Figure 6.2). In addition, the mean of the pre-test for each domain is less than the post-test domain of QOL (see Table 6.7). This indicates that cardiac patients got higher scores of QOL after completing a cardiac rehabilitation programme compared with QOL scores before the programme. In terms of the outcome of the cardiac rehabilitation, the programme was very helpful in assisting patients in the recovery stage and easing their return to normal life.

Table 6.7 Mean & SD on the pre-post measure of QLMI survey

Dimensions	N	PRE Mean	PRE SD	POST Mean	POST SD
Physical	54	4.83	1.12	5.85	.85
Emotional	59	5.03	1.18	5.65	1.01
Social	55	4.66	1.20	5.78	1.00
Total	52	4.87	1.05	5.75	.89

Table 6.8 Paired t-test on three dimensions of QLMI survey

Dimensions	t	df	Sig. (2-tailed)
Physical	9.43*	53	0.00
Emotional	6.47*	58	0.00
Social	9.22*	54	0.00
Total	8.86*	51	0.00

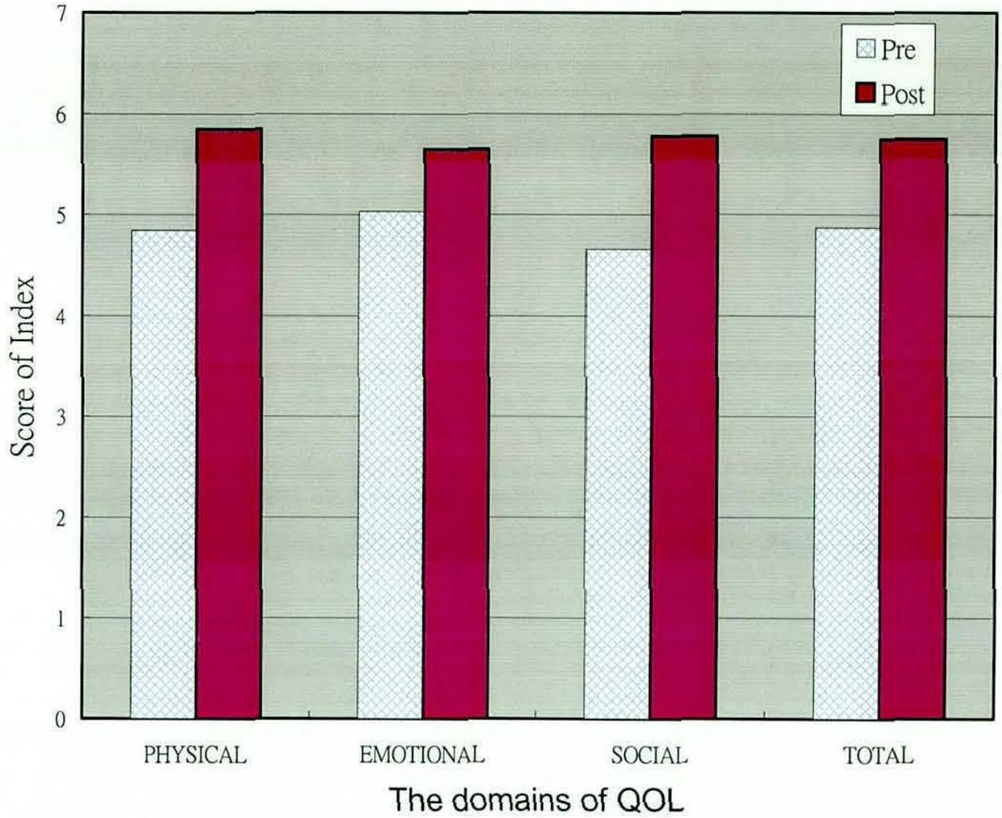


Figure 6.2 Histogram of pre-post QLMI survey of QOL

6.4 Discussion

The QLMI questionnaire of Oldridge et al. (1991) was designed to be interviewer-administered and consisted originally of 23 items. This study used the MacNew QLMI, a modification of the original QLMI, a 27 item seven-point Likert scale that was designed to measure QOL in areas related to physical, emotional, and social domains. Oldridge et al. allocated each item in the QLMI questionnaire to one of five groups, and combined these groups into two dimensions. The two dimensions were interpreted as 'physical limitations' and 'emotions' (Oldridge et al., 1991). 'limitations', includes the groups 'symptoms' and 'restrictions'. 'emotions', includes the groups 'emotional function', 'confidence' and 'self-esteem'. Items were allocated to groups 'intuitively', in contrast to allocation via a data analytic techniques such as factor analysis (Hillers et al., 1994). Lim et al. (1993) suggested three QOL dimensions which were called 'emotional', 'physical' and 'social'.

First of all, it is necessary to evaluate the validity of the QLMI in identifying constructs that unite a set of characteristics of QOL. A 'principal component' factor analysis with varimax rotation revealed clusters of related variables. Four factors, accounting for 63.6% of the variance, were identified as meeting the preset criteria of eigenvalues of 1.0 or greater and an individual loading value of at least 0.40.

Factor 1, or emotional issues accounted for 46.9 % of the variance and loaded thirteen variables: tearful, relaxed, happy with personal life, frightened, down in the dumps, worthless, restless, lack self-confidence, frustrated, confident, others/less confidence in you, burden on others, and worn out. As Oldridge et al. (1991) described, 'Emotions' includes the groups 'emotional function', 'confidence' and 'self-esteem. Thus, most of the loading variables are related to the issue of emotions.

Frustration, due to any limitations and fear of being disabled are closely associated with themes identified by Dildy (1996) in activity limitations or being 'locked in'; 'restricted lives' as described by Charmaz (1983) as well as the fear of being a burden (Pollock & Sands, 1997). The helplessness experienced by patients can be related to the loss of control/powerlessness in order to deal with the overwhelming forces of disease and treatment of disease (Benedict, 1989; Dildy, 1996)

Sense of loss due to changes in lifestyle has been identified by researchers as related to multiple losses such as loss of job, role in the family, creative endeavours and independence (Charmaz, 1983; Dildy, 1996). These findings support the presence of the dimension of emotions.

Factor 2 or physical/restriction issues added an additional 8.2% to the variance and loaded nine items: restricted or limited, sports/exercise limited, physically restricted, unable to socialise, social activities, unsure about exercise, excluded, chest pain, and more dependent. Patrick et al. (1973) pointed out that the condition of the physical function of the patient was usually used by general practitioners to obtain a patient's health status or listening to accounts of the patient's problems so as to find an appropriate treatment. In general, these disabilities include body movement (e.g., difficulty in walking or bending over), limitations in mobility (e.g., having to stay in bed or not being able to drive a car or use public transportation), or interference with self-care activities (e.g., bathing, dressing, or eating without assistance). The capacity to perform daily routines and tasks determines personal independence, a widely shared value in our society. Reduced ability to carry out these activities of daily living is also among the most frequently measured concepts of health and well-being in population studies (Katz & Akpom, 1976).

In addition, Hillers et al. (1994) define one of the domains of QOL as 'restrictions' in order to deeply explain the meaning of 'quality of life'. This domain means restricted or limited sports exercise/physical capacity. Inability to socialise is closely associated to the physical domain of the finding of this study.

Factor 3 or symptom issues added an additional 4.47% of the variance and loaded two variables: short of breath and aching legs. Pain is a common symptom of cardiac patients and a major challenge for medical care. Ferrel et al. (1991) presented a conceptual model of the relationship between pain and quality of life that has proven useful to hospice clinicians and researchers in evaluating the impact of palliative care on the QOL. Patrick et al. (1973) stated that physical symptoms, health problems, impairments, and pain are common patient complaints. However, the frequency of bodily pain or discomfort interferes with normal activities. Thus, the variables - 'short of breath' and 'aching legs' are related to the issue of symptom.

Factor 4 or Social/family issues added 3.97% of the variance and loaded two variables: overprotective family and sexual intercourse. Smith et al. (2000) compared four QOL instruments for cardiac patients using sensitivity analysis. The results indicated that marriage was regarded as the most important cue. This was followed by health, family and return to work. Moreover, Ferrans (1996) set 'family' as a domain of quality of life. Indeed, Ferrans (1996) suggests that the family plays a main role in the patient's recovery from coronary heart disease. Each family member should be interested and concerned about their relative's health and well-being. Also each family member should be aware of demands which their sick relative may make upon them. For example, the relative may need more help or consideration from their family members than they are able to provide. These findings concur with this study suggesting that social/family issue was extracted as an independent domain.

Compared to the studies of Lim et al. (1993) 's three domains and Heller et al. (1993) 's five domains, this research contributes an additional factor (four domains) to the model of QOL. In order to determine the number of domains that are most appropriate, confirmatory factor analysis can be carried out to clarify the extent to which an additional domain is important in defining quality of life. This will be examined in detail in Chapter 7.

The MacNew QLMI instrument achieved an acceptable level of internal consistency reliability on reaching a level of 0.7 or greater. Using Cronbach's alpha the internal consistency reliability was 0.92, which exceeded the minimal level for a new instrument. This indicated that items on the QLMI are a measure of QOL. It would seem that currently there are no other instruments developed to measure suffering that would permit comparison.

6.5 Conclusion

Based on this study, the following conclusions are made:

1. The QLMI demonstrated construct validity through the identification of four factors of quality of life.. 26 items of the QLMI were found to interrelate in measuring the concept of quality of life, thus establishing the presence of construct validity. The variable 'dizzy/lightheaded' was less associated with QLMI instruments.

2. The *four domains* (Emotion (factor 1), Physical/restrictions (factor 2), Symptoms (factor 3) and Social/Family (factor 4) identified in the construct of QOL were consistent with the multidimensional domains of the QOL model utilised as the framework for the development of the instrument. The QLMI demonstrated a high level of internal consistency reliability in this sample.

3. The scores of QOL, including emotion, physical, social aspects, are significantly higher when patients completed the cardiac rehabilitation programme than when entering the programme. Therefore, the QOL for cardiac patients can be significantly improved by a cardiac rehabilitation programme.

CHAPTER 7

TESTING A CONCEPTUAL MODEL OF QUALITY OF LIFE FOR PEOPLE WITH CORONARY HEART DISEASE

7.1 Introduction

In the past decade, research addressing quality of life issues has increased enormously. Indeed, King et al. (1997) noted that in the past 4 years more than 4,000 quality of life articles were published, and over 1,000 of these were related to health-related quality of life. Despite the abundance of QOL research, ambiguity continues to surround the definition and measurement of this concept (King, 1998; Mast, 1995). Quality of life (QOL) is a multivariate construct that has been broadly studied and conceptual models of the construct are still being developed (Ferrans, 1996; Hillers et al., 1994; Hornquist, 1982; Lim et al., 1993; Patrick & Erickson, 1993; Zhan, 1992).

On the whole, two research approaches can provide the multidimensionality, either using a single instrument designed to measure the many domains of QOL, or selecting a group of instruments, each of which measures a single domain of QOL. There is no standard approach to measurement for example, using a single instrument or using a combination of instruments. Both these approaches can attain the important multidimensional nature of QOL. Patient self-reporting is the preferred method of obtaining data (Haberman & Bush, 1998; King et al., 1997; Osoba, 1994).

Although there is a growing coherence and agreement about the conceptual dimensions of health-related quality of life (HRQOL), a number of researchers continue to manipulate these dimensions. Clearly, choosing the most appropriate instrument depends upon the purpose of the research and the particular patient population. In addition, it is evident that further conceptual and theoretical work is needed to guide QOL research (King et al., 1997).

Fawcett (1992) suggests that theory testing be guided by explicit conceptual models as well as middle range theory. Conceptual models provide the overall structure or 'roadmap' for theory development within a discipline. Middle range theory offers the specificity needed to test the direction, shape and strength of relationships between concepts. Each of the theory concepts must then be linked to empirical indicators which provide a method to manipulate the variable of interest.

The conceptual theoretical model developed by Patrick and Erickson (1993) illustrated the relationship amongst health-related quality of life dimensions. This work provided the basis for the development and testing of a QOL instrument. An explicit conceptual-theoretical-empirical structure (Fawcett, 1992), using Patrick and Erickson's conceptual model was developed to test propositions about HRQOL for people with coronary heart disease.

Health-related quality of life measurement instruments may have one (or more) purpose(s). Hillers et al. (1994) proposed that the QLMI instrument has five domains: the symptom domain, the restriction domain, the confidence domain, the self-esteem domain and the emotion domain. It is also proposed that the QLMI instrument tested QLMI performance as both a discriminative and evaluative instrument. This demonstrated a high degree of reliability and was more responsive than other questionnaires including the Quality of Well-being questionnaire (QWB), the Time Trade-Off (TTO), social function, depression symptom, the Profile of Mood States (POMS) and the Spielberger State-Trait Anxiety Inventory (SSTAI). Hillers et al. (1994) further proposed that relations between the QLMI and other measures provide moderate to strong evidence of its validity in discriminating between patients following AMI.

Guyatt et al. (1993) stated a discriminate instrument is designed to discriminate between people at a single point in time. For instance, the instrument may identify patients experiencing moderate or severe depression and/or anxiety post MI. Such instruments require good reproducibility and cross-sectional construct validity and need to demonstrate good correlation between established rating scales.

Lim et al. (1993) suggested that the domains of QLMI are divided into three dimensions: the emotional domain, the physical domain and the social domain using exploratory factor analysis. In their study, a sensitivity analysis revealed relative invariance of results to weighting schemes. In addition, the scores on the three dimensions were responsive to differences between the treatment groups. Moreover, the study emphasised that the QLMI questionnaire has the potential as an instrument for assessing QOL in post-AMI patients and importantly that it can be successfully self-administered.

In Chapter two, Patrick and Erickson (1993) illustrated explicit concepts for health-related quality of life (see Figure 3.1; p65). These concepts describe lucidly the components of quality of life in each domain and demonstrate a causal direction from disease through impairments to functional status, perceptions, and opportunity for health. This conceptual theoretical model is adopted in this chapter in order to develop an appropriate model of quality of life for people with coronary heart disease.

Structural equation modelling (SEM) is a statistical technique which incorporates and integrates path analysis and factor analysis. An important strength of SEM is its ability to take into account the modelling of interactions, nonlinearities, correlated independents, measurement error, correlated error terms, multiple latent independents each measured by multiple indicators, and one or more latent dependents also each with multiple indicators. Clearly, SEM may be used as a more powerful alternative to multiple regression, path analysis, factor analysis, time series analysis and analysis of covariance (Garson, 2000).

According to Garson (2000) the advantages of SEM compared to multiple regression include:

- More flexible assumptions;
- Use of confirmatory factor analysis to reduce measurement error by having multiple indicators per latent variable;
- The attraction of SEM's graphical modelling interface;
- The desirability of testing models overall rather than coefficients individually;
- The ability to test models with multiple dependents and the ability to model mediating variables;
- The ability to model error terms;
- The ability to test coefficients across multiple between-subjects groups;
- The ability to handle difficult data (time series with auto correlated error, non-normal data, incomplete data).

SEM has three main functions: (1) focusing on theory testing: SEM compares the model (including a measurement model and a structural model) and actual data; (2) simultaneous estimation: since all parameters - including measurement errors or correlated residuals are simultaneously estimated, they are more accurate than those estimated in regression analysis; (3) increasing flexibility of the model: SEM can test both recursive and nonrecursive models. Causal links are not necessarily unidimensional (Byrne, 1994; Bollen, 1989; Hayduk, 1987).

There are two key issues to this chapter. Firstly, to compare conceptual models which specify the domains of QOL for cardiac patients and the interrelationships among those domains. Secondly, to examine a theoretical model of QOL and to ascertain whether it is a valid model. In order to address these objectives, a review of the QOL results will be undertaken. In addition, previous studies that attempt to identify the constructs of QOL for cardiac patients will be discussed.

Theories that contribute toward the QOL theoretical model will be described and a theoretical QOL model proposed for cardiac patients. Finally, the proposed QOL model for cardiac patients will be tested using structural equation modelling. In addition, the proposed model will be revised and refined in order to develop an appropriate model of quality of life for people with coronary heart disease.

7.2 Research design

This chapter is divided into two parts. Firstly, a comparison of the different domains between the results of Chapter 6 and previous studies using confirmatory factor analysis will be undertaken. Secondly, an examination of the theoretical model to determine whether this matches the empirical data or not will be undertaken, and structural equation modelling will be used to establish this.

7.2.1 Comparison among QLMI Models

The original QLMI is an interviewer-administered health-related quality of life questionnaire (Hillers et al., 1994; Oldridge et al., 1991). The MacNew QLMI, a modification of the original QLMI, is a self-administered, condition-specific, health-related quality of life instrument that is valid, reliable, responsive and is simpler to administer than the original QLMI (Heller, Knapp, Valenti, & Dobson, 1993; Lim et al., 1993; Valenti, Lim, Heller, & Knapp, 1996) (see Appendix 3).

Table 7.1 shows that Hillers et al. (1994) defined five domains of quality of life: Symptom, Restriction, Confidence, Self-esteem and Emotion. The MacNew QLMI addresses three major health-related quality of life domains, the Emotional, Physical, and Social domains. However, Chapter 6 demonstrated that there are four domains of quality of life for people with coronary heart disease (through exploratory factor analysis): Emotion, Physical/restriction, Symptom and Social/support. Clearly, the definition of QOL domains seem to be confused in two studies. However, Lim et al. (1993) and Hillers et al. (1994), used a similar QLMI questionnaire, with two items different. This part of the chapter will examine all of these domains from the different studies using confirmatory factor analysis. Adopting this approach will enable an appropriate model of quality of life for people with coronary heart disease to be developed. In addition items in the four-domain QOL model in Chapter 6 will be adjusted, if the model is not appropriate for defining quality of life and the factors which govern QOL.

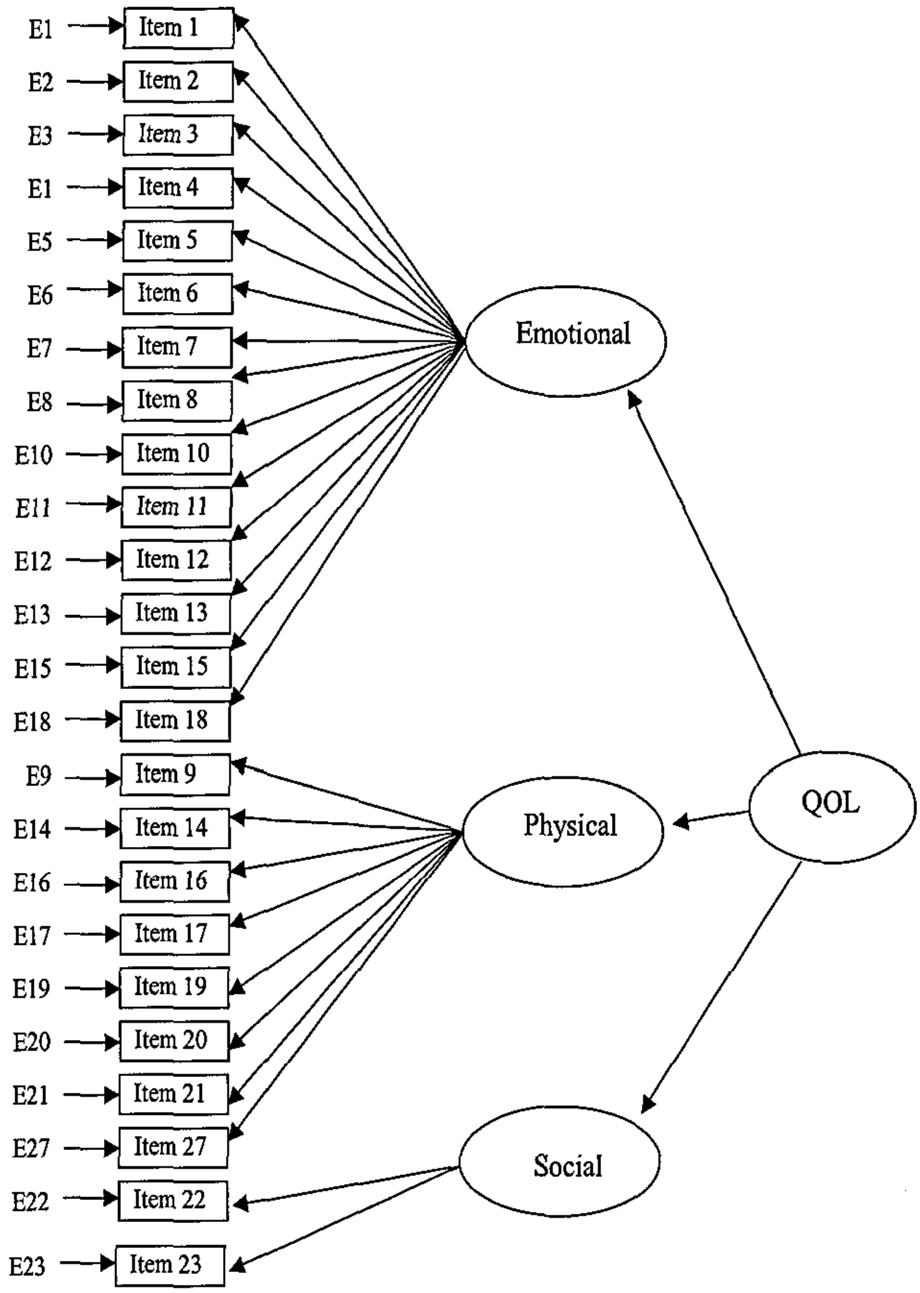
Table 7.1 Domains of quality of life using QLMI questionnaire for cardiac patients

The result of Chapter 6 (4 domains)	Lim, Valenti, et al. 1993 (3 domains)	Hillers, Guyatt, et al. 1994 (5 domains)
• Emotion	• Emotional	• Symptom
• Physical/restriction	• Physical	• Restriction
• Symptom	• Social	• Confidence
• Social/support		• Self-esteem
		• Emotion

Note:
1. This study uses a self-administered 27-item revised MacNew QLMI questionnaire.
2. Lim's study uses a self-administered 25-item adapted QLMI questionnaire.
3. Hiller's study uses an interview-administered 26 item original QLMI questionnaire.

