Musculoskeletal disorders in midwives: prevalence, impact and contributory factors

by

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Abstract

Musculoskeletal symptoms have been problematic for healthcare staff, resulting in sickness absenteeism, functional limitations, staff shortages and financial costs to organisations. Maternity professionals who care for women in labour, particularly midwives and obstetricians, are also at high risk of developing musculoskeletal disorders due to a range of associated risk factors including heavy working conditions and awkward caring positions. There has been, however, limited research into this condition in midwives. The aim of this thesis is to investigate musculoskeletal disorders with prevalence, distribution, severity and impact, and to explore contributing factors from a biopsychosocial perspective.

A first stage survey study (n=635) explored the extent of musculoskeletal disorders and association with risk factors. The Nordic Musculoskeletal Questionnaire identified a very high prevalence of symptoms, mostly in the lower back (71%), neck (45%) and shoulders (45%) within a 12-month period. These symptoms resulted in activity limitation (50%), sickness absences (30%) and change of job/duties (45%). An investigation into the associations between potential contributing factors and musculoskeletal symptoms showed that younger age, less experience in the profession, a higher body mass index, longer working hours, lower job satisfaction and higher job stress can each play a role in developing such symptoms.

In-depth interviews with 15 midwives and a further validation focus group (n=7) explored risk factors and prevention strategies in considerable detail. The majority of such symptoms were considered to be work related, including working tasks, equipment, environment, heavy workloads, staff and mother characteristics. The primary concern expressed by midwives was the lack of application of protective strategies in real practice due to the heavy workload and mother-centred practice approach. They also argued that they did not benefit from standardised manual handling training due to a lack of content dealing with midwifery caring activities.

Finally, the risk of musculoskeletal symptoms associated with common working positions was evaluated by using the Rapid Entire Body Assessment postural

analysis tool with a sample of midwives (n=22). This analysis suggested that working postures resulted in a significant increase in the risk of developing musculoskeletal disorders, with all postures having a very high to medium risk level, indicating that immediate action is required to address this issue. The trunk, neck and upper arm were found to be the most commonly affected body parts.

The findings will inform the development of risk management strategies to reduce musculoskeletal symptoms in the absence of such data in the United Kingdom. Management of such symptoms may have a positive impact on staff shortages, early retirements, individuals' life trajectories, mother and baby safety as well as staff wellbeing. Organisations and professional bodies play a key role in this regard.

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Publications and Awards

Journal publication

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Manuscripts underway

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Okuyucu, K., Hignett, S., Gyi, D., Doshani, A. (2019b). 'Midwives' thoughts about musculoskeletal disorders with an evaluation of working tasks', *Manuscript in preparation*

Conferences

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Awards

PhD scholarship from the Turkish Ministry of Education to work at Department of Health Sciences at Amasya University, Turkey.

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1. Introduction

Musculoskeletal disorders (MSD) are referred to as any injury, discomfort and damage of musculoskeletal organs such as muscles, tendons and ligaments (Waters, 2010). Epidemiological studies have shown that such disorders are experienced by many people from various occupational groups resulting in sickness absenteeism, with considerable financial cost and a negative impact on quality of life and productivity at work. The severity of MSD in literature is described based on these consequences. It is estimated in a study requested by the UK Government that absenteeism of workers in the UK cost around £15 billion a year, and £13 billion was spent for health and wellbeing services (Black and Frost, 2011). Moreover, they added that 140 million working days were lost due to sickness absence (caused by any health conditions including MSD). Similarly, the Institute for Employment Studies (IES) and Ipsos MORI, which is a research company in the UK, carried out a survey with 3650 participants in 2009 to explore health and work related issues (Sissons *et al.*, 2011). They reported that musculoskeletal related problems were the most commonly experienced health problems among all socio-economic work groups (37%), followed by mental health conditions (32%) and long-term/systemic conditions (16%).

In another report in the UK for sickness rates, it was indicated that the most common reason for sickness absence given in 2013 among employers in the UK was MSD with 30.6 million days (Office for National Statistics, 2014). Figure 1.1 shows the days lost due to sickness absence according to reasons in that year. In 2016 and 2017, there were similar figures and MSD was the second most common reason given for the sickness absence following minor illnesses (Office for National Statistics, 2018).

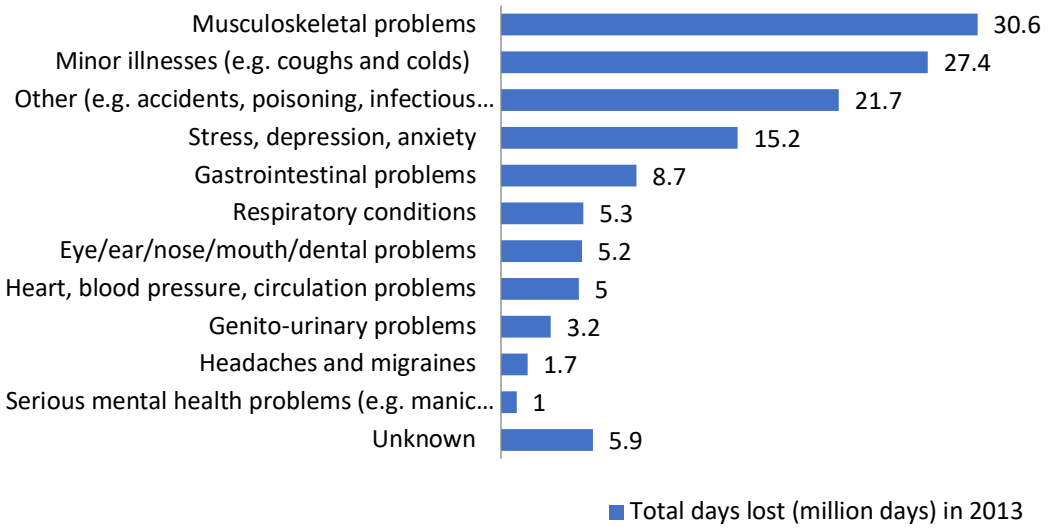


Figure 1.1: A total of 131 million days of sickness absence by reason in the UK, 2013. Data from Office for National Statistics, 2014

The data from the Office for National Statistics (2018) also showed that people working in public health organisations had the highest sickness absence lost rate among all sectors including industrial workers in each year from 2003 to 2017. Although industrial workers are known to engage in more physical activity at work, they have less sick absence than people working in the health care sector. In the US, the health care sector has also reported a considerably higher rate of occupational injuries than other sectors; 8.1% of cases were work-related injuries or disorders in 2014 (Bureau of Labour Statistics, 2015). For example, the rate of cases reported in non-governmental health care sector was 4.5%, while mining (3.8%), manufacturing (4.0%), and transportation (3.6%) sectors had fewer cases in 2014. These observations could be due to working in a health care system requiring both physically and psychosocially demanding activities. However, there may be a limitation in the validity of the data relating to the repeating mechanism (government agency).

An independent report by Boorman (2009) looked at ways of improving UK National Health Service (NHS) staff health and well-being. This review was based on a staff perception survey with 11,337 responses and further engagements with more than 200 calls, meetings and events. The main issues were:

- On average, the NHS loses 10.3 million working days of sickness-related absence in each year;
- Sick leave for all staff in NHS costs £1.7 billion annually;
- Approximately 50% of sickness absence was due to musculoskeletal problems, of which back pain was the most common one.

These findings indicated that health related problems, mainly MSD, have a considerable impact on both well-being of staff and economy. MSD among health professionals might also impact on patient care and safety, functional limitations and individuals' long term career planning, which were not considered in this report.

Finally, Boorman (2009) made recommendations '*to improve the care of staff to improve the care for patients*'. Some of the main points were:

- NHS organisations should develop strategies for prevention,
- Staff should be able to easily access intervention services such as physiotherapy,
- Life-style issues such as physical activity, which actively develop health and well-being, should be improved.

It was also stated that staff health and well-being should not only be the responsibility of occupational or well-being departments, but that each person needs to take responsibility for their own health. This review indicated that if Boorman recommendations were implemented, sickness absence would reduce, and the NHS could save £555 million and obtain 3.4 million working days a year.

In response to the Boorman recommendations, many actions and campaigns have been commenced. For example, in 2011 guidance for occupational health service was published (Department of Health, 2011). Another example was in 2015, Nottingham University Hospitals NHS Trust started a programme to encourage the staff to be physically active (NHS Employers, 2015b). There was a decrease in sickness absence of NHS workers after the Boorman review was launched in 2009, but this has not sustained (Figure 1.2). The Health and Social Care Information

Centre (2015) reported sickness absence rates based on Electronic Staff Record (ESR) as shown in Figure 1.2. For example, the lowest level was reported in 2013-2014 with a 4.06% sickness absence rate. In that year, however, average number of sick absence days was still 14.52 days per person. The years after this showed an increase and reached the highest level of last five years in 2015 (January-March). This report does not fully explain the reasons for sickness absence; but, it is helpful to understand the general wellbeing of NHS staff.

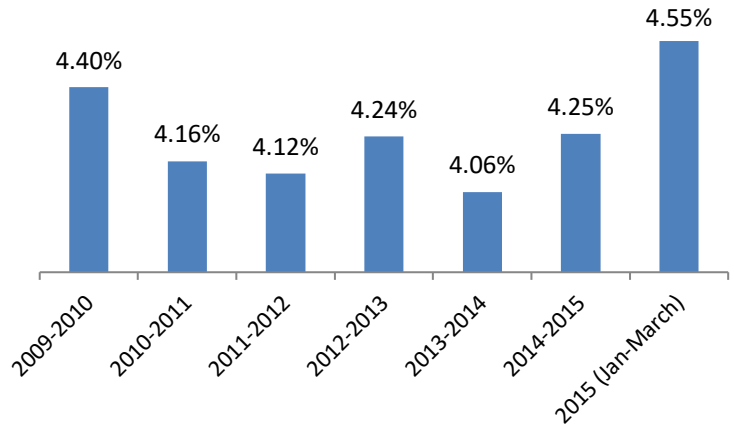


Figure 1.2: The annual sickness absence rates of NHS workers in England, data from (Health and Social Care Information Centre, 2015)

The most commonly affected body part for healthcare staff was reported to be the low back (Boorman, 2009), however different working patterns specific to each profession may lead to differences in distribution and severity for developing injuries. The majority of the literature about work related MSD and manual handling related risk factors focuses on nurses. This might be because it is well known that nursing practice includes many heavy loading activities such as manual lifting and moving patients (Stichler *et al.*, 2012; Lee *et al.*, 2015). Maternity professionals who care for women in labour, particularly midwives and specialised doctors in Obstetrics and Gynaecology (obstetricians), are also at risk of developing MSD. It is the role of the midwives to provide direct care for the mothers during pregnancy, labour and after birth. Obstetricians have the responsibility of caring for complicated or high risk pregnancies including surgical procedures for instrumental delivery (e.g., ventouse, forceps) or caesarean section. It has been well documented that these occupational groups are highly exposed to physical factors (e.g., pulling,

pushing and working in extreme positions to handle two patients: mother and baby at the same time), psychosocial factors (e.g., more sympathetic to mothers due to spending a long time with the promotion of 'continuity of carer'), and organisational factors (e.g., lack of improved equipment support) that can lead to development of MSD (Hignett, 1996; Yoong *et al.*, 2008; Nowotny-Czupryna *et al.*, 2012; Long *et al.*, 2013).

Surprisingly, there has been very little focus on maternity professionals' musculoskeletal health and its potential effects on working activities. The existing literature are over 20 years ago: Hignett (1996) first highlighted the issues regarding manual handling- and working conditions-related risk factors for midwives, and identified that this occupational group has different working activities and equipment, requiring different considerations for manual handling than nurses. Following this, the Royal Colleagues of Midwives (RCM) published a guidance for midwifery practice (RCM, 1999), which included different delivery positions that would put midwives at risk in terms of developing MSD and recommendations to reduce these exposures. Since then, there have been limited key actions and guidelines; despite changes in practice, including staff numbers, mother numbers and demographics, and policies that impact on staff roles and the workforce.

A recent survey about UK midwives' health and wellbeing showed that they have been affected by working demands resulting in absenteeism with most commonly due to MSD (Royal College of Midwives, 2016a). The quote below from RCM (2013) study explains the situation of a midwife:

> *"I am 59 and I'm one of the those women who has just missed out on receiving her state pension at 60. I am a midwife working on labour ward having done a return to practice course 10 years ago so I will not have a good NHS pension and therefore will need to work until I am 65. However, I have been off work for 5 months with a neck problem for which I am taking analgesia. I have had physio and having acupuncture but I am no nearer in finding out where the chronic pain in my shoulder blade is coming from. My doctor has said that from the spondylosis and mild disc prolapse shown on*

my neck x-ray it will be unlikely that I will be able to return to working on labour ward. This has made me concerned as jobs in the antenatal clinic that would be suitable are few and far between in my area. Where does this leave me? Will I be forced out of a job because I physically cannot deliver babies or will my employers the NHS have to facilitate me. I am sure this will happen more and more as midwifery is a very physical job and as the workforce gets older may not be a suitable job for everyone."

1.1 Research Aim

This thesis aims to investigate musculoskeletal disorders among maternity professionals (e.g., obstetricians and midwives), and to explore factors associated with the onset of such disorders. This scope applies to maternity professionals actively involved in delivering babies in the UK.

1.2 Research Questions

The following research questions were identified:

- "Are maternity professionals at risk of developing MSD?"
- "What is the current knowledge about the risk factors for, and impact of, MSD in maternity professionals?"
- "What is the prevalence and impact of, and risk factors for, MSD among maternity professionals?"
- "What is the level of awareness about health and safety, and MSD prevention strategies?"
- "To what extent do the common working postures in delivery cases contribute to development of MSD?"

1.3 Research Objectives

In order to understand MSD in this occupational group, the objectives are listed below:

1. To undertake a literature review to understand the context of MSD and contributory risk factors in maternity professionals.

2. To explore the methodologies appropriate for the study of MSD in health professionals.

3. To conduct a survey study to explore the prevalence and impact of, and risk factors for, MSD in maternity professionals.

4. To conduct an interview study to have an in-depth understanding of survey results and awareness of health and safety and prevention strategies.

5. To conduct a study to analyse the most frequent and extreme working postures with regards to physical exposure on the musculoskeletal system.

1.4 Conceptual Framework for this Thesis

Ergonomics (or Human Factors) (E/HF) is a scientific discipline that focuses on the interactions between people and things related to them such as environment, equipment, tasks and system in order to optimise human wellbeing and system performance (IEA, 2001). In the work context, the application of E/HF provides a holistic consideration by covering all aspects of systems and interactions with people at the centre (Sharples and Wilson, 2015). The strength of E/HF comes from its comprehensive approach. Therefore, this thesis is mainly based on this holistic approach.

Figure 1.3 shows the interactions of factors relevant to the application of E/HF in work context. A person, their technologies and artefacts used represent 'individual interactions' at the centre. These are placed in the context of their tasks and goals, and in the wider contexts of physical and virtual workspaces and organisational context influenced by financial, technical and social consideration.

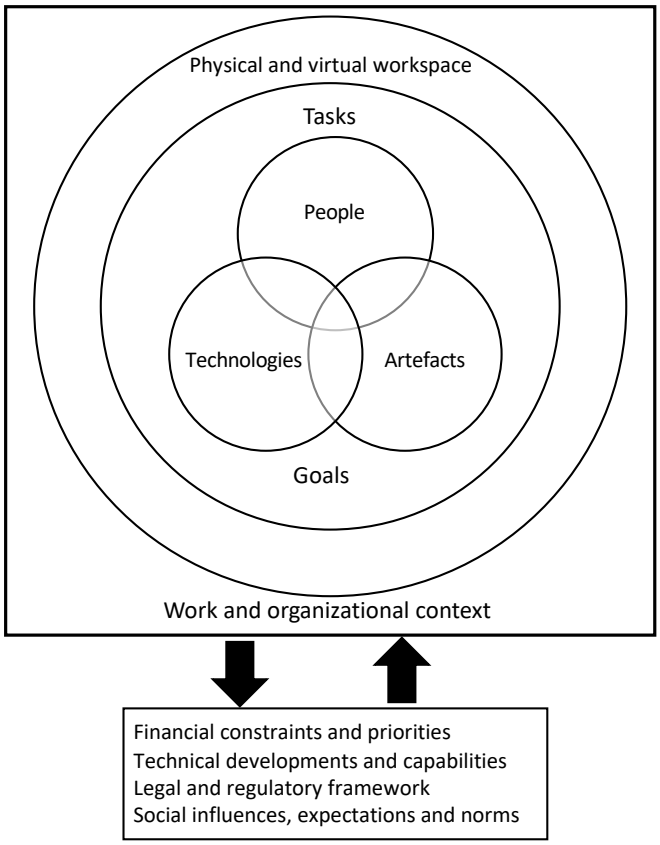


Figure 1.3: A model showing interactions of factors relevant to the application of Ergonomics/Human Factors in work context, from (Sharples and Wilson, 2015) pp. 10

An aspect of 'biopsychosocial approach' is also adopted in this thesis to evaluate and understand the contributory risk factors for MSD in maternity professionals. It has been used to understand the injuries in terms of the body itself (bio-), behaviour (-psycho-) and environment (-social) together (Bartys, 2003; Gatchel *et al.*, 2007; Laisné *et al.*, 2013). This model was first suggested by Engel (1997) in order to better understand illnesses and patients. The biopsychosocial approach provides a comprehensive evaluation by considering the contribution of psychological and social factors in addition to physiological factors. Engel (1997) criticised the traditional 'biomedical model', in which only somatic factors are taken into account, as being inadequate to evaluate and treat the patients.

Gatchel et al. (2007) review gives us an understanding of managing chronic pain physiologically as well as psychosocially. It discusses the biological aetiology of pain based on theories such as Melzack's gate control theory (Melzack and Wall, 1967). Moreover, they indicated that since pain is individually experienced and reported,

the people themselves and the environment will contribute to the occurrence of the symptoms, so a comprehensive approach is beneficial.

It has been suggested that a better management plan to prevent or reduce MSD should start with understanding the risk factors (Van Mechelen *et al.*, 1992; Hignett, 2003; Yazdani *et al.*, 2015). According to an international systematic review of 63 studies analysing the results of the interventions to reduce or prevent MSD (Hignett, 2003), there is moderate evidence that intervention strategies based on risk factor assessment were most likely to be effective. Due to the wide variations of practice and environment within the healthcare professionals, it is important to address factors and hazards in relation to MSD for each profession group. Therefore, a risk assessment model (Figure 1.4) has been developed to understand which MSD predisposing factors might impact on developing MSD for midwives and obstetricians. The model starts with establishing the extent of the MSD among these occupational groups by exploring prevalence, distribution, severity and impact. In order to identify risks, an exposure assessment of individual, occupational, biomechanical and psychosocial factors has been conducted. The results will allow the development of an evidence base for risk management strategies aiming to reduce musculoskeletal symptoms and increase staff and patient safety for future research.

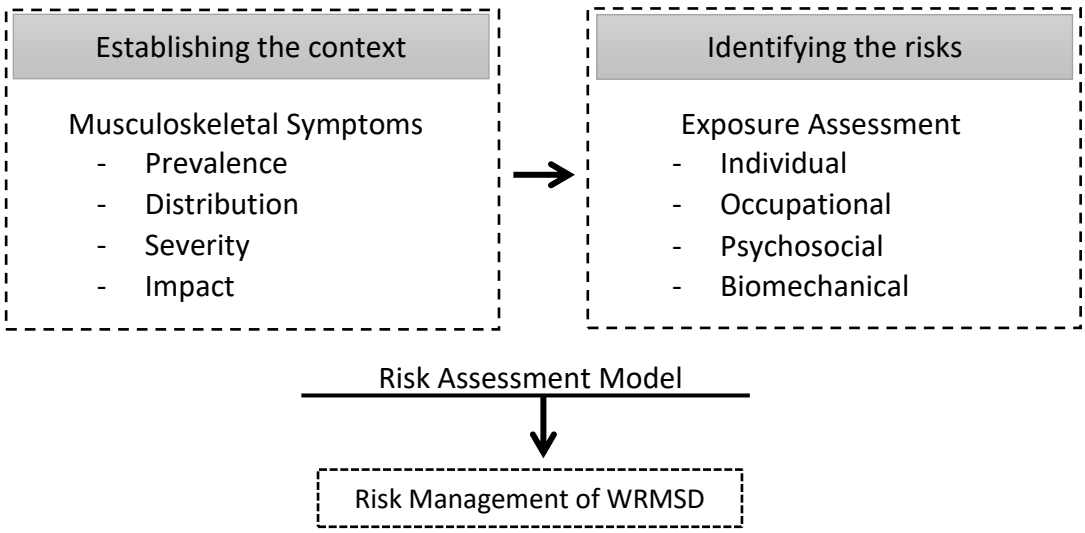


Figure 1.4: Summary of risk assessment model in this thesis

To address the aims and research questions, this thesis describes three studies detailed in Chapter 4, 5, 6 (see Figure 1.5).

1.5 Thesis Outline

Chapter 2 reviews literature to understand 1) MSD and contributory risk factors, 2) work-relatedness of MSD in maternity professionals.

Chapter 3 outlines the research methodologies and data collection methods. Thesis specific methodological approaches are detailed and discussed.

Chapter 4 describes the first (survey) study; '**A cross sectional survey of midwives to explore the scope of the musculoskeletal symptoms'**. The extent of MSD is explored and reported with prevalence, severity, impact and contributory factors.

Chapter 5 describes the second (interview) study; **'An exploration of midwives' views about musculoskeletal symptoms and contributory factors'.** Perceptions about the survey results, health and safety and prevention strategies are explored and reported in this chapter.

Chapter 6 describes the third (observation based postural analysis) study; **'An ergonomic evaluation of midwifery tasks'.** This chapter presents the analysis of most frequent, extreme working positions in terms of contribution of MSD risk.

These studies provide a better understanding of MSD and contributory factors specific to these occupational groups, and establish a form of triangulation.

Chapter 7 combines the results and generate insights from three studies. It provides a discussion of overall research and key messages from this research.

Chapter 8 summarises the research findings and presents implications, recommendations based on the evidence from this research and opportunities for future studies.

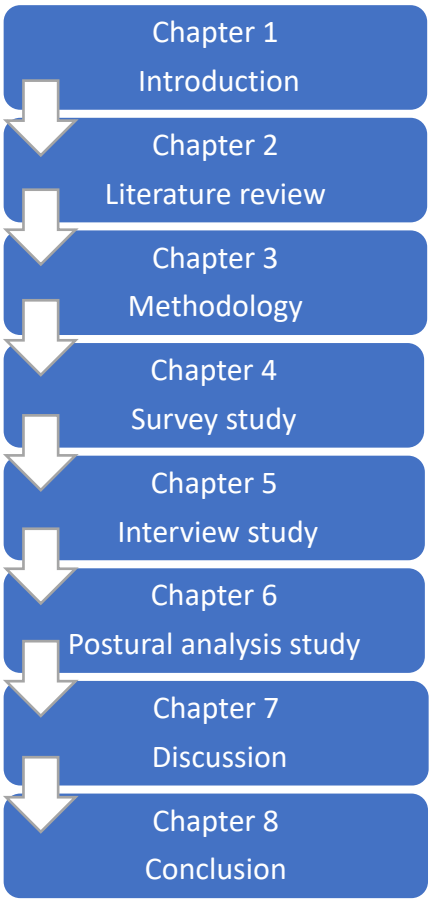


Figure 1.5: Thesis structure

2. Literature Review

2.1 Introduction

The primary objective of the literature review was to understand the context of MSD and contributory risk factors in maternity professionals, to answer the first research questions *"Are maternity professionals at risk of developing MSD?; What is the current knowledge about the risk factors for, and impact of, MSD in maternity professionals?"* This requires knowledge of the nature of musculoskeletal injuries including mechanism. Following this, the size and magnitude of MSD were reviewed starting with healthcare professionals, and then narrowing down to maternity professionals.

Maternity professionals in this thesis referred to midwives and obstetricians who actively care women in deliver cases. Intervention or prevention strategies of work-related MSD extensively exist in the literature; however, this is briefly discussed in this chapter as it is out of the scope of this thesis.

2.2 Review Methodology

A systematic approach was used for the literature review. A search strategy was developed including identification of databases, search terms and inclusion and exclusion criteria. This was applied to several sources and databases, including: Google Scholar; Web of Science; Medline; PubMed; Scopus; Health and Safety Executive (HSE) research; Royal College of Midwives (RCM); Royal College of Obstetricians and Gynaecologists (RCOG).

The search terms included: *"musculoskeletal disorder*"*, *"musculoskeletal injury"*, *"musculoskeletal pain"*, *"soft tissue injury"; "work related*"*, *"work-related*"*, *occupational*, *ergonomic**, *"human factor*"; "maternity profession*", midwi**, *obstetrician**; *"risk factor*"; posture**, *"working position*"*, "*physical exposure"*. These key words were combined with 'AND' or 'OR' for the specific searches.

Titles and abstracts from the initial search were screened for their relevance. Some papers were excluded due to lack of consistency with the inclusion criteria e.g.,

language; sample group involving maternity professionals; outcome measures including MSD, detailed and clear reporting of results/findings, inclusion of a clear research question or objective to be addressed by the data. In addition, the methodological quality of the screened papers was appraised and critiqued for validity and standardisation, sampling strategy and representativeness in the related section.

A systematic critical approach was undertaken based upon the 'Mixed Methods Appraisal Tool (MMAT)' (Pluye *et al.*, 2011). See Appendix 2.1 for the example of papers scored using this tool. This appraisal tool was selected as it allowed appraising mixed studies including quantitative, qualitative and mixed methods; therefore no additional tools were required for each method. Reference lists of the relevant papers were explored to identify any further papers. Mendeley 1.16.3 software was used to store and manage the references.

2.3 The Nature of the Disorders

2.3.1 What is a Musculoskeletal Disorder

Musculoskeletal disorder (MSD) is a general term used to define any injury, damage or disorder of the muscles, tendons, ligaments, nerves, articular cartilage, and bones (Waters, 2010). Although the injury mechanism can involve various body parts, soft tissues tend to undergo a greater deformation than hard tissues (Praemer *et al.*, 1992; Holzapfel, 2001). That is, muscles, cartilage, tendons and ligaments are most commonly injured because of mechanical stress factors, while bones are rarely affected. Nerves generally get injured secondarily following injury to other parts (Kumar, 2001). Clinically, MSD involves certain conditions and are described using terminology depending on the tissue affected and type of condition; such as muscle strain, tendon inflammation and related syndromes (tendinitis, tenosynovitis, bursitis), ligament sprain, osteoarthritis, nerve compression syndromes (carpal tunnel syndrome), and regional pain syndromes with unknown pathology (Punnett and Wegman, 2004).

2.3.2 Analysis of Origin of Injuries

The first question that is generally asked in an event of injury or dysfunction is “How did it happen?” The analysis of origin of injuries has an essential role for researchers and clinicians to develop a more effective investigation. A simple answer for this question is that it occurs when a tissue is exposed to an over load that cannot be endured by the tissue, resulting with mechanical disruption (Whiting and Zernicke, 2008). This definition shows that the key word to identify an injury is ‘mechanical disruption’ when the normal structure of a tissue is damaged. This leads to pain and functional difficulty in daily activities.

The human body is capable of moving in different ways around joints through limbs and spine such as flexion, extension and rotation. Kinesiology is a branch of science studying the human movement of both pathological and healthy actions (Neumann, 2013). Neumann (2013) also describes two terms identifying the *“motion of bones and joints”* and “*forces that cause or arrest the motion*” which are kinematics and kinetics respectively. From a kinesiological aspect, force, which can also be called load, is required for any motion. Although there are many types of force affecting the biomechanical structure of body motion (LeVeau, 2010), they are mainly classified as internal and external forces that provide optimum movements to a human body (Neumann, 2013). Gravity is an example of the external forces generated by outside the body, and the muscles produce the internal forces to both move and stabilise the body.

Besides providing regular body functions, internal forces may cause injury in the body by either themselves or related to external factors. To give an example, the shoulder region is mainly controlled and stabilised by the rotator cuff, which is a group of tendons and muscles linking the head of the humerus and scapula. When the shoulder becomes unstable for some reasons such as repetitive overhead movements, poor posture, prolonged inactivity or previous injury, the rotator cuff compensates for the instability by overworking. Thus, deformation of bursa or tendons around the head of the humerus is inevitable due to over use and strong muscle contraction in that region (Ludewig and Braman, 2011). Another example of

injury caused by internal forces in the hip region is given by Neumann (2013). When the hipbone density is lowered due to disorders such as osteoporosis, a strong muscle contraction connected to this thinned bone can result in a fracture. These examples give an understanding of the injury mechanism and answer the question of 'How does an injury occur?

2.3.3 Ergonomic Origin

From an ergonomics perspective, a biomechanical imbalance develops when the workplace conditions and job demands do not match or fit the capacity of person attempt to it (Waters, 2010; Vanwonterghem *et al.*, 2012). This imbalance has a high chance of resulting in an injury. According to the definition recognised by the World Health Organisation (1985), work-related musculoskeletal disorders (WRMSDs) are problems caused by the work activities and/or environment.

In the literature, certain terminology tends to be used to refer to prolonged over-loading mechanisms that might lead to occupational injury or disorder. Vanwonterghem *et al.* (2012) point out that "cumulative trauma" is a more suitable term to identify the injury caused by an occupational task (unless it is an accident which suddenly occurs), since this term indicates the primary cause of "*increasing poisoning of the muscle-system by successive additions*". That is, increasing exposure to consecutive working tasks that cannot be handled by workers might be an explanation for the occurrence of cumulative trauma (Buckle and Devereux, 2002).