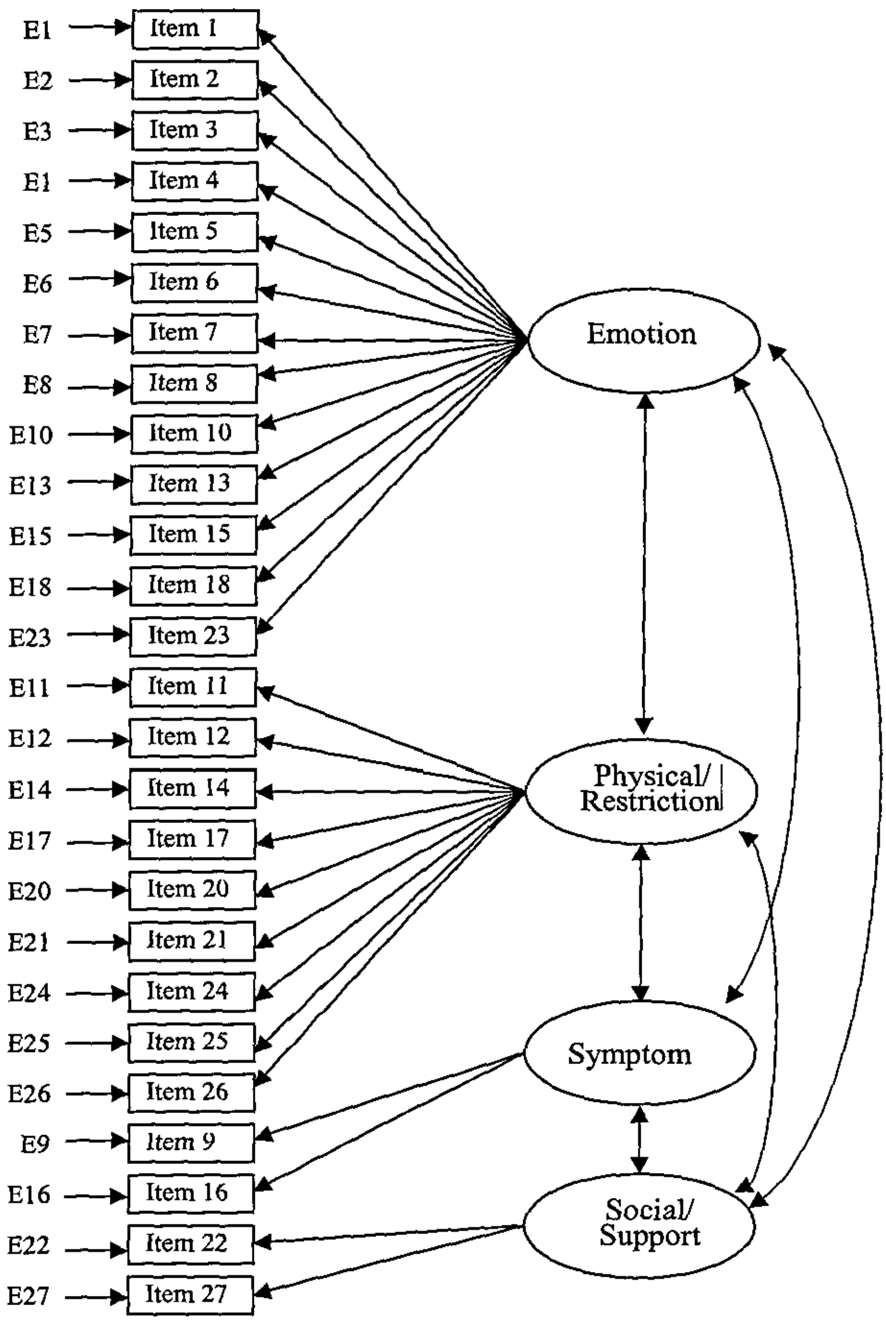
In the ordinary factor model, there are a number of factors that are arbitrarily correlated and these factors are independent variables in the model. Such factors, which are only one unidirectional arrow away from measured variable indicators are usually called 'first-order' factors. It may be desirable to further analyse the intercorrelations among these first-order factors so as to yield higher-order factors. This higher-order factor is also called a second-order factor (Mueller, 1996). Bollen (1989, p.313-14) stated that a second-order factor analysis of the latent variables directly influencing the observed variables, may itself be influenced by other latent variables that need not have direct effects on the observed variables. The theory may argue for some higher level factor that is considered accountable for the lower order factors. Essentially, the number of levels or unidirectional arrows that separate the higher order factor from the observed variables determine whether a factor model is labelled as second-order, third-order, or some higher order (Byrne, 1994, p.17).

As previously stated, the confirmatory factor analysis has one function of examining the hierarchical structure of first order and second order levels. Thus, the first order and second order levels among three studies need to be examined respectively to identify which is the best-fitting model of quality of life for people with coronary heart disease. The diagrams of first-order and second-order models in the three studies are presented in Figure 7.1, (p.134) and Figure 7.2, (p.137).



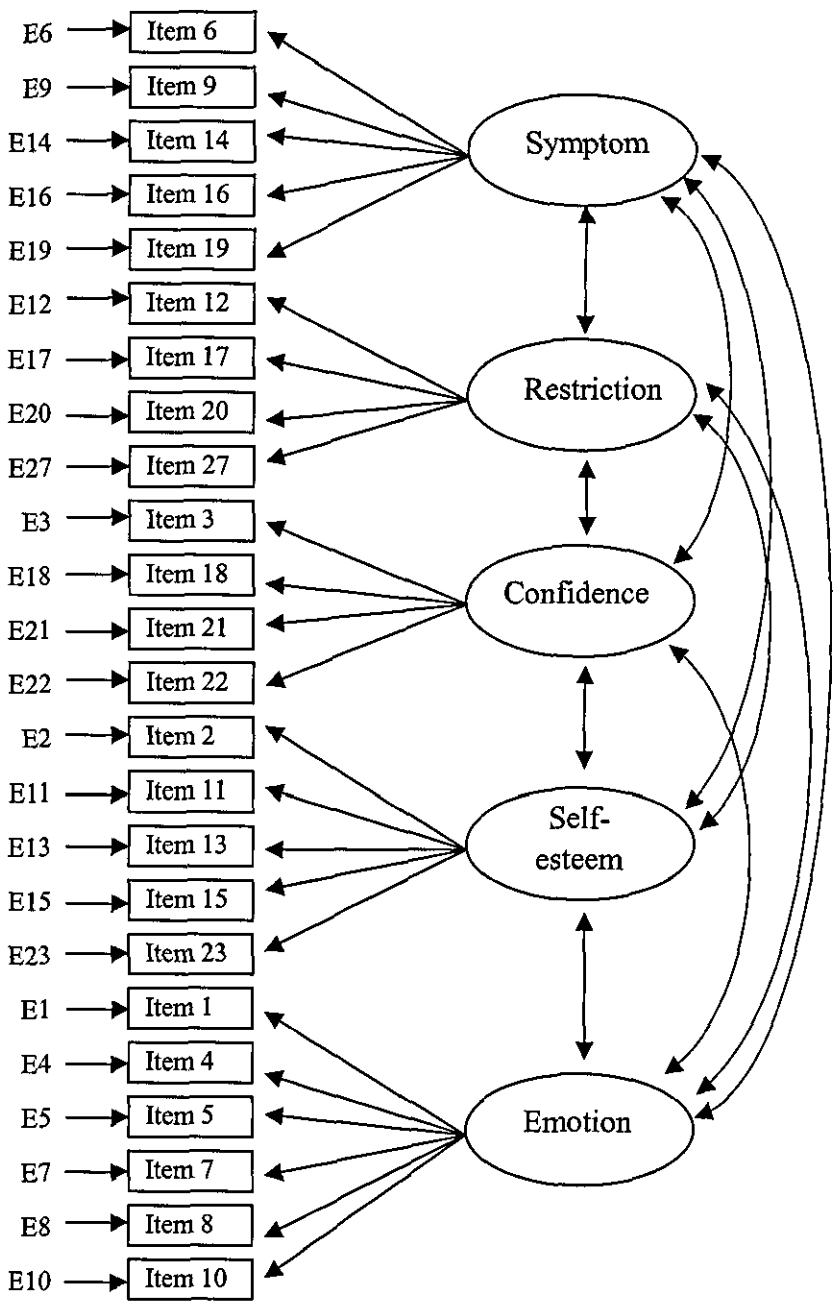
(a) Three domains QOL model

Figure 7.1 The diagram of first-order QOL model



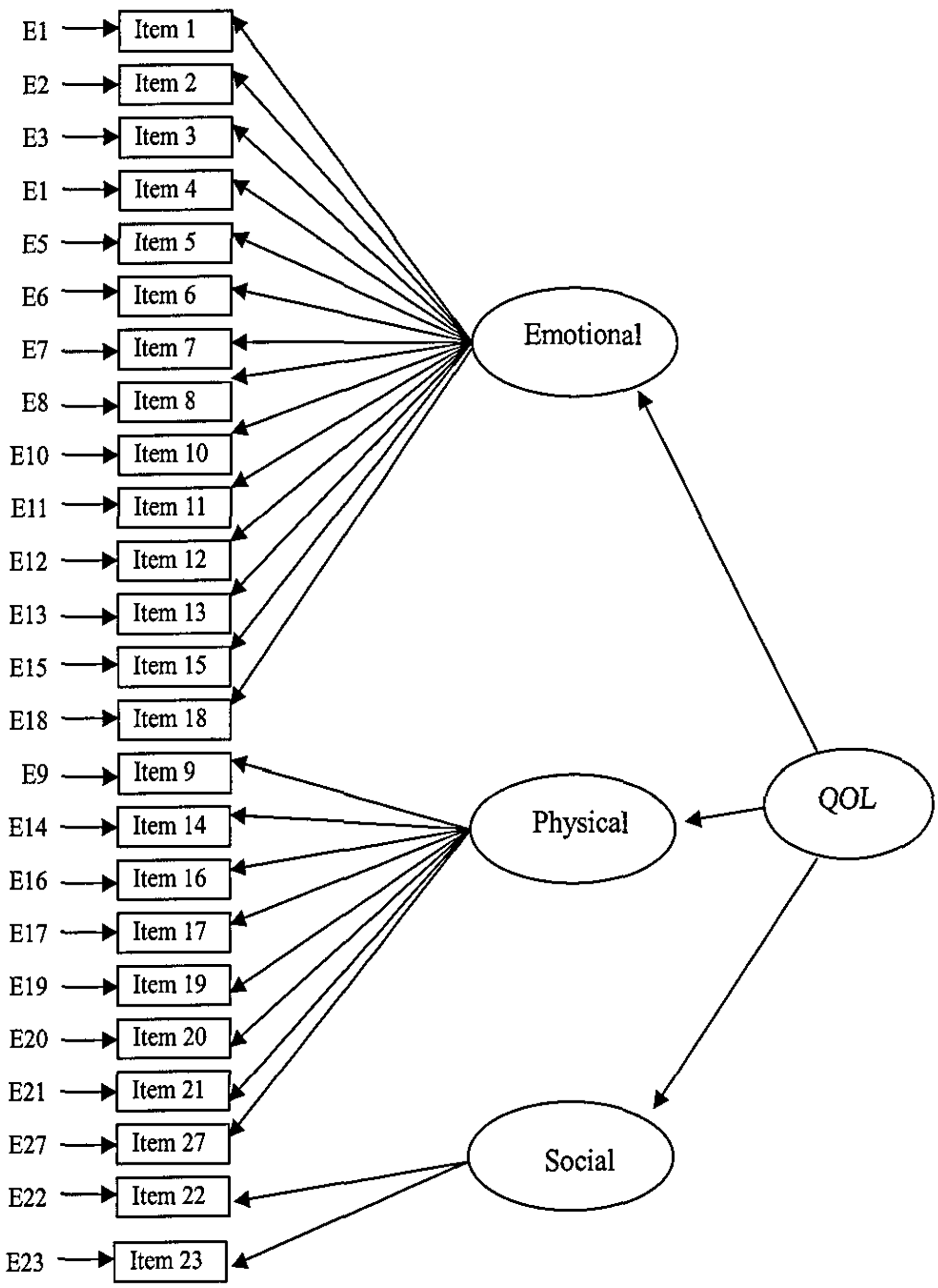
(b) Four domains QOL model

Figure 7.1 The diagram of first-order QOL model (continued)



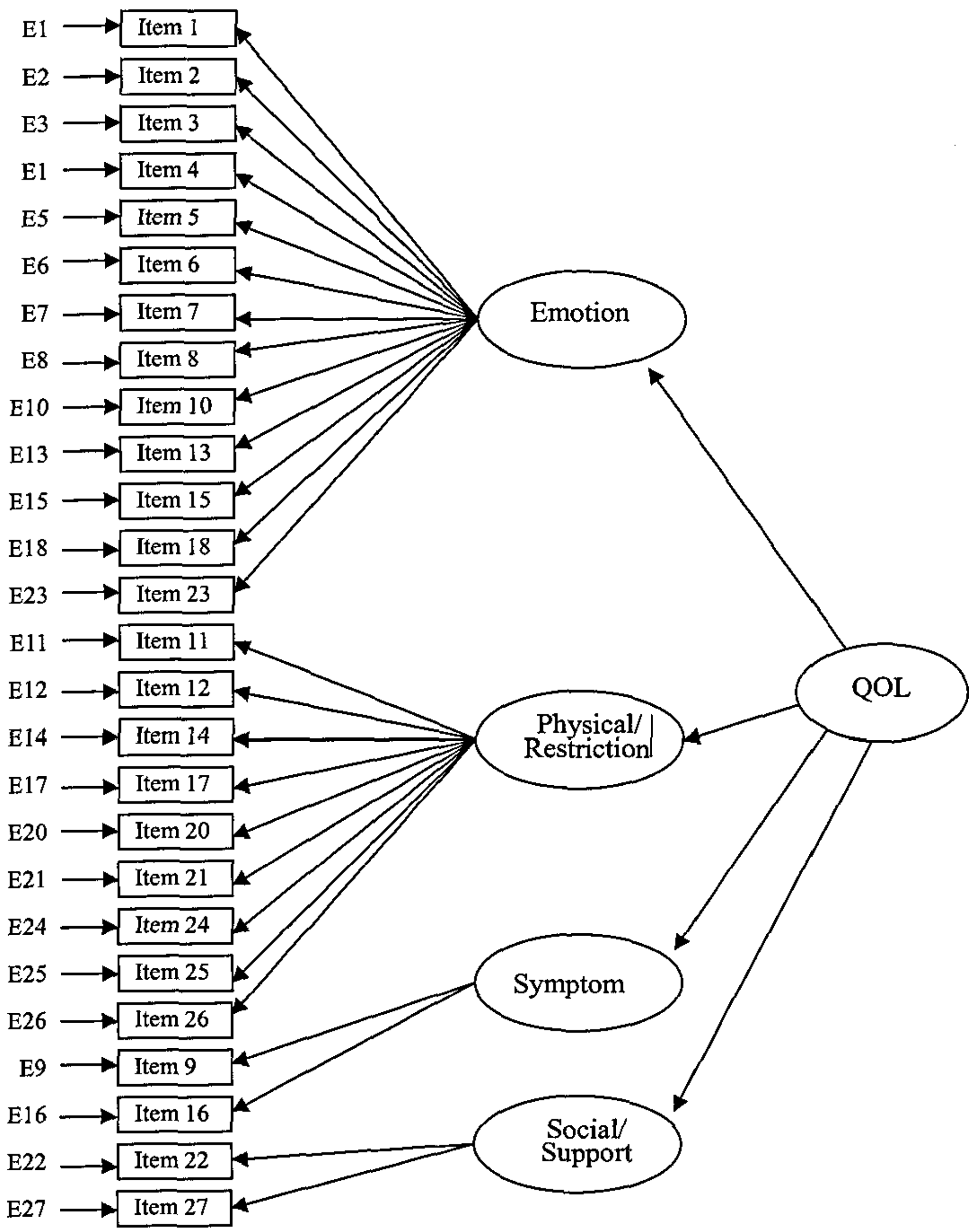
(c) Five domains QOL model

Figure 7.1 The diagram of first-order QOL model (continued)



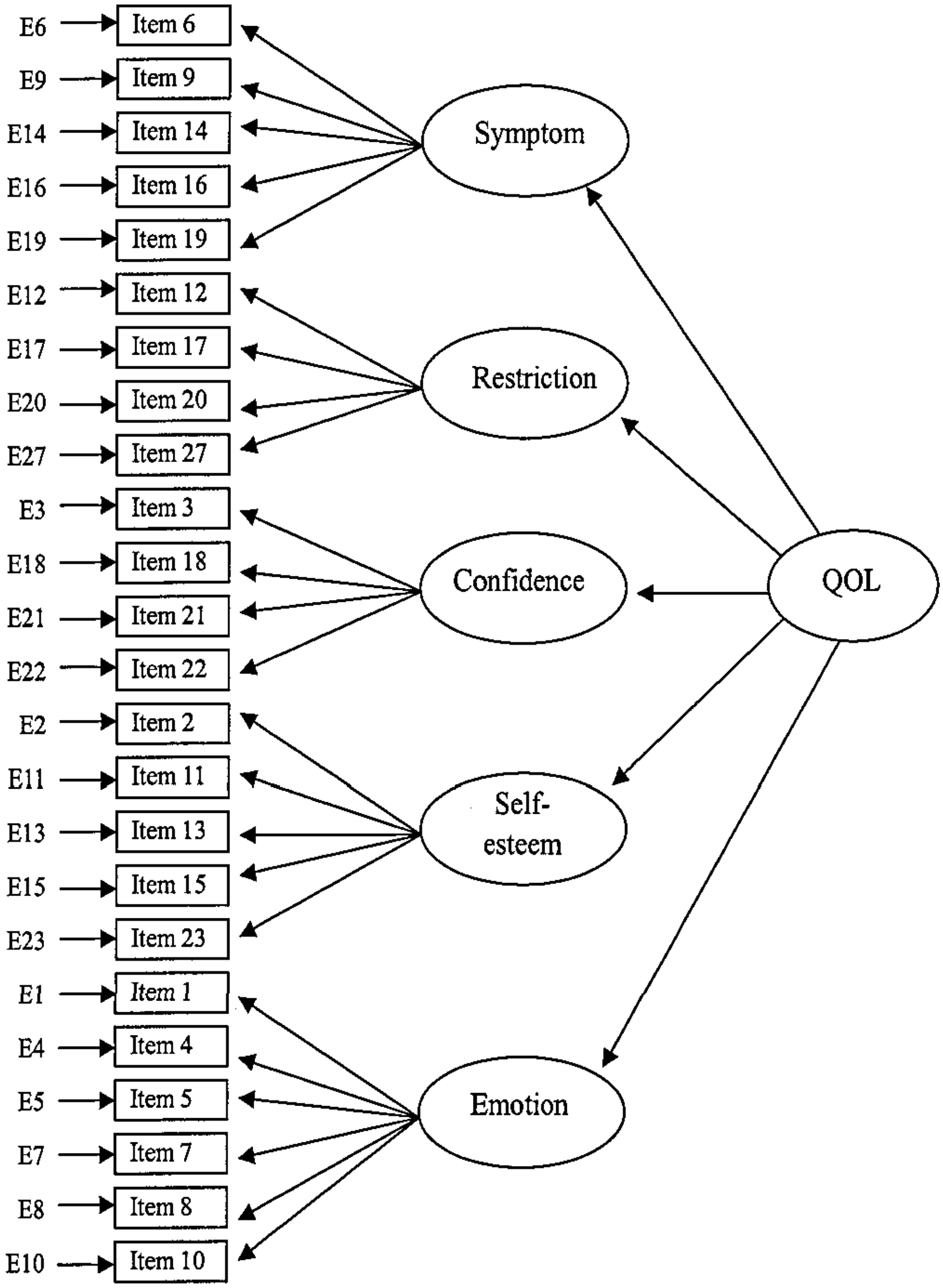
(a) Three domains QOL model

Figure 7.2 The diagram of second-order QOL model



(b) Four domains QOL model

Figure 7.2 The diagram of second-order QOL model (continued)



(c) Five domains QOL model

Figure 7.2 The diagram of second-order QOL model (continued)

7.2.2 A Test of Comparative Models

The results of Chapter 6 indicate that a four-domain model would be a best-fit model of quality of life for people with coronary heart disease. This section tests the four-domain model and examines previous studies that used the same instrument to investigate the quality of life:

(1) The four-domain model is more appropriate than the three-domain model as a best-fit model of quality of life for people with coronary heart disease.

(2) The four-domain model is more appropriate than the five-domain model as a best-fit model of quality of life for people with coronary heart disease.

(3) The second-order and four-domain model is an appropriate model of quality of life for people with coronary heart disease.

7.2.3 Setting a Theoretical Model of QOL

A revised Patrick and Erickson's conceptual model (1993) is employed as an appropriate model for people with coronary heart disease. However, a number of factors in this model have been omitted including environment and prognoses factors. Moreover, Patrick and Erickson (1993) consider the causal sequence may be reversed because reduced health perceptions may affect function. This is a complex model to examine the two-way direction in the structural equation modelling. Therefore, the main factors with one-way direction from Patrick and Erickson's (1993) model were selected in Figure 7.3 as a fundamental model of quality of life for people with coronary heart disease.

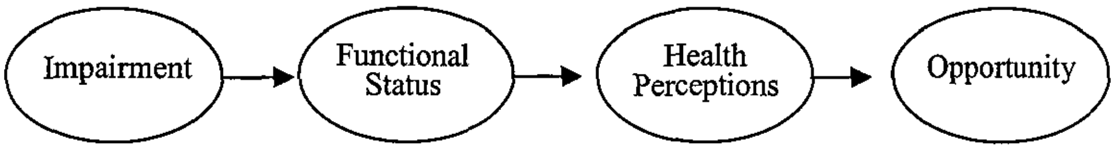


Figure 7.3 The fundamental quality of life model

7.2.3.1 The Null Model

The interrelationship between theoretical and empirical domains is presented in Figure 7.4 as the null model of quality of life. The symptom domain is equivalent to the concepts of impairment in Patrick and Erickson's (1993) theoretical model, the restriction domain is equivalent to the concept of functional status, the confidence, self-esteem and emotion domains are equivalent to the concept of health perceptions, and the overall quality of life is equivalent to the concept of opportunity. The symptom domain is the basic domain. As Patrick and Erickson (1993) stated, the symptom domain refers to a patient's physical and psychological symptoms, sensations, pain, including the patients' subjective feelings associated with their ill health.

In the medical field, Ferrell and colleagues (1991) examined the relationship between symptoms and overall QOL. Defining pain and QOL as the concepts which are determined by patients, they developed their own instrument to measure subjective pain and overall QOL. In addition, functionalist theory has significantly influenced the description of states for health indicators and indexes. The functional restrictions can be evaluated by the patients' performance. Padilla and colleagues (1990) reported that pain had a strong relation to a patient's QOL because the functions of physical, psychological and social were relatively limited. Based on these findings, it was assumed that the restriction domain affects overall quality of life.

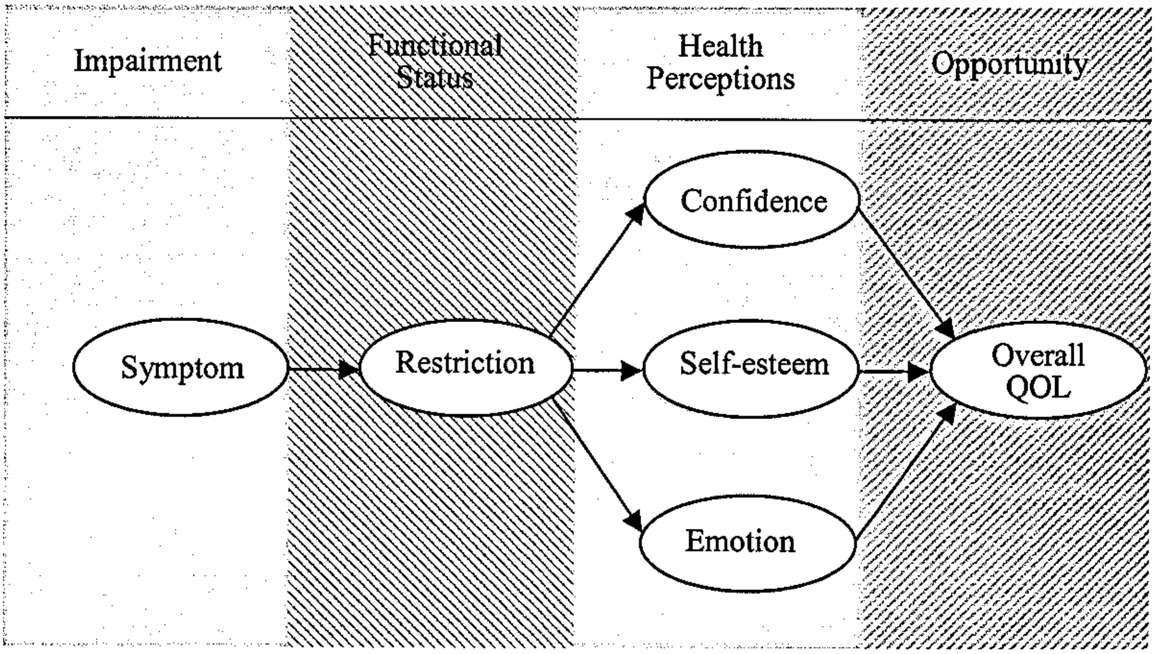


Figure 7.4 The null model for quality of life

7.2.3.2 The Alternative Model I

Although the confidence domain, self-esteem domain and the emotion domain are categorised into one concept, the three domains may not be independent of each other. Lim et al. (1993) reported that quality of life was defined by three domains: emotional, physical and social, using factor analysis. Lim's finding differed from the dimensions proposed by Oldridge et al's (1991) study. In particular, there is much debate between the concept of health in one domain (emotional) and the concept of health in three domains (confidence, self-esteem and emotion). Moreover, Patrick and Erickson (1993) noted that the concept of health perception included: (1) general health perceptions: self-rating of health, health concern/worry; (2) satisfaction with health: satisfaction with physical, psychological and social functions.

In the QOL study, social component refers to a person's health perception, not to the number of his or her tangible supports. As QOL is defined in a subjective sense of well-being, only the subject can provide the answer which is used to produce QOL (Cella & Tulsky, 1990; Aaronson, 1990). Oxman et al. (1992) also reported that the emotional component had a greater effect on depressive symptoms than the instrumental support did.

In the alternative model I (Figure 7.5), the path from the confidence domain to the self-esteem domain and the self-esteem domain to emotion domain will be added. Consequently, the confidence domain positively affects the self-esteem domain and the self-esteem also affects the emotion domain.

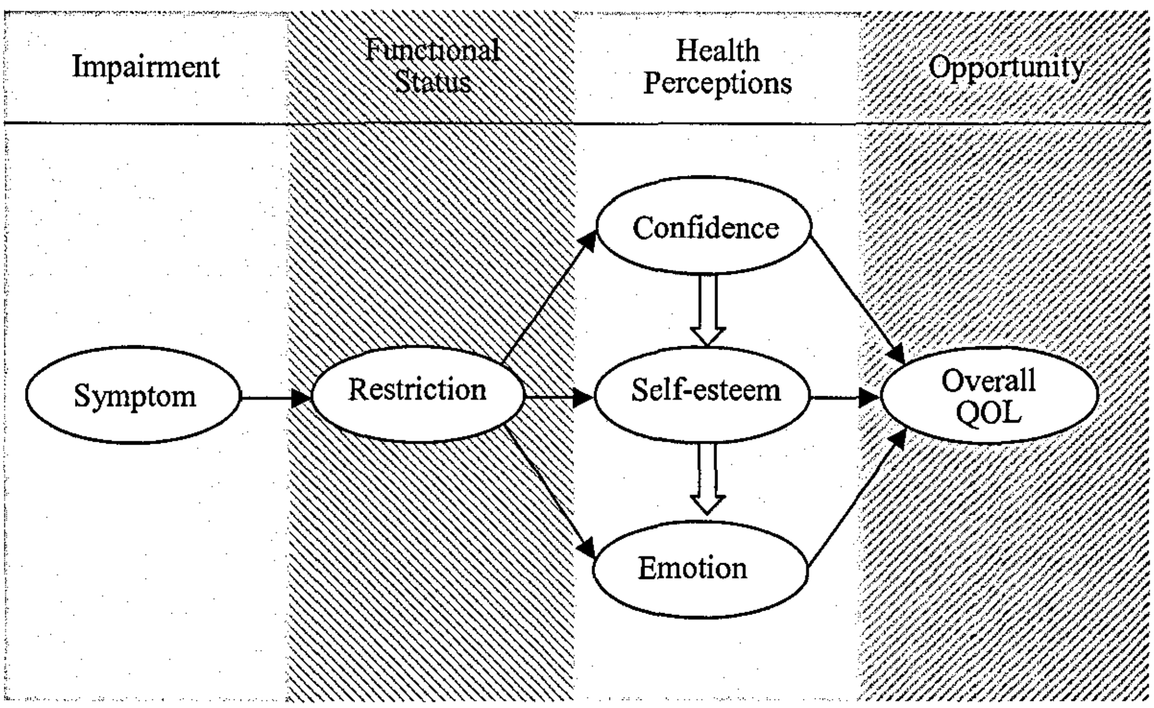


Figure 7.5 The alternative model I for quality of life

7.2.3.3 The Alternative Model II

The functional status includes three sub-functions: social function (limitation in unusual roles, integration, contact, and intimacy and sexual function); psychological function (affective and cognitive) and physical function (activity restriction and fitness). Indeed, the restriction domain directly affects the overall QOL (Patrick & Erickson, 1993, p.77). Thus, the path will be added from the restriction domain to the overall QOL domain in the alternative model II (Figure 7.6).

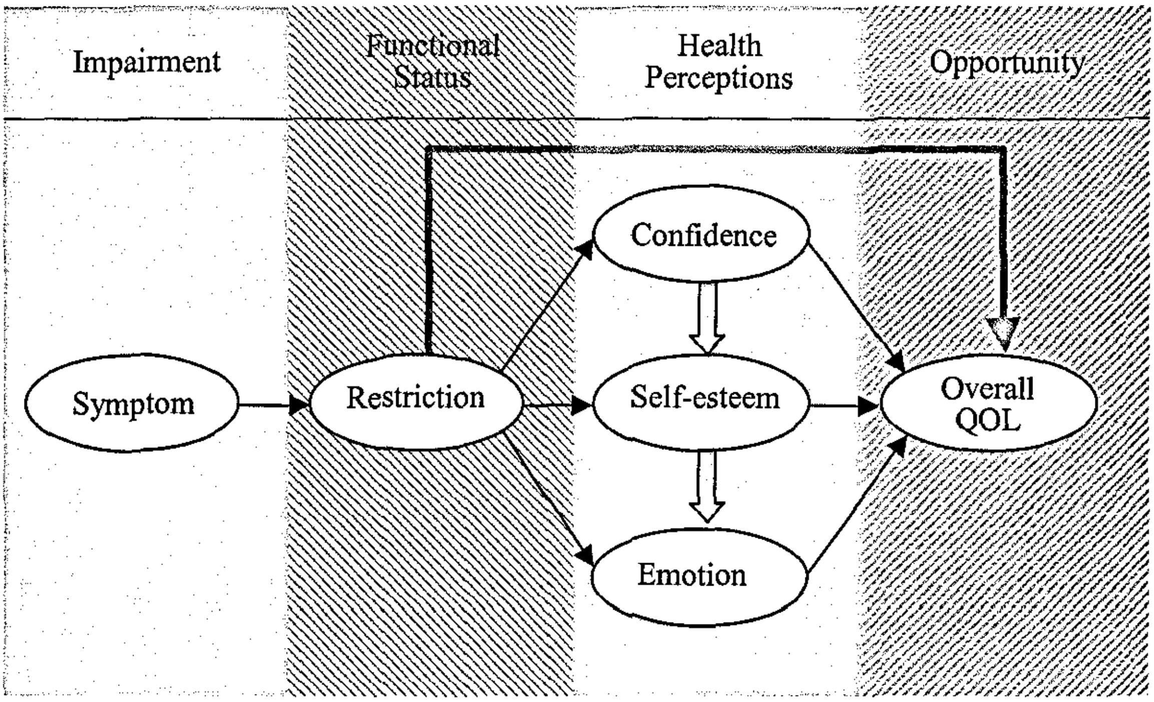


Figure 7.6 The alternative model II for quality of life

7.2.4 A Test for a Theoretical Model of QOL

The hypotheses for each model that will be tested are as follows:

1. All the path coefficients in the three hypothesised models are statistically significant.
2. The sequence of heath perceptions determines the overall QOL for people with coronary heart disease. That is, the value of the confidence domain, self-esteem domain and emotion domain has a direct effect on overall QOL for people with coronary heat disease in the null model.
3. The confidence domain positively affects the self-esteem domain and the self-esteem domain positively affects the emotion domain in the alternative model I.

4.The restriction domain positively affects the overall QOL in the alternative model II.

5. The alternative model I fits the data better than the null model.

6. The alternative model II fits the data better than the alternative model I.

7.3 Method

7.3.1 Sampling and Procedure

One hundred and eighty one consecutive cardiac patients who completed the questionnaire of Quality of Life for Myocardial Infarction were included in this study. The partial data of Chapter 6 was used in this chapter.

The MacNew Quality of Life for Myocardial Infarction (QLMI), a modification of the original QLMI, is a 27-item health status survey constructed to give short, yet comprehensive measures of disease-specific health including emotional, physical and social domains. The original QLMI, an interviewer-administered instrument, defines five domains: symptom, restriction, confidence, self-esteem, and emotion. Therefore, The instrument of Quality of Life for Myocardial Infarction (QLMI) was employed in this study even though the items of MacNew QLMI questionnaire are slightly different from the original QLMI (Hillers et al., 1994; Lim et al., 1993).

In addition, the results of Chapter 6 found that the disease-specific health-related quality of life was composed of four domains: the symptom domain, the physical/restriction domain, the emotion domain, and the support/family domain. It needs to be examined in order to develop an appropriate QOL model for people with coronary heart disease.

The testing of models in SEM is divided into two parts. Firstly, the measurement models, which relate the observed variables to an unobserved or latent factor. Secondly, the structural models (the full latent variable models), which specify the causal pathway between exogenous and endogenous latent variables. The models used in this testing were all recursive.

First, three different measurement models (three, four and five domains) were used to confirm the proper connections between indicators and the unobserved constructs of quality of life through confirmatory factor analysis. Second, the full latent variable model was employed in order to find a best-fitting model of quality of life for people with coronary heart disease.

7.3.2 Data Analysis

Structural equation modelling (SEM) is an effective technique to test various hypotheses (Bollen, 1989), therefore it was used to test the models of the quality of life in this chapter. The analyse was completed using EQS (Bentler, 1995), to analyse the model estimation. EQS software loaded data files from SPSS for windows and transferred it into EQS format.

7.3.2.1 Model Specification

SEM begins with the specification of a model to be estimated. At the most basic level, a model is a statistical statement about the relations among variables. Models take on different forms in the context of different analytic approaches (Bentler, 1995). For instance, a model in the correlation context typically specifies a nondirectional relation between two variables. In SEM, model specification involves formulating a statement about a set of parameters. The parameters that require specification are constants that indicate the nature of the relation between two variables. Although the specification can be quite specific regarding both the magnitude and sign of parameters, parameters are typically specified as either fixed or free. Fixed parameters are not estimated from the data and their value typically is fixed at zero. Free parameters are estimated from the data and are those that the investigator believes to be non-zero (Hoyle, 1995a).

There are three types of relationships between variables, observed or latent, in structural equation models. They are: (1) Association: a relationship between two variables treated within the model as nondirectional, which is identical in nature to the relationship typically evaluated by correlational analysis. (2) The direct effect: the building block of structural equation models, is a directional relation between two variables, which is the type of relation typically evaluated by ANOVA or multiple regression. (3) The indirect effect: it is the effect of an independent variable on a dependent variable through one or more intervening, or mediating, variables (Baron & Kenny, 1986).

7.3.2.2 Model Identification

A fundamental consideration when specifying models in SEM is identification. Identification concerns the correspondence between the information to be estimated (the free parameters), and the information from which it is to be estimated (the observed variances and covariances, derived from the research data). More specifically, identification concerns whether a single, unique value for each and every free parameter can be obtained from the observed data (Hoyle, 1995a).

Structural equation models have three types of identification: (1) Just-identified model: one in which there is a one-to-one correspondence between the data and the structural parameters; (2) Overidentified model: where the number of estimable parameters is less than the number of data points (i.e., variances, covariances of the observed variable) and (3) Underidentified model: where the number of parameters to be estimated exceeds the number of variances and covariances (i.e., data points). Thus a restriction on model specification is that for any model to be estimated it must be either just identified or overidentified (Byrne, 1994).

7.3.2.3 Model Estimation

Once a model has been specified, the next task is to obtain estimates of the free parameters from a set of observed data. However, single stage least squares methods, such as those used in standard ANOVA or multiple regression designs can be used to derive parameter estimates, iterative methods such as maximum likelihood (ML) or generalised least squares are preferred (Hoyle, 1995a). Thus, the estimation method of the maximum likelihood is used in this chapter.

7.3.2.4 Evaluation of Fit

A model is said to fit the observed data to the extent that the covariance matrix it implies is equivalent to the observed covariance matrix (i.e., elements of the residual matrix are near zero)(Hoyle, 1995a). Numerous goodness-of-fit indices are available to assess the adequacy of fit. Several fit indexes are used for assessing the model fit in this chapter and these are shown below (Garson, 2000):

Chi-square: This is the most common fit test. The chi-square value should not be significant if there is a good model fit, while a significant chi-square indicates lack of satisfactory model fit. That is, chi-square is a 'badness of fit' measure since a finding of significance means the given model's covariance structure is significantly different from the observed covariance matrix. If model chi-square < .05, the researcher's model is rejected.

Satorra-Bentler chi-square: This is an adjustment to chi-square which penalises chi-square for the amount of kurtosis in the data. It is an adjusted chi-square statistic which attempts to correct for the bias introduced when data are markedly non-normal in distribution.

Goodness-of-fit index, GFI (Jöreskog-Sörbom GFI): GFI varies from 0 to 1, but theoretically can yield meaningless negative values. A large sample size pushes the GFI up. Though analogies are made to R-square, GFI cannot be interpreted as percentage of error explained by the model. GFI should be equal to or greater than .90 to accept the model.

Adjusted goodness-of-fit index, AGFI. AGFI is a variant of GFI which uses mean squares instead of total sums of squares in the numerator and denominator of 1 - GFI. It varies from 0 to 1, but theoretically can yield meaningless negative values. AGFI > 1.0 is associated with just-identified models and models with almost perfect fit. AGFI < 0 is associated with models with extremely poor fit, or based on small sample size. AGFI should also be at least .90. Like GFI, AGFI is also biased downward when degrees of freedom are large relative to sample size, except when the number of parameters is very large.

Root mean square residuals, or RMS residuals, or RMSR, or RMR. The closer the RMSR is to 0 for a model being tested, the better the model fits. RMS residuals are the coefficients which result from taking the square root of the mean of the squared residuals. These are the amounts by which the sample variances and covariances differ from the corresponding estimated variances and covariances, estimated on the assumption that the model is correct. *Fitted residuals* result from subtracting the sample covariance matrix from the fitted or estimated covariance matrix.

The Comparative fit index, CFI: is also known as the Bentler Comparative Fit Index. CFI compares the existing model fit with a null model which assumes the latent variables in the model are uncorrelated (the 'independence model'). It compares the covariance matrix predicted by the model to the observed covariance matrix, and compares the null model (covariance matrix of 0's) with the observed covariance matrix, to gauge the percent of lack of fit which is accounted for by going from the null model to the researcher's SEM model. CFI should be equal to or greater than .90 to accept the model, indicating that 90% of the covariation in the data can be reproduced by the given model.

The **non-normed fit index, NNFI,** also known as the Bentler-Bonett non-normed fit index, the Tucker-Lewis index, TLI. NNFI close to 1 indicates a good fit. NNFI values below .90 indicate a need to respecify the model. Some authors have used the more liberal cut-off of .80 since TLI tends to run lower than GFI. However, more recently Hu and Bentler (1995) have suggested NNFI ≥ .95 as the cut-off for a good model fit. It is one of the fit indexes less affected by sample size.

Root mean square error of approximation, RMSEA, is also called RMS or RMSE or discrepancy per degree of freedom. By convention, there is good model fit if RMSEA is less than or equal to .05. There is adequate fit if RMSEA is less than or equal to .08. More recently, Hu and Bentler (1995) have suggested RMSEA <= .06 as the cut-off for a good model fit. RMSEA is a popular measure of fit, partly because it does not require comparison with a null model and thus does not require to select as appropriate a model as possible. It is completely independent of the latent variables.

7.3.2.5 Model Modification

The model modification process involves adjusting a specified and estimated model by either freeing parameters that were formerly fixed and free. EQS provides the Lagrange Multiplier Test for model modification. The model can be re-specified, by adding a new path if there is a theoretical rationale to do so. The Lagrange Multiplier Test indicates how much chi-square is expected to decrease by adding additional paths. The Wald test assesses whether any free parameters of a model can be restricted without substantial loss of information (Bentler, 1995). A chi-square difference test is also used to test the relative improvement in model fit. Since the re-specification is testing a new model, the analyses become exploratory (Bollen, 1989). Byrne (1994) also identified that post-hoc modifications are influenced by chance and the information can be useful in providing insight to variations of the hypothesised model. Changing the model is usually advised only when theoretically or logically justified.

Therefore, if the parameters need to be changed, it has to concur with the requirement of the theory or logic in this chapter.

7.4 Results

7.4.1 Testing Measurement Models

This section first specifies the results of the measurement model including three, four, and five domains of the model of quality of life. In order to find out the most accurate model, items in four domains should be adjusted based on the results reported in Chapter 6 that used factor analysis. In addition, items in five domains also need to be revised in order to fit the model. Then, using the valid measurement model found in the measurement test, three of the full latent variable models were analysed - the null model, the alternative model I, and the alternative model II. In addition, to compare an appropriate model, both the *first-order and second-order (higher-order) confirmatory factor analysis* was analysed using EQS.

7.4.1.1 Three Domains of QOL Model

(1) First order CFA model

For model identification, two necessary requirements must be met: (1) the number of parameters to be estimated must exceed the number of variances and covariances (i.e., data points)(Byrne, 1994); and (2) each factor must have its measurement scale. Likewise for the factor model, the t-rule (Bollen, 1989) must be applied to test identification with the measurement CFA model. The factorial validity of the initial specified QOL model was examined. The specified QOL model consists of three factors (domains) and 23 items. Thirteen items including 'Frustrated' (item 1), 'Worthless' (item 2), 'Confident' (item 3), 'Down in the dumps' (item 4), 'Relaxed' (item 5), 'Worn Out' (item 6), 'Happy with Personal Life' (item 7), 'Restless' (item 8), 'Tearful' (item 10), 'More Dependent' (item 11), 'Social Activities' (item 12), 'Others/less Confidence in you' (item 13), 'Lack Self-Confidence' (item 15), 'Frightened' (item 18) were as indicators of the emotional domain; 'Short of Breath' (item 9), 'Chest Pain' (item 14), 'Aching Legs' (item 16), 'Sports/Exercise Limited' (item 17), 'Dizzy/Lightheaded' (item 19), 'Restricted or Limited' (item 20), 'Unsure about Exercise' (item 21) were indicators of the physical domain; 'Overprotective Family' (item 22) and 'Burden on Others' (item 23) were indicators of the social domain.

In the initial first-order Model-1 (see Table 7.2), the value of CFI (0.828), GFI (0.757), AGFI (0.707), NNFI (0.809), RMSR (0.073), RMSEA (0.097) and the chi-square value of the specified model was significant ($\chi^2 = 668.120$, df=249, p<0.001) showed a bad fit of the QOL model. Model modifications can be investigated through the use of the Wald and the Lagrange Multiplier (LM) Tests. The LM test tests the opposite, that is, whether any parameters that were set to zero in the model are, in fact, not zero. It tests the effect of adding free parameters to a model (Bentler, 1995; Byrne, 1994). Thus, the Lagrange Multiplier (LM) test indicated the factorial complexity: the chi-square value

Table 7.2 Summary of Goodness-of-Fit statistics for comparative models of QLMI (Three domains, 25 items)

Fit indices / Models	χ^{2*}	df	S-B χ^2	χ^2/df	CFI	Robust CFI	GFI	AGFI	NNFI	RMSR	RMSEA
Model-1. Initial (1st order)	668.120	249	--	2.683	0.828	--	0.757	0.707	0.809	0.073	0.097
Model-1a Alternative (1st order) Item 10 cross-loaded on F3**; Item 12 cross-loaded on F3.	648.347	247	544.999	2.625	0.840	0.836	0.758	0.706	0.821	0.073	0.096
Model-1b. Initial (2nd order)	658.358	229	--	2.875	0.809	--	0.718	0.668	0.789	0.088	0.102
Model-1c Alternative (2nd order) Item 18 cross-loaded on F1 Item 11 cross-loaded on F2	556.954	227	472.261	2.454	0.858	0.854	0.779	0.731	0.841	0.074	0.091

Note: *χ^2= Chi-Square; S-B χ^2= Satorra-Bentler scaled Chi-Square; CFI= Comparative Fit Index; Robust CFI=Robust Comparative Fit Index GFI= Goodness-of-Fit Index; AGFI= Adjusted Goodness-of-Fit Index; NNFI=Bentler-Bonett NonNormed Fit Index, RMSR= Root Mean Squared Residual; RMSEA= Root Mean Square Error of Approximation.