The terms "*overuse*" and "*repetitive stress*" are also considered the same as "*cumulative trauma*". Thus, when there is an exposure to a repeated overload on a tissue without enough recovery time, this can result in injury (Whiting and Zernicke, 2008). The majority of reported occupational injuries are cumulative trauma disorders such as carpal tunnel syndrome.

Based on these explanations, work related or repetitive MSDs are considered as "chronic conditions" which are long developing, whereas "acute injuries" are sudden and severe like bone fractures or tendon rupture (Whiting and Zernicke,

2008). The authors also add that although acute and chronic conditions are differentiated by this definition, there is still a link between them. For instance, chronic cumulative loading causes degeneration in a tissue and reduction in strength which can result in an acute injury. To give an example, a chronic inflammation of a supraspinatus muscle tendon due to often repeated and overhead movements has a high chance of leading to an acute rupture of that tendon.

The identification of the problematic process of injury occurrence as a result of cumulative exposure at work with time has been described in four phases: adaptation, adapted, cumulative, and critical (Vanwonterghem *et al.*, 2012) in Figure 2.1. The first adaptation process lasts up to 8 months. During this time, muscle development increases to manage the job task, and little discomfort is observed. The second adapted phase is a balanced process when the workload is equal to the capacity of person. This phase may last throughout the working life, if the body system recovers when there is an imbalance. This recovery depends on sufficient time provided from repeated overloads. When the body system cannot manage to handle the imbalances between the work task and the capacity of person attempt to it, the cumulative phase begins. In this period, self-reported symptoms increase and sometimes become worse, causing functional incapacity at work, and a complete recovery cannot be made. The final critical phase is when an inevitable musculoskeletal dysfunction is observed with serious symptoms. Overall, all these processes can end with an injury characterised by progressive tissue degeneration. This evaluation is helpful to understand the cumulative effect on MSD occurrence. In general, therefore, it seems that the aim of the application of ergonomics is to design the working task, system and equipment in order to fit the person; rather than to adapt the person to working situation (Hignett, 1996).

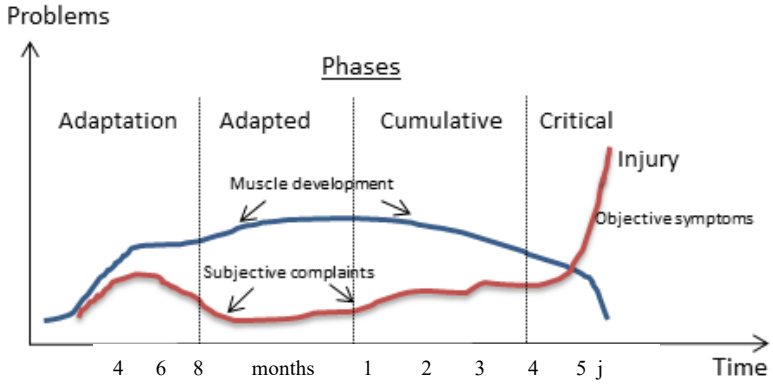


Figure 2.1: Evaluation of cumulative injury process, adapted from (Vanwonterghem *et al.*, 2012)

The biopsychosocial approach has been accepted to provide a comprehensive insight into occupational injuries (Gatchel *et al.*, 2007). It is worth considering the psychosocial mechanism of injuries, even though it has not been clear that whether psychosocial factors cause injuries in themselves or the other way around (Bongers *et al.*, 1993; Bartys, 2003). Davis and Heaney (2000) brought together some possible mechanisms of the association between psychosocial factors and low back pain in their extensive review of 66 research articles: 1) They argued that psychosocial factors can directly affect biomechanical loading of body system, for instance, when there is a limited time and social support at work, muscle activity is increased to finish a task (Bongers *et al.*, 1993; Ando *et al.*, 2000). 2) It was indicated that being exposed to psychosocial factors in a work place environment might increase sensitivity to the symptoms caused by mechanical factors, that is, the level of ability to deal with pain might decrease (Bongers *et al.*, 1993; Burton, 1997).

Overall, the review of the literature on the definition and mechanism of MSD shows that there is more than one definition of injury; it can be defined in various ways depending on occurrence mechanism and exposure to factors (Buckle and Devereux, 2002; Whiting and Zernicke, 2008; Vanwonterghem *et al.*, 2012). A broad and diverse range of definitions arises due to different circumstances resulting in injury, severity of injury, and structure of tissue injured. However, such problems referring to the same characteristics and origins are pooled and mostly described as 'work-related disorders', rather than as 'occupational disorders'. The reason

suggested was that a work-related disorder is characterised where there are multiple factors contributing to the causation of the disorder; while in occupational disorders, there is a 'direct cause and effect relationship' between hazard and disorder, e.g., asbestos-asbestosis (Armstrong *et al.,* 1993). Therefore, the term work-related musculoskeletal disorder is used in this thesis, where it is relevant.

2.4 The Size and Magnitude of the Problem

2.4.1 Healthcare Professionals

Musculoskeletal symptoms are commonly experienced by many people in different occupational groups, and approximately half of the work-related injuries reported in many countries are musculoskeletal related ones (Punnett and Wegman, 2004). It is obvious that these kinds of problems affect quality of life as well as productivity in work places. Furthermore, many studies show that they can also result in many working days lost with considerable costs (Boorman, 2009; Black and Frost, 2011; Office for National Statistics, 2018).

There are several studies investigating musculoskeletal injuries among health care professionals. Self-completed musculoskeletal questionnaire has been a common approach of exploring these problems and impacts (Alexopoulos *et al.*, 2003; Trinkoff *et al.*, 2003; Rafie *et al.*, 2015). The results of a systematic review exploring upper limb symptoms and risk factors among nurses and physicians show that they have suffered from neck, shoulder and upper back MSD, and these have been most commonly associated to physical working positions, job demand and demanding working schedule (Long *et al.*, 2012).

Allied health professionals (AHPs) including physiotherapists, occupational therapists, prosthetists and orthotists and sonographers are known to be at risk of MSD due to being exposed to a range of hazardous working activities and factors (Bork *et al.*, 1996; Cromie *et al.*, 2000b; Glover, 2002). A systematic review of the literature since 1996 looking at WRMSD of AHPs found that they suffer from MSD most commonly in the low back, neck and shoulder areas (Anderson and Oakman, 2016). The majority of the studies were high quality of cross sectional self-reported

surveys, exploring 12 months discomfort and risk factors; however they were limited to looking at causal relationships and open to response bias. Participants reported risk factors, including awkward working position, static positions, continuous and excessive bending, twisting, lifting, and transferring patients.

Most research has focussed on nurses or nurse aides rather than other professional groups and reports the prevalence rates being highest in low back area, followed by shoulders and neck (Davis and Kotowski, 2015). The nature of nursing practice requires many over-loading activities such as manual lifting and moving patients, and often clinical support tasks e.g., feeding, cleaning and paperwork on a computer (Fell-Carlson, 2007; Stichler *et al.*, 2012; Lee *et al.*, 2015). Alexopoulos *et al.* (2003) indicated the self-reported risk factors in nurses (n=351) as manual handling of materials (64%), awkward back postures such as over flexion of spine (50%), and strenuous shoulder movements (46%). Since, "*manual handling of patients is more difficult than handling boxes – people are hard to grasp*"; on this basis, the physical demands of patient care can be considered as "*heavy lifting, pushing, pulling, and working in extreme and stressful body postures to handle patients and equipment, and perform tasks on patients who are in less than ideal positions for receiving patient care."* (Waters, 2010). Moving, lifting, pushing/pulling heavy loads or patients were strongly associated with MSD in back, while awkward positions were associated with neck and shoulder symptoms in Trinkoff *et al.* (2003) study of 1163 randomly selected nurses. In another epidemiological self-completed national survey study, nurses (n=2140) reported that manual or patient handling activities were the biggest contributor to their pain (81%), and statistical analysis showed an association between nursing activities and reported back symptoms (Serranheira *et al.*, 2012). This study had a large national sample (n=2140) in Portugal, increasing the reliability of the results.

Neck and upper back problems have been commonly reported in dentistry practice. This might be because dentists generally work with their neck bent forward and rotated, and shoulders fixed in an abducted position (Lin *et al.*, 2012; Gopinadh *et al.*, 2013; Rafie *et al.*, 2015). Other possible factors that might cause these problems

are organisational factors such as having less assistance and more than 20 patients in a day (Lin *et al.*, 2012). These surveys found that low back pain among dentists was as common as neck and upper back pain. This may be explained by the fact that it is not only heavy lifting, which is a leading factor for the occurrence of low back pain, but that prolonged fixed (static) stressful positions can result in low back problems (Hayes *et al.*, 2009).

WRMSD has also been reported among sonographers; ultrasound practitioners (Pike *et al.*, 1997; Evans *et al.*, 2009). Ultrasound device is also commonly used by the target population in this thesis for screening purposes. Janga and Akinfenwa (2012) conducted a survey to explore the prevalence of MSD among a variety of professionals using an ultrasound device in practice including sonographers, obstetricians and nurses. The participants were the attendees of the 2010 International Society of Ultrasound in Obstetrics and Gynecology (ISUOG) conference, which provided a sample group from different counties. Although the survey used was not a validated tool, there were interesting findings from 407 participants to explore pain complaints in relation to repetitive work tasks, scanning with an ultrasound device. The majority (n=215) were obstetricians and/or gynaecologists, and the rest were radiologists, sonographers, midwives and nurse practitioners. 66% of these professionals experienced musculoskeletal symptoms in the neck, back, shoulder, wrist or elbow while using ultrasound. Neck (42%), back (42%) and shoulder (42%) pain were the most commonly reported complaints, while wrist (25%) and elbow (18%) pain were less common, and 11% reported that they had sick leave related to working task injuries. Around 40 (10%) of those surveyed were using splint support at the time of the survey, and 124 (31%) were seeing a physiotherapist. An interesting observation was that no significant connection was found between number of years working and reported symptoms. A significant relationship, however, was found between symptoms and number of days worked in a week. There was also a significant link between symptoms and lack of regular breaks. These results, therefore, suggest that having regular rests between sessions may be a protection against repetitive strain injuries stemming from occupational tasks. These data also confirm the injury occurrence model due

to repetitive exposure discussed in Section 2.3.3. However, it is important to consider limitations while interpreting these findings; for example, the cross sectional nature of the study does not provide an understanding of causal relationships between factors and MSD. Moreover, there are differences in profession groups and their working conditions (even though *ultrasound device usage* task is the same); therefore the findings cannot be extrapolated.

2.4.2 Maternity Professionals

Search Strategy

To specifically consider MSD and risk factors amongst maternity professionals, particularly midwives and obstetricians a search was conducted using the following databases: Medline (Ovid), Pubmed, Web of Sciences, Scopus, Google Scholar, HSE research, RCM and RCOG. The reference lists of relevant studies were also explored for additional studies.

In the initial search, 634 papers were identified. The papers were screened by their titles and abstracts, and full texts, and finally, 13 papers were included. These papers include journal papers, conference papers and reports. Appendix 2.1 provides the critical appraisal of these papers. The literature search process is shown in Figure 2.2.

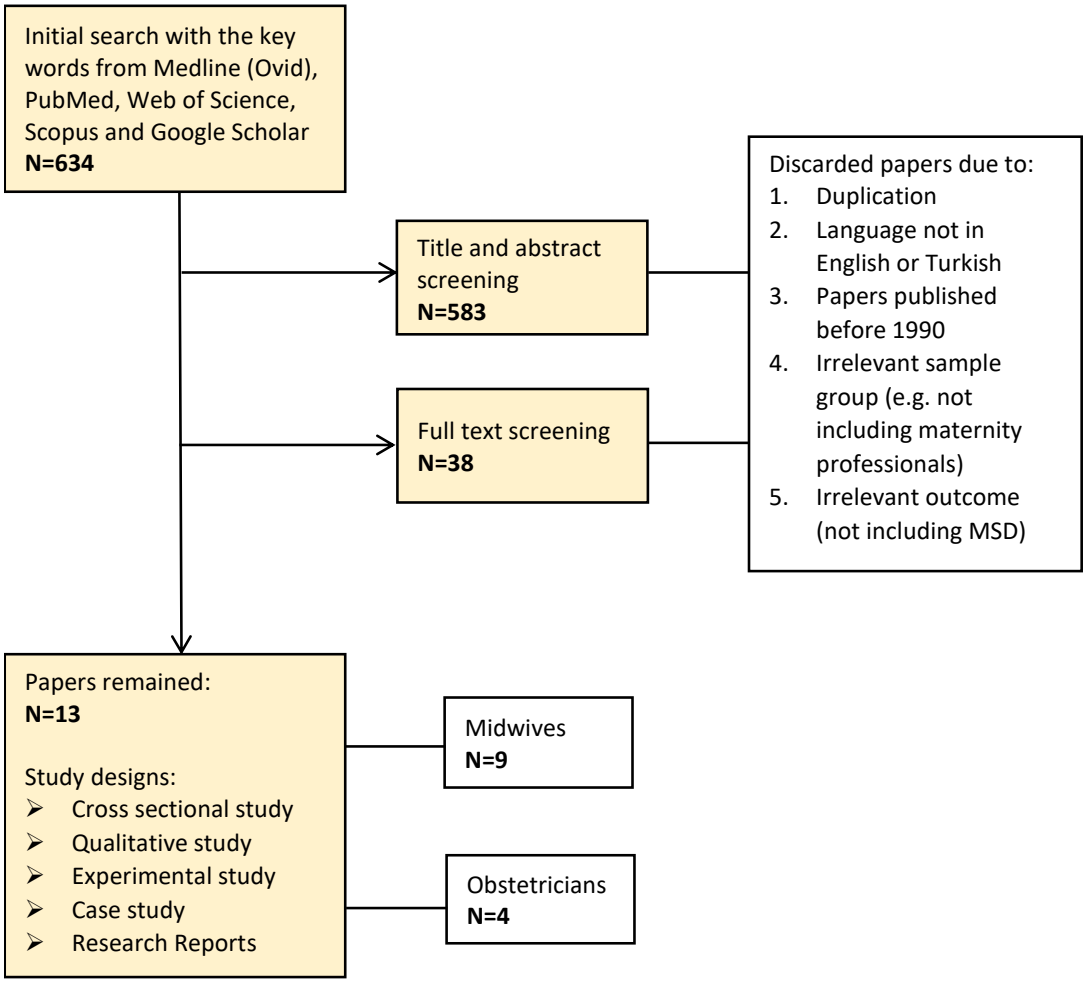


Figure 2.2: Literature review process for maternity professionals (Section 2.4.3)

2.4.2.1 Midwives

Hignett (1996) explored manual handling risk factors from midwives' perspective in a UK maternity unit with a subsequent aim to develop solutions to identified problems. The study had a clearly defined qualitative approach including observation and interview data collection methods with 12 maternity specialists from a range of experience (sister, senior sister, newly qualified) and working locations, with 42 midwives recruited for member checking of the found model. The findings were presented under four main categories (loads: mother and baby, worker, work place and organisation) and additional sub categories (emotional/mental, negotiation, location, equipment layout, work schedule). The key issues highlighted in this study were:

- Midwives care for both the mother and the baby (two patients at the same time) which involves extra physical and mental pressure.
- Delivery is a mother-centred process so the mother chooses her own position which sometimes might not be comfortable for the midwife and the midwife may not have support, courage or ability to negotiate the work place (e.g., hospital, home) and position in caring activities (e.g., delivery, breastfeeding) that the midwife feels best able to assist with.
- Midwives tend to work independently and they are less likely to ask for assistance. There is also a tendency among midwives to prioritise the mother regardless of their own health.

This study reported the findings from only one maternity unit, however many findings are related to the general midwifery context regardless of the setting/location, such as midwives caring for two loads and position of midwives depending on mother's.

Following the Hignett (1996) study, Royal College of Midwives (Royal College of Midwives, 1999) published a report indicating that promoting alternative positions to mothers during the labour as part of best practice has potential to cause musculoskeletal problems for midwives. It was also stated that back injury is the most commonly affected body part and data suggest that approximately 6000 midwives have experienced back injury annually, of those 300 have left the profession due to the symptoms. Unfortunately, this report is limited by the lack of detailed information about the data used to provide the estimation of the MSD and work leave numbers.

Steele and Stubbs (2002) reported a study to measure working postures and related musculoskeletal discomfort when supporting the mother to breast feed the baby. Two focus groups (n=14) and an observational assessment tool (Quick Exposure Check, QEC) (n=30) with self-reporting of musculoskeletal discomfort were used for data collection. The participants were from three different Trusts, which increases the generalisability of findings. Back and neck symptoms were most commonly reported, however there was no information about the numbers of symptoms in

other body parts. The findings highlighted that predisposing factors included behavioural related factors (e.g., failing to adjust the bed) in addition to environment (lack of space) and working postures. It was observed that midwives were in standing, side-seated on the bed, and kneeling positions during their practice. Kneeling on hard surfaces may contribute to knee symptoms and sitting on the side of the bed is likely to result in neck symptoms due to twisting. Back symptoms were attributed to flexed and twisted spinal alignment. Inclusion of mixed methods in this study enriched the findings and provided good evidence that midwives alter their positions during breast feeding support, but these all impact on back and neck MSD.

Nowotny-Czupryna *et al.* (2012) performed a study in Poland to investigate postural hazards of midwives while attending childbirth and to identify differences between senior and junior midwives. They used the method of Ovako Working Posture Analysing System (OWAS) to measure the static overload of working positions through the spine, and the SonoSens Monitor device to calculate individual spinal alignment in every delivery position in a simulated environment. They had to choose certain working positions to measure during delivery, and selected the last stage of the birth since it would be a more uncomfortable and effortful stage for the midwife: delivering the baby's head and body as well as the placenta. The measurements of 95 midwives' spinal alignment demonstrated that almost none of the working positions in every delivery position were optimum, and lumbar spine flexion in the sagittal plane (front/back) was the most significant unnatural spinal position observed. The cervical spine was moderately affected, whit the thoracic spine less over-stressed. Due to the limitation of OWAS, all postures were in 'Action Category 3' implying correction as soon as possible, and did not allow identification of differences between participants. Additionally a survey was conducted to find out the prevalence of back pain. This showed that 67% (n=64) of participants suffered from 'any spinal pain' which occurred most frequently at the same time in at least two segments of the spine in both junior and senior midwives. With regard to functional capacity, interestingly, subjects reporting spinal pain were able to achieve their maximal movement range, which may indicate that they performed

extreme working positions despite discomfort and could result in serious tissue degeneration due to progressive force.

A cross-sectional study in Australia explored the presence of musculoskeletal symptoms in midwifery practice (Long *et al.*, 2013). They studied neck and upper back symptoms in over 1,000 midwives, with data collected from an electronic survey (2006 to 2008). The survey measured individual and work-related exposure factors by self-reported questions, together with the prevalence of MSD among 1,388 midwives. The results showed that the neck and the upper back injuries were common in Australian midwives with prevalence rates reported for neck 41% and for upper back 25% caused by work-related activities. Interestingly, age was not found to be a risk factor in this study, despite its common association with MSD in particularly nurses (Alexopoulos *et al.*, 2003; Ribeiro, Serranheira and Loureiro, 2017). Midwives reporting being physically active (moderate/high) were less likely to experience upper back symptoms. Having a history of diagnosed anxiety was a risk factor for neck symptoms. For workplace physical exposures, '*awkward postures'* was significantly associated with neck and upper back symptoms. However, physical exposure at work was measured by asking participants about their duration and frequency of bending, twisting or static positions; so this finding is open to bias.

Functional consequences such as time off work and functional incapacity (stemming from work related spinal disorders) were investigated in the same study (Long *et al.*, 2013a). 729 midwives replied to two items about sick leave and functional incapacity due to MSD; of those, 49% (n=296) reported neck problems, 29% (n=181) had upper back, and 61% (n=403) had lower back problems. The annual sick leave (absence from work at least one day) prevalence rates due to MSD were 21% (n=62) for neck, 17% (n=31) for upper back and 24% (n=96) for lower back; functional limitation (unable to continue normal activities) due to MSD were 50% (n=149) for neck, 48% (n=90) for upper back and 59% (n=237) for lower back. It is clear that functional incapacity was more common than sickness absence among this sample. For example, almost 20% of the participants had sick leave, while more than half

reported functional incapacity due to any spinal discomfort. This result may indicate that midwives were present at work even though they were injured, which may impact on patient care and safety. Another possible explanation suggested by the authors was that these healthcare staff had enough time for recovery, since almost half of them worked part time. Not surprisingly, pain severity was associated with increasing sick leave and functional limitation. For individual factors, age was inversely associated with sick leave, that is, younger midwives were more likely to be absent from work due to neck symptoms.

Long *et al.* (2013b) conducted a qualitative study (using interviews) of Australian midwives to understand their experience of work related shoulder injuries (n=11). The interviewees attributed their symptoms to awkward working postures and manual handling of patients and equipment. This finding is consistent with survey results (Long *et al.*, 2013) that showed association with self-reported awkward positions and neck and upper back symptoms. To give an example from the interviewees' experiences about awkward positions, it was reported that a mother pushed against the midwife's shoulder with her foot in order to get support. Although this kind of case rarely occurs, there are other working tasks in midwifery which have been found to contribute to the occurrence of shoulder injuries, such as perineal suturing (static position) and giving suprapubic pressure for managing *shoulder dystocia* complication. This static working is similar to dentists' working position. The literature about the dentistry supports that this commonly results in neck, upper back and shoulder disorders (Lin *et al.*, 2012; Gopinadh *et al.*, 2013). To manage their symptoms, analgesics were most frequently reported with minimum or no sick leave. One interviewee reported having a car accident after taking ibuprofen following a night shift in pain; she blamed the sedative side effect as causal in this accident. In the long term, fitness/sport related management strategies were commonly applied such as relaxation activities, walking and swimming. The impacts of shoulder disorders included on sleep disturbances, functional limitations at home and sports activities, and mental health problems (e.g., depression). For example, one interviewee in Long *et al.* (2013b) study had to retire from working in delivery suite; another could not play tennis or squash

anymore. The protection strategies involved having less hands-on activities, awareness of the positions of mothers and themselves, leaving the profession, or reducing working hours with more flexible schedules. Interestingly, one midwife expressed her opinion that her injury increased awareness of hazardous activities at work; before being injured she did not think about her working positions. It was reported that the support from the organisation or colleagues regarding symptoms and limitations were not satisfactory, and this led midwives to abstain from reporting symptoms due to fear of the impact on working life.

A recent survey (part of 'Caring For You' campaign) about midwives' health, safety and wellbeing was conducted by the Royal College of Midwives (RCM) amongst 1361 of its members (Royal College of Midwives, 2016a). The survey included questions about working time schedule, work intensity and pressure, sickness absence, organisational policies, work culture bullying and leadership and reporting concerns. The results showed that midwives have been affected by working demands and pressure. One of the most significant impacts was absenteeism from work; 62% of the participants were absent, with the most common reason for long-term absenteeism being stress and MSD. Over half of participants (54%) reported that they had experienced musculoskeletal problems due to midwifery work. It is possible that the results might be over or under reported in a self-reported study; however, it gives an idea of midwives' self-reported wellbeing.

Very recently, the Health and Safety Executive (HSE) published a research report describing the manual handling related risks to midwives providing care to mothers who choose pool birth and/or home birth (Jones, 2018). The research methods used were a review of incidents and literature to understand the nature and extent of the problems and risk factors, with visits to community (home) and hospitals to identify pool birth procedures and practice. The incidents recorded in relation to pool births between 2003 and 2013 were given as evidence that manual handling related injuries to midwives are common. The suggested contributory factors included: positions of the mother and the midwife resulting in poor posture (e.g., bending over the pool and supporting a mother to enter/exit); high BMI of mothers; and poor design of the birthing pools (e.g., not including handrails and/or steps).

This report also suggested a better design for pools including; appropriate height for mother and midwife, curved pool side to allow knee/feet room for midwife, use of steps/platform to help entrance or exit, seat inside the pool to position mother and help midwife for monitoring, and underwater lighting.

Birthing pool design suggestions were also given over 20 years ago to minimise the potential risk to the mother and midwife's safety, by including a seat to support delivery and vaginal examination, a concave side to make space for midwife's knees, and handrail supports and steps (Hignett, 1996). However, the HSE research found that pools have not been improved in many Trusts since then, therefore, the same design suggestions have been repeated to protect the mother and the midwife. The HSE report also stated that emergency evacuation from the pool needs to be supported by a hoist and lifting net, however this has been rarely preferred by midwives due to slow process, not fitting into the room and lack of confidence with limited or zero training in how to use it. A lack of standard training was identified by the HSE research, as each Trust provides its own training. Overall, this research offers some insights into recent practice and procedures related to manual handling risks to birthing pools.

2.4.2.2 Obstetricians

Literature exploring MSD among obstetricians is more limited than midwives. This might be because the number of midwives is higher than obstetricians in the maternity healthcare workforce. Yoong *et al.* (2008) conducted a cross sectional survey study to explore MSD among obstetrics and gynaecology (O&G) trainees in the London area (n=97), with a limited response rate (23%). It was suggested by the authors that this study is prone to response bias, with respondents more likely to be those who have experienced injury. The participants were asked about their work-related orthopaedic injury, the type of injury and the impact on their training. 28 trainees reported that they had experienced injuries of shoulder and neck (n=9), wrist (n=7), low back (n=6), forearm (n=4), thumb (n=3), elbow (n=2), hands (n=1) and ankle (n=1). These injuries developed during caesarean sections (n=8), forceps

deliveries (n=8), assisting at cervical cerclage (n=1) and running to a delivery (n=1). A total of 80 days was taken as time off work by eight trainees, due to such injuries.

A similar cross sectional survey study was conducted by Okuyucu *et al.* (2017) in an educational training meeting in East Midland region of the UK with 78 O&G trainees, with 59 returns (response rate: 76%). The questions included demographics, injury data during the last 12 months, number of sick leave days and general mental health (job satisfaction, anxiety or depression). 88% of the participants (n=50) reported any MSD; most commonly in the back (n=21), shoulders (n=13) and upper limbs (n=13). Many attributed their injuries (63%) to work related activities. Six participants needed time off work due to their symptoms.

Unfortunately, both of these surveys (Yoong *et al.*, 2008; Okuyucu *et al.*, 2017) are limited by the lack of a validated or standard commonly used questionnaire. Although the questions asked in the questionnaires were clear enough to address the study objectives, this does not allow comparison with other studies. Also, limiting the sample group to a specific region (London and East Midlands) makes the findings less generalizable. Despite these limitations, the studies provide an insight degree of the problem for O&G trainees.

Parupalli *et al.* (2012) reported on the injuries of an obstetrician sustaining mallet finger deformity with rupture of the distal and inter phalangeal extensor tendon in a case report. The injury was reported to have occurred during the management of a *shoulder dystocia*, when trying to deliver the posterior arm of the baby with her hand. The treatment process lasted four months and suggests an impact on colleagues with having more patients due to covering a long term sick leave. This case presents a clear injury occurrence due to an obstructed vaginal delivery. Shoulder dystocia occurs between 0.5% – 1.5% of vaginal births (Lerner, 2004). This is a rare injury and only one case with limited information about the participant does not allow generalisability; however it shows a possible injury while assisting deliveries and the impact on staff.

Another survey study explored MSD among obstetrics staff (n=928, 91% response rate) including; obstetricians (n=330), gynaecologists (n=288) and midwives (n=310) in China (Wang *et al.*, 2017). The survey was self-developed and validated (total Cronbach's alpha= 0.844) referring to previously validated and highly used tools: the Standardised Nordic Musculoskeletal Questionnaire (NMQ) (Kuorinka *et al.*, 1987), Rapid Entire Body Assessment (REBA) (Hignett and McAtamney, 2000), and Job Content Questionnaire (Karasek *et al.*, 1998). The questions asked about demographics, MSD and work related factors including postural, psychosocial and environmental. Hip and ankle body parts were excluded from the NMQ (judged as less important for these occupational groups). The postural factors explored were: duration and/or frequency of movements; flexion/extension and/or twisting involvement with the questions related to the trunk, neck, arms/wrists and legs. However, the full questionnaire was not published, so the way of asking questions to explore postural factors referring to REBA was not clear. Another limitation was that the findings were not reported by occupational group (e.g., obstetricians only or midwives only); therefore, the results cannot be compared with other occupation specific studies due to the differences in working tasks. The findings showed that 86% of the participants experienced any MSD in the last 12 months. The most commonly injured body part was shoulders (62%), followed by neck (60%), low back (54%), hand/wrist (40%), upper back (36%), knees (28%) and elbows (20.2%). Shoulder symptoms were associated with the length of employment; with those working longer being more likely to have MSD; neck symptoms with uncomfortable posture (p=0.016, OR=1.497), coldness (p=0.024, OR=1.604) and job stress (p=0.036, OR=1.494); and low back symptoms with keeping the same posture for a long time (p=0.005, OR=1.715), and physical tiredness after work. However, keeping up with work pace was found to be protective against shoulder, neck and low back symptoms; and freely changing posture and taking enough rest time were protective against low back symptoms. Although this study has a large sample group with a very good response rate (91%), the findings must be interpreted with caution because there is potential error for

self-assessment of postural factors. In spite of their limitations, these studies reflect the magnitude of the problem among both obstetricians and midwives.