** F1= the emotional domain; F2= the physical domain; F3=the social domain.

significance decreased (25.218) when item 10 (Tearful) cross-loaded on the social domain and item 12 (Social Activities) cross-loaded on the social domain (decrease in chi-square value= 20.508).

Through the adjustment of cross-loading, the alternative first-order Model-1a (see Table 7.2, p.153) *also indicated a bad-fit of the model, depending on the* value of CFI (0.840), Robust CFI (0.836), GFI (0.758), AGFI (0.706), NNFI (0.821), RMSR (0.073), RMSEA (0.096) and the chi-square value was also significant ($\chi 2$ = 648.347, df=247, p<0.001). Although the fit indices of the alternative model (Model-1a) were better than Model-1, the cross-loaded factor is very difficult to explain without theoretical support.

(2)Second order CFA model

Model-1b (see Table 7.2, p.153) showed the initial second-order model. The value of chi-square was significant (c2 = 658.358, df=229, p<0.001) and the value of CFI (0.809), GFI (0.718), AGFI (0.668), NNFI (0.789), RMSR (0.088), RMSEA (0.102) was significant. Thus, the fit indices indicated that the model were a bad fit. Through the Lagrange Multiplier test, the chi-square value was significantly decreased (27.449) when item 18 (Frightened) was cross-loaded on the emotional domain and item 11 (More Dependent) was cross-loaded on the physical domain (decrease in chi-square value= 17.708).

Adjusting the cross loading on item 18 and 11 into the emotional domain resulted in the chi-square value remaining significant (c2 = 556.954, df=227, p<0.001) and the value of CFI (0.858), Robust CFI (0.854), GFI (0.779), AGFI (0.731), NNFI (0.841), RMSR (0.074), RMSEA (0.091). These fit indices showed on the alternative Model-1c (see Table 7.2, p.153). For a model with good fit, the value of fit indices must have probabilities of higher than 0.90. Moreover, the other requirements are that RMSR and RMSEA must be below probability of 0.06 (Hu & Bentler, 1995).

In summary, the Lim et al's model of three domains did not achieve the basic requirements of confirmatory factor analysis including both first-order model (initial and alternative models) and second-order model (initial and alternative models) (see Table 7.2, p.153) – requirements which are essential for a well-fitting model of quality of life for people with coronary heart disease.

7.4.1.2 Four domains of QOL Model

From the results reported in Chapter 6 using factor analysis, four domains of QOL model were identified. The MacNew QLMI questionnaire contains twenty-seven items applied to the first-order and second-order analysis excluding 'Dizzy/Lightheaded' (item 19) because of lower item loading. Thirteen items including 'Frustrated' (item 1), 'Worthless' (item 2), 'Confident' (item 3), 'Down in the dumps' (item 4), 'Relaxed' (item 5), 'Worn Out' (item 6), 'Happy with Personal Life' (item 7), 'Restless' (item 8), 'Tearful' (item 10), 'Others/less Confidence in you' (item 13), 'Lack Self-Confidence' (item 15), 'Frightened' (item 18), 'Burden on Others' (item 23) were as indicators of the emotion domain; 'More Dependent' (item 11), 'Social Activities' (item 12), 'Chest Pain' (item 14), 'Sports/Exercise Limited' (item 17), 'Restricted or Limited' (item 20), 'Unsure about Exercise' (item 21), 'Excluded' (item 24), 'Unable to Socialise' (item 25), and 'Physically Restricted' (item 26) were indicators of the physical/restriction domain; 'Short of Breath' (item 9) and 'Aching Legs' (item 16) were indicators of the symptom domain; 'Overprotective Family' (item 22) and 'Sexual Intercourse' (item 27) were indicators of the social/family domain.

(1) First order CFA model

In Model-2 (see Table 7.3) which showed the initial first-order model, the value of CFI (0.848), GFI (0.768), AGFI (0.722), NNFI (0.831) were below 0.90 and RMSR (0.070), RMSEA (0.089) were higher than 0.60. Moreover, the chi-square value of the specified model was significant (c2 = 709.044, df=293, p<0.001).

Table 7.3 Summary of Goodness-of-Fit statistics for comparative models of QLMI: Four domains, 27 items

Fit indices / Models	χ^{2*}	df	S-B χ^2	χ^2/df	CFI	Robust CFI	GFI	AGFI	NNFI	RMSR	RMSEA
Model-2. Initial (1st order)	709.044	293	--	2.420	0.848	--	0.768	0.722	0.831	0.070	0.089
Model-2a Alternative (1st order) Item 10 cross-loaded on F4**; Item 26 cross-loaded on F1.	619.090	291	505.263	2.127	0.882	0.894	0.794	0.751	0.868	0.063	0.080
Model-2b. Initial (2nd order)	715.245	301	--	2.376	0.848	--	0.767	0.728	0.836	0.079	0.088
Model-2c Alternative (2nd order) Item 26 cross loaded on F1	652.233	297	529.701	2.196	0.872	0.884	0.785	0.745	0.860	0.067	0.082

Note: *χ^2= Chi-Square; S-B χ^2= Satorra-Bentler scaled Chi-Square; CFI= Comparative Fit Index; Robust CFI=Robust Comparative Fit Index GFI= Goodness-of-Fit Index; AGFI= Adjusted Goodness-of-Fit Index; NNFI=Bentler-Bonett NonNormed Fit Index, RMSR= Root Mean Squared Residual; RMSEA= Root Mean Square Error of Approximation.

** F1= the emotion domain; F2= the physical/restriction domain; F3=the symptom domain; F4= the social/support domain.

It indicated that this was not a well-fitting model for quality of life. The Lagrange Multiplier test indicated that the chi-square value significantly decreased (24.030) when item 10 (Tearful) cross-loaded on the social/support domain and item 26 (Social Activities) cross-loaded on the emotion domain (decrease in chi-square value= 22.803).

The alternative first-order Model-2a (see Table 7.3, p.156) also indicated this was not a well-fitting model due to the value of CFI (0.882), Robust CFI (0.894), GFI (0.794), AGFI (0.751), NNFI (0.868) being lower than 0.90 and RMSR (0.063) and RMSEA (0.080) being higher than 0.060. In addition, the chi-square value was also significant ($\chi 2 = 619.090$, df=291, $p<0.001$).

(2) Second order CFA model

Model-2b (see Table 7.3, p.156) showed the initial second-order model. The value of chi-square was significant ($\chi^2 = 715.245$, df=301, $p<0.001$) and the value of CFI (0.848), GFI (0.767), AGFI (0.728), NNFI (0.836) were below 0.90 and RMSR (0.079) and RMSEA (0.088) were higher than 0.060. Thus, the fit indices indicated a bad fit with this model. The Lagrange Multiplier test showed the chi-square value significantly decreased (19.262) when item 26 (Physically Restricted) cross-loaded on the emotional domain.

The result of the chi-square test was still high ($\chi^2 = 652.233$, df=297, $p<0.001$) and the value of CFI (0.872), Robust CFI (0.884), GFI (0.785), AGFI (0.745), NNFI (0.860) were lower than 0.90 and RMSR (0.067) and RMSEA (0.082) were higher than 0.60. These fit indices appear in Table 7.3 (p.156) to the alternative Model-2c. In summary, the four-domain model did not conform to the basic requirements of the CFA rule including both first-order models (initial and alternative) and second-order models (initial and alternative) (see Table 7.3, p.156), which is a requirement essential to a well-fitting model of quality of life for people with coronary heart disease.

7.4.1.3 Five domains of QOL Model

The model of five domains was adopted from the original QLMI framework and concepts. The QLMI questionnaire of Oldridge et al. (1991) was designed to be interviewer-administered and originally consisted of 23 items. Oldridge et al. (1991) subsequently added three more items to the questionnaire. However, the MacNew QLMI questionnaire contains twenty-seven items. In contrast to the questionnaire, item 1 to item 23 and item 27 have the same content, differences only occurred with items 24, 25, 26. Therefore, these three items (24, 25 and 26) were excluded from this section.

The QOL model consists of five factors (domains) and 24 items. The symptom domain includes five items: 'Worn Out' (item 6), 'Short of Breath' (item 9), 'Chest Pain' (item 14), 'Aching Legs' (item 16), 'Dizzy/Lighheaded' (item 19); The restriction domain contains four items: 'Social Activities' (item 12), 'Sports/Exercise Limited' (item 17), 'Restricted or Limited' (item 20), 'Sexual Intercourse' (item 27); The confidence domain consists of four items: 'Confident' (item 3), 'Frightened' (item 18), 'Unsure about Exercise' (item 21), 'Overprotective Family' (item 22); The self-esteem domain comprises five items: 'Worthless' (item 2), 'More Dependent' (item 11), 'Others/less Confidence in you' (item 13), 'Lack Self-Confidence' (item 15), 'Burden on Others' (item 23); The emotion domain involves six items: 'Frustrated' (item 1), 'Down in the dumps' (item 4), 'Relaxed' (item 5), 'Happy with Personal Life' (item 7), 'Restless' (item 8), 'Tearful' (item 10).

(1) First order CFA model

Model-3 (see Table 7.4) the initial first-order model indicated that the chi-square value of the model was significant ($\chi^2 = 557.878$, df=242, p<0.001). The values of CFI (0.867), GFI (0.798), AGFI (0.749), NNFI (0.849) were below 0.90 and the values of RMSR (0.065), RMSEA (0.085) were higher than 0.060.

Table 7.4 Summary of Goodness-of-Fit statistics for comparative models of QLMI: Five domains, 24 items

Models / Fit indices	χ^{2*}	df	S-B χ^2	χ^2/df	CFI	Robust CFI	GFI	AGFI	NNFI	RMSR	RMSEA
Model-3. Initial (1st order)	551.878	242	--	2.280	0.867	--	0.798	0.749	0.849	0.065	0.085
Model-3a Alternative (1st order) Item 6 cross-loaded on F5**; Item 11 cross-loaded on F2; Item 21 cross-loaded on F2.	465.542	239	399.090	1.948	0.906	0.910	0.823	0.777	0.891	0.058	0.073
Model-3b. Initial (2nd order)	604.822	251	--	2.410	0.848	--	0.780	0.737	0.833	0.076	0.089
Model-3c Alternative (2nd order) Item 6 cross-loaded on F5; Item 11 cross-loaded on F2; Item 12 cross-loaded on F1	490.959	248	423.529	1.980	0.899	0.902	0.809	0.769	0.888	0.062	0.075

Note: *χ^2= Chi-Square; S-B χ^2= Satorra-Bentler scaled Chi-Square; CFI= Comparative Fit Index; Robust CFI=Robust Comparative Fit Index GFI= Goodness-of-Fit Index; AGFI= Adjusted Goodness-of-Fit Index; NNFI=Bentler-Bonett NonNormed Fit Index, RMSR= Root Mean Squared Residual; RMSEA= Root Mean Square Error of Approximation.

** F1= the symptom domain; F2= the restriction domain; F3=the confidence domain; F4= the. self-esteem domain; F5= the emotion domain.

The fit indices indicated a bad-fitting model for quality of life for people with coronary heart disease.

The Lagrange Multiplier test indicated that the chi-square value significantly decreased (14.827) when item 6 (Worn Out) cross-loaded on the emotion domain; item 11 (More Dependent) cross-loaded on the restriction domain (decrease in chi-square value= 13.299) and item 21 (Unsure about Exercise) cross-loaded on the restriction domain (decrease in chi-square value= 16.215). Through the procedure of cross-loading factors, the alternative first-order model's result was higher than 0.90 (see Table 7.4, Model-3a, p.159) indicating a badly-fitting model caused by the value of CFI (0.906), Robust CFI (0.910), and the result was lower than 0.060 (see Table 7.4, Model-3a, p.159) for RMSR (0.058). However, the value of GFI (0.823), AGFI (0.777), NNFI (0.891) also remained in lower value and RMSEA (0.080) was higher than 0.060. Furthermore, the chi-square value was also significant (χ^2 = 465.542, df=239, p<0.001).

(2) Second order CFA model

Model-3b (see Table 7.4, p.159) showed the initial second-order model. The value of chi-square was significant (χ^2 = 604.822, df=251, p<0.001) and the value of CFI (0.848), GFI (0.780), AGFI (0.737), and NNFI (0.833) were below 0.90 and RMSR (0.076) and RMSEA (0.089) were higher than 0.060.

Thus, the fit indices indicated a bad fit with this model. The Lagrange Multiplier test showed the chi-square value significantly decreased (15.607) when item 6 (Worn Out) cross-loaded on the emotion domain; item 11 (More Dependent) cross-loaded on the restriction domain (decrease in chi-square value= 18.305) and item 12 (Social Activities) cross-loaded on the symptom domain (decrease in chi-square value= 48.692). The result of the chi-square value (see Table 7.4, p.159), for the alternative Model-3c, was still high (χ^2 = 490.959, df=248, p<0.001) and the value of CFI (0.899), Robust CFI (0.902), GFI

(0.809), AGFI (0.769), NNFI (0.888), RMSR (0.062) and RMSEA (0.075) were higher than 0.060. The value of Robust CFI (0.902) is higher than 0.90, therefore the alternative model is not a good fit model for quality of life.

In brief, four models were examined including both first-order models (initial and alternative) and second-order models (initial and alternative) as presented in Table 7.4 (p.159). The first-order alternative model (model-3a) was the best fitting model of the four models, but it required the addition of three cross-loading factors to obtain the significant degree of fit.

7.4.1.4 Revised Four Domains of QOL Model

The four domains of quality of life did not show a well-fitting model for quality of life. In order to develop an appropriate model of quality of life for people with coronary heart disease, the items of four-domain QOL model need to be moved or deleted. Using the results of factor loading reported in Chapter 6 and using standard solution reports of confirmatory factor analysis, a revised four-domain quality of life model was generated. This analysis consists of four factors (domains) and 20 items. The emotion domain includes five items: 'Down in the dumps' (item 4), 'Relaxed' (item 5), 'Happy with Personal Life' (item 7), 'Tearful' (item 10) and 'Frightened' (item 18); the physical/restrictions domain consists of five items: 'Social Activities' (item 12), 'Sports/Exercise Limited' (item 17), 'Restricted or Limited' (item 20), 'Unable to Socialise' (item 25) and 'Physically Restricted' (item 26); the symptom domain comprises of five items: 'Worn Out' (item 6), Short of Breath' (item 9), 'Chest Pain' (item 14), 'Aching Legs' (item 16) and 'Dizzy/Lightheaded' (item 19); the social/family domain includes five domains: 'More Dependent' (item 11), 'Others/less Confidence in you' (item 13), 'Overprotective Family' (item 22), 'Excluded' (item 24) and 'Sexual Intercourse' (item 27).

(1) First order CFA model

Model-4 (see Table 7.5) showed the initial first-order model. The value of CFI (0.831), GFI (0.802), AGFI (0.746), NNFI (0.804) were below 0.90 and RMSR (0.072), RMSEA (0.100) were higher than 0.060. Furthermore, the chi-square value of the re-specified model was significant ($\chi^2 = 460.987$, df=164, p<0.001). It indicated a bad-fitting QOL model for people with coronary heart disease.

The Lagrange Multiplier test indicated that the chi-square value's significance decreased (15.868) when item 6 (Worn Out) cross-loaded on the emotion domain. Thus, the alternative first-order Model-4a (see Table 7.5) also indicated a bad-fitting model because the value of CFI (0.861), Robust CFI (0.860), GFI (0.811), AGFI (0.756), NNFI (0.838) were lower than 0.90 and RMSR (0.071) and RMSEA (0.094) were higher than 0.060. In addition, the chi-square and S-B chi-square value was also significant ($\chi^2 = 413.837$; S-B χ^2=348.539, df=291, p<0.001).

(2) Second order CFA model

Model-4b (see Table 7.5) showed the initial second-order model. The value of chi-square was significant ($\chi^2 = 505.007$, df=169, p<0.001) and the value of CFI (0.808), GFI (0.786), AGFI (0.734), NNFI (0.784) were below 0.90 and RMSR (0.081) and RMSEA (0.105) were higher than 0.060. Thus, the fit indices indicated the bad fit of the model.

The Lagrange Multiplier test showed the chi-square value significantly decreased (22.652) when item 26 (Physically Restricted) cross-loaded on the emotional domain. The result of the chi-square value was still high ($\chi^2 = 448.379$, df=168, p<0.001) and the value of CFI (0.845), Robust CFI (0.843), GFI (0.798), AGFI (0.747), NNFI (0.825) were lower than 0.90 and RMSR (0.076) and RMSEA (0.098) were higher than 0.060. These fit indices showed on Table 7.5 the alternative Model-4c.

Table 7.5 Summary of Goodness-of-Fit statistics for comparative models of QLMI: Revised four domains, 20 items

Fit indices / Models	χ^{2*}	df	S-B χ^2	χ^2/df	CFI	Robust CFI	GFI	AGFI	NNFI	RMSR	RMSEA
Model-4 Initial (1st order)	460.987	164	--	2.811	0.831	--	0.802	0.746	0.804	0.072	0.100
Model-4a Alternative (1st order) Item 6 cross-loaded on F1**.	413.837	163	348.539	2.539	0.861	0.860	0.811	0.756	0.838	0.071	0.094
Model-4b. Initial (2nd order)	505.007	169	--	2.988	0.808	--	0.786	0.734	0.784	0.081	0.105
Model-4c Alternative (2nd order) Item 26 cross-loaded on F1	448.379	168	376.171	2.669	0.845	0.843	0.798	0.747	0.825	0.076	0.098

Note: *χ^2= Chi-Square; S-B χ^2= Satorra-Bentler scaled Chi-Square; CFI= Comparative Fit Index; Robust CFI=Robust Comparative Fit Index GFI= Goodness-of-Fit Index; AGFI= Adjusted Goodness-of-Fit Index; NNFI=Bentler-Bonett NonNormed Fit Index, RMSR= Root Mean Squared Residual; RMSEA= Root Mean Square Error of Approximation.

** F1= the emotion domain; F2= the physical/restriction domain; F3=the symptom domain; F4= the social/support domain.

Briefly, the model of the revised four domains reported in Table 7.5 (p.163) did not concur with the basic requirement of the CFA rule including both first-order models (initial and alternative) and second-order models (initial and alternative) as a good fit model of quality of life for people with coronary heart disease.

7.4.1.5 Revised Five Domains of QOL Model

Four submodels with five domains of the original QLMI (1991)consisting of 15 items are presented in Table 7.6. However, the value of the fit indices was higher than other models (model 1, 1a, 1b, 1c; model 2, 2a, 2b, 2c and 3, 3a, 3b, 3c). Although some models have good fit indices, they require items to be cross-loaded with other factors. If such requirements are applied simply to improve model fit, this process can cause problems with the structural model (Kline, 1998). Therefore, this revision would remove the items which have lower values of standard solution or ambiguous items in order to have a well-fitting model. Items of 4, 8, 9, 11, 15, 16, 17, 18, and 21 were removed.

The revised QOL model consists of five factors (domains) and 15 items. The symptom domain includes three items: 'Worn Out' (item 6), 'Chest Pain' (item 14), 'Dizzy/Lighheaded' (item 19); The restriction domain contains three items: 'Social Activities' (item 12), 'Restricted or Limited' (item 20), 'Sexual Intercourse' (item 27); The confidence domain consists of two items: 'Confident' (item 3), 'Overprotective Family' (item 22); The self-esteem domain comprise three items: 'Worthless' (item 2), 'Others/less Confidence in you' (item 13), 'Burden on Others' (item 23); The emotion domain involves four items: 'Frustrated' (item 1), 'Relaxed' (item 5), 'Happy with Personal Life' (item 7), 'Tearful' (item 10).

Table 7.6 Summary of Goodness-of-Fit statistics for comparative models of QLMI: Revised five domains, 15 items

Models \ Fit indices	χ^{2*}	df	S-B χ^2	χ^2/df	CFI	Robust CFI	GFI	AGFI	NNFI	RMSR	RMSEA
Model-5 Initial (1st order)	129.726	80	--	1.622	0.956	--	0.909	0.864	0.942	0.046	0.059
Model-5a Alternative (1st order)	100.918	80	89.3036	1.261	0.983	0.990	0.930	0.895	0.977	0.039	0.039
Model-5b. Initial (2nd order)	171.167	89	--	1.923	0.927	--	0.886	0.846	0.914	0.056	0.072
Model-5c Alternative (2nd order)	150.879	89	132.702	1.695	0.949	0.951	0.895	0.859	0.940	0.053	0.063

Note: *χ^2= Chi-Square; S-B χ^2= Satorra-Bentler scaled Chi-Square; CFI= Comparative Fit Index; Robust CFI=Robust Comparative Fit Index GFI= Goodness-of-Fit Index; AGFI= Adjusted Goodness-of-Fit Index; NNFI=Bentler-Bonett NonNormed Fit Index, RMSR= Root Mean Squared Residual; RMSEA= Root Mean Square Error of Approximation.

** F1= the symptom domain; F2= the restriction domain; F3=the confidence domain; F4= the. self-esteem domain; F5= the emotion domain.

(1) First order CFA model

Model-5 (see Table 7.6, p.165) showed the initial first-order model. The chi-square value of the model was significant ($\chi^2 = 129.726$, df=80, p>0.05). The value of CFI (0.956), GFI (0.909), NNFI (0.942) were above 0.90 except AGFI (0.864) and RMSR (0.046), RMSEA (0.059) were below 0.060. The fit indices showed a better-fit model for quality of life. Normally the intercorelation between the crossing factor and any other related factor would reduce the value of chi-square. This research has adopted the Heller's model, which does not use a crossing factor.

The alternative first-order model, (Table 7.6 Model-5a, p.165) showed a good fit model owing to the value of CFI (0.983), Robust CFI (0.990), GFI (0.930), NNFI (0.977) being higher than 0.90, and RMSR (0.039) and RMSEA (0.039) lower than 0.060. Only the value of AGFI (0.895) was below the lower threshold. Moreover, the chi-square value was non significant ($\chi^2 = 100.918$, df=80, p> 0.05) and the Satorra-Bentler scaled chi-square was not significant ($\chi^2 = 89.304$, df=80, p> 0.05).

(2) Second order CFA model

Model-5b (see Table 7.6, p.165) showed the initial second-order model. The value of chi-square was significant ($\chi^2 = 171.167$, df=89, p<0.01) and the value of CFI (0.927) and NNFI (0.914) were higher than 0.90 except GFI (0.886), AGFI (0.846) and RMSR (0.056) was lower than 0.060 but RMSEA (0.072) was over 0.060 accepted value.