2.5 Risk Factors

Although there is limited evidence on work-related injuries experienced by maternity professionals, they have been reported to be at a considerable risk of MSD (Royal College of Midwives, 1999; Long *et al.*, 2013a; Long *et al.*, 2013). This is likely to be due to either forceful activities during labour such as pushing, pulling, and moving patients or heavy objects, or harmful and uncomfortable working postures such as repetitive tasks, working in extreme and stressful body postures as well as static positions for a long time (Hignett, 1996; Waters, 2010). Some working tasks specific to maternity professionals caring for women in labour that might result in MSD were identified by Stichler *et al.* (2012) in their study among delivery nurses as:

- Handling pregnant women who are heavier than other patients with moving or transferring after epidural anaesthesia and positioning them.
- Leaning regularly to perform vaginal examination, or to listen fetal heart sounds.
- Experiencing physically stressful position in obstetric emergencies such as shoulder dystocia, placental abruption, Caesarean section or forceps delivery.

From the view of an ergonomist, a large obstetric service in a hospital was evaluated and was found to have risk patterns of manual handling (Hignett, 1996), defined as "*pushing, pulling, carrying, supporting, lifting, putting down or moving thereof by hand or bodily force*" (Health and Safety Executive, 2016). In this study, two specific risk factors were identified for midwives as:

- Body posture during delivery, for example in water births, the midwife has to kneel or squat besides the pool for a long time. Because, the pregnant woman is encouraged to choose the most comfortable position for her during the delivery, the midwife is expected to respond and support her

chosen position (De Jonge *et al.*, 2008). The midwife might have to spend a considerable period in a stressful posture such as stooping and bending.

- Assisting mothers with breastfeeding was reported to cause back pain and discomfort (Hignett, 1996).

In general, therefore, working in such conditions seems to be a major trigger factor for musculoskeletal problems. However, these findings are based upon data from over 20 years ago; so more research is needed in investigation whether these problems are still experienced and if new problems have developed.

From the biomechanical analysis of injury occurrence, it has been clear that physical degeneration of the tissue by some predisposing factors such as over-load, may cause an injury. The risk factors can be categorised as repetitive, prolonged and forceful activities putting mechanical stress on the tissues. In work place settings, the exposure to these factors is most commonly associated with occurrence of injury (Kumar, 2001). However, there are several risk factors that have been associated with MSD in health care staff, including individual, life and behaviour and work-related factors. These possible risk factors are discussed with a wider literature in the following sections.

2.5.1 Demographic Factors

Several studies have shown increased rates of MSD mostly in the low back area and commonly followed by neck and shoulder problems in older health professionals (Alexopoulos *et al.*, 2003; Trinkoff *et al.*, 2003; Gopinadh *et al.*, 2013; Jellad *et al.*, 2013). In some studies younger healthcare staff have been reported to experience more injuries compared to their older age colleagues. For example, Cromie *et al.* (2000b) found that only knee symptoms were related to greater age among physiotherapists. Since age is often connected with length of working, the association between age and MSD might stem from increasing duration of exposure to the physical work demands. This is supported by Coenen *et al.* (2013) prospective study (with follow up of 3 years) concluded that cumulative exposure is a risk factor for MSD in workers from different companies including industrial and service branches. Oakman et al. (2016) report a longitudinal study in workers of a food

industry company which found that repetitive movements and awkward postures were associated with high risk of MSD in middle age (36-49 years old) and older age groups (>50 years old); while for youngest age group (20-35 years old), the physical demands of the job were not risk factor. Additionally, environmental hazards such as heat, cold or noise in the work environment are predictors of MSD in older age groups (>50 years old) (Oakman *et al.*, 2016). The longitudinal nature of these studies provides a high level of validity.

Gender has been reported to have associations with MSD. Females appear to be affected more often with occupational injuries across a range of occupations. For example Bork *et al.* (1996) found an association between increased risk of MSD in the neck, upper back, low back and wrists/hands and female gender in physiotherapists. Female nurses were also found to be at a higher risk for shoulder and low back disorders than male nurses (Camerino *et al.*, 2001; Trinkoff *et al.*, 2003). Some possible explanations for the association of injuries with the female gender were suggested by Barbosa *et al.* (2013):

- Women are generally less physically strong than men due to '*biological differences'* such as muscle power or cardiac capacity.
- Many women tend to do house work in their free time, while men do sports or outside activities. This would increase the effects of physical exposure to work for women and give less time for recovery.
- Women have been found to mention their discomfort more than men.

2.5.2 Life Style Factors

Physical activity level has been associated with the existence of musculoskeletal pain. It has been commonly measured with self-reporting of physical activity participation, frequency and duration, or objective measurements such as metabolic equivalent of activities (Feng *et al.*, 2014; Borg *et al.*, 2016). For example, Hildebrandt *et al.* (2000) categorised less than 12 hours leisure time activities in a week as inactive life style, and reported that life style was associated with the occurrence of low back symptoms and sick leave (OR 1.54 and OR 1.28 respectively). However, physical activity might be a risk factor depending on the

level and type. For example, knee pain was associated with high-level physical activity, measured with International Physical Activity Questionnaire (Uz and Yeldan, 2012). Yoga practice or any other physical activities were found to be a protective factor for MSD in dentists (n=220) (Koneru and Tanikonda, 2015). In general, it is hard to make an interpretation about the association of physical activity in MSD due to the variety of physical activities and measurement methods.

Individuals' increased weight might contribute to MSD. This effect can be explained with a biomechanical approach, as discussed in Section 2.3.2. Excessive fat tissue in the body, defined as *'dead weights attached to the musculoskeletal system',* results in over muscular exertions and increased load through weight bearing joints and other body structures in different postures (Park *et al.*, 2009). High BMI workers are likely to develop carpal tunnel syndrome, because the pressure caused by the fat tissue within carpal tunnel decelerates the median nerve activity; osteoarthritis due to over load on joints; and back pain due to increased internal force on spine and other structures in the back (Capodaglio *et al.*, 2010; da Costa and Vieira, 2010).

With regards to smoking, Abate *et al.* (2013) demonstrated in their review that smoking has been associated with a decrease in bone mineral content, increased incidence of osteoporosis and fractures. An association between smoking and musculoskeletal pain and tendon degeneration has been assumed, but there is still limited evidence of their direct influence independently from other risk factors such as physical activity (Abate *et al.*, 2013). In a cross sectional study of Japanese nurses, smoking was positively associated with likelihood of increasing neck symptoms (Odds Ratio (OR) 2.45) (Smith *et al.*, 2006a). Smoking, therefore, is thought to increase the probability of MSD due to:

- Decreased blood supply which would also affect aerobic capacity (Vo *et al.*, 2011),
- Reduced bone density (Benson and Shulman, 2005),
- Delayed healing process (Abate *et al.*, 2013).

2.5.3 Work and Organisational Factors

The organisation and the schedule of work have an impact on developing MSD (Oakman *et al.*, 2014). The organisation-related hazards may include staff shortage, heavy workload, role conflict, inadequate breaks, long working hours and shifts. These factors may increase the exposure to work related load and result in fatigue and/or stress. Healthcare staff may have to work in non-standard work patterns such as on-call, weekends, long hour shifts or night shifts. These characteristics have been associated with MSD (Janga and Akinfenwa, 2012; Long *et al.*, 2012; Jellad *et al.*, 2013). The Health and Safety Executive (HSE) also found that non-standard shifts, particularly at night, may disrupt the body clock, cause fatigue, sleep difficulties, disturbed digestion and diet, and increase the use of sedatives and stimulants (Health Safety Executive, 2006). A possible explanation was provided by Fell-Carlson (2007) with respect to the 24-hour internal `*biological/body clock'*, which controls the circadian rhythm.

The literature on nurses shows an association between longer working hours (per week) or more than 12 hours in a shift and increased risk of MSD (Engkvist *et al.*, 2000; Lipscomb *et al.*, 2002). The results of a longitudinal study of nurses (n=2617) showed that working schedule factors such as duration and rest periods (working more than 13 hours a day, weekends, less than 10 hours between the shifts) and working on time off days (sick leave, rest days, breaks) were contributors for developing neck, shoulder and back disorders (Trinkoff *et al.*, 2006).

Physical demands of jobs are usually the most obvious contributory factor for MSD. Physical work load factors and the level of exposure include posture, movement, vibration, force, repetitiveness and duration (Li and Buckle, 1999; David, 2005). Of those demands, working in awkward positions, manual lifting and repetitive tasks have been most commonly associated with MSD in health professionals (Russo *et al.*, 2002; Long *et al.*, 2012). The analysis of data by Long *et al.* (2013) demonstrated associations between individual and work related factors, and neck or upper back problems in midwives. Physical job demands (pushing/pulling/lifting and working in static and awkward postures) were significantly associated with upper back

symptoms (OR=1.54), and working in awkward postures was associated with neck symptoms (OR=1.36). Szeto *et al.* (2009) found that the most significant contributors for neck symptoms among surgeons were physical ergonomic factors (OR=2.028). They added that 89% of surgeons in the study were injured due to sustaining static and awkward posture during the surgery, while 44% by forceful exertion and 38% by repetition.

The Manual Handling Operations Regulations provides prevention suggestions for workers and employers with manual handling operations which includes *'transporting (including the lifting, putting down, pushing, pulling, carrying or moving) or supporting a load (may be either inanimate, e.g., a box or a trolley, or animate, e.g., a person or an animal) in a static position with involving human effort rather than mechanical handling (by the hands or any other part of the body e.g., the shoulder)'* (Health and Safety Executive, 2016). And it is well documented that the risks for manual handling are very common in all sectors, including agriculture, construction, healthcare, transport and logistics. According to the Health and Safety at Work Act (HSW Act), it is highly essential to provide an effective health and safety information and training to workers from varied sectors to recognise the potential hazardous activities and to learn the way of avoiding or modifying them with using the equipment appropriately or applying good handling techniques. Therefore, it is the duty of employers to ensure that a specific information and training on manual handling of work activities are given to the workers and it is mandatory to attend this training once a year.

A number of models and tests have been developed to measure psychosocial work demands including possible stressors such as job demands, workload, support from colleagues, technical skills, social interactions, job satisfaction and organisational factors (Karasek *et al.*, 1998; Ørhede *et al.*, 2000; Siegrist *et al.*, 2004). Stress is considered to occur as a result of psychosocial hazards, with a combination of individual and work place related factors (Oakman *et al.*, 2014).

Many researchers have claimed that psychosocial factors at work such as time pressure, high perceived workload, low job control, poor social support are potential antecedents for development of MSD, besides ergonomic factors and physical exposures (Bongers *et al.*, 1993; Smedley *et al.*, 2003; Smith *et al.*, 2004; Smith *et al.*, 2006b; Hauke *et al.*, 2011), as people experiencing MSD-related pain are also likely to report anxiety and fear symptoms. The reason for this may be they are worried about the impact of their symptoms on their lives and futures (Gatchel *et al.*, 2007). It is, however, unclear whether psychosocial conditions have a causal role or a consequence of MSD (Bartys, 2003). Bartys expanded her argument that psychosocial factors seem to be obstacles for recovery from MSD, but did not report any strong association between psychosocial factors and length of absence from work. Fransen *et al.* (2002) also suggested that psychosocial factors impact on the progression and outcome of MSD, rather than onset of injuries.

A systematic review by Lang *et al.* (2012) found that stress can predict severe somatic symptoms, and a cross-sectional study with physicians found that psychosocial risk factors associated with MSD, included too much overtime, high mental pressure, inadequate work support, and inadequate work discussion (Smith *et al.*, 2006b). Thus, the contribution of psychological, social and organisational factors of work and environment on health and wellbeing should be taken into consideration.

Overall, demographics, life style behaviours (physical activity, BMI, smoking), working schedule, physical and psychological working demands have been reported to be related to the likeliness of severe MSD. It is very rare for these factors to individually have an impact for developing MSD; it is more common that a combination and interaction of these factors will result in WRMSD.

2.6 What has been happening in UK maternity services for over last 20 years?

This section reviews development of maternity services in the last 20 years which may have had an impact on care activities and MSD. (NB: There was limited data for obstetricians). Most of the data in this section is from the Royal College of Midwives

(RCM). RCM publishes regular reports on the mothers, babies and midwives. These reports include changes in maternity services that could help to identify issues and trends.

2.6.1 Change in the Staff Profile

A midwife has the responsibility of caring the women during the pregnancy, labour and after birth (Royal College of Midwives, 2016b). This care is provided directly by the midwife and it includes measurements aiming to prevent health problems and abnormality during pregnancy and labour. When there is need for obstetric or medical involvement, the midwife is still responsible for providing holistic support, continuity of carer and a positive birth experience. An obstetrician gets involved with complicated or high risk pregnancies with performing surgical procedures including instrumental delivery (e.g., ventouse, forceps) or caesarean section.

According to the most recent reports (RCM, 2015; RCOG, 2015), there were around 26,000 midwives and 4,000 obstetricians working in the UK. The changes in numbers of midwives in England over the last 14 years can be seen in Figure 2.3. Unfortunately, no similar data was found for obstetricians.

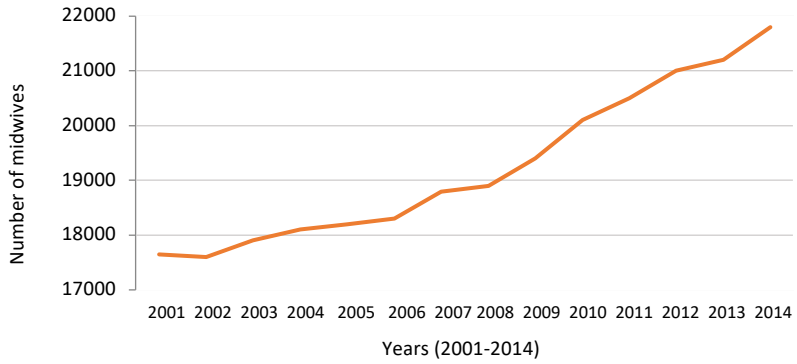


Figure 2.3: Number of midwives in England between 2001 and 2014, data from (RCM, 2015)

Although, an increase is seen in the number of midwives, it has been regularly considered that there has been always a shortage of midwives. For example, the RCM stated a shortage of around 3,500 midwives in England in 2016 based on a calculation of midwifery work demand (RCM, 2016c). It has been argued that the

UK decision to leave the European Union (EU) in 2016 has had an impact on staff shortages with more staff leaving than joining in this occupation from European countries (Bonar, 2018). Additionally, there is a concern about a possible decrease in the number of midwives due to a Governmental regulation ending NHS bursaries paid to student midwives in August 2017 (Department of Health and Social Care, 2017); this means that student midwives now have to pay full tuition fees, £9,000 per year, whereas previously there were no such fees.

The age profile of NHS midwives was described by RCM (Figure 2.4), showing that the age profile of midwives has been increasing. In 2016, one third of NHS midwives in England were over 50 years old, this is higher in Scotland (41%), Wales (35%) and Northern Ireland (40%). These figures might be due to an increased average age of qualification; RCM reported that only 2% of the increase between the years 2005 and 2014 were midwives aged younger than 50 (RCM, 2015).

The increase in the number of older midwives, who are generally more experienced, is positive in terms of care provision; however, older staff is more prone to the cumulative effect of injury because muscle strength and flexibility decline with age, while work load stays same or increases (Bassey, 1998; Grandjean, 1976). Moreover, there is a need for younger, newly qualified midwives so that older midwives can transfer their level of experience and skills in practice to them before they retire (RCM, 2016).

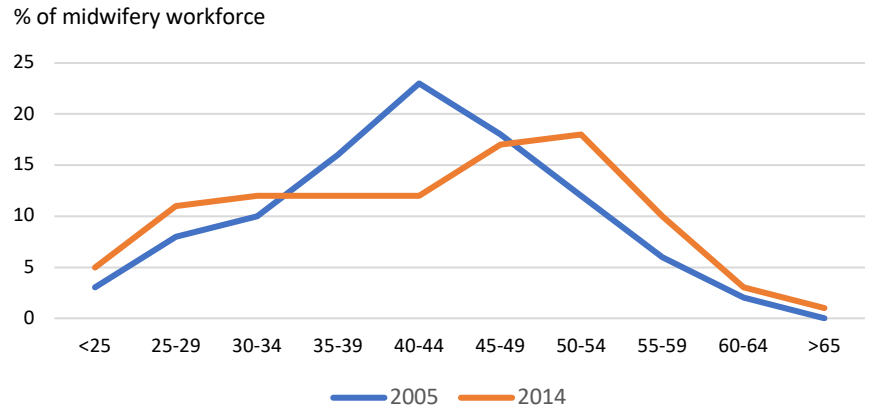


Figure 2.4: Comparison of age profile of NHS midwives in England in 2005 and 2014, data from (RCM, 2015)

The average time practicing as a midwife was recorded as 8.2 years in 2009, 9.6 in 2008 and 10 in 2007; a gradual decrease in the length of service. Between 2012 and 2017, the number of midwives that left NHS England increased (Figure 2.5). There has been increasingly more midwives leaving, but information about the reasons for leaving was not given in this report. According to RCM survey in 2016 exploring the reasons for leaving midwifery (n=837, left midwifery in the last two years), the most common reasons were: lack of staff (52%), dissatisfied with the quality of care delivered (48%), heavy workload (39%), lack of support from colleagues (35%), unhappy with working patterns (shift pattern (30%) and long working hours (26%)) (RCM, 2016d).

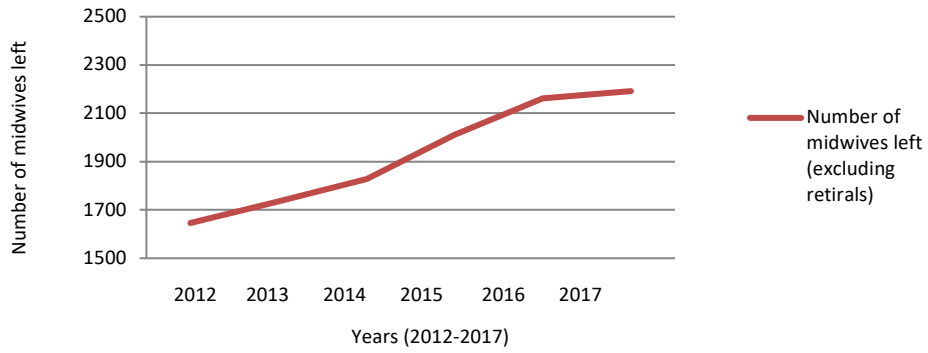


Figure 2.5: Number of midwives that left the NHS (excluding retirees) in England between 2012 and 2017, data from (Health and Social Care Information Centre, 2018)

2.6.2 Change in the Mother Profile

Figure 2.6 shows the number of live births between the years 1990 and 2016. There was a continuous rise from 2002 to 2013, and then it dropped but is still almost 100,000 higher than it was in 2001.

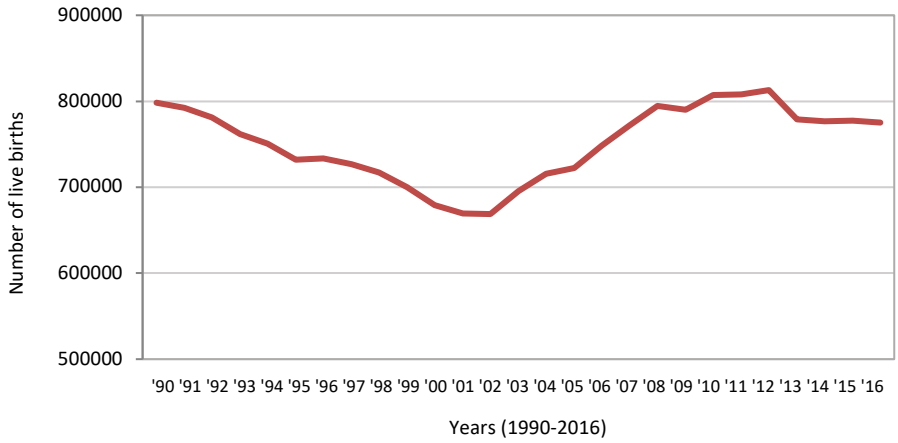


Figure 2.6: Number of live births in the UK from 1990 to 2016, data from (Statista, 2018)

There has also been an increase in the average age of mothers (Figure 2.7). From 2001 to 2014 the number of mothers giving birth in their late thirties (35-39) rose by 33%, and rose by 78% for mothers aged 40 and over (RCM, 2015). Older mothers are reported to be at a higher risk of operational procedures, prematurity and obstructed labour (Gustafsson, 2001), with a high dependency level requiring more staff and effort for their care.

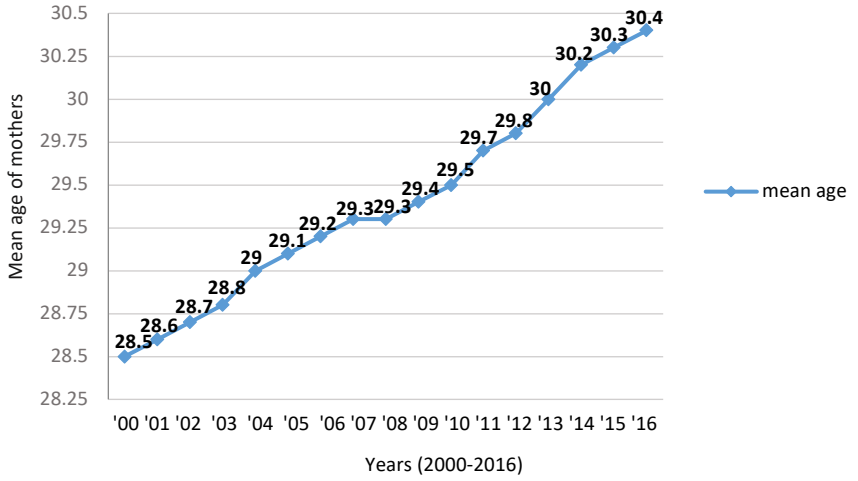


Figure 2.7: Mean age of mothers at child birth in England and Wales between 2000 and 2016, data from (Statista, 2018)

2.6.3 Advent of the 12-hour Shift

The traditional shift pattern for midwives was defined by the NHS as three 8-hour shifts per day. However during the 1990s, two 12-hour shifts were introduced and

recommended to the NHS with advantages of saving money (by reducing the numbers of overlap between the shifts) and improving quality of care (by providing continuity of care for longer hours) (Todd *et al.*, 1993; Fountain *et al.*, 1996). There has been an increase of the incorporation of the 12-hour shift in the NHS over the recent years (Ball *et al.* 2014).

An RCM survey study of more than 2,700 midwives exploring the reasons why midwives leave found that they were concerned about making mistakes due to working 12-hour shifts (RCM, 2016d). 48% of leavers reported not being satisfied with the quality of care they were able to deliver, and 30% were not happy with the shift hours. A midwife who left the profession in 2014 said that *"Long shifts on a busy delivery suite are not healthy for either the midwife or the women they are caring for. I would have been very happy to move into a different area of midwifery working less hours and shorter shifts but this was not possible due to being newly qualified".* Another said that *"We live in a blame culture where I have seen midwifery colleagues destroyed by management if something goes wrong and yet they had worked an 12 hour shifts without breaks and no-one will accept that the system has caused the failure, they let the midwife take the fall."* Thus, midwives have acknowledged the impact of 12-hour shifts as being increased exhaustion and potential errors. In contrast, some midwives reports benefits with reducing childcare costs and travel expenses. Considering the majority of midwives are female and having childcare responsibility, this seems to be favourable to work fewer days of the week.

Overall, there has been an increase in staff preferring 12-hour shifts (NHS, 2011a). Savings are estimated at £1 million a year due to the reduction in overlap between shifts (NHS, 2011a). It was also reported that continuity of care has increased with a positive impact on clinical quality and patient satisfaction. With regard to patient safety, reduction is anticipated in possible information lost, miscommunication or incidents with fewer handovers (Health Safety Executive, 2006). However, these results cannot be generalised for maternity services, because the data was of all staff in an NHS Trust.

2.6.4 Key Actions and Professional Guidelines

In summary, there is a lack of guidance and research specific to maternity professionals. The timeline in Figure 2.8 showed the key actions and important UK studies in the last 20 years. This section includes the summary of these actions and highlights the lack of focus on maternity professionals' health and safety.

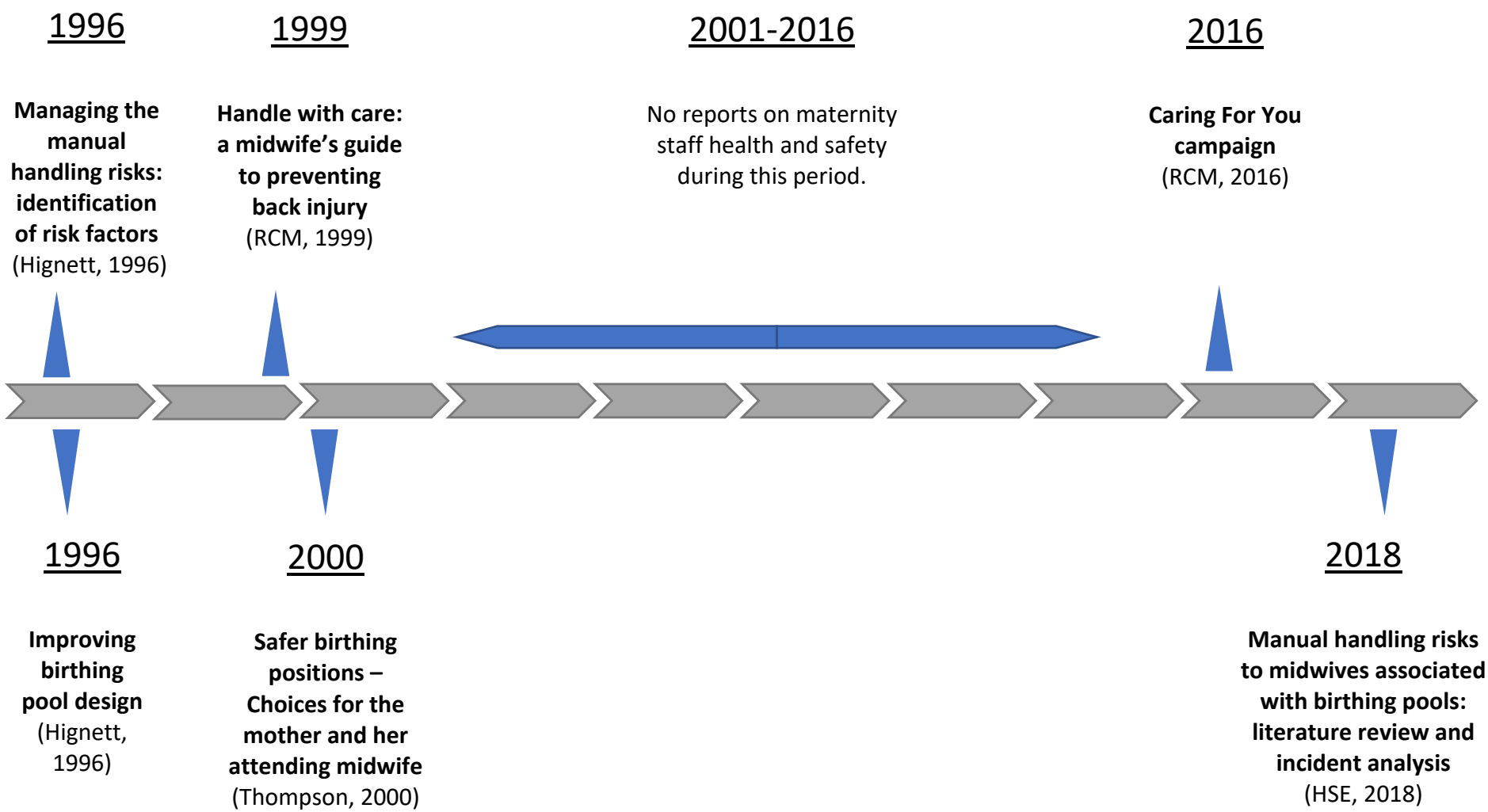


Figure 2.8: Key actions and important studies specific to maternity professionals in the last 20 years in the UK

Although manual handling related risk factors were well recognised in nursing from 1990s (Smedley and Coggon, 1994; Hignett and Richardson, 1995; Smedley *et al.*, 2003; Stubbs, 2009), it was not until 1996 that research focussed specifically on midwives. Hignett (1996) identified the manual handling risk factors in midwives in a maternity unit with key issues being load, staff, the environment and the organisation. As part of managing the risks, birthing pools were evaluated and guidelines were developed to advise on safer design for both mothers and midwives (Hignett, 1996). In 1999, RCM published advice for best practice in midwifery about the delivery positions. The following year, Thompson (2000) prepared a booklet giving information for both mothers and midwives on choosing the most appropriate birthing position, and indicating risky and modified positions. After this period, the focus shifted on patient safety; and away from staff health and safety. In 2016, RCM started the 'Caring For You' campaign which aimed to improve members' health, safety and wellbeing at work to provide high quality maternity care. Within this campaign, a survey was conducted to detail the health and wellbeing of midwives in the UK. Very recently, the Health and Safety Executive (HSE) published a report (HSE, 2018) describing the manual handling related risks to midwives providing care to women choosing to use birthing pool at home or in hospital. Recommendations were provided for better care in pool births, which include curved pool side to allow knee room for the midwife, use of steps or platforms and underwater lightning.

Overall, comparisons of maternity related profile data in the last 23 years (1995-2018) show that there have been some developments for maternity staff roles and the work force. These changes include the number and demographics of maternity staff (such as an increase in the total number of midwives, but still shortages according to demand), increases in midwives leaving the profession and increasing age of midwives (which means many skilled and experienced staff will be retiring in the coming years). In addition, working conditions have changed to more 12-hour shifts rather than 8-hour shifts. There have been also changes in the birth rate and the demographics of the mothers, such as an increase in the number of births, an increase in the age of mothers and an increase in complicated and risky births.

However, it should be noted that the dataset was not complete and did not cover the whole of the UK; for example, the data for number of midwives only showed statistics in England and the data for the age profile of mothers was from England and Wales. There was a gap in key actions and guidelines between 2001 and 2016. During this period, the professional bodies seem to have focussed on patient safety; it was their top priority. However, it does not seem to have been considered that staff health is directly related to patient care and safety (Krämer *et al.*, 2016).

2.7 Summary

The literature review has shown that there is limited evidence investigating MSD among maternity professionals in the UK. However the consequences of MSD problems in health professionals more widely have been well documented. MSDs have noticeable impact on sick leave rates, functional ability at work and wellbeing of staff, affecting patient care and safety. There is a need to increase the understanding of MSD among midwives and obstetricians who care for women in labour in the UK community.

This proposed research will examine the prevalence of, and the contributory risk factors for, MSD in the UK. The focus of this thesis is to examine WRMSD among maternity professionals actively involving in delivery cases. It will investigate both neck and upper back MSD symptoms as well as upper/lower extremities and the spine.

3. Methodology

3.1 Introduction

This chapter presents the possible research paradigms and methods in order to achieve the research objectives. Methodological approaches will be discussed for the study of musculoskeletal disorders, the predisposing factors, impact of symptoms at work and/or leisure and their views and thoughts for the physical challenges at work to manage risk factors in maternity professionals. Detailed description and discussion of the tools used and analysis approaches specific to each study are given in Chapters 4, 5, 6.

To determine the appropriate methods / techniques for these research questions, the methodological approaches will be discussed. Saunders *et al.* (2009) developed the `Research Onion` (Figure 3.1) and illustrated the stages to be followed when articulating the methodology of research. In this paradigm, the outer layers of the Onion are research philosophies and approaches; to consider methodological strategies, choices and time horizons, for the context and boundaries. The inner layer allow selection of the appropriate data collection and analysis techniques.

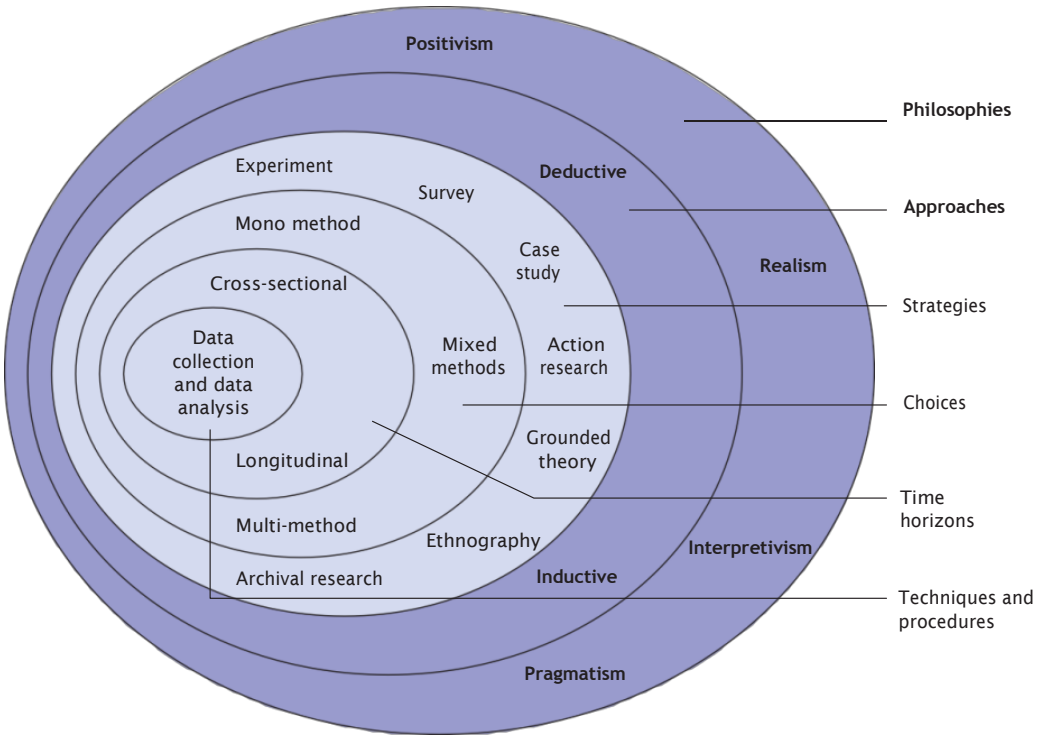


Figure 3.1: The Research Onion, from (Saunders *et al.*, 2009) *pp.108*

3.2 Research Philosophy and Approach

Research philosophies include important assumptions about ways of thinking as a basic for research strategies. Saunders *et al.* (2009) identified four main philosophies: positivism, realism, interpretivism and pragmatism (Figure 3.1). In positivism, the knowledge can be gained from observations or experiences and it focuses on facts and causality. The researcher has an objective stand with the role of proposing theories and collecting data without reflection or any views or opinions (Robson and McCartan, 2016). Positivism based approaches have been criticised for not providing a full understanding of research due to limitations of accepting that '*reality equals to observed*' (Blaikie, 2007). Realism is similar to the positivist approach in the sense that the truth is based on what we experience through our senses (Saunders *et al.*, 2009). Interpretivism is far from these two, and it proposes that humans play a role to understand the world because we interpret the actions and social world around us. In this paradigm, the researcher is expected to have an empathetic stance (Saunders *et al.*, 2009).

The research philosophy adopted in this thesis is based on pragmatism, whereby the research question is the key to choosing the best way to answer it (Morgan, 2007). Moreover, the researcher can adopt objective and/or subjective knowledge to interpret the research area, so the focus is on 'practical applied research' (Saunders *et al.*, 2009). This thesis aims to explore the prevalence and severity of MSD and occupational, individual and psychosocial risk factors in maternity professionals with a subsequent aim to prevent or reduce such problems; therefore, a pragmatic approach is used in this thesis to enable the combination of different, but appropriate ways to reach positive practical consequences.

Peeling the next layer of the onion, there are two main research approaches: deductive and inductive. In deductive approach, the researcher starts with developing a theory and hypotheses, and then collects data and analyses them to test the hypotheses. In contrast, the inductive approach begins with data collection and which is then analysed to develop a theory (Bowling, 2014).

This thesis includes a combination of deductive and inductive approaches to best address the research questions. Deductive logic supports generalisation of the results, for example MSD prevalence and distribution to make assumptions about this occupational group and explanations of causal relationships between variables (Saunders *et al.*, 2009). One of the objectives is to investigate reasons for MSD in this occupational group, so relationships between MSDs and potential risk factors are explored. This is achieved by developing hypotheses, for example one hypothesis states that MSD are more likely to be prevalent among older staff. However, inductive logic focuses on a deep understanding of the research context with less concern about generalisation (Saunders *et al.*, 2009). There is a need to better understand the contributory factors for MSD, therefore, this approach enables discovery of other risk factors or reasons behind the potential relationships between MSD and risk factors.

3.3 Methodological Strategies

The two outer layers of the Research Onion introduce the underlying paradigms of the thesis research methodology. The inner layers address the process of the research design in the individual studies. Robson and McCartan (2016) identified three main different classifications of research purpose: exploratory, descriptive and explanatory Table 3.1. In the absence of literature about maternity professional musculoskeletal health and MSD risk factors, this research has been exploratory with different factors investigated and new insights sought. It uses a description to precede explanation, which is known as *'descripto-explanatory'* studies (Saunders *et al.*, 2009).

Table 3.1: Classification of research purposes (Robson and McCartan, 2016)

Classification	Objective
Exploratory	Investigation of the research area and seeking new insight
Descriptive	Presenting the picture of issues and situations
Explanatory	Discussion and explanation of situations or relationships between variables

There are different types of research design strategies: fixed, flexible and multi-strategy (Robson and McCartan, 2016) (Table 3.2). The design strategy adopted in this thesis is based on multi-strategy, with a combination of fixed and flexible designs. The approach is also called *'sequential transformative design'* in that *'one method precedes the other with either the qualitative or the quantitative method first. The results are integrated during interpretation. It is guided primarily by a theoretical perspective.'* (Creswell, 2003). The usage of a multi-strategy design provides several advantages (Bryman, 2006):

- Triangulation: combination of different methods to triangulate the findings and increase validity.
- Offset: whereby limitation of one method can be neutralised by another, leading to stronger assumptions.
- Completeness: combining different methods to give a more complete and comprehensive understanding.
- Different research questions: each method can address different research questions; so, multi-strategy methods can answer a wide range of questions.
- Explanation: one method can be used to explain findings from the other method; e.g., survey results can be explained by interviews.

Table 3.2: Research Strategy (Robson and McCartan, 2016) *pp.74-75*

Research strategy	Characteristics
Fixed design	• Has a tight pre-specification before main data collection • Data are almost in the form of numbers; referred to quantitative • e.g., Experiment, Survey
Flexible design	• Develops during data collection • Data are typically non-numerical (usually in the form of words); referred to qualitative • e.g., Case study, Ethnographic study, Grounded theory study
Multi-strategy (Mixed) design	• Combines substantial elements of fixed and flexible design; qualitative and quantitative at different stages • e.g., Sequential explanatory, Sequential exploratory, Sequential transformative, Concurrent triangulation, Concurrent nested, Concurrent transformative

There are two main types of research: qualitative and quantitative (Creswell, 2003). These differ predominantly in data type (numerical or non-numerical) and data analysis (Saunders *et al.*, 2009). In quantitative methods, the numerical data are collected and analysed using statistical analyses to test an existing hypothesis; while qualitative methods use non-numerical data such as words, pictures and videos to generate hypotheses (Robson and McCartan, 2016). A multi-method approach refers to combining data collection and analysis methods of either qualitative or quantitative; it is subdivided as multi-method quantitative and multi-method qualitative, whereas mixed-method refers to combining both qualitative and quantitative techniques (Saunders *et al.*, 2009). In the mixed methods approach, different techniques and procedures can be used either sequentially or in parallel. In this thesis, the research objectives are addressed using a mixed-method approach. This offered better opportunities to answer the research questions and include different perspectives (Tashakkori and Teddlie, 2003).

This research was planned to address specific issues at a particular time, so is a cross sectional study. This kind of study (for example surveys) are conducted at a specific time and can provide prevalence of a situation and relationships between variables; however changes and developments in issues over the time cannot be observed (Saunders *et al.*, 2009).

3.4 Thesis Specific Research Methods

This thesis uses several methods. Table 3.3 summarises the selected and potential methods identified in literature to meet each objective. The detailed methodology, data collection and analysis and approaches for each study are discussed and presented in the relevant chapters (Chapter 4, 5, 6). Research questions 4 and 5 are investigated into two different methods (questionnaires and interviews) and selected data collection methods (questionnaire based survey, semi-structured interviews and posture analysis) are covered in this section including with a discussion of advantages and disadvantages of using them.

Table 3.3: Potential and selected research methods

Research Question	Research Objective	Potential Methods	Selected Method
"Are maternity professionals at risk of developing MSD?" **"What is the current knowledge about the risk factors for and impact of MSD in maternity professionals?**	To undertake a literature review to understand the context of MSD and contributory factors in maternity professionals	Literature review - • Narrative • Unstructured Systematic • Systematic	**Literature review – unstructured, systematic**
"What is the prevalence of MSD among maternity professionals who are actively involved in delivery cases in the UK?"	To conduct a study to explore the distribution, prevalence and severity of MSD in maternity professionals	• Survey – self/researcher completion (telephone/face to face), postal / online distribution	**Survey – self completion, online distribution**
"What are the factors that have association with MSD in this occupational group?	To conduct a study to identify the individual, psychosocial and occupational factors associated with MSD	• Survey – self/researcher completion (telephone/face to face), postal/online distribution • Focus groups • Interviews – structured/ semi-structured/unstructured, telephone/face to face	**Survey – self completion, online distribution** **Interview – semi structured, face to face**
"What is the impact of MSD on work or leisure activities in this occupational group?	To conduct a study to understand the impact of MSD on work or leisure activities	• Survey – self/researcher completion (telephone/face to face), postal/online distribution • Focus groups • Interviews – structured/ semi-structured/unstructured, telephone/face to face	**Survey – self completion, online distribution** **Interview – semi structured, face to face**

"What is the level of awareness and support about health and safety and MSD prevention strategies in this occupational group?"	To conduct a study to explore level of awareness of health and safety, and prevention strategies; and support and safety activities undertaken by the organisation	• Focus groups • Interviews – structured/ semi-structured/unstructured, telephone/face to face	**Interview – semi structured, face to face**
"To what extent do the common working postures in delivery cases contribute to development of MSD?"	To conduct a study to analyse the most frequent and extreme working positions with regards to physical exposure on musculoskeletal system	• Self-reports • Observational methods – pen and paper/computer assisted, video based/live • Direct measurements (e.g., electronic goniometer, EMG)	**Observational methods – pen and paper, video based**

3.4.1 Questionnaire-based Survey

Questionnaires, with a series of standardised questions, are a widely used data collection method (Bowling, 2014). The questions may be completed either by the participants (self-completion) sent via postal or internet; or the researcher via phone call or face to face. A questionnaire based survey was used as a starting point to explore and describe MSD in UK maternity professionals to achieve the following objectives:

- To explore the distribution, prevalence and severity of MSD in maternity professionals
- To identify the individual, psychosocial and occupational factors associated with reported MSD
- To understand the impact of MSD on work and/or leisure activities

There are several advantages and disadvantages of using questionnaire based surveys (Bowling, 2014; Robson and McCartan, 2016):

Advantages

- Provides clear and easy to count answers; high amount of data standardisation
- An economical way of data collection from a large sample in a short period of time (self-completion, online distribution)
- High level of concordance between health-related records and patients' reports
- Collect generalised information from human population
- Allows anonymity

Disadvantages

- Restricted to pre-coded response choices; may not be comprehensive and fully represent the views
- Possibility of misunderstanding/ambiguity of the questions
- Respondents' characteristics (e.g., memory, experience, knowledge, behaviour, etc.) may influence the data.

- Potential for low response rate and non-representative sample as non-respondents are unknown.

3.4.2 Semi-structured Interviews

Interviews are used to collect data through talking to participants via telephone or face to face and recording their responses (McQueen and Knussen, 2002). Semi-structured interviews were used for exploratory *('to find out what is happening and to seek new insight')* and explanatory *('relationships between variables such as those found from questionnaire')* purposes in this thesis to achieve the following objectives:

- To explore the individual, psychosocial and occupational factors associated with reported MSD in maternity professionals
- To understand the impact of MSD on work and/or leisure activities
- To explore individuals' level of awareness of health and safety, and prevention strategies; and support and safety activities undertaken by the organisation

There are three main types of interviews: structured, semi-structured and unstructured (Figure 3.2).

Fully structured interview.
Has predetermined questions with fixed wording, usually in pre-set order. The use of a greater number of open-response questions is the only essential difference from an interview-based survey questionnaire.

Unstructured interview.
The interviewer has a general area of interest and concern but lets the conversation develop within this area. It can be completely informal.

Semi-structured interview.
The interviewer has an interview *guide* that serves as a checklist of topics to be covered and a default wording and order for the questions, but the wording and order are often substantially modified based on the flow of the interview, and additional unplanned questions are asked to follow up on what the interviewee says.
The interview *guide* involves:
- Introductory comments
- List of topic headings and key questions
- Set of prompts
- Closing comments

Figure 3.2: Types of interview structure, adapted from (Robson and McCartan, 2016) *pp.279,280,285*

Semi-structured interviews provide flexible and adaptable structure that allows questions to be modified to follow up or expand interesting responses and to investigate underlying cause or actions. Interviews are also useful to increase the validity of findings from questionnaires (Bryman, 2006). However, they are time consuming for data collection and analysis as the interviewer has to meet the interviewee for at least half an hour (less than half an hour is argued to be less valuable (Robson and McCartan, 2016) and time is needed for transcription and analysis of recordings. Moreover, interviews may be ineffective for collecting trustworthy knowledge about sensitive topics due to interviewees' emotional feelings (Thomas, 2003).

Focus groups were considered as a potential data collection method, but were rejected in favour of the interviews. Although focus groups allow interactions and discussions that provide rich data in a short period of time with minimum cost (Neale, 2008), interviewees may not openly express their behaviours or thoughts in a group of people (mostly their colleagues), particularly about the impact of MSD in work activities or patient care. They were, however, used for validation of the interview results and confirmation that theoretical saturation had been reached (no new themes emerging).

3.4.3 Posture and Exposure Analysis Methods

There are various methods for assessing exposure to physical workload (e.g., force, posture, movement and duration) and identifying potentially risky tasks. These have been grouped into three techniques: self-reports of posture and exposure, observational methods, direct methods (Li and Buckle, 1999; David, 2005). Following a review of literature, observation based pen and paper posture and exposure analysis method was preferred over self-report and direct measurements to achieve the following objective:

- To analyse the most frequent and extreme working postures with regards to physical exposure on musculoskeletal system

Observational methods can be used to analyse work positions/postures with minimal interruption of working activities. However, not all posture observation techniques consider all the physical factors such as posture, load/force, movement frequency, vibration and duration (known to contribute to the development of musculoskeletal disorders (Li and Buckle, 1999). So, selection of the most appropriate method depends on the study. Table 3.4 shows examples of some observational methods.

Observations can be performed field-based, in which the work elements and activities are recorded by using a checklist or expert's own documentation; or video-based where data are analysed from video recordings. Observational methods for posture and exposure analysis were criticised due to the lack of precision in intermittent recording and not providing an opportunity to repeat or reproduce the analysis (Burdorf and van Riel, 1996). Video recording of real time working activities allows more detailed and reproducible analysis which eliminates this limitation (Takala *et al.*, 2010). On the other hand, a video recording still has drawbacks; such as requiring significant time for data collection and analysis as well as positioning cameras for a moving target. It was therefore decided to use video recording of simulated tasks rather than real time practice so as not to disrupt work activities (David, 2005).

Table 3.4: Examples of observational methods

Technique	Reference	Exposures measured	Applications	Recording mode
Ovako working posture assessment system (OWAS)	(Karhu, Kansi and Kuorinka, 1977)	Posture, load/force	Whole body posture is recorded and analysed	Pen and paper
Quick exposure check (QEC)	(Li and Buckle, 1998)	Posture, load/force, duration, movement frequency, vibration	Assessment of the back, shoulder/upper arm, wrist/hand and neck for static and dynamic tasks, with subjective data	Pen and paper
Rapid upper limb assessment (RULA)	(McAtamney and Corlett, 1993)	Posture, load/force, movement frequency	Assessment of the neck, trunk and upper limbs	Pen and paper, video
Rapid entire body assessment (REBA)	(Hignett and McAtamney, 2000)	Posture, load/force, movement frequency, coupling,	Whole body assessment for static and dynamic tasks	Pen and paper, video
NIOSH lifting equation	(Waters *et al.*, 1993)	Posture, load/force, movement frequency, duration, recovery	Risk factor assessment related to biomechanical load of manual handling	Pen and paper, computerised
Posture, activity, tools and handling (PATH)	(Buchholz *et al.*, 1996)	Posture, load/force, work activity	Developed based on OWAS, including more neck and trunk positions	Pen and paper, video, computerised
Health and Safety Executive (HSE) upper limb risk assessment method	(HSE, 2002)	Posture, load/force, movement frequency, duration, vibration	Assessment of upper limb risk factors and recording with yes/no questions	Pen and paper
Cumulative trauma checklist	(Keyserling, Brouwer and Silverstein, 1992)	Posture, load/force, movement frequency, duration, vibration	Assessment of legs, trunk and neck for repetitive tasks	Pen and paper
Strain index (SI)	(Steven Moore and Garg, 1995)	Posture, load/force, movement frequency, duration,	Assessment of risks for distal upper extremity disorders	Pen and paper

Self-reports of posture and exposure are also used to assess physical work load with visual analogue scales, questionnaires providing categorical data for physical workload, interviews and reporting of exposure. Although the application of these tools is easy and cost effective for large number of groups in almost every working area, workers' perceptions on exposure are not considered accurate and reliable (David, 2005). This may be due to differences between individuals in interpretation of questions and perception of exposures (Spielholz *et al.*, 2001). For example, in a study of cleaners and office workers, it was found that participants with severe musculoskeletal symptoms reported higher level of physical exposure and duration than those without symptoms, although direct measurements showed lower levels of exposure in this group (Balogh *et al.*, 2004). Moreover, difficulties in the estimation of the range of motions and duration of activities for workers can also result in low precision for self-reported assessments (Viikari-Juntura *et al.*, 1996).

Direct methods include measurements of range of motion, muscle activity and force by using either hand-held or electronic equipment. These require attachment of the device to the body and are not advised for dynamic tasks with continuous movement (Li and Buckle, 1999) as they may cause discomfort leading to potential changes in postural behaviour. Examples of direct methods are shown in Table 3.5.

Table 3.5: Examples of direct methods

Technique	Reference	Main features and application
Goniometer or inclinometer	(Loebl, 1967)	Attached to the body parts. Assessment of joint range of movement.
Electronic goniometer	(O'Brien and Paradise, 1976; Hannah *et al.*, 1979)	Attached to the body parts. The measurements are recorded continuously. There are several types.
EMG	(BENDIX and HAGBERG, 1984; Wells *et al.*, 1997)	Myoelectrical activity is recorded from muscles. Measurements of muscle force and tension.
Lumbar motion monitor (LMM)	(Marras *et al.*, 1992)	Triaxial electrogoniometer. Three-dimensional components of trunk position, velocity and Acceleration.
Scanning systems	(Li and Buckle, 1999)	Optical, sonic or electromagnetic markers are placed on body segments. Displacements, velocities and accelerations are measured.

3.5 Sampling Strategy

A sample is selected from the population of interest to the research due to the fact that it is not always possible to collect data from each individual of the population (Saunders *et al.*, 2009). The sampling strategy is very important as it is linked to the validity and generalisability of the findings to the population (Robson and McCartan, 2016). Sampling techniques are divided into two main types: probability or representative (where the chance of the selection of each case is known), non-probability or judgemental (where it is not known). Table 3.6 presents a number of different sampling strategy types with descriptions.

Table 3.6: Summary of sampling techniques, adapted from (Robson and McCartan, 2016) *pp.271-275*

Sampling strategy	Description
Probability Samples	
Simple random sampling	Selection at random from a population list
Systematic sampling	Taking every *n*th name from a population list
Stratified random sampling	Dividing a population into groups (strata, where members of a group share particular characteristics) and then randomly selecting within these groups
Cluster sampling	Dividing a population into groups (cluster, where individuals have a range of characteristics. It is chosen on a random basis) and then a subpopulation is selected within clusters.
Multi-stage sampling	An extension of cluster sampling where the sample is selected in stages, i.e. taking samples from samples (e.g., sample of schools, classes and students)
Non-probability Samples	
Quota sampling	Obtaining representatives of a population in relative proportions in their occurrence.
Dimensional sampling	An extension of quota sampling where at least one representative of every possible combination of factors or dimensions is included within the sample.
Convenience sampling	Choosing the nearest and most convenient persons to act as respondents. The process is continued until the required sample size has been reached.
Purposive sampling	The selection principles are decided by the researcher to satisfy specific needs of the project.
Snowball sampling	Participants in a research population are used to identify other potential samples from the population.

Non-probability sampling was adopted in this thesis as the overall target population is known from official records; it was not possible to specify the probability that any individual would be included. In addition, a selection of different strategies was used: convenient, purposive and snowball. A detailed discussion of sampling strategies used for each study is given in the Chapters 4, 5, 6.

3.6 Summary

The methodological approaches and data collection methods have been identified and discussed by considering their advantages and disadvantages. This thesis uses a mixed methods strategy with a combination of qualitative and quantitative research based on pragmatic research philosophy combining deductive and inductive approaches. A selection of non-probability samples techniques has been adopted. The evaluation and discussion of the potential and selected methods was helpful to ensure that selected data collection methods are appropriate for the context of this thesis.

4. Study 1: A cross Sectional Survey of Midwives to Explore the Scope of the Musculoskeletal Symptoms

4.1 Introduction

As concluded in the literature review, maternity professionals are at high risk of developing musculoskeletal symptoms at work which results in lost working days resulting significant financial impact. Such problems are also known to affect quality of care and patient safety, but there is limited reported data on maternity professionals in the UK. In the absence of such data, the starting point should be exploring the extent of musculoskeletal symptoms in this occupational group. This chapter presents the methodology and results of a survey study to explore the characteristics and predisposing factors of musculoskeletal symptoms in maternity professionals.

4.2 Aim and Objectives

A survey was conducted to understand the extent of musculoskeletal symptoms in maternity professionals with the following objectives:

- To explore the distribution, prevalence and severity of musculoskeletal symptoms
- To identify the individual, psychosocial and occupational factors associated with the musculoskeletal symptoms
- To understand the impact of musculoskeletal symptoms

4.3 Participants

The target population for this study was maternity professionals who are actively assisting the delivery process in women in the UK. The questionnaire was sent to obstetricians and midwives, irrespective of whether they had injury or not. It was planned to survey both midwives and obstetricians, but it was anticipated that equal responses from each group would be unlikely as there are more midwives than obstetricians.

4.3.1 Sample Size

Although most sample size calculations are for interventional studies (which this is not) two different calculations were performed as an exercise to estimate sample size.

The first calculation was performed using Slovin's formulation, which is normally used when there is no information about the population behaviour. The sample size, 'n', is calculated by the formula: $n = N / (1 + Ne^2)$ where N = total population, e = margin of error. With a 95% confidence level, the error tolerance was considered as 0.05. The total population is estimated to be around 26,000 for midwives and 4,000 for obstetricians (RCM, 2015; RCOG, 2015). Therefore, this calculation produced the figure of 394 for midwives and 364 for obstetricians.

The second method is used to calculate the sample size for a regression study depending on the number of predictors for the dependent variable (Soper, 2017). With the 19 predictors, for a desired statistical power level of 0.8, $p<0.05$ and of a medium effect size of 0.15, the calculation produced a minimum sample size of 153.

Therefore, the target of 394 for midwives and 364 for obstetricians were selected, which also meets the minimum sample size target of 153 for regression analysis.

4.4 Methods

4.4.1 Design of the Survey

A questionnaire was designed based on the available literature and the study aims. Two previously validated questionnaires were used: 1) Standardised Nordic Questionnaire (Kuorinka *et al.*, 1987), and 2) Effort-Reward Imbalance questionnaire (Siegrist *et al.*, 2009). Additional questions considered to be related to the occurrence of symptoms (e.g., demographics, work-related and life style) were developed based on the literature and following discussions with supervisors and clinical experts.

It was decided to design the questionnaire as an online survey as it has the advantage of reaching participants in a geographically wider area, as well as being cost effective and efficient way of collecting data (Robson and McCartan, 2016). The self-administered online questionnaire titled 'Musculoskeletal health of maternity professionals' (Appendix 4.1) consisted of four main sections with each section having a specific focus (Figure 4.1).

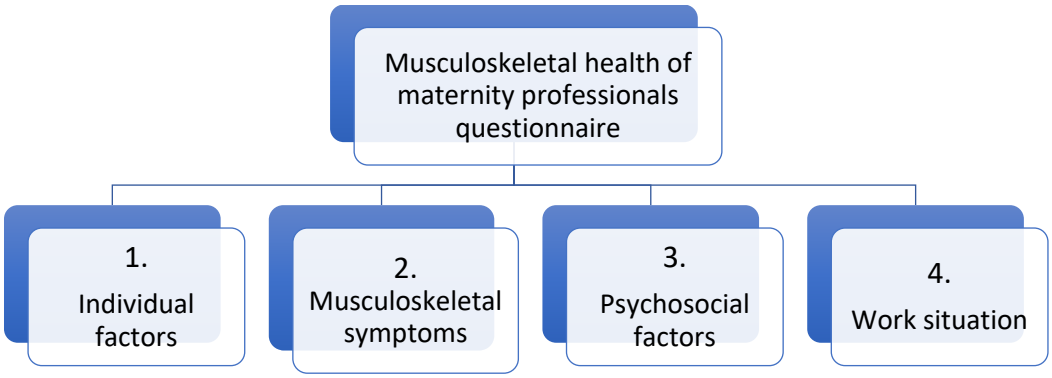


Figure 4.1: Summary of the domains included in the questionnaire

4.4.1.1 Individual factors

Demographic information was collected through questions on age, gender, weight, height, dominant hand, ethnicity, smoking, physical activity level, marital status, sleeping hours and quality were included. These domains were shown by the literature to be linked with musculoskeletal symptoms (Long *et al.*, 2012; Anderson and Oakman, 2016). The participants were not required to give their names or date of birth in order to protect their privacy. Age, height and weight were requested as numbers (instead of tick boxes) as it would give continuous data which is evidenced to generate more powerful effects in statistical tests compared to categorical data (Pallant, 2013). Body Mass Index (BMI) was calculated based on the height and weight values. Tick boxes were used to specify other data e.g., gender, dominant hands, ethnicity, smoker (or not). Marital status was categorised as: 'Single, never married; Married or domestic partnership; and Widowed, divorced, separated.' For

sleeping hours, eight hours were the cut point as an average of eight hour of daily sleep duration was recommended for adults (Hirshkowitz *et al.*, 2015).

All participants were asked to indicate their physical activity level as low, medium or high. These levels were advised by National Health Services (NHS) guidelines for adults, aged 19 to 64 (NHS, 2011b). Low level physical activity was described as 'Less than 150 min/week of moderate activity or 75 min/week of vigorous activity'. Medium level physical activity was explained as '150-300 min/week of moderate activity or 75- 150 min/week of vigorous activity'. Finally, high level was 'More than 300 min/week of moderate activity or 150 min/week of vigorous activity' (Table 4.1).