Table 7.6 (p.165) the alternative Model-5 indicated the value of chi-square was 150.879, df=89, p<0.01; S-B $\chi^2 = 132.702$ and the value of CFI (0.949), Robust CFI (0.951), NNFI (0.940) were below 0.90 except GFI (0.895), AGFI (0.859) and RMSR (0.053) was lower than 0.060 but RMSEA (0.063) was higher than 0.060. Although the value of Robust CFI, CFI, and NNFI were higher than 0.90, in total the alternative model is not a good fit model for quality of life.

In summary, four models including both first-order models (initial and alternative) and second-order models (initial and alternative) are shown in Table 7.6 (p.165). The first-order alternative model (model-5a) was the best fitting model applied to the data of the four models considered. The second-order model, Table 7.6 Model 5c (p.165) was the best-fitting model compared with the other models. However, that model did not achieve a statistically significant degree of fit, because the chi-square value was too high. The standardised solution of confirmatory factor loading of Model-5a and Model-5c are shown on Table 7.7 and Table 7.8. The diagrams (see Figure 7.7, p.169 and Figure 7.8, p.170) explain the interrelationship of Model-5a and Model-5c in more detail.

Table 7.7 The standardised solution of confirmatory factor loadings on QLMI constructs: 15-item, 1st-order model-5a

	Symptom	Restriction	Confidence	Self-esteem	Emotion
Item 6	.751	-	-	-	-
Item 14	.475	-	-	-	-
Item 19	.401	-	-	-	-
Item 12	-	.836	-	-	-
Item 20	-	.641	-	-	-
Item 27	-	.335	-	-	-
Item 3	-	-	.620	-	-
Item 22	-	-	.316	-	-
Item 2	-	-	-	.865	-
Item 13	-	-	-	.631	-
Item 23	-	-	-	.784	-
Item 1	-	-	-	-	.816
Item 5	-	-	-	-	.849
Item 7	-	-	-	-	.824
Item 10	-	-	-	-	.666

Note: All loadings are significant at .05 levels.

Table 7.8 The standardised solution of confirmatory factor loadings on QLMI constructs:15-item, 2nd-order model-5c

	Symptom	Restriction	Confidence	Self-esteem	Emotion
Item 6	.797	-	-	-	-
Item 14	.481	-	-	-	-
Item 19	.410	-	-	-	-
Item 12	-	.736	-	-	-
Item 20	-	.625	-	-	-
Item 27	-	.319	-	-	-
Item 3	-	-	.810	-	-
Item 22	-	-	.354	-	-
Item 2	-	-	-	.871	-
Item 13	-	-	-	.635	-
Item 23	-	-	-	.800	-
Item 1	-	-	-	-	.821
Item 5	-	-	-	-	.847
Item 7	-	-	-	-	.820
Item 10	-	-	-	-	.659

Note: All loadings are significant at .05 levels.

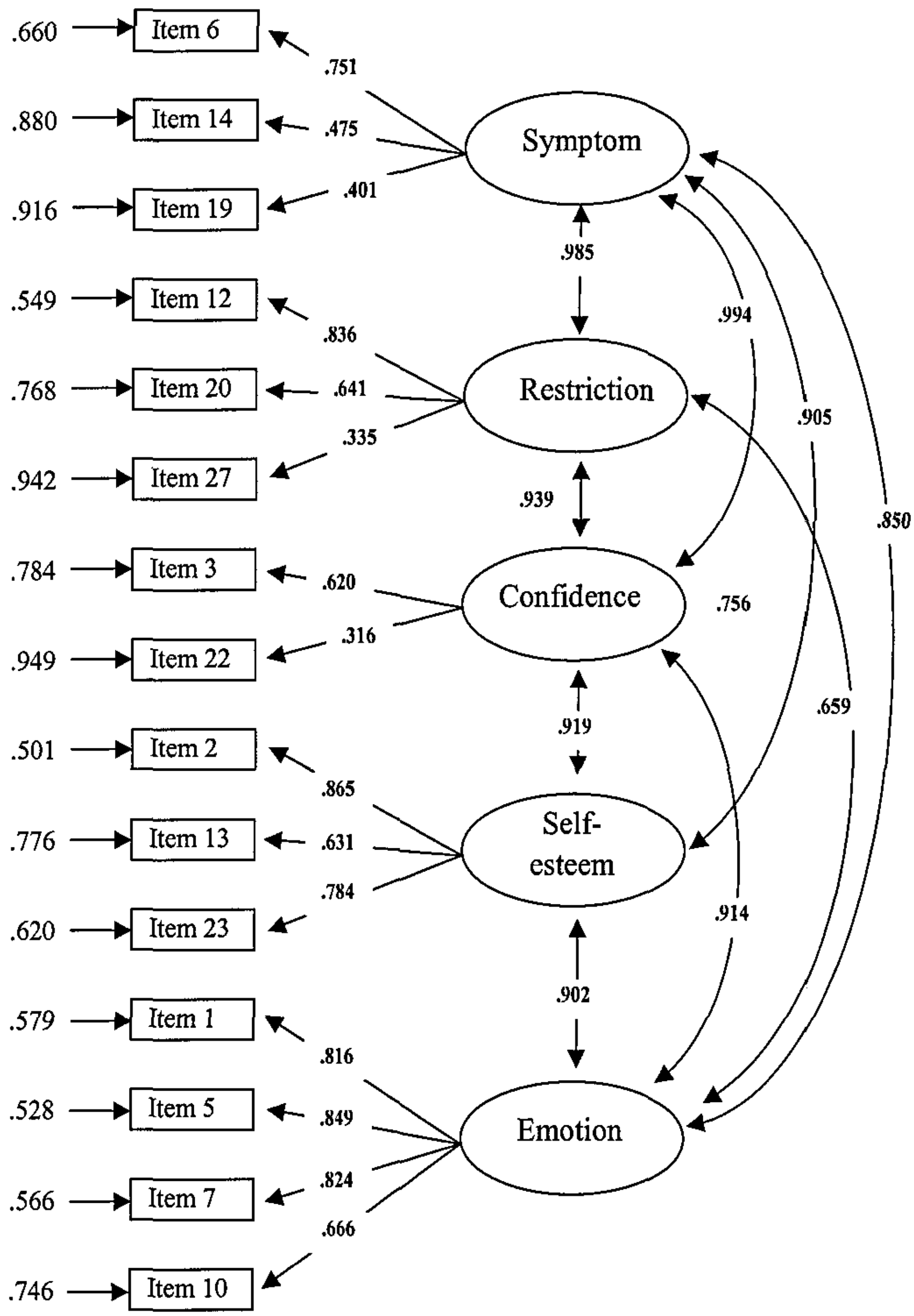


Figure 7.7 The diagram of first-order QOL model

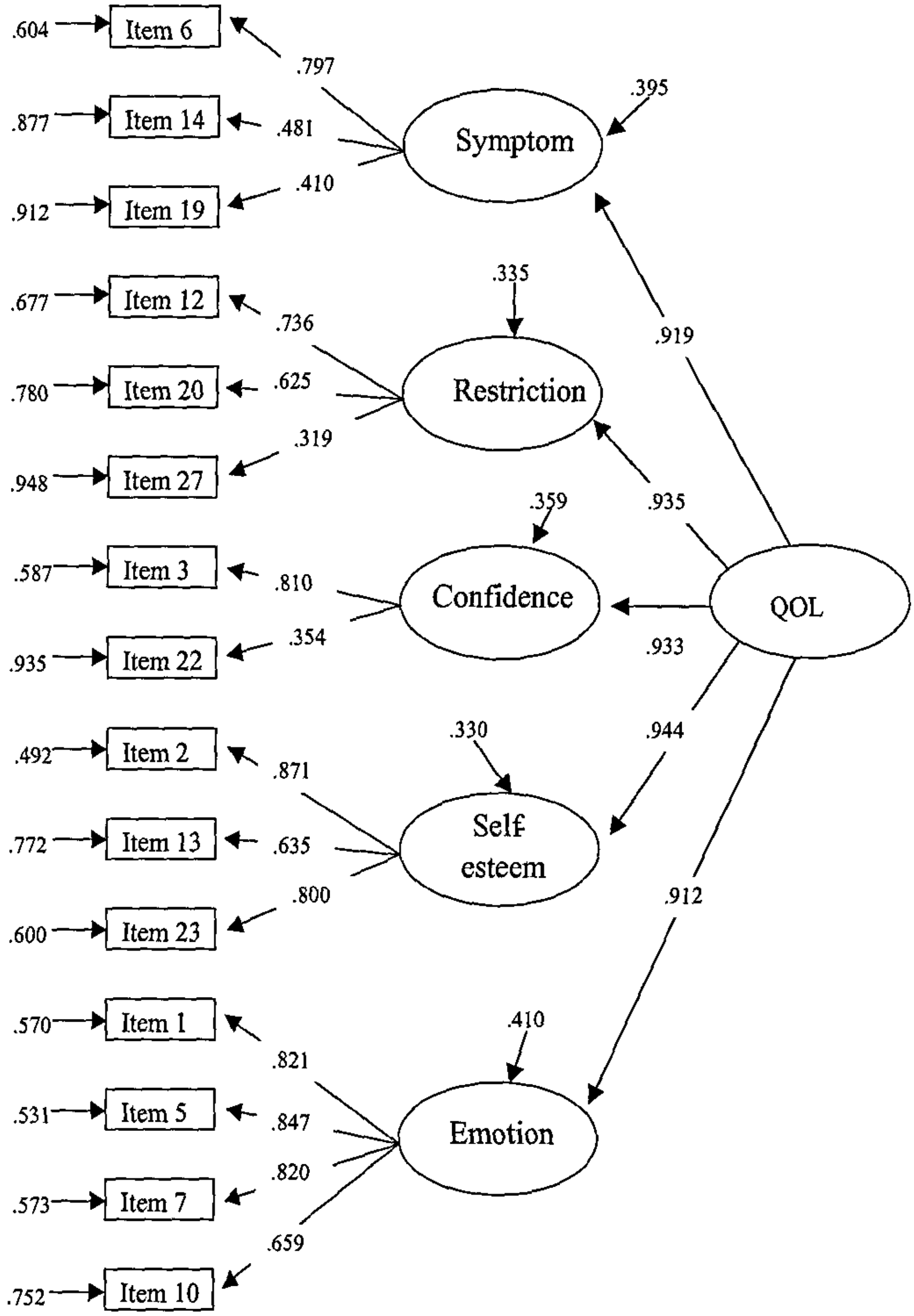


Figure 7.8 The diagram of second-order QOL model

7.4.2 Testing the Full Latent Variable Models

7.4.2.1 Preliminary Analyses

An important preliminary step in the analysis of models is to test first for the validity of the measurement model before making any attempt to evaluate the full latent variable models. This is because of: (a) the structural portion of a standard full structural equation model involves iteration between the latent variables, and (b) the primary concern in working with a standard full model is to assess the extent to which these relations are valid. Consequently, the indicator variables are tested using CFA procedures. The measurement model is operating adequately confidence in conducting the assessment of the hypothesis relating to the full latent variable models (Byrne, 1994).

Using Bollen's t-Rule (Bollen, 1989) for the model identification, endogenous latent construct 'Overall QOL' and its single indicator 'TQ' were included in the full latent variable models. The factor 'Overall QOL' must have a scale in order for the model to be identified, the loading of the 'TQ' on the latent construct 'Overall QOL' was fixed to be 1.00 and the error variance of 'TQ' had to be constrained. There were 16 observed variables in this model, the total number of data points was 16x(16+1)/2=136. The total number of free parameters was 47 (10 regression coefficients, 15 factor covariances, 16 error covariances and 6 factor variances). It is an overidentified model with 89 degrees of freedom with each of the six factors having its own measurement scale. The model meets the necessary requirements for model identification.

There were no additional problems linked to adding the endogenous dependent variable overall and its single indicator 'TQ'. The overall fit of the model was good (S-B χ^2 = 135.110, df=90, p>0.001). The values of GFI 0.904, NNFI were 0.953 and both CFI and Robust CFI were 0.965, representing a very good fit. As no specification problems arose, all variables and items in this preliminary CFA model were re-specified in the full latent variable models. The last procedure was to test the full latent variable model (structural model) that examines the relations among constructs.

All three full latent variable models (the null model, the alternative model I and the alternative model II) were analysed using EQS for Windows (Bentler, 1995). In the three full latent variable models, the symptom domain was the exogenous latent variable to the restriction domain. The restriction domain was the intermediate endogenous variable to the confidence, self-esteem and emotion domains. These domains were also endogenous and had a direct effect on the dependent latent variable 'Overall QOL'.

7.4.2.2 Model Identification of the Full Latent Variable Models

The parameters in the full latent variable models have to follow the rule: the total number of (1) variances and covariance of the exogenous latent factors, measurement errors, and disturbances; (2) direct effects on the indicators caused by the factors (factor loading); (3) direct effect on latent endogenous factors from other factors (path coefficients), equals the number of parameters (Hoyle, 1995b).

Twenty-two variances must be estimated in the full latent variable models including one exogenous factor (the symptom domain); five disturbances of latent endogenous factors (the restriction domain, the confidence domain, the self-esteem domain, the emotion domain and overall QOL); and sixteen measurement error terms of the indicators. The other parameter consists of 10 factor loading effects and 10 latent factors effects. Thus, with 86 free points and 42 parameters to be estimated, it has an overidentified model with 44 degrees of freedom.

Kline (1998) suggested that the pure measurement model underlying a full structural equation model needs to be tested. If the fit of the measurement model is found acceptable, the full latent variable models should be tested by comparing its fit with that of different full latent variable models (e.g., with models generated by trimming or building, or with mathematically equivalent models). In addition, if it is a recursive model, the full latent variable models are identified. Otherwise, the full latent variable model should be evaluated against the requirements for identification. The first step was completed in preliminary analysis and the model was identified. Thus, the full latent variable model was recursive and the model met the two-step rule.

7.4.2.3 Testing the Full Latent Variable Models

(1) The null model

Figure 7.9 presents the relationship among QOL domains in the null model and the estimates of the null model shown in Figure 7.10. Based on an alpha level of .05, the test statistic needs to be greater than ± 1.96 before the hypothesis can be rejected (Byrne, 1994). All items had statistically significant loadings, ranging from .303 to .969. The model indicated a bad-fit model, even though all path coefficients were significant at .05 levels. In the preliminary analysis, the null model represented a good fit with the data in terms of the factors and indicators. The bad-fit is due to problems in the full latent variable model, and is not caused by the measurement model. Furthermore, the value of chi-square was significant ($\chi^2 = 383.727$, df=103, $p<0.001$), the values of CFI (0.839), GFI (0.837), AGFI (0.784), NNFI (0.812) were lower than .90, and RMSR (0.055) and RMSEA (0.124) were greater than the basic requirement of .060.

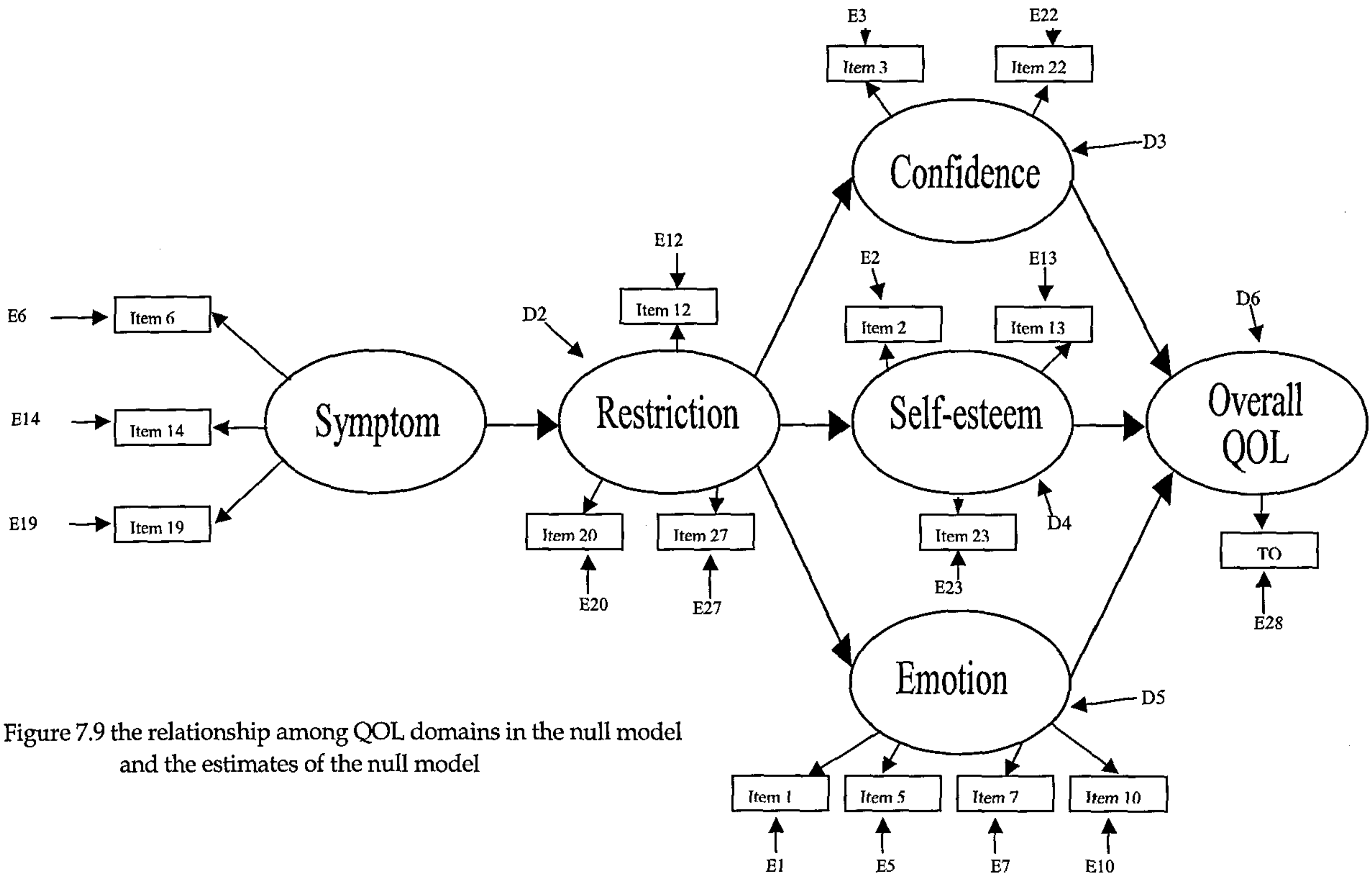


Figure 7.9 the relationship among QOL domains in the null model and the estimates of the null model

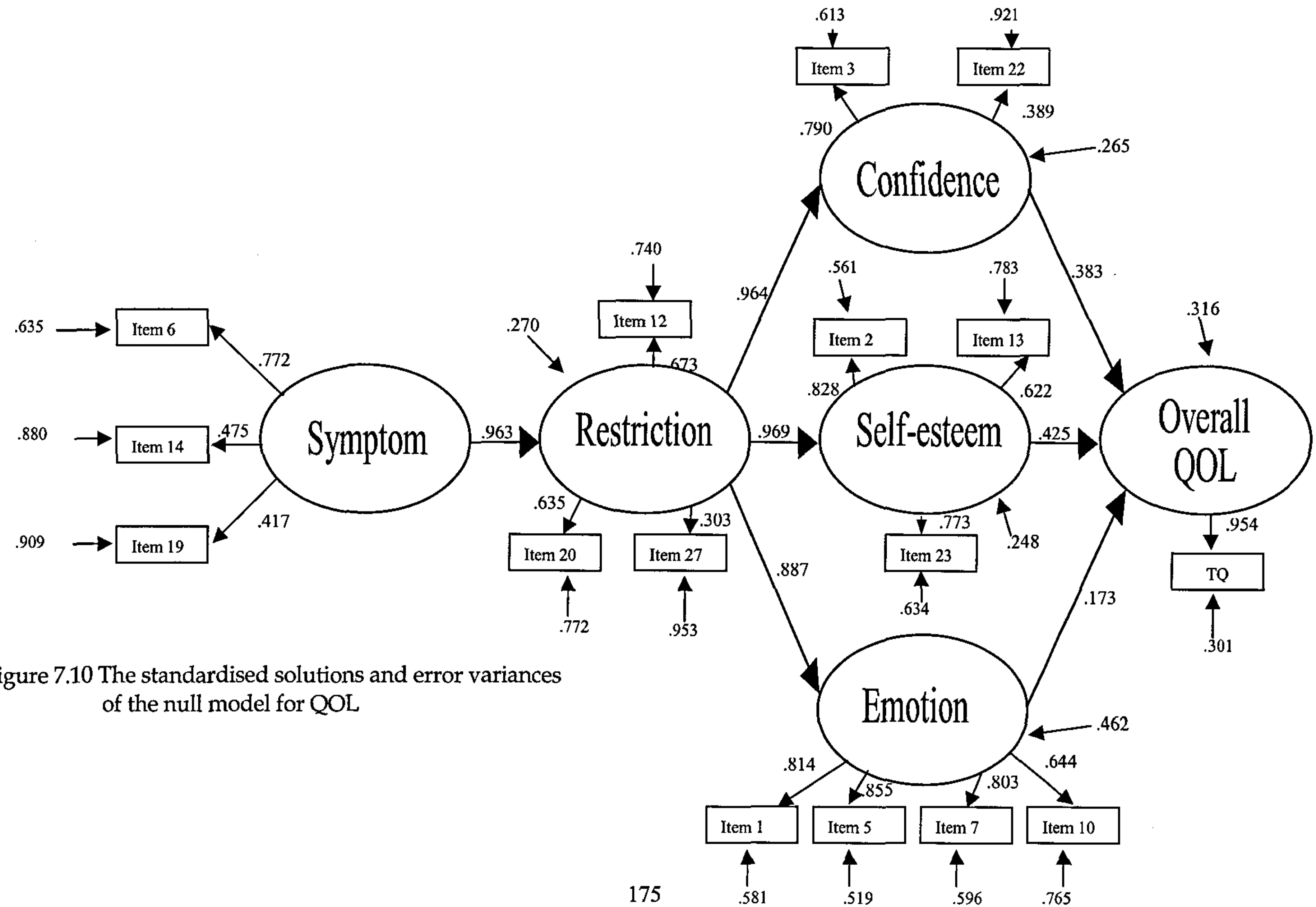


Figure 7.10 The standardised solutions and error variances of the null model for QOL

Therefore, the overall null model was rejected as an appropriate model of quality of life for people with coronary heart disease in spite of the results showing significant relationships among domains.