Table 4.1: Physical activity guidelines for adults (NHS, 2011b)

Low level	Medium level	High level
Less than 150 min/week of moderate activity (or 75 min/week of vigorous activity)	150-300 min/week of moderate activity (or 75-150 min/week of vigorous activity)	More than 300 min/week of moderate activity (or 150 min/week of vigorous activity)

The participants were also given the explanations of moderate or vigorous activity as '**Moderate activities** refer to activities that take moderate physical effort and make you breathe faster and feel warmer like carrying light loads, bicycling at a regular pace, doubles tennis (not walking). One way to tell if you are exercising at a moderate level is if you still talk, but you can't sing the words to a song. **Vigorous activities** refer to activities that take hard physical effort and make you breathe hard and fast like heavy lifting, digging, aerobics and fast bicycling. If you're working at this level, you won't be able to say more than a few words without pausing for breath.'

4.4.1.2 Musculoskeletal symptoms

To assess musculoskeletal injury and pain, the Standardised Nordic Questionnaire (Kuorinka *et al.*, 1987) was used. It included questions asking about musculoskeletal symptoms in nine body parts (neck, shoulders, upper back, elbows, wrists/hands,

lower back, hips/thighs, knees, ankles/feet); duration of symptoms; severity of the symptoms in terms of affecting activities at work and during leisure time; work modification; seen by doctor, physiotherapist, chiropractor or other such person; missed days of work; and any medication taken due to symptoms. Point prevalence (7 day), period prevalence (12 month) and life-time prevalence were investigated in different body parts. The severity of symptoms was demonstrated with the question of 'Has the trouble caused you to reduce your normal activity (work or leisure) during the last 12 months?'

In the original tool (Kuorinka *et al.*, 1987), body region specific questions such as duration, severity, hospitalisation, work/job changing and away from work were only for the neck, shoulders and low back. An extended version of this questionnaire was identified for nine body parts. It was tested in terms of reliability by Pugh *et al.* (2015), and found to have a good agreement for all body regions with a kappa statistics of 0.86 for prevalence questions. In addition, Pugh *et al.* (2015) tested the usability of the questionnaire online, and found no difference compared to a paper version. Throughout this section of the questionnaire, participants were reminded in each question that they should respond according to their symptoms in specific injured body parts.

There are several advantages of using this questionnaire:

- It addresses the main objective of this study, which is 'to explore the presence of musculoskeletal symptoms in a specific population'. It also covered affected body parts, severity and impact of musculoskeletal symptoms. Therefore, a considerable amount of time was saved in terms of designing a questionnaire and a further validation process.
- It has been widely used to identify musculoskeletal symptoms in occupational settings. That gives the advantage of potentially comparing the data with other literature.
- It is an appropriate tool for self-administration as it is short and easy to use.

- Although it is a self-reported tool, it has a good agreement with physical examination with high sensitivity and specificity (Descatha *et al.*, 2007; Takekawa *et al.*, 2015).

4.4.1.3 Psychosocial factors

Social and psychological factors were assessed with the Effort-Reward Imbalance (ERI) model developed by Siegrist (1996). This tool has been commonly used to assess these factors among health professionals (Weyers *et al.*, 2006; Simon *et al.*, 2008; Lamy *et al.*, 2013; Bonzini *et al.*, 2015). The short version of the ERI questionnaire was used consisting of three main scales: effort, reward and over commitment (Siegrist *et al.*, 2009). Of these components, effort-reward ratio represents extrinsic work stress, while over commitment represents intrinsic work stress. It comprises 16 domains assessing demands/obligations, esteem, wage/salary, promotion, security, and motivation. Each question is measured using a 4-point Likert scale, suggested as: 1- strongly disagree, 2-disagree, 3- agree, 4 - strongly agree. However, four of the 16 items were reverse coded as '4- strongly disagree, 3-disagree, 2- agree, 1 -strongly agree'. The sum of each group, followed by division of the effort scores by reward scores, and multiplication of the final score by a correction factor produces an ER score (Siegrist *et al.*, 2013). Where ER> 1, the person reports more effort for the reward, and where ER < 1, there are less efforts for each reward. The data is interpreted for descriptive purposes showing the job stress level. In the literature, there are several surveys measuring psychosocial factors. As reported in a systematic review (Bernal *et al.*, 2015), one of the other most commonly used tools is the Job Content Questionnaire (JCQ) based on Karasek's demand-control model (Karasek *et al.*, 1998). However, the ERI model was suggested to better address job stress than JCQ in health professionals (Li *et al.*, 2006; Lee *et al.*, 2014). It also accounts for the economic concerns and satisfaction, whereas JCQ does not. Additionally, job satisfaction level was recorded on a 10 point scale, 0 representing 'not satisfied at all' and 10 representing 'completely satisfied'.

4.4.1.4 Work situation

The final section was designed to obtain information about participants' working conditions including professional status; years of work experience; working hours in a week; working place collapsed into categorises of maternity unit in a hospital, midwife-led unit in a hospital, standalone midwifery unit, home birth; number of babies delivered in a year; duration of a shift work; proportion of night shift and breaks. These questions were asked in the light of the literature to understand the impact of working characteristics on risk of musculoskeletal symptoms (Long *et al.*, 2012). However, physically challenging working positions and frequency or duration of these positions in each shift were not included in the survey as previous research (Long *et al.*, 2013) has suggested that this question is prone to inaccurate recall of cases and positions. It was planned to explore working tasks and organisational factors in detail using different methods e.g., interviews and postural analysis as part of this thesis.

The questionnaire was designed to take five to seven minutes to complete. The questions mainly were designed with multiple-choice responses and rating scales to increase the response rate from the participants, and ease the data analysis (Robson and McCartan, 2016). Some questions included the response choice of 'other', 'I can't remember' or 'prefer not to say' to improve the accuracy. Participants were given the option to contact the researcher via email to receive the results of the survey and take part in further studies.

4.4.2 Research Approval

All relevant Sponsor Green Light Review Processes were followed to ensure that the study fulfilled the regulations. The University of Leicester was the sponsor for this study. It was reviewed by the representatives and the Sponsor authorisation was confirmed on 19/01/2016. The study was also reviewed by the University of Leicester Ethics Committee and the ethical approval was given on 05/02/2016. NHS Ethics Approval was not required because the research did not involve NHS patients; it only involved NHS staff. However, NHS Research and Innovation (R&I) application was required to launch the study in NHS organisations, which was

submitted for approval on 22/01/2016. As a process of the review by University Hospitals of Leicester (UHL), an informative presentation about the study was made to the clinical management group team. Once the R&I approval was placed, a Sponsor Green Light letter was issued and the survey was launched on 05/05/2016.

4.4.3 Piloting of the Survey

The survey was piloted in order to test the clarity of the questions, layout of the survey, time required to complete the survey, and the data analysis approach. The content of the survey was first tested with a small group of senior midwives (n: 7) working at the Leicester Royal Infirmary. Following explanation of the aims and objectives, they were provided with a copy of the survey in an A3 paper format, and asked to give feedback. They found it lengthy, but easy and clear. Part of the reason for this perception might have been the layout of the questionnaire on an A3 sheet. However, they managed to complete the questionnaire within five minutes.

Although the survey was first designed online, it was advised by the Heads of Midwifery that paper versions might also be helpful as some midwives rarely access their emails. Therefore, approval for the amendment of using paper copies in relevant clinical areas was gained. The paper version for the main study was prepared as a leaflet to ease of reading on separate pages. Similarly, the online version allowed the participants to click on relevant questions and jump through the pages; therefore, it looked less intimidating.

The time required to respond the questions was considered carefully as this was one of the main limitations in a study by Turner *et al.* (2008). In this study, the response rate was less than 5%, which was low considering the duration of the data collection. One of the reasons for this low response rate was considered to be the length of the electronic survey, which consisted of more than five separate tools each containing several items. Since it was an electronic survey, lack of internet access might also have been a barrier for midwives. The limitations of previous studies were taken into account to try to eliminate these in the current study.

The online survey was modified to include the comments by Band 7 midwife groups and academic supervisors as well as other researchers in the department. After the modifications, this was further piloted for user feasibility, readability, accessibility, layout etc. to the same midwife group and other maternity professionals from Leicester General Hospital. 17 responses and written feedback were returned. Based on this feedback, minor changes were made to the wording of the questions.

4.5 Data Collection Procedure

The survey was conducted online using the internet based survey software, Bristol Online Survey (BOS), as well as the paper copies disseminated local areas for a seven-month period, starting on 12th May 2016 and concluding on 12th December 2016. The link for the survey is: https://leicester.onlinesurveys.ac.uk/musculoskeletal-health-of-maternity-professionals.

The survey (Appendix 4.1) was disseminated across the UK through the Heads of Midwifery, Heads of service in Obstetrics, Consultant Midwifery Groups, and support by the Royal College of Midwives (RCM) and Royal College of Obstetricians and Gynaecologists (RCOG). The RCM published the survey on their website (Appendix 4.2), official social media (Twitter) account and the e-news on 07/10/2016. Unfortunately, the RCOG was late in responding, although they agreed to circulate the survey in their newsletters. Therefore, a combination of 'purposive' and 'snowball' sampling was used (Robson and McCartan, 2016).

Multiple methods were used to publicise the survey to potential participants nationally and locally including the use of social media (Twitter), e-news, a poster including a QR code presented at the RCM annual conferences and the regional obstetrics training day (Appendix 4.2), newsletters (LGH Maternity Newsletter on 13/07/2016), staff briefings at UHL (Friday teachings, AGM, labour ward visits), manager briefings at UHL (community midwife meetings), together with reminder emails. The Heads of Midwifery and Heads of Services were contacted to send regular reminders and encourage their teams to complete the survey.

4.6 Data Analysis

The data was analysed using IBM SPSS Statistics 23. Basic descriptive statistics were used to present frequency of musculoskeletal symptoms and characteristics of the samples. The following tests were used to find out the potential associations as appropriate.

Independent Samples t test

An independent samples t-test was used to compare differences with continuous, interval data of two independent groups. For this study, it was used to understand whether the mean ages, BMI, practice year, working hours, actively delivery involved days, ERI and over-commitment scores (interval data) differ based on the presence of MSD (two independent groups - 'Yes' and 'No' groups). It also gives the probability of the difference occurring by chance.

Mann Whitney U

Mann Whitney U test was used to compare differences with continuous, ordinal data of two independent groups. In this study, it was used to understand whether job satisfaction measured on an ordinal scale differ based on presence/prevalence of MSD (two independent groups - 'Yes' and 'No' groups).

Chi Square

Chi square test was used to find out if there is a relationship between two independent categorical data. Chi-square for independence tests were conducted to explore the relationship between normal shift length (3 groups: less than 8 hours, 8-12 hours, more than 12 hours), night shift proportion (5 groups: 0%, 25%, 50%, 75%, 100%), physical activity levels (3 groups: low, medium, high), smoking status (2 groups: formerly/never smoked, currently a smoker), sleeping hours (2 groups: >8 hours, ≥ 8 hours), carer status for an adult/child (2 groups: yes, no), and presence/prevalence of MSD (2 groups: Yes, No).

Kruskall Wallis

Kruskall Wallis test is a non-parametric alternative of one-way ANOVA test. It is used to determine the differences between two or more groups of a variable and on a continuous variable. The relationship between total length of time being away from work because of the low back symptoms (an independent variable with 4 groups: 0 days, 1-7 days, 8-30 days, more than 30 days) and age, BMI, practice year, and working hours (dependent continuous variable) was explored using this test.

Pearson's Correlation Coefficient (r)

This investigates the association between two continues variables. This test was used to explore these associations: age*BMI, age*working hours, age*ERI score, age*over-commitment score, practice year*ERI score, practice year*over-commitment score. It also measured the strength, direction and significance level of the association.

Spearman's Correlation Coefficient (r_s)

This is the non-parametric version of Pearson's correlation coefficient. It measures the strength and direction of association between two variables which are at least on an ordinal scale. In this study, it was used to investigate the associations of these factors: age*physical activity levels, age* shift length, age*job satisfaction, BMI*physical activity levels, physical activity levels*working hours, physical activity levels*shift length, shift length*job satisfaction, shift length*ERI score, shift length*over-commitment score, practice year*job satisfaction.

Logistic Regression Analysis

Logistic regression analysis was used to assess the importance of the relationship between a categorical outcome variable (presence of MSD: Yes or No groups) and one or more predictors (age, BMI, shift length, working place etc.). It can also be used to estimate odds ratios for each independent variable in the presence of more than one exploratory variable.

4.7 Results

This section presents the findings of the survey study. Firstly, participants' characteristics regarding demographics, working and life style will be presented. Effort Reward Imbalance Questionnaire results are reported next, followed by the results from the Nordic Musculoskeletal Questionnaire and then related to the demographics (age, body mass index), working characteristics (practice year, working patterns), life style (physical activity, smoking, sleeping, carer for adult/child) and psychosocial factors.

4.7.1 Sample

A total of 686 midwives and obstetricians across the UK responded to the questionnaire. The data were screened in terms of errors and missing variables and it was found that not all participants answered all questions. In addition, only 49 of the respondents were obstetricians. Due to the limitation of small sample size and different working patterns, these 49 obstetricians were excluded from the main quantitative analysis. The characteristics and MSD prevalence of obstetricians (n=49) is presented in Appendix 4.3 for interest and information but is not analysed further.

Respondents who did not complete the Nordic Musculoskeletal Questionnaire were also excluded from analysis (n=2), because MSD is the main objective of the study and the dependent variable for some analyses. Although there were some incomplete questions from the remaining participants, these respondents were included and a pairwise exclusion method was used to deal with the missing data. In this method, the participants were excluded only if they did not answer the question required for the specific analysis, otherwise they were included all analyses for which they answered the question (Pallant, 2013). Therefore, the 635 qualified midwives constitute the sample size for this research. Appendix 4.4 contains a summary of the main characteristics of these participants.

4.7.1.1 Demographics

The majority of the sample were female with only one respondent of the 635 participants being male. The mean age of those responded to the age question was 42.7 (SD=11.5) years. The average height and weight of the respondents were 1.65 metres (SD=0.07) and 75.8 kilograms (SD=16), respectively. Body Mass Index (BMI) was calculated by dividing weight in kilograms to the square of height in meters. The mean BMI was 27.73 (SD=5.53). According to BMI scale defined by World Health Organisation (2018), only 34.8% of the respondents were in the normal range of BMI. The majority of the remainder were either in the overweight (30.4%) or obese group (30.1%). Most of the respondents were right-handed (90.4%); only 8.1% were left-handed and the rest reported using both hands equally.

4.7.1.2 Working Characteristics

When it comes to the working patterns of the participants, the respondents' mean years practicing in midwifery was 15 years (SD=11.10), and 43.8% reported working part time, which is less than 37.5 hours in a week. The average working time involved in actively delivering babies in a week was reported as two hours (SD=1.62). Over half of the respondents' work place was a maternity unit in a hospital (66.3%). The remainder reported working in a midwife-led unit in a hospital (7.9%), in a standalone midwifery unit (4.1%) or supporting home birth (19.2%). Most of the respondents (84.6%) were working in England; others were from Scotland (8.1%), Wales (4.1%), Northern Ireland (1.9%), and UK Islands (1.3%). Of those participants that responded to the working night shift question (n=625), 4.3% only work at nights, while 34.7% never work at nights. Overall, 65.3% of respondents work night shifts. A normal shift was eight hours, and up to 12 hours for 44.5% of the respondents, whereas 39.6% of the respondents reported working more than 12 hours in a shift. The rest (15.9%) reported shift hours work of less than eight hours. Almost half of the respondents (43.3%) said that they were not given sufficient breaks during work, and 34.7% thought that they were sometimes satisfied with the breaks. The rest 21.9% reported that sufficient breaks were given. The majority of the respondents, who responded the manual handling attendance

question (n=632), attended manual handling training every year (65.8%), while some of them attended every three years (24.2%) or only when they started working (8.4%). These respondents were asked to rate the effectiveness of the manual handling training from 0 to 10, 0 representing 'not at all' and 10 representing 'a lot', and the mean score was 5.1 (SD=2.5).

4.7.1.3 Life-style

With regards to marital status, many of the respondents (73.5%) were married or in a domestic partnership. Nearly half of the respondents had children at home requiring care, and 28% reported caring more than 50 hours a week. One in five of the respondents had an adult dependant at home, but only a few were caring more than 50 hours a week. Smoking is another lifestyle factors asked in the survey, and of those who responded (n=630), only a few (5.4%) were currently a smoker. Sleeping hours and difficulties in sleeping were also investigated. Most of the respondents (81.1%) reported to sleep less than eight hours in 24-hour period, and many of them reported difficulty in sleeping. Physical activity level was stated as low by half of the respondents (49.4%), and most of the remainder were medium level (44.4%) and a few were in high level (5.7%). Most of the respondents were in White British ethnic group.

4.7.1.4 Psychosocial

In regards to psychosocial factors, job satisfaction was rated by most of the midwives participated in the survey (n=626). The mean score was 6.2 (SD=2.2) out of 10, 0 representing 'not satisfied at all' and 10 representing 'completely satisfied'.

Effort Reward Imbalance Questionnaire

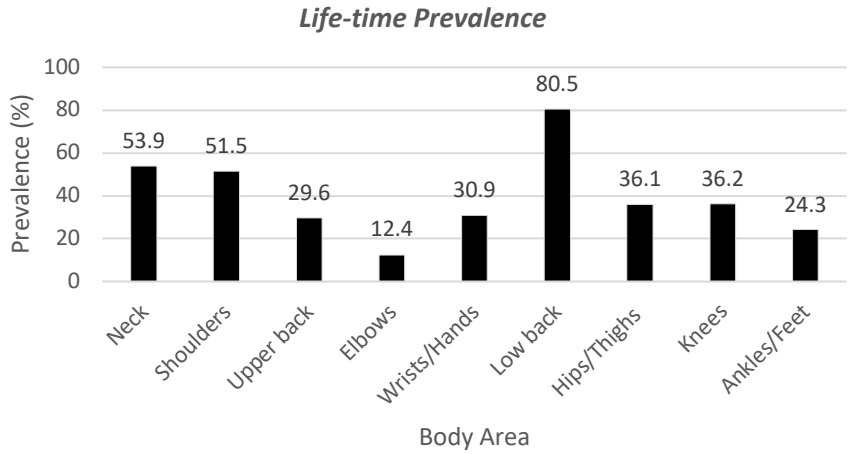
According to Effort Reward Imbalance (ERI) model, for the majority of the respondents' (75.1%) ERI ratios were more than one. That is, they reported more efforts for each reward, which can result in chronic work-related stress. The mean over commitment score was 16.49 (SD=3.3.) in the range of 6 to 24, 6 representing 'low' and 24 representing 'high' over-commitment.

4.7.2 Musculoskeletal Symptoms

4.7.2.1 Prevalence

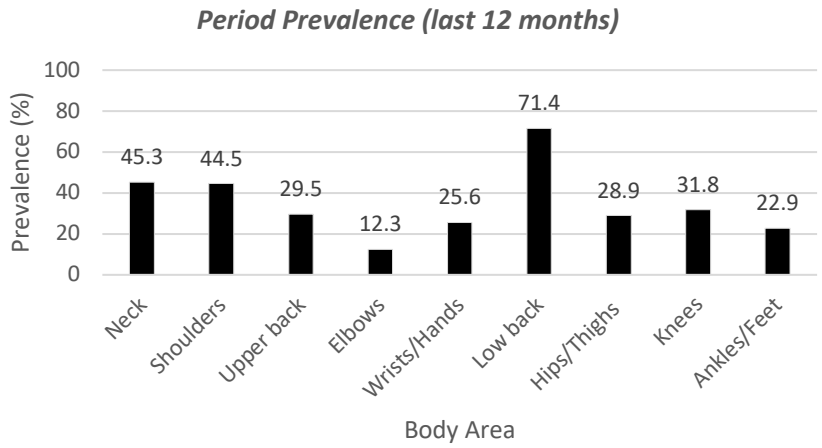
Almost all of the midwives in this research reported that they had experienced musculoskeletal symptoms at some time in their lives (97.5%); only a few (2.5%) did not report any. The life-time prevalence rates are shown in Figure 4.2. The low back symptoms were most commonly reported with an 80.5%, followed by the neck and shoulders with 53.9% and 52.5% rates, respectively.

Figure 4.2: The life-time prevalence of musculoskeletal symptoms by body area (n=635)



12-month prevalence rates (Figure 4.3) were also high. Overall, 91.5% (n: 581) of the respondents reported musculoskeletal symptoms during the last 12 months. For example, 12-month prevalence of symptoms in the low back was 71.4%, followed by the neck (45.3%) and shoulders (44.5%). For the lower body, the prevalence of symptoms in the hips/thighs during the last 12 months was 28.9%; knees prevalence was 31.8%, and ankles/feet prevalence was 22.9%. Reported symptoms in the wrists/hands was also high (25.6%).

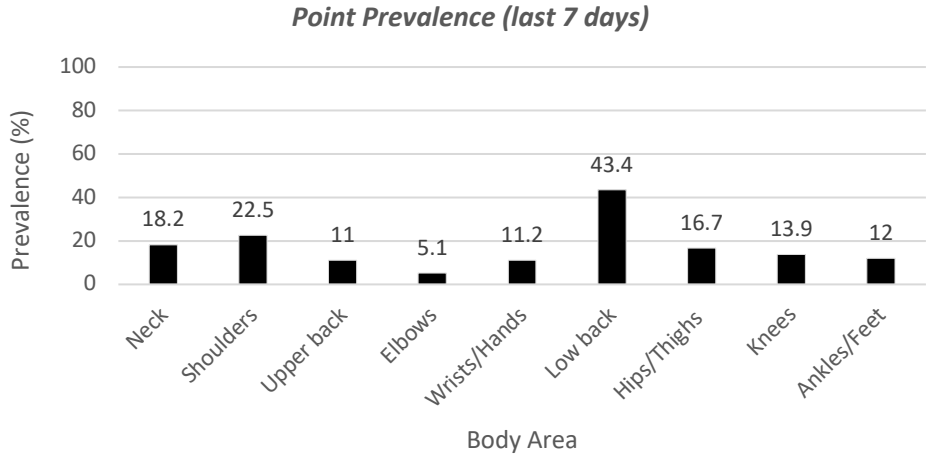
Figure 4.3: The period prevalence (last 12 months) of musculoskeletal symptoms (n=633)



Of those who reported low back symptoms during the last 12 months, most (64.5%) had symptoms more than 30 days or every day. Similarly, shoulders, hips/thighs, knees and ankles/feet symptoms were commonly experienced more than 30 days or every day during the year.

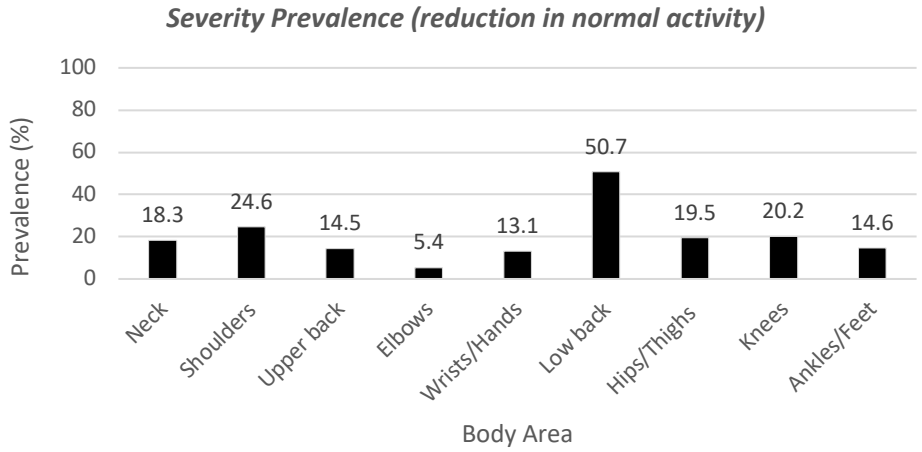
The participants were also asked to report 7-day musculoskeletal symptoms (Figure 4.4). Of those responded (n=627), 71.5% reported that they had experienced such symptoms in the last seven days. The highest 7-day MSD prevalence was in the low back with 43.4%, which was followed by the shoulders (22.5%) and neck (18.2%).

Figure 4.4: The point prevalence (last 7 days) of musculoskeletal symptoms by body area (n=627)



The severity of musculoskeletal symptoms was investigated by considering reduction in activity during the 12 months (Figure 4.5). Half of these respondents (50.7%) thought that their symptoms caused a reduction in leisure and work activity.

Figure 4.5: The severity prevalence (reduction in normal activity) of musculoskeletal symptoms by body area (n=633)



It is worrying that overall a third of the all respondents reported being hospitalised due to musculoskeletal symptoms; most commonly due to low back (10%), knees (5.8%) and shoulders (4.3%) problems. In addition, almost half of the respondents (45%) had to change jobs or duties because of the symptoms they experienced.

30.4% of the participants took sick leave due to musculoskeletal problems during the last year. Of those, almost half of them were due to low back symptoms which required typically one to seven days of sick leave. Most of those with shoulder symptoms required more than 30 days sick leave. Overall, the number of injuries requiring sick leave was very low (less than 10%) compared to the number of injuries reported, especially for neck, upper back and elbows. For example, of those reporting neck symptoms, only 6% took sick leave. Similarly, for those reporting upper back and elbow symptoms only 7.4% and 8.9% asked for sick leave.

The majority of the midwives in this research (n=385, 60.6%) were seen by GP or other health professionals, and most commonly due to low back, shoulder and neck symptoms. However, many of them did self-management of their symptoms or

were seen by a physiotherapist or occupational therapist. Anti-inflammatory drugs were most commonly taken for self-management of symptoms, followed by simple pain killers. Injections were commonly applied for shoulder problems within the other body areas (n=21, 30%).

Over half of the participants (56.5%) with some kind of musculoskeletal symptom believed that their symptoms were due solely to activities at work, while others (34.5%) either attributed them to combination of both leisure and work activities, or only leisure activities (9%).

4.7.2.2 Musculoskeletal Symptoms and Demographics

Point (last 7 days), period (last 12 months) and severity prevalence (reduction in activities) rates will now be presented in terms of the differences in musculoskeletal symptoms reporting Yes or No groups. Due to the high number of musculoskeletal criteria and potential predictors, only the significant differences will be discussed in the following sections. Appendix 4.5 contains the full settings of comparison analyses.

N.B. Gender was not considered as a factor to look at for the differences as there was only one male in the sample group.

Age

An independent-samples t-test was conducted to compare the age of respondents reporting musculoskeletal symptoms between Yes and No groups. There was a significant difference in age point prevalence of musculoskeletal symptoms in the upper back, elbows, knees and ankles/feet (Table 4.2). Midwives reporting elbow, knee and ankle/feet symptoms during the last 7 days were older on average than those did not report those symptoms, while midwives with upper back symptoms were younger on average than those did not report upper back symptoms.

Table 4.2: Significant differences found from the comparison of age by musculoskeletal symptoms Yes and No groups during last 7 days

Body area (n=622)	Mean age years (SD)		t	Significance level
	Yes	No		
Upper back	38.62 (12.17)	43.25 (11.22)	-3.20	p=0.001**
Elbows	47.31 (9.70)	42.49 (11.45)	2.33	p=0.02*
Knees	46.05(11.35	42.20 (11.34)	2.93	p=0.003**
Ankles/feet	48.43(10.22)	41.97(11.35)	5.03	p<0.0001***

*p<0.05; **p<0.01; ***p<0.001

There was also a significant difference by age in the period prevalence of upper back, low back and knees (Table 4.3). Participants who reported upper back and low back symptoms were younger on average than those who did not.

Table 4.3: Significant differences found from the comparison of age by musculoskeletal symptoms Yes and No groups during the last 12 months

Body area (n=628)	Mean age years (SD)		t	Significance level
	Yes	No		
Upper back	39.33(11.41)	44.13(11.17)	-4.89	p<0.0001***
Low back	41.71(11.41)	45.23(11.16)	-3.51	p<0.0001***
Knees	44.24(11.30)	42.00(11.45)	2.29	p=0.02*

*p<0.05; **p<0.01; ***p<0.001

The difference in age according to the severity of musculoskeletal symptoms was significant for upper back, elbows, knees and ankles/feet (Table 4.4). Midwives having reduction in activity due to the upper back symptoms were younger on average than those did not.

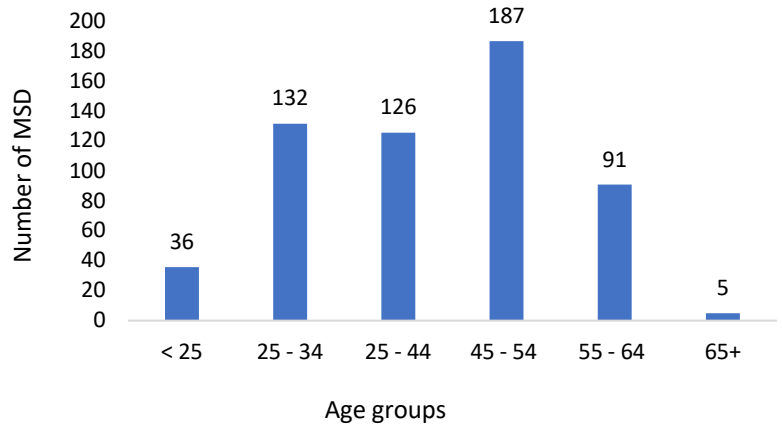
Table 4.4 : Significant differences found from the comparison of age by severity of musculoskeletal symptoms

Body area (n=630)	Mean age years (SD)		t	Significance level
	Yes	No		
Upper back	39.16 (10.87)	43.36 (11.45)	-3.25	p=0.001**
Elbows	49.06 (9.03)	42.40 (11.48)	4.11	p<0.0001***
Knees	45.62 (10.96)	42.03 (11.48)	3.18	p=0.03*
Ankles/feet	45.49 (11.87)	42.28 (11.33)	2.5	p=0.01*

*p<0.05; **p<0.01; ***p<0.001

In general, in this sample the frequency of MSDs reported during the last 12 months was higher with increasing age but was less in respondents who were over 55 years of age, as shown in Figure 4.6.

Figure 4.6: The number of MSDs reported during the last 12 months in the six different age groups (n=628)



BMI

It is necessary to note that BMI could be a susceptibility factor in developing MSD, and can interact with work and organisational exposures such as heavy workload, inadequate break, irregular working patterns and shifts.

There was a significant difference in the BMI of those that said 'Yes' and those that said 'No' for the wrists/hands (point prevalence (p), hips/thighs (point p.), knees (point p., period p., severity), and ankles/feet (point p., period p., severity) (Table 4.5). Other body areas were not significant.

Table 4.5: Significant differences found from the comparison of BMI by musculoskeletal symptoms Yes and No groups

Body area	Mean BMI (SD)		t	Significance level
	Yes	No		
Point prevalence (n=602)				
Wrists/hands	29.07 (5.59)	27.57 (5.52)	2.10	p=0.03*
Hips/thighs	28.79 (5.82)	27.54 (5.47)	2.05	p=0.04*
Knees	29.35 (6.15)	27.49 (5.41)	2.59	p=0.01*
Ankles/feet	30.41 (6.63)	27.38 (5.29)	3.69	p<0.0001***
Period prevalence (n=608)				
Knees	28.67 (5.95)	27.30 (5.29)	2.72	p=0.007**
Ankles/feet	29.74 (6.13)	27.12 (5.21)	4.59	p<0.0001***
Severity prevalence (n=610)				
Low back	28.30 (5.38)	27.14 (5.62)	2.60	p=0.009**
Knees	29.09 (6.02)	27.38 (5.35)	3.07	p=0.002**
Ankles/feet	30.03 (6.35)	27.34 (5.29)	3.79	p<0.0001***

*p<0.05; **p<0.01; ***p<0.001

There was also a strong significant difference in the BMI of those who had time off from work during the last 12 months and those who were not absent from work due to musculoskeletal symptoms (p<0.0001, t (608) = 3.79,). Midwives who were absent from work had a higher BMI on average than those who were not absent due to musculoskeletal symptoms. A significant difference was also found between the BMI of participants' length of time absent from work with low back pain (p=0.04), with those who were absent from work for more than a week having a higher BMI than those had less than a week sick leave. (With a mean BMI of 27.52 for '0 days' group, 27.85 for '1-7 days' group, 29.73 for '8-30 days' group, 29.60 for 'more than 30 days' group).

4.7.2.3 Musculoskeletal Symptoms and Working Characteristics

Practice year

The number of years practicing in midwifery significantly differed between musculoskeletal symptoms 'Yes' and 'No' groups for upper back, knees and ankles/feet during last 7 days; upper back and low back during last 12 months; and severity of upper back, elbows, hips/thighs, and knees (Table 4.6). No significant difference between sick leave and number of years in practice was evident.

Midwives reporting upper back and low back symptoms had spent less time in midwifery on average than those that did not report any upper back or low back symptoms. On the other hand, midwives reporting elbow, hip/thigh, and knee symptoms had more experience in midwifery compared to those did not report those symptoms.

Table 4.6: Significant differences found from the comparison of practice year in midwifery by musculoskeletal symptoms Yes and No groups

Body area	Mean years of practice in midwifery (SD)		t	Significance level
	Yes	No		
Point prevalence (n=619)				
Upper back	10.60 (9.37)	15.47 (11.25)	-3.91	p<0.0001***
Knees	17.36 (11.98)	14.55 (10.99)	2.17	p=0.03*
Ankles/feet	18.74 (12.04)	14.43 (10.95)	3.13	p=0.002**
Period prevalence (n=625)				
Upper back	11.89 (9.38)	16.15 (11.62)	-4.8	p<0.0001***
Low back	14.11 (10.87)	16.87 (11.69)	-2.8	p=0.005**
Severity prevalence (n=627)				
Upper back	11.16 (9.1)	15.50 (11.29)	-4.02	p<0.0001***
Elbows	20.02 (10.42)	14.59 (11.08)	2.74	p=0.006**
Hips/thighs	17.62 (11.29)	14.21 (10.97)	3.07	p=0.002**
Knees	17.47 (12.03)	14.22 (10.77)	2.76	p=0.006**

*p<0.05; **p<0.01; ***p<0.001

Working patterns

Working hours

A significant difference was found in the working hours of those reporting musculoskeletal symptoms 'Yes' and 'No' in the shoulder, upper back, ankle/foot during the last 7 days; and neck, shoulder, upper back during the last 12 months. The difference in working hours in a week for severity of upper back symptoms was significant at the p=0.01 level. The mean, standard deviation and significant level are presented in Table 4.7. Midwives who reported neck, shoulder and upper back symptoms worked more hours on average than those who did not report those symptoms. However, midwives with ankle/foot problems worked fewer hours than those without ankle/foot problems during the last 7 days.

Table 4.7: Significant differences found from the comparison of working hours by musculoskeletal symptoms Yes and No groups

Body area	Mean working hours in a week (SD)		t	Significance level
	Yes	No		
Point prevalence (n=627)				
Shoulder	33.72 (7.61)	32.15 (8.14)	2.04	p=0.04*
Upper back	34.41 (6.58)	32.26 (8.15)	2.39	p=0.01*
Ankles/feet	30.14 (10.61)	32.82 (7.59)	-2.11	p=0.03*
Period prevalence (n=633)				
Neck	33.24 (7.72)	31.94 (8.26)	2.02	p=0.04*
Shoulders	33.42 (7.42)	31.81 (8.44)	2.51	p=0.01*
Upper back	33.51 (7.54)	32.12 (8.21)	2.05	p=0.04*
Severity prevalence (n=635)				
Upper back	34.18 (7.05)	32.24 (8.18)	2.38	p=0.01*

*p<0.05; **p<0.01; ***p<0.001

Shift length

A chi-square test for independence was conducted to explore whether there was a difference in shift length and musculoskeletal symptoms 'Yes' and 'No' groups. A significant difference was found between shift length and shoulder ($x^2(2)=9.59$, p=0.008), upper back ($x^2(2)=11.09$, p=0.004), low back ($x^2(2)=7.79$, p=0.02) and ankle/foot ($x^2(2)=6.30$, p=0.04) symptoms during the last 7 days; low back ($x^2(2)=11.28$, p=0.004) symptoms during the last 12 months. The Chi-square test also showed a significant difference between shift lengths and severity of upper back ($x^2(2)=7.86$, p=0.02) symptoms. As shown in Table 4.8, those who had more than 8 hours shifts were more likely to report those musculoskeletal symptoms.

Table 4.8: The prevalence of musculoskeletal symptoms by shift length (hours)

	< 8 hours	8 hours – up to 12 hours	≥ 12 hours	Significance level
Point prevalence (n=622)				
Shoulders	13.5%	35.5%	51.1%	p=0.008**
Upper back	2.9%	44.9%	52.2%	p=0.004**
Low back	12.6%	41.6%	45.7%	p=0.02*
Ankles/feet	14.7%	57.3%	28%	p=0.04*
Period prevalence (n=627)				
Low back	14.1%	42.2%	43.8%	p=0.004**
Severity prevalence (n=629)				
Upper back	16%	41.7%	42.3%	p=0.02*

*p<0.05; **p<0.01; ***p<0.001

Night shift

There was a significant difference between the proportion of night shifts in a month and musculoskeletal symptoms in the shoulders (p=0.01) and wrists/hands (p=0.006) during the last 7 days; knees (p= 0.02) and ankles/feet (p=0.03) during the last 12 months. The prevalence rates are presented in Table 4.9. The participants who had fewer night shifts were more likely to report those musculoskeletal symptoms.

Table 4.9: The prevalence of musculoskeletal symptoms by night shift (proportion) in a month

	0%	**25%**	**50%**	**75%**	**100%**	**Significance level**
Point prevalence (n=618)						
Shoulders	42.1%	17.1%	27.9%	10%	2.9%	p=0.01*
Wrists/hands	53.6%	24.6%	14.5%	4.3%	2.9%	p=0.006**
Period prevalence (n=623)						
Knees	41.5%	20%	27%	8.5%	3%	p=0.02*
Ankles/feet	42.4%	19.4%	22.9%	11.8%	3.5%	p=0.03*

*p<0.05; **p<0.01; ***p<0.001

Actively involved in deliveries

There was a significant difference between days actively involved in deliveries and musculoskeletal symptoms in the wrist/hand during the last 7 days, p=0.009; and severity of upper back (p= 0.02) and wrist/hand (p=0.03) symptoms (Table 4.10). Interestingly, midwives reporting wrist/hand symptoms were actively involved in delivery fewer days on average than those did not report such problems. However, midwives with upper back symptoms were actively involved in deliveries more days than those without upper back problems.

Table 4.10: Significant differences found from the comparison of actively delivery involved days in a week by musculoskeletal symptoms Yes and No groups

Body area	**Mean actively delivery involved days in a week (SD)**		**t**	**Significance level**
	Yes	**No**		
Point prevalence (n=602)				
Wrists/hands	1.53 (1.65)	2.07 (1.61)	-2.60	p=0.009**
Severity prevalence (n=607)				
Upper back	2.37 (1.69)	1.94 (1.60)	2.29	p=0.02*
Wrists/hands	1.63 (1.57)	2.05 (1.62)	-2.16	p=0.03*

*p<0.05; **p<0.01; ***p<0.001

4.7.2.4 Musculoskeletal Symptoms and Life-style

Physical activity

A significant difference was found between physical activity level and hips/thighs, knees and ankles/feet point, period and severity prevalence of musculoskeletal symptoms. These are presented in Figure 4.7, Figure 4.8, and Figure 4.9. Midwives with a low physical activity level were more likely to report musculoskeletal symptoms in the hips/thighs, knees and ankles/feet.

Figure 4.7: The point prevalence of musculoskeletal symptoms by physical activity levels (n=626)

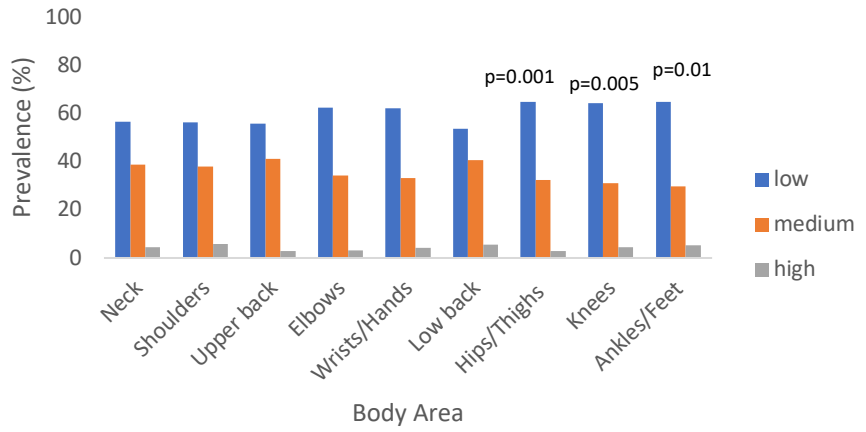


Figure 4.8: The period prevalence of musculoskeletal symptoms by physical activity levels (n=630)

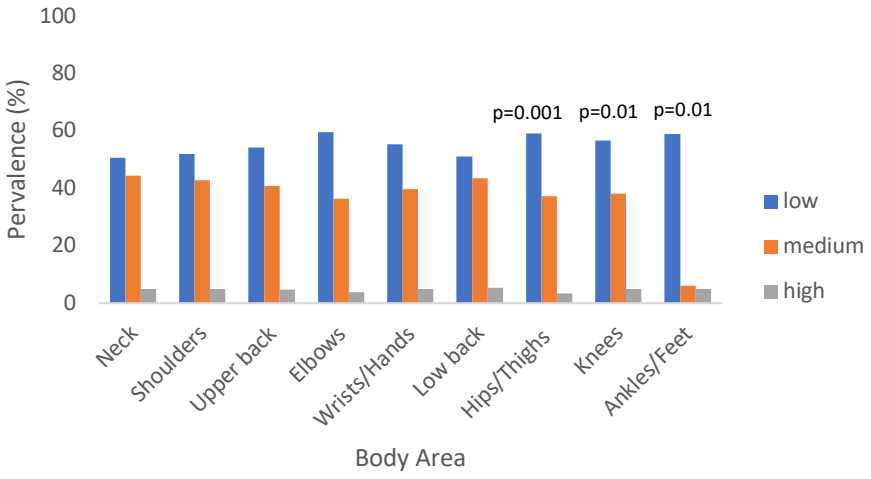
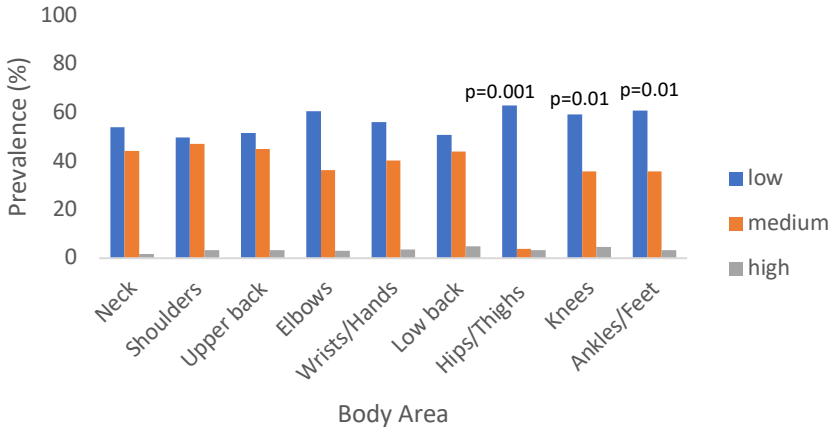


Figure 4.9: The severity prevalence of musculoskeletal symptoms by physical activity levels (n=632)



Smoking

The Chi-square test did not show any differences between smokers and non-smokers, and musculoskeletal symptoms reported.

Sleeping hours

There was a significant difference between the number of hours sleeping and musculoskeletal symptoms (Table 4.11). Midwives reporting less than 8 hours sleep were more likely to report those musculoskeletal symptoms.

Table 4.11: The prevalence of musculoskeletal symptoms by sleeping hour groups

	< 8 hours	**≥ 8 hours**	**Significance level**
Point prevalence (n=625)			
Upper back	72.5%	27.5%	p=0.04*
Period prevalence (n=629)			
Shoulders	84.6%	15.4%	p=0.04*
Knees	86.5%	13.5%	p=0.01*
Ankles/feet	88.9%	11.1%	p=0.006**
Severity prevalence (n=631)			
Neck	91.3%	8.7%	p=0.002**
Shoulders	90.3%	9.7%	p=0.001**
Being absent from work (n=631)	85.9%	14.1%	p=0.04*

*p<0.05; **p<0.01; ***p<0.001

Carer for adult/children

Adult

There was a significant difference between being carer for an adult and not being a carer for wrists/hands ($x^2(1)= 5.84$, p=0.01*), and knees ($x^2(1)= 8.55$, p=0.003**) symptoms during the last 7 days (n=626); elbows ($x^2(1)= 6$, p=0.01*), wrists/hands ($x^2(1)= 7.49$, p=0.006**), and knees ($x^2(1)= 11.78$, p=0.001**) symptoms during the last 12 months (n=630). The Chi-square test also showed significant differences between being carer (or not) for an adult and the severity of musculoskeletal symptoms in all body parts, except upper back and low back (n=632).

Child

Being carer for a child results in significant complaint of pain in the shoulders (p=0.01*) and upper back (p=0.001**) during the last 7 days (n=626); and reduction in activities in the hips/thighs (p=0.04*, n=632).

4.7.2.5 Musculoskeletal Symptoms and Psychosocial Factors

Job satisfaction

A Mann Whitney test indicated that the job satisfaction level (rated from 0 to 10) significantly differed for musculoskeletal symptoms 'Yes' and 'No' groups in the shoulders, low back and hips/thighs during the last 7 days and last 12 months; severity of neck, shoulders, low back, and hips/thighs (Table 4.12). The job satisfaction levels were lower on average for midwives with musculoskeletal symptoms than those without symptoms.

Table 4.12: Significant differences in job satisfaction and musculoskeletal symptoms Yes and No groups

Body area	Job satisfaction (0-10) (Median)		U	Significance level
	Yes	No		
Point prevalence (n=620)				
Shoulders	6.15	6.82	29642	p=0.02*
Low back	6.06	7.07	36278	p<0.0001***
Hip/thigh	5.85	6.79	22488	p=0.01*
Period prevalence (n=624)				
Shoulders	6.25	6.99	41876	p=0.004**
Low back	6.36	7.28	31586	p<0.0001***
Hip/thigh	6.19	6.84	35322	p=0.02*
Severity (n=626)				
Neck	6.05	6.84	24727	p=0.007**
Shoulders	5.91	6.94	29248	p<0.0001***
Low back	6.14	7.17	37665	p<0.0001***
Hip/thigh	5.91	6.81	26595	p=0.01*
Being absent from work (n=626)	5.93	7.00	31652	p<0.0001***

*p<0.05; **p<0.01; ***p<0.001

Effort-reward Imbalance

There was a significant difference in the ERI scores for the musculoskeletal symptoms listed in Table 4.13. MSD 'Yes' groups had higher ERI scores on average than MSD 'No' groups. Midwives with musculoskeletal symptoms tended to report more work stress on average than those without such symptoms.

Table 4.13: Significant differences in ERI score and musculoskeletal symptoms Yes and No groups

Body area	ERI score		Significance level
	Yes	No	
Point prevalence (n=608)			
Shoulders	1.36	1.25	p=0.01*
Low back	1.35	1.22	p<0.0001***
Hips/thighs	1.41	1.25	p=0.001**
Period prevalence (n=612)			
Shoulders	1.33	1.23	p=0.008**
Severity prevalence (n=614)			
Shoulders	1.37	1.25	p=0.006**
Wrists/hands	1.37	1.26	p=0.03*
Low back	1.34	1.21	p<0.0001***
Hips/thighs	1.37	1.26	p=0.03*
Being absent from work (n=614)	1.39	1.23	p<0.0001***

*p<0.05; **p<0.01; ***p<0.001

Over commitment

The mean scores for over commitment significantly differed for musculoskeletal symptoms 'Yes' and 'No' groups in the neck, shoulders, and hips/thighs during the last 7 days; neck, shoulders, low back, and ankles/feet during the last 12 months; severity of neck, shoulders, low back, and hips/thighs at different significance levels (Table 4.14). Midwives reporting symptoms had higher over commitment scores than those not reporting any.

Table 4.14: Significant differences in over commitment score and musculoskeletal symptoms Yes and No groups

Body area	Over commitment score		Significance level
	Yes	No	
Point prevalence (n=613)			
Neck	17.06	16.36	P=0.04*
Shoulders	17.25	16.27	p=0.002**
Hips/thighs	17.21	16.34	p=0.01*
Period prevalence (n=616)			
Neck	16.90	16.16	p=0.006**
Shoulders	17.17	15.95	p<0.0001***
Low back	16.69	16.01	p=0.02*
Ankles/feet	17.05	16.33	p=0.02*
Severity prevalence (n=618)			
Neck	17.42	16.29	p=0.003**
Shoulders	17.38	16.20	p<0.0001***
Low back	16.90	16.08	p=0.002**
Hips/thighs	17.22	16.31	p=0.007**

*p<0.05; **p<0.01; ***p<0.001

4.7.3 Associations Between Individual and Working Characteristics

Several sub-group analyses were performed to explore the associations between individual (age, BMI, physical activity level) and working characteristics (working hours, shift length, practice year, job satisfaction, ERI score and over-commitment) using correlation coefficient (Pearson's or Spearman's) analysis. Appendix 4.6 presents the full context of the analysis.

The interpretation of the correlation coefficient value (r) was suggested as being the closer (r) is to ±1 the stronger the relationship. In order to find out the strength of the relationship, Evans (1996) suggests for the absolute value of r:

- 0.00 – 0.19: 'very weak';
- 0.20 – 0.39: 'weak'
- 0.40 – 0.59: 'moderate'
- 0.60 – 0.79: 'strong'
- 0.80 – 1.00: 'very strong'

Age was strongly associated with practice year in midwifery (r=0.7, p<0.0001), with older midwives having more experience. Age was associated negatively with working hours in a week (r=-0.2, p<0.0001), and shift lengths (r_s=-0.2, p<0.0001): Older midwives were more likely to work fewer hours and shorter shift lengths. No significant correlation was found between age and physical activity level (r_s=-0.02, p=0.6). There was evidence of a very weak relationship between age and BMI (r=0.1, p=0.002), with older participants having higher BMI scores. Midwives with higher BMI scores were unlikely to be physically active, with a weak but significant association (r_s=-0.2) at p<0.0001 level.

Shift length was associated with job satisfaction (r_s=-0.1, p=0.01), with those working longer hours in a shift were less satisfied. There was also relationship between shift length and ERI score (r_s=0.1, p<0.0001), and over-commitment (r_s=0.09, p=0.02). Midwives having longer shifts reported more efforts for each reward resulting in work-related stress and higher over-commitment scores. No significant correlations were found between number of years in midwifery and psychosocial factors.

4.7.4 Logistic Regression Analyses

The statistical tests conducted so far have provided evidence of differences for each variable that can inform future studies. Logistic regression analysis was performed to assess the importance of the relationship between symptoms in the low back, neck and shoulders (a categorical outcome variable: Yes or No groups) within the last 12 months and potential individual and work-related independent predictors. This analysis can show whether the individual and work-related factors (independent variables) have an effect on developing MSD or not (dependent variable).

Body areas of low back, neck and shoulders were selected due to high prevalence figures in midwives in the study. Both the current data and the literature indicate that these are most commonly affected areas in midwives. When conducting the logistic regression analysis, it is important that there should not be a strong association between the independent variables. It is known to affect the efficiency

of the analysis (Sperandei, 2014), so in order to avoid this, all independent variables were examined (Section 4.7.3) and only one strong correlation was found; age and the number of years practicing in midwifery (r = 0.7). This variable was therefore not included in the logistic regression models; age was selected to be included as it was an important variable from the bivariate analyses.

The results of the logistic regression analyses are shown in Table 4.15 for the low back; and Table 4.16 for the neck and shoulders, and the details are presented below.

Low back

Table 4.15 indicates that age, BMI and job satisfaction were significantly associated with low back symptoms, as reported below:

- Age was negatively associated with low back symptoms, that is, low back symptoms were found less frequently with increasing age.
- BMI was positively associated with low back symptoms: Low back symptoms were reported commonly with increasing BMI score.
- Another significant predictor was job satisfaction, and low back symptoms were reported less commonly with increasing job satisfaction scores.

Although, shift length, night shift proportion and work place factors were found significant in bivariate analyses, they were not significant when entered alongside other predictors.

Table 4.15: Results of the logistic regression analysis showing OR (95% CI) and significant associations between potential predictors and low back symptoms during the last 12 months

	Low back **OR (95% CI)**
Age	**0.97 (0.95 – 0.99)***
BMI	**1.05 (1.00 – 1.09)***
Adult caring None, n=429 Carer for 1-19 hours a week, n=77 Carer for 20-49 hours a week, n=15 Carer for >50 hours a week (Ref), n=14	 0.82 (0.21 – 3.24) 0.88 (0.21 – 3.72) 1.09 (0.17 – 6.86)
Child caring None, n=280 Carer for 1-19 hours a week, n=62 Carer for 20-49 hours a week, n=38 Carer for >50 hours a week (Ref), n=155	 1.01 (0.67 – 1.78) 0.66 (0.32 – 1.34) 1.05 (0.45 – 2.44)
Physical activity level Low, n=266 Moderate, n=238 High (Ref), n=31	 0.90 (0.37 – 2.15) 0.74 (0.31 – 1.78)
Working hours in a week	0.99 (0.96 – 1.02)
Shift length < 8 hours, n=76 8 hours - up to 12 hours, n=235 > 12 hours(Ref), n=224	 1.01 (0.48 – 2.13) 0.69 (0.41 – 1.14)
Proportion of night shift in a month 0%, n=178 25%, n=147 50%, n=139 75%, n=45 100% (Ref), n=26	 0.87 (0.27 – 2.77) 1.08 (0.34 – 3.40) 0.82 (0.27 – 2.48) 1.01 (0.29 – 3.49)
Working place Maternity unit in a hospital, n=365 Midwife – led unit in a hospital, n=40 Standalone midwifery unit, n=22 Home birth (Ref), n=108	 1.50 (0.86 – 2.61) 1.31 (0.54 – 3.16) 0.55 (0.20 – 1.47)
Actively delivery involved days in a week	1.01 (0.88 – 1.18)
Job satisfaction score	**0.89 (0.81 – 0.99)***
ERI score	0.90 (0.51 – 1.60)
Over commitment score	1.06 (0.99 – 1.13)

*p<0.05; **p<0.01; ***p<0.001

Neck

Table 4.16 considers that caring for an adult and the over commitment score were the factors significantly associated with neck symptoms, as detailed below:

- Being a carer for an adult dependent was associated with neck symptoms. Those caring for an adult dependent for more than 50 hours a week were 4.54 times more likely to have neck discomfort than those who were not.
- Neck symptoms were commonly reported with increasing over commitment scores.

There was a significant difference in working hours in a week between neck symptom reporting groups (Yes, No), but no evidence was found for associations in logistic regression analysis when all the predictors were included.

Shoulders

Table 4.16 also shows that working hours in a week and over commitment were significant predictors for shoulder symptoms, as specified:

- Shoulder symptoms were reported more commonly with increasing working hours in a week.
- Shoulder symptoms were found more commonly with increasing over commitment scores.

Although job satisfaction and ERI scores were found significant in bivariate analyses, they were not significantly associated with neck symptoms in logistic regression analysis.

Table 4.16: Results of the logistic regression analysis showing OR (95% CI) and significant associations between potential predictors and neck and shoulder symptoms during the last 12 months

	Neck OR (95% CI)	**Shoulder OR (95% CI)**
Age	0.99 (0.97 – 1.01)	1.01 (0.99 – 1.03)
BMI	1.00 (0.97 – 1.04)	0.97 (0.94 – 1.01)
Adult caring		
None, n=429	**0.22 (0.06 – 0.75)***	0.37 (0.11 – 1.21)
Carer for 1-19 hours a week, n=77	0.30 (0.08 – 1.07)	0.47 (0.13 – 1.67)
Carer for 20-49 hours a week, n=15	0.21 (0.04 – 1.08)	0.53 (0.10 – 2.69)
Carer for >50 hours a week (Ref), n=14		
Child caring		
None, n=280	1.33 (0.86 – 2.04)	1.00 (0.64 – 1.55)
Carer for 1-19 hours a week, n=62	0.76 (0.39 – 1.51)	0.71 (0.36 – 1.41)
Carer for 20-49 hours a week, n=38	2.07 (0.98 – 4.39)	1.74 (0.81 – 3.73)
Carer for >50 hours a week (Ref), n=155		
Physical activity level		
Low, n=266	1.29 (0.58 – 2.23)	1.62 (0.70 – 3.74)
Moderate, n=238	1.23 (0.55 – 2.74)	1.22 (0.53 – 2.82)
High (Ref), n=31		
Working hours in a week	1.00 (0.98 – 1.03)	**1.02 (1.00 – 1.05)***
Shift length		
< 8 hours, n=76	1.14 (0.58 – 2.23)	0.85 (0.43 – 1.69)
8 hours - up to 12 hours, n=235	1.28 (0.82 – 2.00)	0.69 (0.44 – 1.09)
> 12 hours(Ref), n=224		
Proportion of night shift in a month		
0%, n=178	1.25 (0.48 – 3.29)	1.76 (0.64 – 4.79)
25%, n=147	0.78 (0.30 – 2.02)	1.33 (0.50 -3.54)
50%, n=139	1.14 (0.45 – 2.86)	2.11 (0.81 – 5.50)
75%, n=45	2.15 (0.76 – 6.08)	2.92 (0.99 – 8.58)
100% (Ref), n=26		
Working place		
Maternity unit in a hospital, n=365	0.95 (0.57 – 1.59)	0.74 (0.43 – 1.25)
Midwife – led unit in a hospital, n=40	0.75 (0.33 – 1.70)	0.53 (0.23 – 1.23)
Standalone midwifery unit, n=22	0.75 (0.28 – 1.97)	1.02 (0.38 – 2.72)
Home birth (Ref), n=108		
Actively delivery involved days in a week	1.03 (0.90 – 1.17)	1.02 (0.89 – 1.17)
Job satisfaction score	0.97 (0.89 – 1.06)	0.93 (0.85 – 1.02)
ERI score	0.79 (0.47 – 1.30)	1.09 (0.65 – 1.83)
Over commitment score	**1.07 (1.01 – 1.14)***	**1.11 (1.04 – 1.18)****

*p<0.05; **p<0.01; ***p<0.001

4.8 Discussion

This chapter has described the findings of a survey which was designed to investigate musculoskeletal symptoms in midwives and explore individual and work related contributory factors. It appears to be the largest with regards to exploring both the prevalence of and risk factors for MSDs among midwives in the UK. They

were first investigated by Hignett (1996), followed by Royal College of Midwifery (1999) and Steele and Stubbs (2002) but, to the best of our knowledge, not since then. In this section, significant findings will be discussed followed by the strengths and limitations of the study.