(2) The alternative model I

The alternative model I is depicted in Figure 7.11. The path from the confidence domain to the self-esteem domain was added to this model. Figure 7.12 shows the standardised solutions and error variances of the alternative model II. Most of the path coefficients were positive and significant ($p < .05$) except the path from the restriction domain to the self-esteem domain and from the self-esteem domain to the overall QOL domain - these were both not statistically significant. The goodness of fit indices revealed poor fit of the model according to the fit statistics (CFI= 0.834, GFI= 0.847, AGFI = 0.791, RMSR= 0.062, and RMSEA= 0.127 without reaching acceptable values). Furthermore, the chi-square value ($\chi^2 = 387.284$, df=100, $p<0.001$) was significant. The Lagrange Multiplier test indicated a 17.04 point decrease in chi-square, if the path from item 2 (Worthless) to overall QOL was added. It is suggested that although these post-hoc modifications are influenced by chance, the information can be useful in providing insight to variations of the hypothesised model. Changes are usually advised only when theoretically or logically justified (Byrne, 1994).

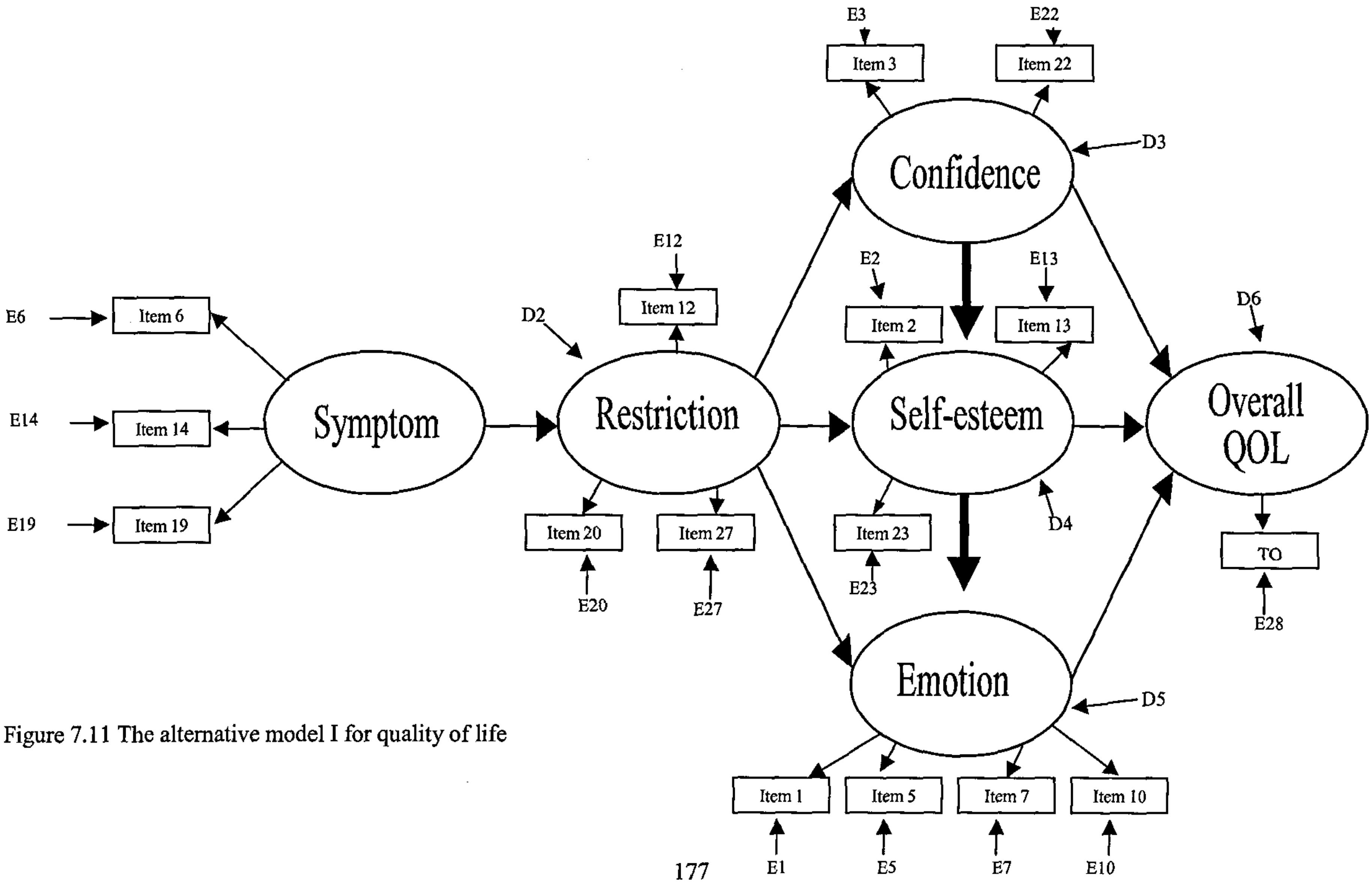


Figure 7.11 The alternative model I for quality of life

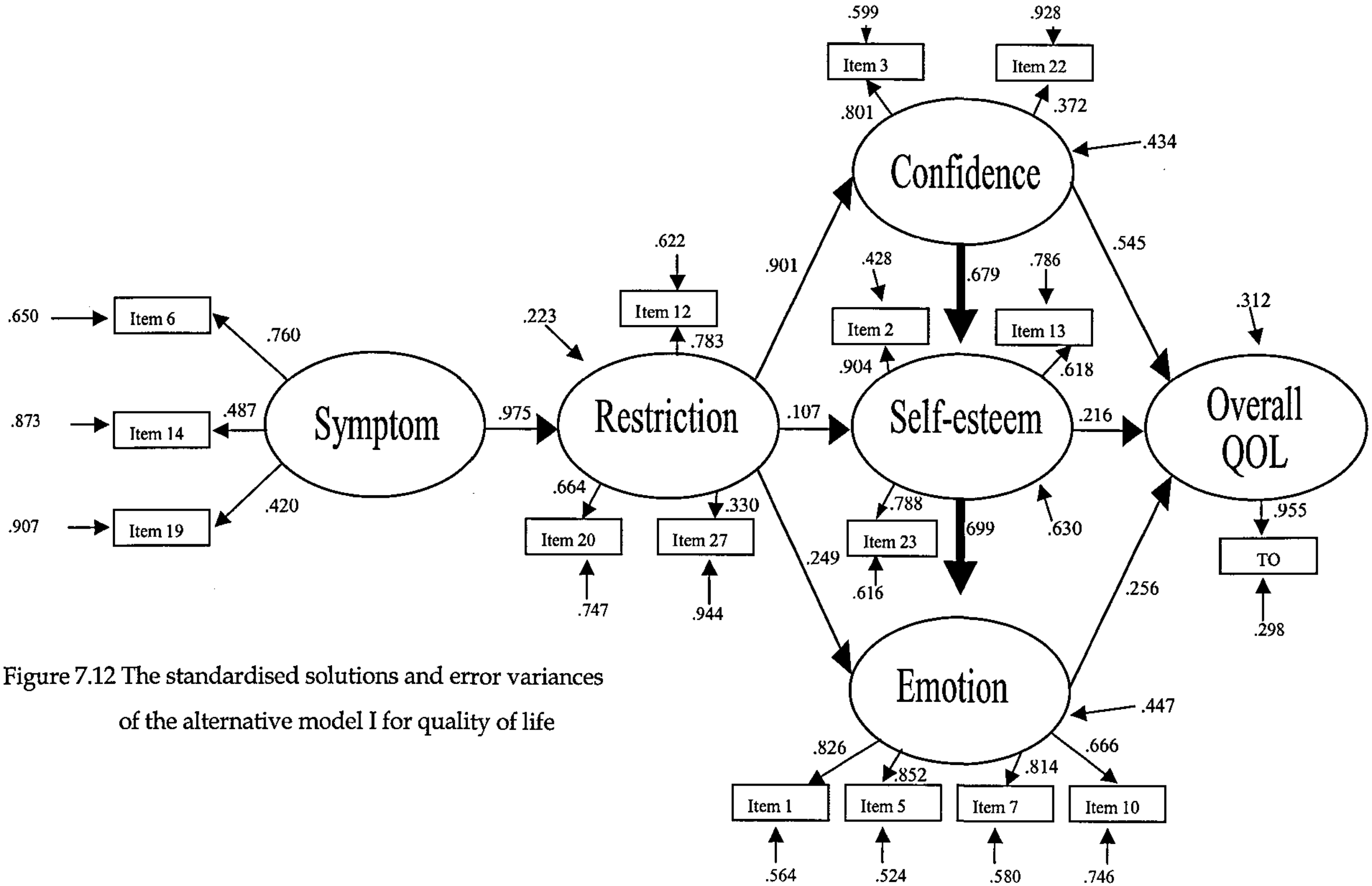


Figure 7.12 The standardised solutions and error variances of the alternative model I for quality of life

(3) The alternative model II

Figure 7.13 presents the relationship among QOL domains in the alternative model II. The standardised solutions and error variances of the alternative model II are shown on Figure 7.14. Based on the fundamental model, the paths from the confidence domain to the self-esteem domain and from the self-esteem domain to emotion domain were added. In addition, a path was added from the restriction domain to overall QOL domain. A few path coefficients were not significant ($p > .05$) including the paths from the restriction domain to the self-esteem and the emotion domains, and from the confidence domain to the overall QOL. The other path coefficients reached significantly statistical levels.

The chi-square value of the model was significant ($\chi^2 = 354.842$, df=99, $p<0.001$). The values of CFI (0.854), GFI (0.858), AGFI (0.804), NNFI (0.823) were under 0.90 and RMSEA (0.121) were higher than 0.060, although the RMSR (0.055) reached an acceptable level (below .06). In terms of overall fit, all values of fit indices were improved. As a whole, it showed a poor fit with the model for quality of life. The Lagrange Multiplier test suggested adding the path also from item 2 (Worthless) to the endogenous latent construct 'overall QOL', the chi-square value significant decreases 15.092 point. The Wald Test (Byrne, 1994) did not suggest any parameters need be dropped from the model but the LM Test revealed that if paths linking the item 2 (Worthless) to overall QOL were added, significant improvement in the model's fit would result. However, adding this path could not be justified on theoretical grounds, so it was decided that these paths would not be added.

In summary, three hypothesised models, including the null model, the alternative model I and the alternative model II did not reach an acceptable level of Goodness-of-Fit Indices. This was despite the fact that the models were improved from the null model to alternative model -I and alternative model- II according to the hypotheses of testing the full latent variable models. Three

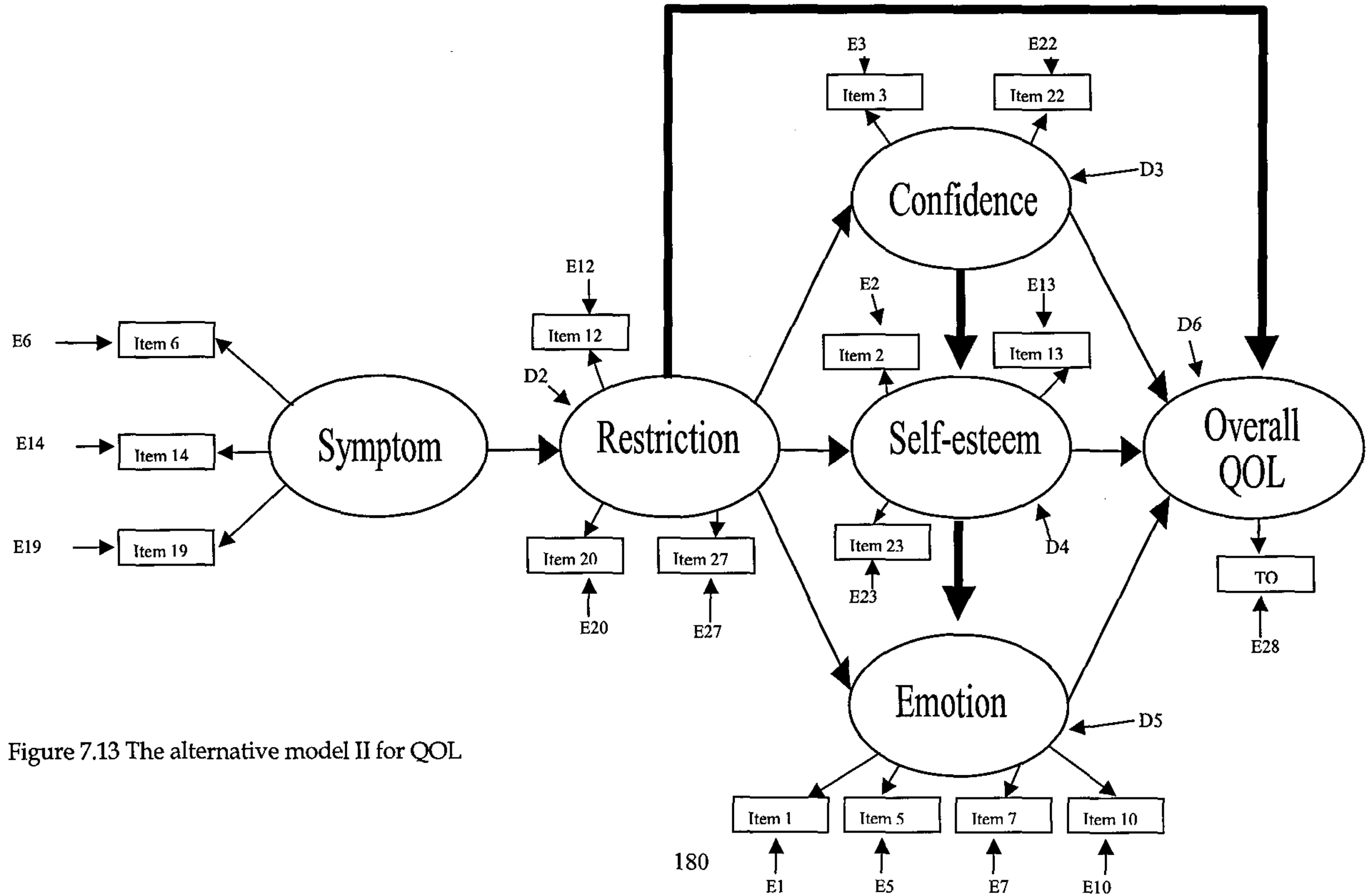


Figure 7.13 The alternative model II for QOL

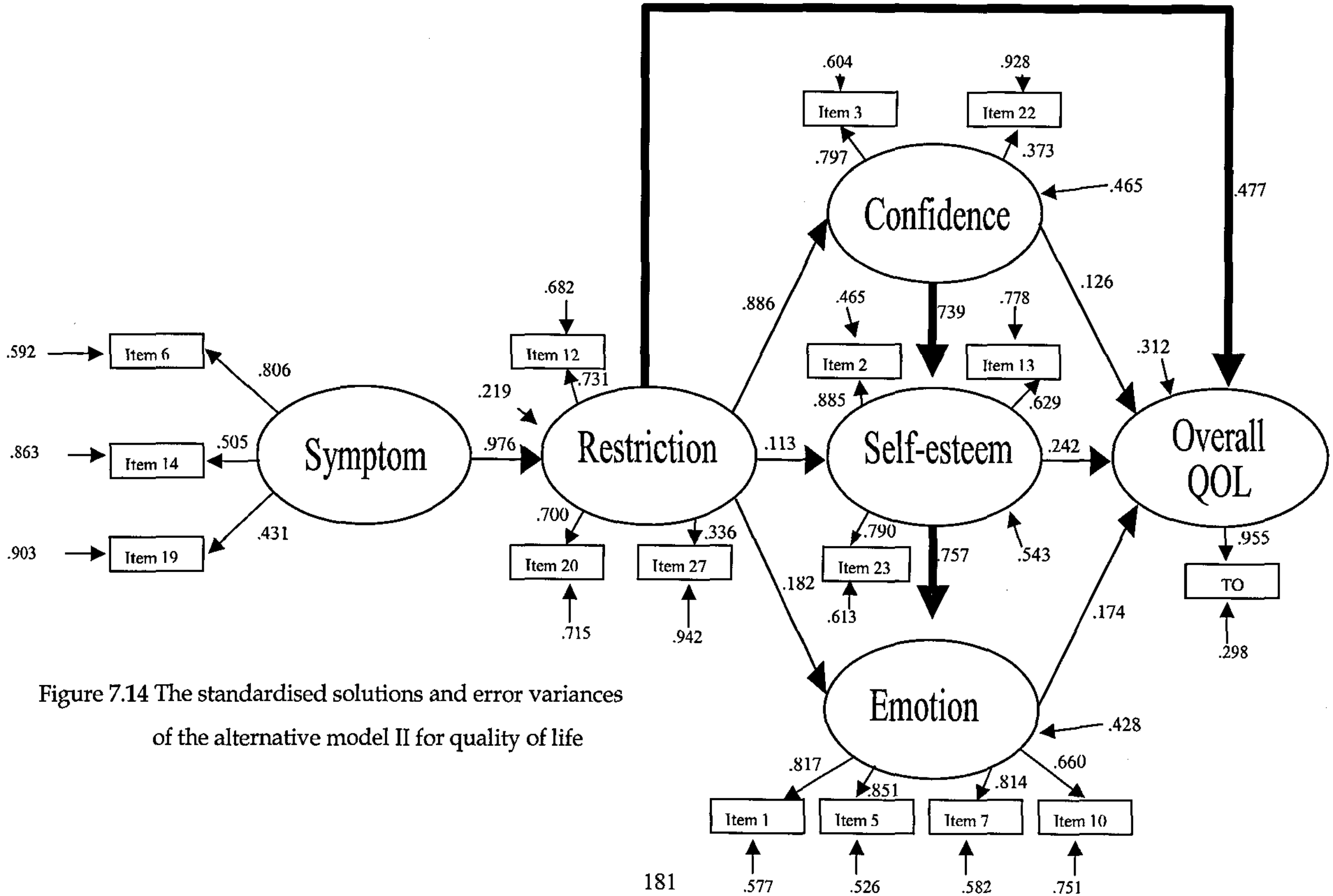


Figure 7.14 The standardised solutions and error variances of the alternative model II for quality of life

hypothesised models did not reveal gradually increasing regression coefficients from the null model to alternative model-I and alternative model-II. Therefore, the first hypothesis was rejected. Meanwhile, the hypothesised models did not prove that the confidence domain, self-esteem domain and emotion domain has a direct effect on overall QOL in the null model. However, there are no obvious results to support either the confidence domain effects on the self-esteem domain; or the self-esteem domain effects on the emotion domain in the alternative model-I; or the restriction domain effects on the overall QOL in the alternative model-II (see Table 7.9).

Table 7.9 Summary of Goodness-of-Fit statistics for the full latent variable models of QLMI

Models \ Fit indices	χ^{2*}	df	χ^2/df	CFI	GFI	AGFI	NNFI	RMSR	RMSEA
The Null Model	387.727	103	3.764	0.838	0.837	0.784	0.812	0.055	0.124
The Alternative Model-I	387.284	100	3.873	0.834	0.847	0.791	0.801	0.062	0.127
The Alternative Model-II	354.842	99	3.584	0.854	0.858	0.804	0.825	0.055	0.121

Note: *χ^2= Chi-Square; CFI= Comparative Fit Index; Robust CFI=Robust Comparative Fit Index

GFI= Goodness-of-Fit Index; AGFI= Adjusted Goodness-of-Fit Index; NNFI=Bentler-Bonett NonNormed Fit Index, RMSR= Root Mean Squared Residual; RMSEA= Root Mean Square Error of Approximation.

There is slight improvement in the full structure model performance from the null model to alternative model–I and from the alternative model-II. However, the results of this study did not reach the statistically significant levels of the fit indices nor meet the basic requirement of structural equation modelling.

7.5 Discussion

7.5.1 The Confirmatory Factor Analysis

Schumacker and Lomax (1996) stated that the confirmatory factor analysis (CFA) reflects the entire measurement models, in which observed variables define constructs. Thus, the CFA provides useful and relevant information about the actual number of latent constructs and factorial complication, particularly the overall model fit. The different fit indices are reported: Chi-Square ($\chi 2$); Satorra-Bentler scaled Chi-Square (S-B $\chi 2$); Comparative Fit Index (CFI); Robust Comparative Fit Index (Robust CFI); Goodness-of-Fit Index (GFI); Adjusted Goodness-of-Fit Index (AGFI); Root Mean Squared Residual (RMSR) and Root Mean Square Error of Approximation (RMSEA).

In this chapter, the models of the quality of life for people with coronary heart disease were tested with three different models: three-domain, four-domain and five-domain. Lim et al. (1993) proposed three domains of quality of life: emotion, physical and social using the questionnaire of QLMI and some of the items in QLMI belong to the multidimensional domain. In fact, the multidimensional domain is an ambiguous definition in the quality of life because it is very difficult to identify the latent variables. The CFA model was assumed to be unidimensional, so all items uniquely represent and load on their own factors because each domain is defined as the unique aspect of cardiac patients' QOL. As a whole, the three-domain model through the CFA test indicated that it does not fit well with this research data.

Many studies have supported the four-domain model of quality of life as an appropriate model for cardiac patients (Ferrans, 1996; Ferrans & Powers, 1992; Miwa, 1999; Zhan, 1992), although the names of domains have been defined in slightly different ways. The results reported in Chapter 6 in this thesis indicated that the four-domain is a suitable model for people with coronary heart disease using exploratory factor analysis. However, when the four-domain models including first-order and second order were tested by the confirmatory factor analysis, the results indicated the four-domain (emotion, physical/restriction, symptom and social/family) did not fit the data. Therefore, the items of the original four-domain model were removed based on the factor loading in exploratory factor analysis. The revised four-domain models included five items in every domain, these revised models did not reach a significant statistical level using the CFA test as well. This is due in part to Structural Equation Modelling being viewed as a confirmatory rather than exploratory procedure, which uses goodness-of-fit tests to determine if the pattern of variances and covariances in the data is consistent with the full latent variable models.

Garson (2000) stated SEM is a more powerful way which takes into account the modelling of interactions, nonlinearities, correlated independents, measurement error, correlated error terms, multiple latent independents each measured by multiple indicators, and one or more latent dependents also with each multiple indicators. Because of a more strict and precise statistical method, this may reveal different results between the confirmatory factor analysis and exploratory factor analysis. Thus, the results of a CFA test can reconfirm the hierarchical structure of the quality of life.