4.8.1 Prevalence of MSDs

The findings show very high prevalence of musculoskeletal symptoms (91.5%) reported by midwives within the last 12 months. Not surprisingly, low back was the most commonly reported body area (71.4%), followed by the neck (45.3%) and shoulders (44.5%). Over half of the participants attributed their symptoms to work related activities. This is probably because caring for a woman in labour requires being in awkward postures with frequent involvement of the upper body to carry out examinations; for example, if a woman kneels on the bed for delivery, the midwife has to bend for examination and reach for auscultation and support frequently. As expected, life-time prevalence rates for symptoms were higher than period prevalence (12 months) rates.

MSD prevalence rates seem to be consistent with a study of Australian midwives (n=729) (Long *et al.*, 2013a), in which 61.2% reported low back and 48.8% neck discomfort. In another study of midwives in Poland (n=95) investigating the spinal discomfort and hazards of working postures, it was reported that 67.4% indicated having pain at various parts of the spine (Nowotny-Czupryna *et al.*, 2012). These results indicate that midwives from different countries experience much the same musculoskeletal symptoms.

The prevalence rates were also considerably higher compared to the UK general population MSD prevalence rates, with 34% for neck (Palmer *et al.*, 2001) and 37% for low back symptoms (Papageorgiou *et al.*, 1995).

In addition, the prevalence rates reported by midwives are not very different compared to the other healthcare professionals, for example dentists who spend most of their working hours in neck bent and shoulders fixed position, Rafie *et al.* (2015) found the period prevalence (12 months) of neck symptoms to be 55.9% and

43.8% for the shoulders in dentists (n=130). Lee *et al.* (2015) also reported work related musculoskeletal symptoms within a 12-month period among nurses, most commonly in the low back, neck and shoulders at 54%, 41%, 34%, respectively. This may be explained by the fact that midwives have similar working postures to dentists with regards to involvement of upper body, and with nurses regarding lifting tasks.

4.8.2 Impact of MSDs

The impact of musculoskeletal symptoms can be clearly seen from the participants' responses to the 'severity question' as half of the respondents' normal activities were affected. Nelson *et al.* (2006) evaluated a multifactor intervention programme aiming to reduce work related musculoskeletal injuries and to provide a safe environment on 23 units with nursing staff. Post intervention tests showed that there were significant decreases in injury rates as well as the number of self-reported 'unsafe patient handling practices'. Although the comparison is not possible with the current study due to differences in measurements (this current study did not consider 'safe patient handling' as Nelson *et al.* (2006)'s did), it is therefore very likely that the discomfort experienced by the staff providing direct patient care will impact on the quality of care provided and/or patient safety as well as individuals' daily life.

Nearly half of the respondents (45%) in this current study reported to change jobs or duties due to MSDs. Also, one third of the participants took sick leave due to musculoskeletal problems during the last 12 months. This can result in staff shortages and/or replacement with more inexperienced staff would lead to disruptions of care. The effect of sickness absenteeism in the NHS with regards to financial consequences has been well documented (Boorman, 2009). Sickness absenteeism is also known to result in increased work load for the rest of the staff. It is interesting to note that the overall number of MSDs requiring sick leave was very low compared to the number of MSDs reported, particularly for the neck, upper back and elbows. This indicates that the midwives were mostly at work while they were experiencing discomfort.

4.8.3 Individual Factors

Age has been commonly associated with MSDs in studies of health professionals, particularly nurses (Alexopoulos *et al.*, 2003; Gopinadh *et al.*, 2013; Jellad *et al.*, 2013; Ribeiro *et al.*, 2017). Contrary to the general expectation of increased age having a detrimental effect on MSD (Ribeiro *et al.*, 2017), low back symptoms during the last 12 months in this present study were reported less frequently with increasing age. The period prevalence rates were also inversely associated to age in the study of Australian physiotherapists (n=536) (Cromie *et al.*, 2000a). The therapists who were in 20-29 age group reported the highest prevalence rates for upper back ($x^2(4)=15.27$, p=0.004) and low back ($x^2(4)=19.02$, p=0.001). Glover *et al.* (2005) also found in their study of UK physiotherapists (n=2688) that age was significantly related to occurrence of MSD; majority (59%) experienced their most serious symptoms aged <30 years. Tibunu *et al.* (2010) reported a similar finding in their cross sectional survey study exploring work-related musculoskeletal symptoms and associated factors among nurses (n=128). They found that the lowest 12-month prevalence rates of MSD reported by nurses who were over 50 years old. A possible explanation observed by the authors is that senior nurses have less clinically active roles but more management duties than junior nurses and therefore avoid exposure to the same level of physical working risk factors. The data in this present study supports this idea as the older midwives reported fewer days actively involved in delivery for example. Alternatively, these findings might be subject to the 'healthy worker effect', where unwell older midwives who suffered from MSD might not be in occupation group, therefore not included in sample. In addition, another explanation might be that older midwives are generally more experienced, and therefore more knowledgeable about prevention and coping strategies. This hypothesis helps explain the association between years practicing and period prevalence rates in this present study: those with less experience in midwifery were more likely to report upper back and/or low back symptoms during the last 12 months. This explanation was supported by Bork *et al.* (1996) as the 'survivor effect', in which older individuals develop strategies such as modifying techniques and positions and asking for more support to carry on working in their current roles.

The 12-month period prevalence of knee symptoms was however related to greater age for this sample group, and this is consistent with Cromie *et al.* (2000a)'s study of physiotherapists. However, age was only significant in the logistic regression analysis for period prevalence low back symptoms.

60.5% of the participants in this current study were overweight or obese. This result is in line with the general population prevalence rate in England: 58% of women were over the normal weight, according to a survey conducted in 2015 (Moody and Neave, 2016). Increased BMI was associated with low back musculoskeletal symptoms during the last 12 months in the logistic regression analysis. There was also a large significant difference in individuals' BMI ($p<0.0001$) in terms of absenteeism reporting groups (yes/no), with those having higher BMIs more likely to be absent from work. Jensen *et al.* (2012) investigated risk factors for developing low back pain among health care staff in their prospective cohort study. They found that BMI and low back pain were not causally related. Although this study is not directly comparable with this present study (as it is a cross sectional study), this present study found that high BMI is a predictor of low back symptoms during the 12-month period.

Caring for an adult was found to be a risk factor for neck symptoms in this study. Adult carers (for more than 50 hours a week) were 4.54 times more likely to report neck symptoms than those not caring, in this study, however the confidence intervals (CI: 1.33 - 16.6) were wide indicating that a larger sample size would give a more convincing conclusion for this factor. This result is still in agreement with that obtained by Long *et al.* (2013) in their study of Australian midwives (n=1388). They found a 36% increased risk of neck symptoms for a participant caring for an adult dependent. It was suggested by the authors that because most of the midwives are women, they are likely to also have a caring role outside of the work, and therefore this becomes an individual related risk factor for neck symptoms.

Participants reporting moderate/high physical activity levels were less likely to report musculoskeletal symptoms in the hips/thighs, knees and ankles/feet. Although sedentary activity has been associated with low back symptoms and

absenteeism (Hildebrandt *et al.*, 2000), this present study did not find any such relationship for low back symptoms. Feng *et al.* (2014) found associations between regular physical activity and neck pain in their survey study of Chinese dentists (n=272). The participants doing regular exercise reported neck symptoms 2.7 times less frequently. However, no details were given about the types of exercises. It seems likely that physical activity in leisure time might be protective against developing MSD. Half of the participants in this current study reported low physical activity levels, this may be due to lack of time because of the intense working schedule. As Atkinson and Davenne (2007) specified in their review, regular physical activity can hardly find a place in a shift-workers' life-style. A significant association found between longer shift lengths and low physical activity levels in this current study, also supports this explanation.

4.8.4 Working Characteristics

Longer working hours in a week were associated with shoulder musculoskeletal symptoms in the last 12 months in the logistic regression analysis. This seems to be consistent with other research on nurses, for example Lipscomb *et al.* (2002) found an association between upper body discomfort and working long hours: more than 40 hours a week and/or more than 12 hours a day. Long working hours have also been associated with the risk of obesity in nurses due to irregular eating patterns (Han *et al.*, 2011; Chin *et al.*, 2016), which is likely to have an impact on an individuals' musculoskeletal system. The high prevalence of overweight midwives in this current study also corroborates this finding.

Almost 40% of the respondents reported working 12 hours or more in a shift in this current study. England has a reputation among European countries, of having long shifts for nurses and midwives due to staff shortages (Buscher *et al.*, 2010). Although a significant interaction was found between shift length and low back musculoskeletal symptoms during the last 12 months ($x^2(2)=11.28$, $p=0.004$), with midwives working 8-12 hours (42.2%) or more than 12 hours (43.8%) being more likely to report low back symptoms than those working less than 8 hours (14.1%); shift duration was not significant in the logistic regression analysis. Longer shift

durations were also associated with less job satisfaction in this present study, but, some research has found nurses prefer 12-hour shifts and were satisfied with their jobs (Stone *et al.*, 2006). It may be that these nurses benefitted from more days off and more social time compared to those doing 8-hour shifts. Despite such advantages of 12-hour shift, longer shifts have been argued to cause fatigue leading to impact on performance, quality of care and safety (Smith *et al.*, 1998; Health Safety Executive, 2006; Griffiths *et al.*, 2014). Mitchell *et al.* (2000) evaluated the effects of switching from 8-hour to 12-hour shift on industrial workers. Interestingly, although the authors noted a significant improvement in the social life of the individuals, there was an increase in error rates at work. Longer shift hours might have an impact on quality of care or patient safety; however this is outside the scope of the current study.

4.8.5 Psychosocial Factors

The overall job satisfaction score of the participants (6.2 on a 0-10 scale) seems to be lower compared to the overall general population job satisfaction in the UK. For example, it was rated 5.39 on a 7-level scale: 1 representing 'not satisfied at all' and 7 representing 'completely satisfied' in a study by Oswald and Gardner (2001). However, the comparison of the results must be done with caution due to the differences in measurement criteria.

Job satisfaction was found as a significant risk factor for low back pain in the present study. That is, low back symptoms were reported more frequently with lower job satisfaction levels. A significant association was also found between being absent from work due to sickness absence and low satisfaction levels. Consistent with these findings, Urquhart *et al.* (2013) found associations between low job satisfaction, low back pain and time off work in a cross sectional study with 1,111 nurses in Australia. Although it is beyond a cross sectional study to find out whether job satisfaction has a causal link or not for low back symptoms, it could be a major factor that should be further investigated in future longitudinal studies. It should also be noted that satisfaction at work can also be influenced by other factors in

health carers such as reward, professionalism (Hampton and Hampton, 2004), support and mental pressure (Smith *et al.*, 2006b).

Job stress was explored using the ERI model, which assumes that the imbalance between effort and reward results in stress reactions. This model consists of two components of work stress: extrinsic (effort-reward score) and intrinsic (over commitment). ERI scores were significantly higher in midwives reporting shoulder symptoms than those that did not. Similarly, over commitment was also significantly higher for midwives with neck and shoulder symptoms. Yet, no statistical association was observed for ERI scores and risk of shoulder symptom complaints in the logistic regression analysis, whereas over-commitment was significantly associated with risk of musculoskeletal symptoms in the neck and shoulder. This finding was unexpected and suggests that intrinsic work stress is a major factor for this occupational group. According to the model, over-committed people cannot withdraw from the responsibility of work, therefore, they spend excessive effort at work (Siegrist *et al.*, 2004). Weyers *et al.* (2006) found in their cross sectional study with nurses (n=367) that ERI was significantly associated with risk of increasing musculoskeletal complaints in the low back, neck and shoulder, while over commitment was not. This differs from the findings of this current study. The inconsistency in over commitment results could be attributed to differences between nursery and midwifery. The midwives are more prone to continuous work due to the nature of their work. They spend many hours with childbearing mothers and may therefore develop close relationships and become more sympathetic, which could lead to over-caring. It is also important to bear in mind that over commitment could be related to an individual's characteristics, rather than just work related patterns.

4.9 Limitations

This cross sectional study was unique in terms of exploring musculoskeletal symptoms and risk factors for midwives in the UK. However, it was limited in some aspects. Although with a self-reported questionnaire, participants have time to think about their responses and send it anytime they want in the given period of

time, there is the risk of not reflecting reality. For example, health conditions might be over- or under-reported by participants. Although it is a documented response bias of this method (Robson and McCartan, 2016), there is evidence that self-report gives similar results to experts' examinations concerning the presence of musculoskeletal conditions among workers (Perreault *et al.*, 2008; Mehlum *et al.*, 2009; Takekawa *et al.*, 2015).

Non-response bias is another potential concern because people with MSDs may have been more likely to participate. In order to reduce the effect of this limitation, the survey title was changed to 'Musculoskeletal Health Survey', whereas it was originally planned as 'Musculoskeletal Injuries Survey'. Moreover, in the invitation emails, it was always emphasised that those who have not experienced any MSD or pain are also invited to take part in the survey. However, this bias might limit the validity or generalisability of the findings.

Although an online survey is the most appropriate data collection method for large scale data collection (Robson and McCartan, 2016), pilot work indicated that some participants had problems accessing the survey page, requiring advice to either change the web browser or computer. One of the difficulties arising from using an online survey is that these participants had limited access to their emails, requiring a paper version to be made available.

One limitation of survey studies argued by Neale (2008) is that participants are generally restricted to certain responses, therefore, it is not possible to explore the reasons behind their responses. In order to provide more data, it has been advised to support a quantitative survey study with a qualitative study (Carpenter and Suto, 2008), which was planned for the second study of the thesis.

An issue that was not addressed in the study was the physical working patterns for example frequency or duration of awkward and/or static postures, and pushing/pulling/lifting activities. The reason is that these factors are very prone to recall bias, that is, participants may not remember correctly or be aware of their positions while working. This is a limitation of survey studies. An observational

study was considered to be more appropriate to address these factors, and this is planned for the third study of the thesis.

An additional weakness of the study is the length of the questionnaire due to including a wide variety of potential factors and nine different body parts. Although it takes around five minutes to complete it and giving the opportunity of having a comprehensive exploration, it looks lengthy and complicated to answer all questions. In spite of the questionnaire being long, completion rate was always more than 95% for each question.

Finally, although the target population was both midwives and obstetricians at the start, the response from the obstetricians was low (n=49). Doctors and midwives have different working tasks even if they are both maternity professionals therefore it was not advisable to combine the responses. The dominance of female population reflected the responses with only one male participant.

4.10 Summary

The aim of this study was to find out the extent of the musculoskeletal symptoms in this occupational group. The overall objective of the survey study has been achieved. The prevalence, severity, impact, and potential risk factors have been explored. The findings support the following conclusions:

- Midwives have a high prevalence of musculoskeletal symptoms, mostly in the low back, neck and shoulders. These symptoms affect midwives' normal activities at work or out of work.
- There are a considerable number of midwives who have changed their jobs/duties due to such symptoms. One third of midwives asked for time off work due to musculoskeletal symptoms.
- Age and time practicing in midwifery were inversely related with the musculoskeletal symptoms. That is, younger midwives who have less experience in midwifery have the high risk of developing low back and upper back symptoms.

- BMI was positively correlated with the high risk of developing low back symptoms.
- With regards to working characteristics, longer working hours was found to be a risk factor for developing shoulder discomfort.
- Low level of job satisfaction was related to increasing risk of low back symptoms; similarly, work stress (intrinsic) with neck and shoulder symptoms. However, it is not clear whether psychological factors are cause or effect.

In the light of these conclusions, certain issues have been identified for further exploration:

- The high prevalence of musculoskeletal symptoms in midwives
- The impact of these symptoms on working activities
- The effect of age and experience in midwifery on symptoms

Exploration of these issues and more will be the focus of the qualitative study reported in Chapter 5.

5. Study 2: An Exploration of Midwives' Views about Musculoskeletal Symptoms and Contributory Factors

5.1 Introduction

As discussed in literature review (Chapter 2), there are several individual and work related factors which have been associated with MSD in healthcare professionals (Long *et al.*, 2012). However, there is little evidence on investigating factors specific to maternity professionals that might have the potential to cause injury. The survey study (Chapter 4) explored prevalence, impact and severity of MSD, as well as individual and work related associated risk factors. The statistical analysis results showed commonly affected body parts, impact on work and individuals' daily life and the factors having correlation with the occurrence of MSD. However, there have been some issues that might have impact on injury occurrence but were not included in the survey context such as the impact of injuries on caring activities, level of awareness about prevention strategies, role of the organisations and physical work challenges. Because these issues are prone to potential biases; restricted nature of the survey studies; for example participants might want to add more answers than presented in the survey question options. Moreover, lack of awareness is another potential concern; for example it is very likely that participants might not be aware of their positions while working and/or may not remember how many times they have been in a certain position. It is therefore better to explore these issues and more by interviews. These professionals' thoughts about impact of their symptoms and potential risk factors considering the survey results can contribute to the understanding of the occurrence of such problems as well as managing risk factors. It would allow having a better in-depth understanding to explore maternity professionals' perception as they spend time in the environment and experience the challenges of the occupation. In addition, '*the use of multiple data collection strategies would strengthen the credibility of the findings'* of the survey study and *'encourage the cross-checking of facts and subjective comments*' (Hammell *et al.*, 2000).

5.2 Aim and Objectives

This study aims to explore midwives' experiences and views about WRMSD and risk factors, and to investigate their level of awareness and support by the organisation about safe practice and MSD prevention strategies. This study therefore also aimed to triangulate the findings of the survey study which was conducted before (Chapter 4).

The objectives are detailed as below:

1. To explore perceptions and opinions about;
    a) the impact of MSD on providing patient care.
    b) the level of awareness of health and safety, and prevention strategies.
    c) the level of support and safety activities undertaken by the organisation.
2. To identify;
    a) physical job demands and common work tasks that could accountable for injuries.
    b) strategies to prevent their injuries.

5.3 Study Design

Interviews were chosen as an appropriate data collection method to understand the issues related to MSD and explore interviewees' experiences from their perspective (Neale, 2008). Furthermore, interviews are useful following a quantitative study to investigate reasons behind unexpected or interesting findings (Neale, 2008), as *"The human use of language is fascinating both as a behaviour in its own right and for the virtually unique window that it opens on what lies behind our actions."* (Robson and McCartan, 2016)

Another reason for choosing individual interviews is because interviewees can openly express their opinions and views about topics that they might not speak about in a group, for instance impact of their problems in personal relationships or performance at work, or support from the organisation. Interviews also allow

access to interviewees from a geographically wider pool as data can be collected via telephone or video call.

The semi-structured interview style was chosen within the three main types: fully structured, semi-structured and unstructured (Robson and McCartan, 2016). In semi-structured interviews, there is a question guide including the main themes to be covered during the interview, but the interviewer does not need to follow the order or the wording in this guide. The interview should flow as freely and naturally as possible. Additional unplanned questions can be asked to follow up the interviewee's responses.

5.3.1 Interviewees

The target population in this study were midwives who have been practicing in the UK healthcare system. An open invitation was sent to midwives through the Head of the Midwifery at University Hospitals of Leicester NHS Trust and Consultant Midwifery UK network to recruit interviewees for the study. Multiple purposive sampling techniques, in which interviewees are selected based on certain characteristics such as addressing best for the research questions and enabling the diversity and more detailed information (Teddlie and Tashakkori, 2009), were used for recruitment. One of the results from the survey study (Chapter 4) was that younger and less experienced midwives were more likely to report MSD. Based on this, the purposive sampling allowed approaching and selecting younger and less experienced midwives to explore their perceptions and impact on working and personal circumstances. Some of the interviewees were identified and invited to join the study by other interviewees who were interviewed earlier than them, so the snowball sampling technique was also used for recruitment. Additionally, midwives who were interested in contributing but who could not attend the interviews were encouraged to participate by emailing their comments.

5.3.2 Interview Schedule

An interview schedule (Appendix 5.1) was developed based on the previous literature and the survey study results to explore midwives' perspectives of injury occurrence and risk factors, impact on patient care, support by the organisation,

coping strategies as well as suggestions for better care. Prompts were developed to encourage the interviewees to provide more depth in their responses.

The main themes included:

I. WRMSD and management strategies
II. Support and actions undertaken by the organisation
III. Awareness of health and safety, and prevention strategies
IV. Perception of impact on patient care/safety
V. Identification of working tasks that could be accountable for injuries
VI. Suggestions for better care

The first theme explored MSDs and their work relatedness. Interviewees were asked to briefly describe their symptoms and their thoughts about whether it was work related. If they did not report any symptoms, they were asked about commonly experienced symptoms by their colleagues and whether they thought that work could be a contributory factor. The survey results (Chapter 4) showed that majority of the midwives had experienced MSDs; so interviewees were asked about their views on actions or regulations over the last 20 years which might contribute to this high prevalence rates. Therefore prompts and probes were included to encourage them to talk more about changes and to reflect on why MSD prevalence rates are so high since 2000s, when the last time there was a focus on midwives' health and contributory risk factors. Interviewees were asked whether they thought ageing and experience in midwifery has an effect on MSD. This theme additionally allowed exploration of management strategies (Chapter 4) such as self-management or referral to health professionals and the decision process. As reported in literature, short/long term coping strategies were also included (Long *et al.*, 2013b).

The second theme, 'support and actions undertaken by the organisation' investigated the role of the organisations for MSD including management and prevention strategies. This theme included the work place and equipment related issues that might be considered as a risk factor by midwives (Hignett, 1996).

The third theme focussed on exploring the knowledge about prevention strategies at work including self-developed strategies and trainings. This was included to understand whether midwives protect themselves at work, and if they do what strategies they use. From the survey data (Chapter 4), almost all of the midwives reported attending manual handling training every 1-3 years. Interviewees were encouraged to talk about this training to understand its benefits with the questions: 'Do you find them useful?', 'How problem solving are they?' and 'How job relevant are they?'

The fourth theme explored the impact of MSD on patient care and safety. The survey results (Chapter 4) showed that musculoskeletal symptoms have caused reduction in work and/or leisure activities. Therefore, this theme further explored the impact of midwives' limitations due to MSD on the caring activities. The questions asked included '*Have you ever felt that you could not support the mother*?', '*Have you influenced the mothers' choices for the delivery based on the number of options given (e.g., birthing pool, epidural)?*', and '*What is your coping strategy, if the mother wants to deliver in a particular position that you don't feel able to support her?'*

The physical work challenges have been explored to identify the most frequent and extreme working tasks for further study (Chapter 6). Interviewees were also asked to rate those tasks from 0 to 10, with 0 representing 'not a challenge at all' and 10 representing 'extremely challenging'. The interview schedule concluded with asking interviewees' views about their suggestions to reduce MSD and to enable continued working in their current role without injuries.

5.3.3 Ensuring Ethics and Approvals

All relevant processes were followed to ensure the study complied with relevant legislation and guidelines. Once the Sponsor (Loughborough University) authorisation was confirmed, the protocol, informed consent form (Appendix 5.2), interviewee information sheet (Appendix 5.3) and any proposed advertising material (Appendix 5.4) were reviewed by Loughborough University Ethics Committee and University of Hospitals of Leicester, Research and Innovation (UHL

R&I) and written approval was given for the study from the both institutes. Furthermore, a Health Research Authority (HRA) approval was ensured on 28th April 2017 as the interviewees are part of the National Health Service (NHS).

5.3.4 Pilot Study

A pilot study was conducted to test the clarity of questions, layout and flow of the interview schedule, time required to complete the interview, prompts to encourage more detailed explanations about the responses, and the device for recording interviews. Two midwives and two obstetricians were the interviewees of the pilot study who were convenient at the time. Convenience sampling is appropriate for pilot studies (Robson and McCartan, 2016). Obstetricians were only used for the pilot study due to the close multidisciplinary relationships with the midwives. The changes to the interview schedule included:

- Words such as MSD and ergonomics needed to be expressed in a different way such as 'musculoskeletal pain/discomfort' for MSD and 'efficiency at work' for ergonomics to make them more understandable.
- Duration was acceptable (25-41 minutes).
- The questions under the theme of 'perception of impact on patient care/safety' needed more prompts as this theme was open for defensive responses; interviewees tended to protect themselves when they were asked 'Do you think your symptoms impact on patient safety?'.

5.3.5 Data Collection

An invitation email was sent to all the midwives, irrespective whether they have experienced any MSD or not, via the Head of the Midwifery and the Consultant Midwives network. Volunteers to participate contacted the researcher to arrange a time and place for the interview. Telephone and email interviews were arranged with interviewees who could not make a face to face meeting due to time limitation for travelling.

Before starting the interview, the overall study and information about the objective of the interview was introduced to the interviewees. Confidentiality and anonymity was explained. The interviewee was asked if s/he consented to be interviewed and

for the interview to be recorded using a voice recorder. Demographic details were collected such as age, working status, year of experience and place of working. The questions were not restricted to the order in the schedule, which permitted the discussion to flow naturally and freely (semi-structured interviews). The researcher assisted interviewees to encourage to talk as appropriate with phrases such as 'can you tell me more about that?' and 'can you give me an example of that?' Interviewees' names were not used at any stage of the data collection process.

5.4 Data Management and Analysis

5.4.1 Data Handling

The recorded interviews were allocated a unique identifying number (e.g., M01, M02, M03…). That number was used to name audio files and transcript documents. Audio recordings were listened to carefully and then transcribed into Microsoft Word 2010 and then exported to Nvivo11, a qualitative data management software tool for coding and analysis. The recordings were transcribed verbatim, and non-verbal expressions were noted during the interviews and considered.

5.4.2 Data Analysis

This study uses a qualitative approach as a flexible designed study based on a grounded theory. 'A grounded theory study seeks to generate a theory which relates to the particular situation forming the focus of the study.' (Robson and McCartan, 2016) The main feature of this approach is to develop theories while continuing data collection and analysis based on the theories generated. Therefore, it requires a dynamic process of data collection and analysis. For example, the researcher starts field work, then starts analysing and generating theories; and then goes back to collecting more data based on the previous analysis; and etc. That process ends when there is no new knowledge added on the existing categories, which is also called 'theoretical saturation'.

One advantage of grounded theory is an exploration when there is limited evidence or clarity in a research area (Auerbach and Silverstein, 2003; Robson and McCartan, 2016). However, to use this approach in a research, first there should be

assumptions and a starting framework about the research question. A framework was formed based on the existing literature, previous survey and interview schedule for the initial interview coding (Figure 5.1). Transcripts were entered into NVivo11 and then coded using a thematic coding approach. A coding template was developed based on the initial framework (Table 5.1).

Figure 5.1: Framework developed for initial coding

MSD	Characteristics - Work relatedness
	Management (Reporting, sick leave, return to work)
	Consequences (impact on work/leisure activities, patient safety)
Organisation	Intensity of work, Equipment, Support, Work place
Work load	Physical or psychological work challenges
Staff	Age and experience
What has changed?	

The thematic coding is a generic approach, in which the data are coded and labelled according to similar interests, then the codes with the same labels are grouped together as a theme (Robson and McCartan, 2016). New codes and themes emerge by reviewing the data or previous literature. The thematic coding approach is an essential part in grounded theory as *'the codes arise from interaction with the data and they are based on the researchers' interpretation of the meaning or patterns in the text*.' (Robson and McCartan, 2016) Overall, this approach has two main principles: 1) 'generating theory using theorical coding' and 2) 'questioning rather than measuring' (Auerbach and Silverstein, 2003). Additionally, a quasi-statistical approach, which uses frequency of words or phrases referenced by interviewees in the interviews as a method of determining the importance of the theme, was used for certain themes; for example identification of work challenges.

The template (Table 5.1) was used to code later transcripts in an on-going process as data was collected and updated as new themes or ideas emerged. The analysis was conducted by reading the data line by line, trying to identify the underlying meaning or concepts behind the statement (Straus and Corbin, 1998). Lines were labelled according to the idea(s) in the transcript, using a short title, and used to create a new node.

Table 5.1: Coding framework with new codes highlighted in grey

Themes	Codes
MSD	Characteristics - Work-relatedness Management Reporting Sick leave Return to work Consequences Impact on leisure activities Impact on work activities Patient safety Prevention Strategies Protect yourself Manual handling training – Specific for maternity
Organisation	Breaks Intensity of work Equipment Support Work place
Midwifery	Physical work challenges Psychological work challenges
Staff – midwives	Age and experience Anthropometry Practicing defensively Caring nature - 'Hero culture'
Patients – mothers	Characteristics – High BMI Choice of delivery methods Education Personal attributes – High expectation
What has changed?	

5.5 Results / Discussion of Findings

This section presents the results and discussion of the interview data. The main six themes and the sub-themes emerging from the data are reported and discussed with quotations as examples of empirical data.

5.5.1 Demographics

Eight midwives were interviewed in the first-round of the interviews, with a further seven interviews in the second-round. The 15 interviewees' demographic and employment characteristics are provided in Table 5.2. The study population had a wide range of diversity in terms of MSD, age, practice year and roles in midwifery. It is suggested that this adds to the external validity of this study by supporting potential transferability.

Table 5.2: Demographic and employment characteristic of the interviewees

Interviewee	Age	MSD	Age at first symptoms	Practice year	Current role	Work pattern
1	46	Low back	34	15	Midwife (mostly office work, 7 hours clinical)	Full time
2	38	No	N/A	8	Midwife	Full time
3	50	Sacroiliac joints	19	21 years clinical+4 years educator	Education and practice development midwife - cascade manual handling trainer	Full time
4	43	Low back	20	23	Divisional Risk management midwife	Full time
5	62	Low back	39	44	Midwife – mostly antenatal clinic	Part time
6	41	Knee	38	12	Midwife	Part time
7	31	Back	27	4	Midwife – Band 6	Full time
8	34	Back	14	11	Midwife	Full time
9	58	Back and wrist	56	10	Midwife – Band 7 coordinator	Full time
10	51	Wrist, shoulders, low back	45	12	Midwife coordinator on labour ward, RCM rep for health and safety	Part time
11	37	No	N/A	1	Midwife	Full time
12	50	Back	35	25	Midwife + corporate role	Full time
13	24	Knee	22	2	Midwife	Full time
14	50	Shoulder	40	25	Midwife	Full time
15	58	No	N/A	21	Senior midwife - matron	Full time

The interview coding generated 29 codes and these codes were grouped into six main themes (Table 5.3).