It is not the purpose of this chapter to focus on a comparison between the exploratory factor analysis and the confirmatory factor analysis using the same sample. The important consideration concerns how many domains in the quality of life need to be identified in order to do so. Importantly, the results of this study contributed to recognising the attributions of a four-domain model using the same sample.

The original five-domain model was designed by Oldridge et al. (1991). Subsequently Hillers et al. (1994) compared the QLMI questionnaire with related measures including the Quality of Well-being questionnaire (QWB), the Time Trade-off (TTO), social function, depression symptom, the Profile of Mood States (POMS) and The Spielberger State-Trait Anxiety Inventory (ATAI). The results indicated QLMI is a reliable and consistent measure of health-related quality of life for people with coronary heart disease. Therefore, it can be concluded that the five domains of QLMI have sound validity and construct. In this study according to the fit indices of structural equation modelling, the original five-domain model did not fit the data very well. However, this fit was better than that achieved for the three-domain and four-domain model. For this reason, the items of the five-domain model were changed depending on the factor loading of the original five-domain model in order to identify the most appropriate model for cardiac patients. The revised five-domain model consists of fifteen items including the symptom domain: item 6, 14, 19; restriction domain: item 12, 20, 27; the confidence domain: item 3, 22; the self-esteem domain: item 2, 13, 23; the emotion domain: item 1, 5, 7, 10 and the overall QOL: item 28 (TQ).

Through CFA, the results of the revised five-domain revealed an appropriate model from the first-order alternative model and second-order alternative model respectively according to a fit indices report. One of the fit indices (AGFI=0.895) was close to the 0.90 acceptable level. Although there are rules of thumb for acceptance of model fit (e.g., that CFI should be at least .90), Bollen (1989) observes that these cut-offs are arbitrary. A more salient criterion may be simply to compare the fit of one's model to the fit of other, prior models of the same phenomenon. For example, a CFI of .85 may represent progress in a field where the best prior model had a fit of .70. Furthermore, the remaining fit indices reached the rules of thumb for the first-order alternative model (see

Table 7.6 Model-5a, p.169). In terms of second-order models, the five-domain model (Model-5c) was also an appropriate QOL model for people with coronary heart disease.

7.5.2 The Full Latent Variable Models

The issues of quality of life have been discussed in a variety of ways. Indeed, quality of life does not have an ingrained theory or conceptual framework to follow. Certainly, many studies have attempted to integrate or include related theory explaining the purpose of the quality of life (Farquhar, 1995; Ferrans, 1996; Guyatt, Bombardier, & Tugwell, 1986; King, 1981; Tam, 1998; Zhan, 1992). Even with this work, the issue of considering quality of life in an integrated way has not been resolved. However, computer science, statistics and structural equation modelling (SEM) has greatly assisted these considerations by using a complicated full latent variable model.

After testing the full latent variable models, four important features are identified. First, there are no previous studies that examine the health-related quality of life for people with coronary heart disease using structural equation modelling. For example, most studies defined the domains of quality of life by exploratory factor analysis or by using qualitative approaches that may contribute meaningful information to concept development. However, Bollen (1989) described confirmatory factor analysis (CFA) as providing a more direct and informative approach in evaluating the measurement model compared to the conventional exploratory factor analysis (EFA).

Furthermore, Anderson (1987) notes that structural equation analysis combines regression and factor analysis in simultaneously assessing structural and measurement relationships of hypothesised constructs. He also notes that structural equation analysis accounts for measurement errors of the items used to measure hypothesised constructs, whereas regression analysis procedures assume perfect measurement of the items, thereby ignoring how well specific items measure the hypothesised constructs. Therefore, structural equation analysis provides more precise and powerful statistical analysis than regression analyses in evaluating the treatment effect on QOL (Siddiqui & Ali, 1999).

Second, an ideal model of health-related quality of life needs to be based on a related theory or the clarity of a conceptual model. Ferrans (1996) emphasised that conceptual clarity is extremely important. In particular, Ferrans (1996) noted that differences in meaning could lead to profound differences in outcomes for research, clinical practice and allocation of health care resources. For this reason, Patrick and Erickson's (1993) conceptual model was applied in this study as it has a complete systematic structure and demonstrates the precise diagram for the health-related quality of life (Patrick & Erickson, 1993). Nevertheless, some of the variables in Patrick and Erickson's (1993) conceptual model were removed due to two-way directions or unpredictable variables (e.g., survival or environment variables).

The essential components of Patrick and Erickson's (1993) conceptual model were extracted. These were the fundamental concepts of quality of life as considered in this chapter. This includes four unidirectional main aspects: impairment → function status → health perceptions → opportunity (see Figure 7.3, p.141). The components of Patrick and Erickson's (1993) conceptual model are in accordance with the five domains of QLMI.

Third, this is a first attempt to place the five-domain model of QLMI into the path diagram in order to place the relationships among domains of quality of life for people with coronary heart disease. Through the use of structural equation analyses, the results of this study show that the null model, the alternative model I and the alternative model II did not have an significant statistical significance to support the relationships among five domains in the revised Patrick and Erickson's (1993) conceptual model. However, it has provided an opportunity to understand the relationships within a full systematic structural model.

Finally, SEM examines the full latent variable model, and also provides path analysis to realise the correlation between domains. For instance, the value of the path coefficient in the null model from the symptom domain to the restriction domain was .963, indicating high correlation between two domains. As Garson (2000) stated that a 'good fit' is not the same strength of relationship: one could have perfect fit when all variables in the model were totally uncorrelated. In fact, the lower the correlations stipulated in the model, the easier it is to find 'good fit.' The stronger the correlations, the more power to detect an incorrect model. However, in cases where the variables have low correlation, the structural (path) coefficients will also be low.

Unfortunately, the path coefficients in this study had strong path coefficient values (over .90), particularly in the symptom domain to the restriction domain, the restriction domain to the confidence domain, the restriction domain to the self-esteem domain, and the restriction domain to emotion domain in the null model. For this reason, the fit indices of the full latent variable model did not reach an acceptable level. The hypothesis, of the sequence of health perceptions determining the overall QOL for people with coronary heart disease, was rejected.

Furthermore, when the paths were added in the alternative model I from the confidence domain to self-esteem domain and from the self-esteem domain to the emotion domain, the path coefficients dropped to 0.113 and 0.182 from the restriction domain to the self-esteem domain and from the restriction domain to the emotion domain respectively. By adding path arrows, the path coefficients might relatively decrease. In addition the path was added from the restriction domain to overall QOL in the alternative model II, the path coefficients changed slightly, similar to the alternative model I.

This section provides a meaningful approach to examining the five-domain model grounded on the related theory. The results revealed an appropriate full systematic structural model, but the value of fit indices increased gradually from the null model to alternative model I and from the alternative model I to the alternative model II.

7.6 Conclusion

The objectives of this chapter were: (a) to compare conceptual models which specify the domains of QOL for cardiac patients and the interrelationships among those domains, and (b) to examine a theoretical model of QOL and to ascertain whether it is a valid model.

Confirmatory Factor Analysis was applied to ascertain the number of domains of the QOL model and Structural Equation Analysis was used to identify an appropriate full latent variable model. Based on the findings of this chapter, the first-order five domains, applying the prerequisite of revised QLMI, is an appropriate model of quality of life for people with coronary heart disease compared to the three-domain model and four-domain model. The QOL model of five domains includes the symptom domain, the restriction domain, the confidence domain, the self-esteem domain and the emotion domain. In terms of the second order QOL model, the five-domain model also has a better fit to the data.

The results of the structural equation analysis show that the null model, the alternative model I and the alternative model II did not fit the data sufficiently. The construct of full latent variable model gradually improved to fit statistics from the null model to the alternative model I and from the null model to alternative model II. In other words, the paths or indicators of three models need to be further adjusted in the future in order to improve the model. Therefore, the proposed three full latent variable models did not fit the data perfectly. Nevertheless, this is a first attempt to examine a full model of quality of life for people with coronary heart disease using the structural equation analyses.

CHAPTER 8

GENERAL DISCUSSION OF QUALITY OF LIFE

8.1 Introduction

Four empirical studies of quality of life have been presented in chapters four, five, six and seven. This thesis has used several approaches to develop an appropriate model of quality of life for people with coronary heart disease. This has enabled the sub-problems associated with the four empirical studies to be solved. However, this has not enabled health-related quality of life to be understood systematically. This chapter will therefore integrate the results of those empirical studies with the research issues and findings from the QOL literature. The aims of this chapter are: (a) to present a critique of the conceptual model; (b) to discuss controversial issues and questions; (c) to revise and explain the health-related quality of life model for people with coronary heart disease.

8.2 Theoretical Foundations for the Health-Related QOL

Theory provides the foundation and a framework on which to build up a firm structure. Indeed, King et al. (1997) argued that ambiguity continues to surround the definition and measurement of quality of life despite the abundance of QOL research over the last three decades. The following points are important in developing an understanding of the relevant issues relating to QOL.

Firstly, terminology is crucial when attempting to explain a concept clearly. The term 'quality-of-life' includes a number of meanings, but it needs to be considered that 'quality-of-life' also represents the real quality of a person's life.

For instance, there are ambiguous terms such as well-being, happiness and self-esteem. The latent variables cannot be defined on the basis of a patient's response on a single occasion and the interaction of factors among these latent variables are very difficult to identify. It could be argued that if the QOL is highly correlated with happiness, self-esteem or well-being then the term could be substituted for 'quality-of-life'.

Secondly, the *definition* of quality of life - QOL- is defined in different ways by various researchers. A generalised explanation of the term quality of life could include numerous living things and an entire evaluation of our society. For individual approaches, the quality of life also has a complicated construct that has been broadly studied, and conceptual models of the construct are still being developed (Ferrans, 1996; Hillers et al., 1994; Hornquist, 1982; Lim et al., 1993; Patrick & Erickson, 1993; Zhan, 1992).

In terms of the health-related quality of life, Guyatt et al. (1993) stated that two basic approaches to quality-of-life measurement are available. Firstly, generic instruments that provide a summary of HRQL. Secondly, specific instruments that focus on problems associated with single disease states, patient groups, or areas of function. Generic instruments include health profiles and instruments that generate health utilities. It is important to note that these approaches are not mutually exclusive. Indeed, each approach has its strengths and weaknesses and may be more or less suitable for particular circumstances. Research and development work in HRQL has produced instruments suitable for detecting minimally important effects in clinical trials, for measuring the health of populations and for providing information for policy decisions.

Health-related quality of life can be considered in the context of two research approaches: generic instrument and more recently specific instrument studies (Dempster & Donnelly, 2000; Hillers et al., 1994; McHorney, Ware, Lu, & Sherbourne, 1994; Ware & Sherbourne, 1992). If consideration is given to theoretical background, previous studies indicate that health-related quality of life lacks a stable denotation to take into account both generic and specific instruments simultaneously. The SF-36 questionnaire is preferred for use in generic measures. However, there have been only a few studies examining the related theory with generic measures of health-related quality of life.

A large scale international research project from the international quality of life assessment (IQLA) used structural equation modelling to test the construct validity of the SF-36 health survey. The results suggest that SF-36 scales and summary physical and mental health measures have similar interpretations across the ten countries (Keller et al., 1998). This study contributed to a new approach to using structural equation modelling to confirm the hierarchical construct in a generic measure quality-of-life model. However, the study did not provide clear information for the model of health-related quality of life. Thus, further study needs to be undertaken to identify the theoretical or conceptual model for generic measure.

Thirdly, a theoretical or conceptual model can be identified. A successful theory or model needs to be examined by qualitative and quantitative approaches. A sound empirical study needs to be based on the theory or model, which provides firm rules or stable principles in order to construct the entire framework. Many studies have proposed a perfect theoretical model for QOL, but it is problematic and difficult to test these latent variables (Hornquist, 1982; Hornquist, 1990; Tam, 1998; Zhan, 1992). For example, Tam (1998) noted that a culturally relevant theoretical foundation is essential for the development of valid and reliable life quality measuring tools for a rehabilitation programme evaluation.

8.2.1 The Essential Concepts of the Health-Related QOL

The key purpose of this study is to develop an appropriate QOL model for people with coronary heart disease. By using confirmatory factor analysis, this study found that the five-domain QOL model is a better disease-specific QOL model to use. However, it is necessary to take into consideration the generic measure QOL domains as defining the essential components of the health-related QOL. Keller et al. (1998) used structural equation modelling to examine the generic measure QOL (SF-36 questionnaire) which indicated the three-order structure of SF-36 including eight factors in the first-order, three factors in the second-order and one factor in the third order fitted the data (CFI= 0.982).

This study has already noted that conceptual models or theories provide the overall structure for theory development. Theory offers the specificity needed to test the direction, shape and strength of relationships between concepts. Each of the theory concepts must then be linked to empirical indicators, which provide a method to manipulate the variables of interest (Fawcett, 1992). Unfortunately, Keller et al.'s (1998) study did not undertake related theory to confirm or test the model.

King et al. (1997) noted that researchers have used a variety of instruments to measure QOL. Choosing the most appropriate instrument depends upon the purpose of the research and the particular patient population. Clearly, further conceptual and theoretical work is needed to guide QOL research. In the meantime, there is no standard approach to measuring QOL.

According to Patrick and Erickson's (1993) conceptual model of health-related QOL and with specific reference to people with coronary heart disease, the essential concepts of QOL model should consider a number of factors.

First, Patrick and Erickson's (1993) conceptual model provides more detailed information and conditions in order to recognise the patient's quality of life. For example, the impairment concept consists of six domains: symptoms/ objective complaints; signs; self-reported disease; physiologic measures; tissue alternation and diagnoses. Five of the domains belong to the medical treatment, the exception is the symptoms/objective complaints domain. However, the procedure can become more complicated and difficult. According to King et al.

(1997), the patient self-report is the preferred method of obtaining data. Thus, the symptoms/ objective complaints domain can represent mainly the impairment concept from the patient's viewpoint.

In addition, Hillers et al. (1994) proposed the symptom domain as the QOL model for cardiac patients and it was confirmed by using structural equation modelling analysis from the results reported in Chapter 7 (see Figure 7.7, p.169 and Figure 7.8, p.170).

Second, the functional status includes three domains and eight sub-domains. The social function domain is composed of four sub-domains: limitation to usual roles; integration; contact and intimacy, and sexual function. The psychological function domain contains the affective and the cognitive sub-domains. The physical function domain contains the activity restrictions and the fitness sub-domains. A patient who has suffered from coronary heart diseasemay find functions and movement have been restricted, if the patient has suffered from (Patrick and Erickson, (1993, p.77). The three function domains were positively associated with the restriction domain in the confirmatory factor analysis.

Third, the health perception can be classified into two domains: general health perceptions and satisfaction with health. Patrick and Erickson (1993) described health perceptions as the feeling of satisfaction with physical, psychological, social function and self-rating health. Therefore, the confidence domain, self-esteem domain and emotion domain are extremely correlated with the health perceptions concept. Finally, the opportunity concept infers a good quality of life, which has a capacity for health and the ability to withstand stress.

8.3 Measurement of the Health-Related QOL

8.3.1 The Outcome of Cardiac Rehabilitation Programme

Cardiac rehabilitation was recognised more than two decades ago as being of value to the patient with CHD. However, it is only recently that the adoption of programmes of rehabilitation has become more widespread. According to the British Cardiac Society (BSC) survey published in 1992, cardiac rehabilitation programmes had been installed in 161 district hospitals (76%) and 3 community-based programmes in the UK (British Association for Cardiac Rehabilitation, 1995). Consequently, between 1989 and 1992, the proportion of hospitals in the UK offering rehabilitation increased from one-half to three-quarters and this has continued to increase. However, the type and coverage of rehabilitation offered varies considerably (Horgan et al., 1992).

The standardisation and assessment of cardiac rehabilitation programmes are the most important tasks to be carried out in cardiac care. However, there are few studies that have attempted to standardise or assess these programmes. To do this, meta-analysis, which integrates the related research findings into more valuable information for researchers and clinical staff is the best approach. In this thesis, meta-analysis was applied to link related literature and integrated explicit systematic information in an empirical study (see Chapter 4). Furthermore, compared with entering and completing the cardiac rehabilitation programme (CRP) using the questionnaires of SF-36 and QLMI, the patient's physical, psychological and social functions improved after cardiac rehabilitation programme (Chapter 5 and 6).

Newton et al. (1991) assessed the potential benefits of an exercise-based cardiac rehabilitation programme in Glasgow, UK and suggested that exercise-based cardiac rehabilitation has psychological benefits. Patients undergoing rehabilitation suffered fewer cardiac events and less anxiety and depression (Pell, 1997). In addition, Oldridge (1988) stated that cardiac rehabilitation was demonstrated to be associated with reduction of both cardiac and all-cause mortality.

Clearly, there is epidemiological evidence that increased physical activity is associated with a lower risk of atherosclerotic heart disease. Exercise training can be beneficial in preventing the development and progression of ischaemic heart disease. Studies have shown a number of benefits from exercise training following MI or coronary artery by-pass graft (CABG) including an 11%-66% increase in maximal functional capacity and greater myocardial contractility (Pell, 1997). These findings support those from this thesis that a cardiac rehabilitation programme provides a number of benefits for patients.

8.3.2 The SF-36 Generic Measure

The SF-36 questionnaire is a self-administered questionnaire containing 36 items, which takes about five minutes to complete. It measures health on eight multi-item dimensions, covering physical functioning, social functioning, role limitations-physical and emotional, mental health, vitality, pain, general health perception and health change.

Many studies have shown that the SF-36 questionnaire is easy to use, acceptable to patients, and fulfils strict criteria of reliability and validity (Brazier et al., 1992; Dempster, Bradley, Wallace, & McCoy, 1997; Garratt, Ruta, Abdalla, Buckingham, & Russell, 1993; Jenkinson, Layte, Wright, & Coulter, 1996; Lin & Ward, 1998). Discriminant function analysis is a suitable approach to use to determine which variables discriminate between two or more independent SF-36 groups (see Chapter 5). Three groups including gender, disease type and age were included as independent variables.

The results indicated that older people (over 65) with coronary heart disease gained more pain relief than their younger counterparts (at a .05 level of statistical significance). Compared with related studies, the score of the social function domain, the role physical domain and the body pain domain were lower than these studies (Dempster, Bradley, Wallace, & McCoy, 1997; Jenkinson, Layte, Wright, & Coulter, 1996; Lalonde, Clarke, Joseph, Mackenzie, & Grover, 1999; McHorney, Kosinski, & Ware, 1994). This phenomenon might be caused by variation and non- standardisation in the setting up of programmes of rehabilitation (Pell, 1997).

Regarding the definition of SF-36 dimensions, Brazier et al. (1992) categorised this into three areas: functional status (physical functioning, social functioning and role limitations-physical and emotional), well-being (mental health, vitality and pain), and overall evaluation of health (general health perception and health change). This method could provide an appropriate category for Patrick and Erickson's (1993) conceptual model of quality of life. However, Keller et al. (1998) proposed a three-order domain QOL model for SF-36 instrument using confirmatory factor analysis. As already stated, further study needs to be carried out in order to confirm a generic measure of the QOL model, which is based on grounded theory.

8.3.3 The QLMI Disease-Specific Measure

The MacNew QLMI is a reliable disease-specific measure of health-related QOL, which is able to discriminate between patients with coronary heart disease according to patient's individual emotional function and overall view of quality of life. The MacNew QLMI can examine the treatment effects in most cardiac rehabilitation programmes, especially those with a small sample size. Correspondingly, the QLMI was developed to evaluate a comprehensive cardiac rehabilitation programme for their with coronary heart disease, consisting of 27 items with scores ranging from 0-7, where higher scores represent higher functioning.

Studies have shown the instrument of QLMI includes three domains: emotional, physical and social (Lim et al., 1993; Valenti et al., 1996; Smith et al., 2000). However, Hillers et al. (1994) considered that the QLMI instrument should be classified into five domains: symptom, restriction, confidence, self-esteem and emotion. The results reported in Chapter 6 in this thesis suggest four domains of the QLMI instrument - emotion; physical/restriction; symptoms and social/family domain. These were selected by eigenvalue and scree test values greater than 1, accounting for 63.5% of the variance for the sample using exploratory factor analysis.

Ferrans (1996) identified four domains of quality of life: health and functioning, psychological/spiritual, social and economic, and family. Zhan (1992) proposed a conceptual model of quality of life, which includes four domains: life satisfaction, self-concept psychological well-being, health functioning and socio-economic factors. In this model, the numbers of domains in quality of life models are not considered important. However, this thesis is concerned with how many domains can really represent the health-related quality of life. Therefore, structural equation modelling was developed and applied in Chapter 7 in order to confirm and test an appropriate QOL model for people with coronary heart disease.

Through a confirmatory factor analysis examination, the five-domain model demonstrated an acceptable fit to the data, whilst the first-order QOL was slightly higher than the second-order QOL model (see Table 7.6, p132). Testing the full latent variable model, the alternative model II was a better model of the three models to fit the data but fit indices showed no statistical significance among these models (see Figure 7.13, p180). Therefore, reducing the paths and adding indicators in the QOL model might achieve a best fit to the data.

Moreover, the original questionnaire of QLMI with 27 items has a high reliability and validity but it did not achieve the basic requirement of SEM. However, it indicated a good fit to the data when reducing the items from 27 to 15 in total. It is proposed that further studies need to be undertaken to identify the revised QLMI with 15 items.

8.4 An Appropriate Model of the Health-Related QOL

As discussed in the last section, the first-order five domains QOL model is an appropriated model for using confirmatory factor analysis. However, adopting it as a theoretical model requires alternative examinations and tests. Although the hypothesised null and alternative models did not reveal an adequate fit to the data in this thesis, it does not lead to the rejection of Patrick and Erickson's (1993) conceptual model or other theories. In fact, a systematic or hierarchical structure is particularly robust if it can identify the 'cause and effect' or paths especially containing latent variables in the model.

Garson (2000) suggested some useful solutions to the problems mentioned earlier by modification of the SEM: (1) Eliminate feedback loops and reciprocal effects. (2) Specify at fixed levels any coefficient estimates whose magnitude is reliably known. (3) Simplify the model by reducing the number of arrows, which is the same as constraining a path coefficient estimate to 0. (4) Simplify the model by constraining a path estimate (arrow) in other ways: equality (it must be the same as another estimate), proportionality (it must be proportional to another estimate), or inequality (it must be more than or less than another estimate). (5) Consider simplifying the model by eliminating variables. (6) Eliminate variables, which seem highly multicollinear with others. (7) Add exogenous variables (which, of course, is usually possible only if this need is considered prior to gathering data). (8) Have at least three indicators per latent variable. (9) Make sure the listwise, not pairwise, missing data treatment option has been selected. (10) Consider using a different form of estimation (ex. GLS or ULS instead of MLE).

Therefore, examining repeatedly Patrick and Erickson's (1993) conceptual model with the result of full latent variable models, an appropriate model of the health-related QOL could be developed by revising the four-domain model. The health perception concept would be combined with the confidence domain, the self-esteem and the emotion domain as a domain called 'self-perception'. A modified appropriate model is shown on Figure 8.1.

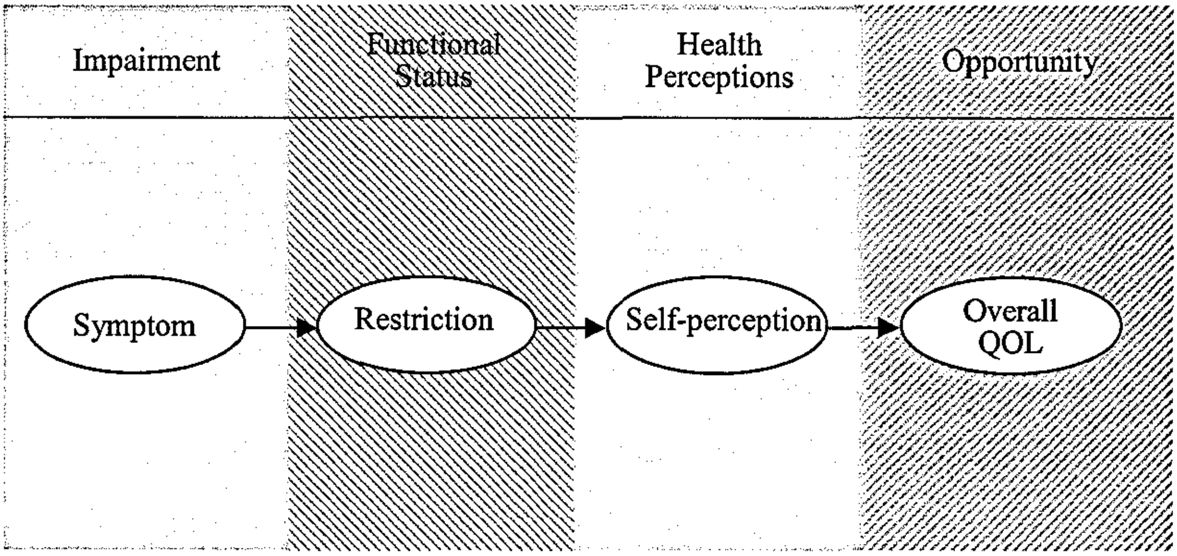


Figure 8.1 A modified appropriate model with Patrick and Erickson's (1993) concept.

8.5 Questions on the Health-Related QOL

In this thesis, five primary questions were proposed in Chapter 1. Through the full understanding of conceptual models and empirical studies, these questions and sub-questions were answered in Chapter 4, 5, 6, 7 respectively. The five questions are summarised below:

Q1. What domains of the quality of life are appropriate for people with coronary heart disease?

A1: Through confirmatory factor analysis, Hillers et al. (1994) proposed a first-order five domain QOL model. This is an appropriate model for people with coronary heart disease, which includes the symptom domain, the restriction domain, the confidence domain, the self-esteem domain and the emotion domain.

Q2. Does a conceptual model of 'health-related quality of life' adequately fit the data?

A2: According to the structural equation analysis, the full model of health-related QOL did not reveal an appropriate fit to the empirical data. However, the results provided a systematic construct of health-related QOL.

Q3. Are there any demographic differences in the areas addressed by the research?

A3: Based on the findings of generic measures QOL (SF-36) using discriminate analysis, older people (over 65) with coronary heart disease gained more pain relief than their younger counterparts. There is no significant difference between gender and disease event.

Q4. Does the use of 'health-related quality of life' concepts and its measurement meet the needs of coronary heart disease patients in cardiac exercise rehabilitation programmes?

A4: From systematic literature analysis (meta-analysis) and generic measure (SF-36) and disease-specific measure (QLMI), the health-related quality of life is an effective way to realise patient's health status and provides useful information for clinical staff and researchers.

CHAPTER 9

CONCLUSION AND IMPLICATIONS

9.1 Summary and Conclusion

Health-related QOL is imperative in clinical research and essential for cardiac patients. The concept of health-related QOL has been recognised for the last two decades, but has not been investigated systematically in higher education or in clinical research. The primary purpose of this thesis has been to develop a health-related quality of life model for people with coronary heart disease in order to clarify the concept of a health-related quality of life and to evaluate cardiac rehabilitation programmes. In this study Patrick and Erickson's (1993) conceptual model was used as the fundamental framework. In addition, the short form 36 health survey (SF-36) and MacNew QOMI were also adopted.

Using the methods of meta-analysis, discriminant analysis and structural equation modelling, the health-related QOL model for people with coronary heart disease was explored. This was achieved through a range of systematic approaches that established an appropriate quality of life model. Indeed, the model has a theoretical basis and is practically effective. Consideration will now be given to the studies, objectives, and the findings.

First, evaluating a cardiac rehabilitation programme as to whether it has beneficial effects on people with coronary heart disease. Three stages were undertaken: (1) meta-analysis was applied to link related literature and integrate explicit systematic information; (2) a comparison was made between entering and completing the cardiac rehabilitation programme (CRP) using the generic measure - SF-36 survey; and (3) a disease-specific measure – the QLMI survey was used to examine the difference between entering and completing the cardiac rehabilitation programme (CRP). The findings illustrate that the patient improved (including physical, psychological and social functions) after CRP training. Therefore, the findings support related studies that the cardiac rehabilitation programme provides a number of benefits for patients. Patients undergoing rehabilitation suffered fewer cardiac events and less anxiety and depression. Meanwhile, the cardiac rehabilitation programme was demonstrated to be associated with a reduction of both cardiac and all-cause mortality.

Second, an evaluation of people with coronary heart disease was conducted relating to the primary components of generic health-related quality of life by their demographic characteristics. Discriminant function analysis was used to determine which variables discriminate between two or more independent SF-36 groups, which consist of three subgroups: gender, disease type and age. The findings indicate that older people (over 65) with coronary heart disease gained more pain relief than their younger counterparts. Other groups did not have significant differences.

Third, regarding the identification of the main factors governing disease-specific health-related quality of life amongst people with coronary heart disease and the two processes necessary to identify the domains of the QOL model: (1) using traditional exploratory factor analysis; (2) using confirmatory factor analysis. The four-domains of the quality of life model were selected and were extracted in the first step. Subsequently, by comparing models with three, four, and five domains, the findings revealed that the first-order five domains QOL model is the most appropriate of all the models for people with coronary heart disease.

Finally, a model of health-related quality of life can be verified as to its ability to predict the direct and indirect effects on individual patients. Patrick and Erickson's (1993) revised conceptual model was applied to the causal unidirectional structure model. The hypothesised and alternative models did not achieve the best fit to the data. However, the results of structure equation modelling showed it clearly provided the direct and indirect correlations among factors or variables (see Figure 7.10, p.175; Figure 7.12, p.178; Figure 7.14, p.181).

9.2 Implications

The aim of this study was to clarify the crucial concept of health-related quality of life and to develop an appropriate model for people with coronary heart disease. The implications of this study can be categorised into five major points.

First, the cardiac rehabilitation programme performs an essential role in improving the quality of a patient's life within weeks of suffering CHD. The assessment of any cardiac rehabilitation programme is crucial because it provides an explicit index for cardiac patients, clinical staff and researchers. Cardiac rehabilitation programmes have been designed in various ways. More studies are needed to define the core 'curriculum' and to provide this curriculum in a coherent and integrated cardiac rehabilitation programme. The findings from the meta-analysis support the hypothesis that the cardiac rehabilitation programme has a positive effect on cardiac patients. Indeed, mortality will be decreased if cardiac patients are recruited into cardiac rehabilitation programmes.

Second, although the instrument of SF-36 has high reliability and validity there are a number of problems. The problems associated with using this instrument include difficulty with respondents completing the questionnaire. However, the findings in this study indicate that the SF-36 survey provided a better way to monitor the improvement of health status including the physical, psychological and social functions without any intrusive equipment.

Third, disease-specific instruments are more sensitive to detecting change in health status than generic instruments. In this thesis, exploratory factor analysis and confirmatory factor analysis were applied in order to develop an appropriate QOL model. The findings revealed that the first-order five domains model was the best fit to the data. The results provide a new approach to confirm the conceptual or theoretical QOL model through quantitative research.

Finally, the identification of a conceptual or theoretical model needs to be fully discussed in different aspects. The proposed hypothesised model and alternative models did not get best fit to the data. Uniquely, this study used SEM to reconfirm the QOL model for people with coronary heart disease. The findings of this thesis therefore illustrate a benefit where the initial setting of the QOL model is modified in accordance with Patrick and Erickson's conceptual model (1993).

9.3 Limitations

There are several constraints and limitations to this study:

First, cardiac rehabilitation programmes have a drop out rate of up to 50 percent (Pell, 1997). Only 36 percent of cardiac patients completed the whole programme in this study. The addition of an intervention or interviews would lead to clearer understanding of the high drop out rates in CRP in general and in this study in particular.

Second, although the sample size of this study was over the minimum required by an exploratory factor analysis and structural equation analysis, it would have been advantageous to have a larger sample in order to gain more exact explanations and inferences regarding health-related quality of life.

9.3 Suggestions for Future Research

Considering the generic measure QOL model - although SF-36 is an effective instrument for investigating quality of life generally, it needs more evidence to support the three-order QOL model. The generic QOL model shows considerable promise. However, with only one study completed to date it lacks grounded research to justify and support its development. Therefore, further studies to support the three-order model are required.

With respect to the generic measure QOL model, the SF-36 survey was used to compare the differences before entering and after completing the cardiac rehabilitation programme. More discussion and analysis relating to the generic quality of life model and testing of the model between the generic measure and disease-specific health-related quality of life is needed. Such discussions will enhance our understanding of the model's appropriateness and usefulness. It is only after this has been addressed that the health-related QOL model for people with coronary heart disease could integrate the generic and disease-specific domains underlying a conceptual model or theory.

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Appendix 1

THE SHORT FORM 36 HEALTH SURVEY QUESTIONNAIRE (SF-36™)

The following questions ask for your views about your health, how you feel and how well you are able to do your usual activities. If you are unsure about how to answer any questions please give the best answer you can and make any of your own comments if you like. Do not spend too much time in answering as your immediate response is likely to be the most accurate.

1. **In general,** would you say your health is:

(Please tick one box)

Excellent ☐

Very good ☐

Good ☐

Fair ☐

Poor ☐

2. **Compared to one year ago,** how would you rate your health in general now?

(Please tick one box)

Much better than one year ago ☐

Somewhat better than one year ago ☐

About the same ☐

Somewhat worse now than one year ago ☐

Much worse now than one year ago ☐

3. **HEALTH AND DAILY ACTIVITIES**

The following questions are about activities you might do during a typical day. Does your health limit you in these activities? If so, how much?

(Please tick one box on each line)

		Yes, limited a lot	Yes, limited a little	No, not limited at all
a)	**Vigorous activities**, such as running, lifting heavy objects, participating in strenuous sports	☐	☐	☐
b)	**Moderate activities**, such as moving a table, pushing a vacuum, bowling or playing golf	☐	☐	☐
c)	Lifting or carrying groceries	☐	☐	☐
d)	Climbing **several** flights of stairs	☐	☐	☐
e)	Climbing **one** flight of stairs	☐	☐	☐
f)	Bending, kneeling or stooping	☐	☐	☐
g)	Walking **more than a mile**	☐	☐	☐
h)	Walking **half a mile**	☐	☐	☐
i)	Walking **100 yards**	☐	☐	☐
j)	Bathing and dressing yourself	☐	☐	☐

4. During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of your physical health?**

(Please answer Yes or No to each question)

		Yes	No
a)	Cut down on the **amount of time** you spent on work or other activities	☐	☐
b)	**Accomplished less** than you would like	☐	☐
c)	Were limited in the **kind** of work or other activities	☐	☐
d)	Had **difficulty** performing the work or other activities (eg it took more effort)	☐	☐

5. During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of any emotional problems** (such as feeling depressed or anxious)?

(Please answer Yes or No to each question)

		Yes	No
a)	Cut down on the **amount of time** you spent on work or other activities	☐	☐
b)	**Accomplished less** than you would like	☐	☐
c)	Didn't do work or other activities as **carefully** as usual	☐	☐

6. During the **past 4 weeks**, to what extent have your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours or groups?

(Please tick one box)

- Not at all ☐
- Slightly ☐
- Moderately ☐
- Quite a bit ☐
- Extremely ☐

7. How much **bodily pain** have you had during the **past 4 weeks**?

(Please tick one box)

- None ☐
- Very mild ☐
- Mild ☐
- Moderate ☐
- Severe ☐
- Very Severe ☐

8. During the **past 4 weeks** how much did **pain** interfere with your normal work (including work both outside the home and housework)?

(Please tick one box)

- Not at all ☐
- A little bit ☐
- Moderately ☐
- Quite a bit ☐
- Extremely ☐

YOUR FEELINGS

9. These questions are about how you feel and how things have been with you **during the past month.** (For each question, please indicate the one answer that comes closest to the way you have been feeling).

(Please tick one box on each line)

	How much time during **the last month:**	**All of the time**	**Most of the time**	**A good bit of the time**	**Some of the time**	**A little of the time**	**None of the time**
a)	Did you feel full of life?	☐	☐	☐	☐	☐	☐
b)	Have you been a very nervous person?	☐	☐	☐	☐	☐	☐
c)	Have you felt so down in the dumps that nothing could cheer you up?	☐	☐	☐	☐	☐	☐
d)	Have you felt calm and peaceful?	☐	☐	☐	☐	☐	☐
e)	Did you have a lot of energy?	☐	☐	☐	☐	☐	☐
f)	Have you felt downhearted and low?	☐	☐	☐	☐	☐	☐
g)	Did you feel worn out?	☐	☐	☐	☐	☐	☐
h)	Have you been a happy person?	☐	☐	☐	☐	☐	☐
i)	Did you feel tired?	☐	☐	☐	☐	☐	☐
j)	Has your **health limited your *social activities*** (like visiting friends or close relatives)?	☐	☐	☐	☐	☐	☐

HEALTH IN GENERAL

10. Please choose the answer that best describes how **true** or **false** each of the following statements is for you.

(Please tick one box on each line)

		Definitely true	**Mostly true**	**Not sure**	**Mostly false**	**Definitely false**
a)	I seem to get ill more easily than other people	☐	☐	☐	☐	☐
b)	I am as healthy as anybody I know	☐	☐	☐	☐	☐
c)	I expect my health to get worse	☐	☐	☐	☐	☐
d)	My health is excellent	☐	☐	☐	☐	☐

Appendix 2

The permission of using QLMI

From: Tracy Dixon [mailto:tracy.dixon@anu.edu.au]

Sent: Thursday, April 13, 2000 8:04 AM

To: Z.R.Lin@lboro.ac.uk

Cc: noldridg@iupui.edu; Lynette.Lim@anu.edu.au

Subject: QLMI instrument

Dear Zin-Rong,

Thank you for your interest in the Quality of Life after Myocardial Infarction instrument. We would be delighted for you to translate and use it in your research. Attached is a copy of the instrument along with scoring details and a list of useful references. Please contact us if you have any other questions.

I have cc-ed this message to Professor Neil Oldridge, one of the original developers of the QLMI who has extensive experience in translating it, you may wish to contact him at noldridg@iupui.edu for further information.

All the best for your research,

Tracy Dixon (for Dr Lynette Lim)

The Glenfield Hospital in Leicester, UK is authorized to use MOS SF-36 questionnaire.

Appendix 3

MacNew MYOCARDIAL INFARCTION QUALITY OF LIFE QUESTIONNAIRE **(MacNew QLMI)**

We would now like to ask you some questions about how you have been feeling <u>during the last 2 weeks</u>.

In the questions that follow, please circle the <u>one</u> number that best matches your answer.

1. In general, how much of the time during the last 2 weeks have you felt **frustrated, impatient or angry?**

All of the time	1
Most of the time	2
A good bit of the time	3
Some of the time	4
A little of the time	5
Hardly any of the time	6
None of the time	7

2. How often during the last 2 weeks have you felt **worthless or inadequate?**

All of the time	1
Most of the time	2
A good bit of the time	3
Some of the time	4
A little of the time	5
Hardly any of the time	6
None of the time	7

3. In the last 2 weeks, how much of the time did you feel **very confident and sure that you could deal with your heart problem?**

None of the time.. 1
A little of the time.. 2
Some of the time 3
A good bit of the time.. 4
Most of the time 5
Almost all of the time 6
All of the time.. 7

4. In general, how much of the time did you feel **discouraged or down in the dumps** during the last 2 weeks?

All of the time 1
Most of the time 2
A good bit of the time 3
Some of the time 4
A little of the time 5
Hardly any of the time 6
None of the time 7

5. How much of the time during the last 2 weeks did you **feel relaxed and free of tension?**

None of the time.. 1
A little of the time.. 2
Some of the time 3
A good bit of the time.. 4
Most of the time 5
Almost all of the time 6
All of the time.. 7

6. How often during the last 2 weeks have you felt **worn out or low in energy?**

All of the time 1
Most of the time 2
A good bit of the time 3
Some of the time 4
A little of the time 5
Hardly any of the time 6

None of the time 7

7. How **happy, satisfied, or pleased** have you been with your personal life during the last 2 weeks?

Very dissatisfied, unhappy most of the time 1
Generally dissatisfied, unhappy 2
Somewhat dissatisfied, unhappy 3
Generally satisfied, pleased 4
Happy most of the time 5
Very happy most of the time 6
Extremely happy, could not have been
more satisfied or pleased 7

8. In general, how often during the last 2 weeks have you felt **restless, or as if you were having difficulty trying to calm down?**

All of the time 1
Most of the time 2
A good bit of the time 3
Some of the time 4
A little of the time 5
Hardly any of the time 6
None of the time 7

9. How much **shortness of breath** have you experienced during the last 2 weeks while doing your day-to-day physical activities?

Extreme shortness of breath 1
Very short of breath 2
Quite a bit of shortness of breath 3
Moderate shortness of breath 4
Some shortness of breath 5
A little shortness of breath 6
No shortness of breath 7

10. How often during the last 2 weeks have you felt **tearful, or like crying?**

All of the time	1
Most of the time	2
A good bit of the time	3
Some of the time	4
A little of the time	5
Hardly any of the time	6
None of the time	7

11. How often during the last 2 weeks have you felt as though you were **more dependent** than you were before your heart problem?

All of the time	1
Most of the time	2
A good bit of the time	3
Some of the time	4
A little of the time	5
Hardly any of the time	6
None of the time	7

12. How often during the last 2 weeks have you felt **unable** to do your **usual social activities, or social activities with your family?**

All of the time	1
Most of the time	2
A good bit of the time	3
Some of the time	4
A little of the time	5
Hardly any of the time	6
None of the time	7

13. How often during the last 2 weeks have you felt as if **others no longer have the same confidence in you** as they did before your heart problem?

All of the time	1

Most of the time 2
A good bit of the time 3
Some of the time 4
A little of the time 5
Hardly any of the time 6
None of the time 7

14. How often during the last 2 weeks have you experienced **chest pain while doing your day-to-day activities?**

All of the time 1
Most of the time 2
A good bit of the time 3
Some of the time 4
A little of the time 5
Hardly any of the time 6
None of the time 7

15. How often during the last 2 weeks have you felt **unsure of yourself or lacking in self-confidence?**

All of the time 1
Most of the time 2
A good bit of the time 3
Some of the time 4
A little of the time 5
Hardly any of the time 6
None of the time 7

16. How often during the last 2 weeks have you been **bothered by aching or tired legs?**

All of the time 1
Most of the time 2
A good bit of the time 3
Some of the time 4
A little of the time 5
Hardly any of the time 6
None of the time 7

17. During the last 2 weeks how much have you been **limited in doing sports or exercise** as a result of your heart problem?

Extremely limited	1
Very limited	2
Limited quite a bit	3
Moderately limited	4
Somewhat limited	5
Limited a little	6
Not limited at all	7

18. How often during the last 2 weeks have you felt **apprehensive or frightened?**

All of the time	1
Most of the time	2
A good bit of the time	3
Some of the time	4
A little of the time	5
Hardly any of the time	6
None of the time	7

19. How often during the last 2 weeks have you felt **dizzy or lightheaded?**

All of the time	1
Most of the time	2
A good bit of the time	3
Some of the time	4
A little of the time	5
Hardly any of the time	6
None of the time	7

20. In general, during the last 2 weeks, how much have you been **restricted or limited** as a result of your heart problem?

Extremely limited	1
Very limited	2
Limited quite a bit	3
Moderately limited	4

Somewhat limited 5
Limited a little 6
Not limited at all 7

21. How often, during the last 2 weeks, have you felt **unsure as to how much exercise or physical activity** you should be doing?

All of the time 1
Most of the time 2
A good bit of the time 3
Some of the time 4
A little of the time 5
Hardly any of the time 6
None of the time 7

22. How often during the last 2 weeks have you felt as if your **family is being over-protective toward you?**

All of the time 1
Most of the time 2
A good bit of the time 3
Some of the time 4
A little of the time 5
Hardly any of the time 6
None of the time 7

23. How often, during the last 2 weeks, have you felt as if you were a **burden on others?**

All of the time 1
Most of the time 2
A good bit of the time 3
Some of the time 4
A little of the time 5
Hardly any of the time 6
None of the time 7

24. How often during the last 2 weeks have you felt **excluded** from doing things with other people because of your heart problem?

All of the time	1
Most of the time	2
A good bit of the time	3
Some of the time	4
A little of the time	5
Hardly any of the time	6
None of the time	7

25. How often during the last 2 weeks have you felt **unable to socialise** because of your heart problem?

All of the time	1
Most of the time	2
A good bit of the time	3
Some of the time	4
A little of the time	5
Hardly any of the time	6
None of the time	7

26. In general, during the last 2 weeks, how much have you been **physically restricted or limited** as a result of your heart problem?

Extremely limited	1
Very limited	2
Limited quite a bit	3
Moderately limited	4
Somewhat limited	5
Limited a little	6
Not limited at all	7

27. How often during the last 2 weeks have you felt your heart problem **limited or interfered with sexual intercourse**?

Not applicable	0
All of the time	1
Most of the time	2
A good bit of the time	3
Some of the time	4
A little of the time	5
Hardly any of the time	6
None of the time	7

Thank you for taking time to answer this questionnaire.