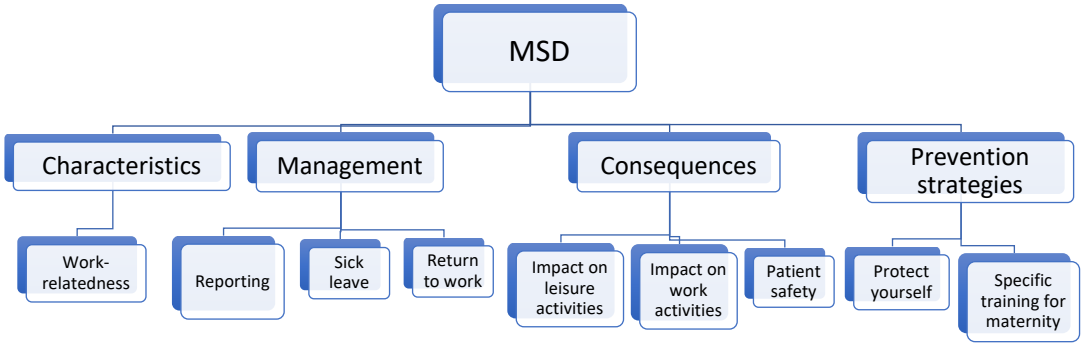
Table 5.3: The analysis generated six categories and 29 codes

Themes	Codes
MSD	Characteristics - Work-relatedness Management Reporting Sick leave Return to work Consequences Impact on leisure activities Impact on work activities Patient safety Prevention Strategies Protect yourself Manual handling training – Specific for maternity
Organisation	Breaks Intensity of work Equipment Support Work place
Midwifery	Physical work challenges Psychological work challenges
Staff – midwives	Age and experience Anthropometry Practicing defensively Caring nature - 'Hero culture'
Patients – mothers	Characteristics – High BMI Choice of delivery methods Education Personal attributes – High expectation
What has changed?	

5.5.2 MSD

The subthemes of characteristics, management, consequences and prevention strategies were presented under the MSD theme (Figure 5.2).

Figure 5.2: MSD thematic analysis from interviews (n=15)



5.5.2.1 Characteristics

Of those interviewed, 80% (n=12) reported having MSD, the back being the most affected area (n=8, 53%). This triangulates from the survey data (Chapter4). They also suggested that shoulder and knee symptoms were quite common among midwives. When asked about how they think they were injured, the interviewees were unanimous in the view that they occurred due to work related activities or their current injuries were aggravated by working tasks. For example, back symptoms were thought to be due to assisting breast feeding or the positions for internal examination e.g., sitting on edge of the bed, turning and twisting to access the woman, as expressed in the following quotes;

> *"I can remember that I never had any problems with my back until there was a scenario. I had one mother that I was trying to do an internal examination."(M01)*

> *"I would imagine that lower back pain is because of twisting and being in [an] awkward position to try to get the woman to feed." (M11)*

Shoulder symptoms may be exacerbated during vaginal examination process due to applying some force in an excessive rotated position of the shoulder, quoted as;

> *"…so they are on the bed and we sit side ways and push our shoulders – I know for certain that was the cause majority of my damage to my shoulder."(M10).*

And knee symptoms were thought due to supporting the mother on the floor. This support required midwives being on their knees and doing the necessary procedures in this position, which would cause injury of the knees due to over pressure and bending for a long time;

> *"My knees, from being kneeling - specifically from looking after a few labours in a room and I was on the floor" (M07)*

Another awkward position contributing to their symptoms was delivering in a birthing pool with regular bending over the pool and stretching for examinations. This was thought to harm the back;

> *"Obviously, the pools are static – you can't get them up or down, so when you are listening to foetal heart in the pool, you do a lot of bending." (M03).*

The exposure to the physical working activities has commonly been associated with MSDs in various health professionals, particularly nurses (Lipscomb *et al.*, 2002; Smedley *et al.*, 2003; Smith *et al.*, 2006a), surgeons (Szeto *et al.*, 2009), sonographers (Russo *et al.*, 2002), as well as midwives (Long *et al.*, 2013). The midwifery caring tasks during the delivery involving mostly static and/or awkward positions mainly based on the mother's comfort as well as manual handling activities such as supporting mother with breast feeding were agreed to result in potential MSDs (Hignett, 1996; Nowotny-Czupryna *et al.*, 2012). Most interviewees attributed their symptoms to static or awkward positions during delivery and assisting mother with breast feeding, similar to the reported physical demands for Australian midwives (Long *et al.*, 2013). Although many attributed their symptoms to specific working tasks, the origin of injuries at work also varied from patient-related;

> *"I did suffer a hairline fracture to my rib following a patient kicking me during birth" (M03)*

to staff attributes or equipment related factors, as reported;

"I was providing care for a woman in labour and went to get some ice for the woman. While in the kitchen someone came in and opened the dishwasher door behind my ankles without telling me and then walked away from the kitchen. As I turned I fell over onto the ground twisting and pulling my back. On returning to the room the woman I was caring for then birthed quickly and I continued to provide care. At the end of the shift I was in significant pain and had sciatica." (M05)

5.5.2.2 Management

The most commonly used self-management process was medication, particularly analgesics;

"I am not one taking time off rather take paracetamol and get back to work." (M14)

Many of the interviewees tended not to ask for sick leave and carried on at work. Concerns were expressed about taking sick leave. For example, one interviewee stated that if she takes sick leave, her colleagues will be overloaded to cover her absenteeism, and she commented:

"I could not make anybody suffer… It is not something that I want... if it was infectious or if I was vomiting, fair enough – but because it is just pain, get pain killers and get on with it." (M01)

A small number of interviewees had been referred to Occupational Health Department due to their injuries. However, many midwives did not report their problems because they did not feel that they would get benefit from reporting and the following management procedures, which they thought include advice to avoid hazardous activities and referral to physiotherapist (but the individuals need to book an appointment themselves). Another reason was also the time delay as the referral process after Occupational Health Department was very long before seeing a health professional for their problems;

"…why I haven't reported it, because it is time consuming, nothing really gets done."(M10)

"I had my hands injected, but six months down the line I am just seeing consultant tomorrow to tell her that I have been suffering last three months

with it. So she will refer me and it will take another three months. It takes a long time." (M03)

Overall, the midwives self-managed their symptoms in order to carry on their roles at work, and waited a long time for treatment. This resulted in midwives being present at work while unwell, which is called 'presenteeism'. Many interviewees preferred to stay at work voluntarily despite their MSD as they felt guilty for any additional workload for their work team. This finding was also reported by Tveten and Morken (2015) in their qualitative study exploring experiences about decision processes for taking time off due to MSD. Their interviews with eight women working in nursing and caregiving showed that many chose to stay at work because of guilt and shame towards both colleagues for covering their absenteeism by over working and patients for providing limited care. The authors suggested that this was related to the caring nature of the nurses, including more sympathy to patients and the attribution a meaning to caring activities more than a checklist of work requirements.

Another underlying reason for not taking sickness absence leave due to MSD may have been the perception of '*musculoskeletal symptoms are part of the job'* as reported by Long *et al.* (2013b). However, sickness presenteeism raises the possibility of serious injuries due to cumulative effects on the musculoskeletal system. Another possible impact of the presenteeism could be on patient care and safety due to functional limitations caused by symptoms, which will be discussed in the next section (Section 5.5.2.3.).

5.5.2.3 Consequences

Limitations in normal activities at work or outside the work were mentioned by many of the interviewees;

"I am really upset that I can't do the everything I can. I can't physically walk most of the time when I finish."(M01)

"My hands are becoming a problem now – washing your hair, doing trousers zip…" (M03)

They also expressed their feelings about being restricted at work due to their symptoms, and not being as active and healthy as they used to be before their injuries;

> *"I go very slowly. Everything just takes longer, so the women are waiting longer." (M01)*

> *"There is no way I will crawl around the floor or bend over for pool birth or something." (M03)*

Some interviewees argued that having MSD would affect the care they provide, while others indicated that their symptoms did not change anything they did at work. One interviewee from the latter group supported the idea that they let the mother do what they want to do, and said:

> *"If she really wanted to be in a certain position, I wouldn't say 'no'. I would try to manage it best I could. I would hope it [my pain] did not impact on my patients." (M07)*

In situations where midwives cannot support the mother due to their symptoms, there were some suggestions such as requesting assistance from their colleagues;

> *"If I was really struggling, I would get somebody else who could do whatever as how comfortable she was" (M11)*

However, the concern here might be finding an available member of staff to provide support at that moment. Unfortunately, due to increased work demand on most maternity units, it is not always possible. The nurse and midwife shortages reported in the NHS (Buscher *et al.*, 2010; RCM, 2016c) also means that it may not always be easy to get help from colleagues. Another solution expressed by one of the interviewees was transferring mothers between midwives: from one who cannot care for the mother due to her symptoms to another midwife who is able to provide the care. Overall, almost all of the interviewed midwives indicated that they asked for help from either their colleagues or the birth partners in situations where they could not support the mother due to their symptoms. However, they acknowledged that this can impact on the continuity of the care they provide. The definition of continuity of care in midwifery is that '*care is provided by the same*

midwife or the small team of midwives starting from early pregnancy till the end of the postnatal period' (Homer *et al.*, 2008). The importance of continuity in providing care was highlighted many years ago (Page, 1988) and a recent systematic review also provided evidence for the benefits of continuity care model compared to other care models (obstetrician-provided, family doctor-provided, and shared models care including different health professionals) (Sandall *et al.*, 2016). It was stated that the number of epidural episiotomy, and instrumental delivery decreased in midwife-led continuity care groups. There was also a decrease in the risk of early birth and stillbirths. RCM supports this model; however it requires appropriate conditions to be implemented such as more midwives and funding (RCM, 2016b). The interviewees reported that they did not fully apply the continuity model (they only provide care during the labour). Yet, they were aware of the possible impact of midwife change due to their MSD on mother and baby.

It was also suggested that negotiating with the mother to encourage her to help the midwife as much as she can and/or using the equipment and environment to support the midwife for carrying on care. However, concerns were expressed about influencing the mothers' choices;

> *"If you have got the woman who wants to kneel [on the bed], there are always other things that would help: bed can go up, you don't have to bend down all the time. Whether or not in your mind, you start influencing without even knowing you might influence the woman because of your injuries." (M03)*

> *"If you can't lean then you get the women in…say you are in the pool and it is impossible for you to lean over because you hurt your back or shoulder, then you give the woman the doppler and she does it. It might impact or compromise a certain point the women's choices." (M10)*

In another case, one interviewee was unable to support the mother on the floor, and asked her to kneel on the bed rather than on the floor, where the mother initially wanted to be. Therefore, the interviewee adjusted her working position or the mother's preferences according to her own limitations and carried on working. It is understandable to look for these kinds of adjustments for the benefit of

midwife. Yet, there is a possibility of influencing the mother's choice of delivery position due to the limitation of the midwife who is caring.

The consideration of patient safety during the caring process was emphasized by many of the interviewees but opinions differed as to whether their discomfort affected patient safety or not. Some midwives argued that their symptoms did not influence patient safety because they prioritised mothers rather than themselves. On the other hand, the interviewees supported the idea that it could have an impact on patient care and safety;

> *"I tire more easily and when tired it is possible that people make different decisions. Because I have chronic pain and sleep badly I cannot cope with night duties – I consider myself unsafe at night due to the level of exhaustion I face." (M05)*

> *"…my capabilities would be reduced, therefore risking my patient." (M13)*

Sickness absence data has generally been used as a measure of health status at work places (Black and Frost, 2011; Health and Social Care Information Centre, 2015). Recently, sickness presenteeism has also been widely accepted as an indicator of the health state, despite the fact that it is difficult to measure reliably (e.g., number of days unwell at work and/or productivity) (Whysall *et al.*, 2018). The potential detrimental effects of presenteeism for both individuals and organisations have been well documented in literature. For example, workers can have more critical injuries due to ongoing exposure to work load and inadequate time for recovery. It can also influence the workers' productivity and safety at work (Aysun and Bayram, 2017). All these impacts can also lead to higher economic costs (e.g., medication, physiotherapy), in addition to indirect costs (e.g., use of agency staff to fill a vacant shift) (Bergström *et al.*, 2009).

5.5.2.4 Prevention strategies

Protect yourself

The interviewees mostly agreed that each midwife needs to have the responsibility of protecting themselves from potential injuries. This responsibility included either

being aware of the hazards as part of the job and use your body parts properly and/or using the equipment or external support efficiently to minimise the force;

> *"Putting legs on lithotomy – nobody should lift anybody's legs." (M10)*

> *"If I am bending down quite a lot to see what is happening, I would move the bed up so that it is at the height that is better for me." (M11)*

> *"Once I am feeling the strain on my back, that is a sort of thing that warn me – 'do something' like a sign." (M12)*

However, many indicated that in emergencies it was not always possible to think about all of these things (e.g., adjustment of equipment, thinking about their own position and adapting for the most suitable posture):

> *"I have to think about myself as well as that woman. But in an emergency, I would just go and do it. I do know it is the same for a lot of midwives as well. I think in the situations we forget, it just goes out the window because you are just thinking about the woman and just giving her the care." (M04)*

> *"I know what I can do to make sure – I will not kneel unless it was an emergency or something was falling and I had to be on the floor." (M07)*

> *"I don't pull beds, I push. And when we are in theatre, when we transfer the mother I always take the legs." (M14)*

In the 1990s, '*hands on'* practice was applied in midwifery. However midwifery practice has changed to support/encourage more maternal mobility. Midwives recently have been encouraged to give '*hands off*' care during the labour. The definition of 'hands off' care covers a general approach where the midwife does not get physically involved unless necessary (e.g., perineal support) (Wickham, 2009a). For example, a midwife should not automatically put her hands on the baby's head during the delivery, instead she should wait till it is required; or if helping a mother to breastfeed her baby the care provided should be verbal with minimum physical support. The 'hands off' approach is mainly based on where the mother has an more active role during and after the labour, but it also has protective benefits for midwives. The interviewees described the advantage of the 'hands off' approach in terms of less physical demand on midwives (and possible protection from potential

injuries), even though this approach was generally accepted as mother-centred, which enhances the mothers' involvement in labour and self-confidence to look after herself and baby in the absence of a midwife (Wickham, 2009b; Swerts *et al.*, 2016a).

More specific training for maternity

With respect to training, all interviewees reported that they had done a standardised mandatory manual handling e-learning training course every year (which used to previously be run face to face). Some Trusts also organised clinical training days 2-3 times in a year. Although there is no research about moving to e-learning, it was believed to be related to time constraints by some interviewees. Interviewees talked about the benefit of the training, but some commented unfavourably on e-learning:

> *"You can't learn to how to lift by doing e-learning. That does not teach you anything. Half of the time you are not even paying attention, you are just doing. Because it is just another e-learning tick box after this. (M14)*

All interviewees commented on the content of training, and the majority (n=11) agreed that the training was not specific to midwifery related tasks or positions, rather it was general for mostly nursing manual lifting activities. Therefore, the trainings do not provide support or advice for the common midwifery working activities:

> *"You get basic training as in moving a patient from a bed to chair whatever, but actually nobody concentrates on maternity sort of manual handling. It is very focussed on older people or sick people - not on sort of maternity for example positioning when you are delivering, or breast feeding – that is never covered on manual handling trainings." (M04)*

> *"I think a lot of the manual handling we have had has been quite generic and very sort of nurse led. You know, in terms of getting your patient out of bed and into a chair, and they collapse in the chair getting them into floor, when they fall and that sort of stuff – yes it does happen in maternity but on the whole the women are fit and well and can move their own bodies." (M02)*

"It is not relevant to midwifery practice rather it is generic to all hospital activity. It does not teach staff how to manage the delivery process." (M05)

"Interesting and useful in terms of general knowledge, but I don't think give us any solutions how to protect ourselves or how to prevent injuries." (M06)

"On a delivery room, women don't deliver on one position - maybe stand maybe sit maybe on the bed maybe off the bed. And you have got to be prepared and facilitate everything. It is really hard to do a deliver without twisting. And there is no training to show how you should". (M14)

As suggested by Hignett (1996), manual handling tasks for midwifery differs from nursing care mainly due to having two 'loads'(mother and baby) and caring for healthy mobile 'patients'. It should also be noted that the equipment and environment is unique for midwifery such as birthing beds and pool. All these factors would change the nature of the manual handling operations (Hignett, 1996). Although midwives would benefit from manual handling training, it does not seem to be targeted at their specific activities.

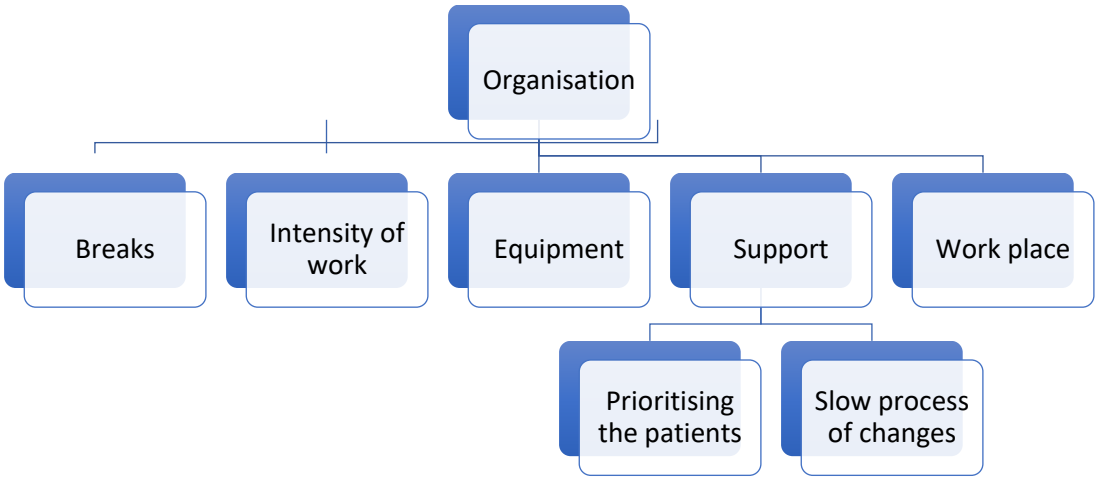
Some interviewees also added that the training run by some Trusts for maternity professionals are not practical for real life as quoted below:

"The practicality is and the reality is of how you are taught are not married with being in a room and looking after somebody – it is not easy." (M07)

"It could be in a real-time, more scenario-based unit." (M15)

5.5.3 Organisation

Figure 5.3: Organisation thematic analysis from the interviews (n=15)



5.5.3.1 Breaks

Not having enough breaks during shifts was mentioned many times as a contributory factor for MSDs;

> *"The midwives very rarely actually manage to get a break and if they do it is a short break constantly rushing around" (M12)*

This could also result in dehydration and irregular eating patterns, which would impact on staff well-being:

> *"I have my breakfast at 6.00 and I don't normally have my lunch before 17.00."(M08).*

The consequence of not having enough breaks and irregular eating patterns was linked to increasing obesity among midwives, which indirectly contributes to the increasing MSD by putting extra pressure on the musculoskeletal system.

5.5.3.2 Intensity of Work

Here, it was described the intensity of work based on interviewees' views of long shift hours, decreased staffing numbers and increased number of deliveries. The all agreed that fewer staff and an increased work load led to gradual exhaustion, as one interviewee said;

"I can guarantee to you that in practice, when you have got [a] busy ward, not enough members on duty, coordinators pressing you to make a space, emergencies going on, the last thing you will think is your backache and how to prevent it." (M08).

The workload caused them to skip ordinary tasks due to time pressure which would protect them such as raising the bed;

"We just do things to save time, because we are so busy – we don't think about ourselves, we just do it automatically." (M04)

"If you go on to the clinical areas to observe 'why you didn't raise the bed in that occasion', they would probably say 'I need to go to get blood pressure next door, I haven't got time to raise that bed. I have to move on to next task."(M12)

Many interviewees argued that the shifts were too long so that they can't have enough breaks, which could also contribute to MSD. All interviewees commented that the change in shift hours from 8 to 12.5 has impacted negatively on their health;

"The hours kill me. I was much better with the shorter hours – 12 hours do kill me." (M01).

"I think the most extreme work related that challenges midwife role is the working hours."(M08).

Two 12-hour shifts were introduced and recommended for NHS staff instead of three 8-hour shifts in 1990s. The application of 12-hour shifts has increased in nursing staff after 2010 (Ball *et al.* 2014). Midwives also started working 12.5 hours to incorporate for the 12-hour shift regulation depending on the local organisations' request. It has been suggested that some might find this beneficial as working longer days results in fewer number of days worked.

"I would rather do less days or longer shifts –better to be tired two days then three recover." (M07).

However longer shifts with fewer breaks have been argued to lead to decrease in productivity and opportunities for errors (Rogers *et al.*, 2004; Health Safety Executive, 2006; Griffiths *et al.*, 2014).

5.5.3.3 Equipment

Some interviewees commented on the equipment provided in terms of design, suitability and availability; specifically: birthing pools, beds, slide sheets, desks and chairs. One interviewee said that birthing pools were quite high for the depth of the water; the midwife had to lean over very often;

> *"You are having sort of lean over it in order to auscultate and then – and there is nothing to do about that because the pool can't change and you still have to." (M02)*

Design problems with birthing pools causing risks for both mothers and midwives were highlighted by Hignett (1996). The pools were improved by including steps and hand rails to help getting in and out, 'u' shaped edges to provide support for the mother, a concave side for midwives caring for mothers in kneeling or sitting positions, and an integral seat for delivery and internal examination (Hignett, 1996). However, the birthing pools described by some of the interviewees and pictures showed in the birth centres seemed to be far from the suggested design. A recent research by the HSE (Jones, 2018) also found the lack of improvement of birthing pools in many Trusts and renewed the same suggestions for improving them.

The birthing beds have three main parts with mattress: top, end and detachable end. Some felt that birthing beds were quite good as they could be adjusted (compared to the beds in the past), while others considered that the removable foot end of the bed was very heavy and required a lot of physical effort to lift off and put back. Slide sheets were found to be useful by some interviewees, but they felt that they did not have time to fetch and use them. Time issues were also highlighted in this theme. For example, many midwives did not adjust the beds or use other equipment designed to help staff (e.g., hoists) due to time constructions. This might also be due to lack of education on how to use them. Additionally, one

interviewee reported that equipment on the delivery suite was widely spread in the area and hard to find.

Another issue mentioned by three interviewees was the comfort and adjustability of chairs. Interviewees reported being in uncomfortable positions during suturing and completing paperwork at a desk. The ergonomic consideration of chairs has been studied for office workers, students and dentists who mostly work in sitting positions (Pandis *et al.*, 2007; Feathers *et al.*, 2013; Swerts *et al.*, 2016b). For a midwife, there are some long duration sitting tasks, for instance, a suturing process can last around half an hour; and paperwork can take around 2 hours in a shift. The comfort and adjustability of chairs have a key role to prevent MSD.

5.5.3.4 Support

The support provided by the employers was explored and opinions were moved from mostly supportive to dismissive;

> *"With our head of services, head of midwifery allows every midwife or whoever to attend; in one of those would be manual handling. So, they are giving you the opportunities, they have given the things to do. I think the responsibility is midwives' - the hospital takes it seriously." (M04)*

> *"I would say that organisationally, yes I think support is there. We are taught, advised and given information, and we can access support for that.' (M12).*

On the other hand, some believed that training was given instead of improving conditions, as indicated;

> *"There is a lot of stuff could be better is not necessarily provided by the trust either, but you are expected still to give that care because like I said you can't deny woman – that choice." (M02).*

And also the comment below suggests a reason why adjustments do not happen in organisations:

> *"Adjustments can be made but are not encouraged by managers as this limits staffing!" (M09)*

One interviewee indicated that she knew that if something went wrong with patients or etc. Trusts would support them. That feeling made her confident at work and so she would not force her limits and damage herself. On the other hand, some interviewees expressed their opinion that patients have been always prioritised in the system; staff come third after the organisation, rather than being given equal importance;

> *"I can't think of any time that an injury of a member of staff has instigated a change. I can tell that injuries to patients or errors to patients completely change practices but not for staff – there is not one. (M10)*

Although there have been actions by the organisations, this was felt to be a slow process, as one interviewee quoted;

> *"…anything in the NHS takes an age to sort of. It is like dragging a lumber of dinosaur behind you." (M10)*

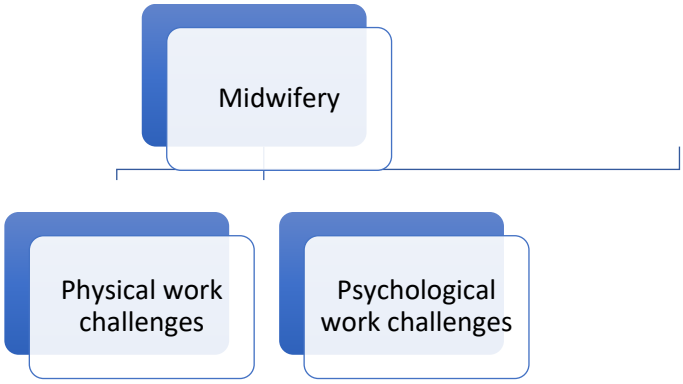
5.5.3.5 Work Place

Environmental issues also came up during the interviews. A small number of interviewees mentioned that the delivery rooms were not practical in terms of design. For example, they thought that sockets or plugs were too low and insufficient as they had a lot of equipment needing electric supply; resulting in over stretching. One interviewee mentioned about the size of the rooms being very small. Another issue highlighted was doors not staying open:

> *"The doors are wide enough but don't stay open, you have to try open a door and at the same time move the bed through. I think that is probably where there are a lot twisting and tremors sort of come from. Because you will be in a position where you have got a heavy woman on a bed and the door open and one leg on the door one leg on the floor and your arms are trying to pull the bed through with two of you doing it." (M01)*

5.5.4 Midwifery – Nature of Work

Figure 5.4: Midwifery – nature of work thematic analysis from the interviews (n=15)



Many acknowledged the physical and psychological demands of midwifery care. There are certain things that they believe are the nature of the work and they cannot be changed. Six main issues of midwifery work were highlighted as:

1) Caring for more than one patient (mother and baby) at a same time:

> *"I am aware that sometimes we have two or three lives in our hands in one room." (M07)*

2) Working autonomously; so it is very rare that they ask for help:

> *"We don't always have the ability to ask for help if we needed and wanted. I am not talking in an emergency – I just mean like holding legs." (M07)*

3) Unpredictability of cases, as one interviewee said:

> *"In our job, you never know what can happen next." (M08)*

4) Being positioned depending on the mother's preferences, and staying there sometimes for a long time, as commented:

> *"…sort of weird midwifery positions, you know we adapt our bodies to fit with the interesting positions women do" (M10)*

> *"You don't always get the opportunity to move a lot. If you are caring a somebody and trying to pick up baby's heart beat or trying to just be there and then you are often very close to and you don't move as much." (M07)*

5) Midwives care for mobile mothers with regular examinations off bed, on birthing ball or pool;

> *"…women are encouraged to remain mobile in labour and adopt different positions. This means midwives are having to get into awkward positions themselves." (M09)*

6) Continuously changing positions;

> *"You can be in all kinds of different positions. You could sometimes be there for a good few minutes in mostly twisted position to try to assess your woman. This is the only way you can do it." (M02)*

> *"You could be stuck there [bending and twisting position] for twenty minutes without really realising – that is what we are doing." (M10)*

Due to the factors listed above, the interviewees thought that having any pain was an inevitable consequence in their occupation. This agrees with a previous qualitative study with Australian midwives, where all participants (n=11) perceived the injuries as part of the job (Long *et al.*, 2013b). Furthermore, nurses' and therapists' experiences from Gropelli and Corle (2010) study showed that more than half of the participants accepted injuries as a normal consequence of their job. The reason for this phenomenon is not clear but it may be explained by the high prevalence rates leading to the perception of normality.

5.5.4.1 Physical work challenges

In this theme, interviewees expressed their thoughts about physical challenges which potentially result in MSD. When asked about the most frequent physical challenges, a variety of scenarios were described (Table 5.4).

Table 5.4: Physical work challenges mentioned by interviewees (n=14)

Physical challenges	Number of interviewees
Assisting breast-feeding	7
Internal examination – midwife sitting on the edge of the bed and twisting to assess	6
Woman preferring to deliver on standing or on kneeling position, and midwife positioning herself to provide the care	8
Obstetrics emergencies - Shoulder dystocia, cord prolapse	4
Bending and leaning over the birthing pool	6
Moving beds through doors	2
Putting women in lithotomy	3
Taking out the end of bed and putting it back in	3
Perineal suturing – staying same position for a long time and unable to adjust light in that position	7

Obstetrics emergencies such as shoulder dystocia or cord prolapse were discussed;

> *"…they [midwives] are sort of locked on the event – they have got to carry on. And instead of swopping with somebody else" (M10)*

From the staff safety point of view, some raised their concerns. For example, one commented that the steps used by midwives for birthing pools were not safe. Another issue was the mothers' uncontrolled movements when they are in pain:

> *"You know you could be kicked any point and it does happen. And quite often we have a foot on our hip." (M02)*

These findings are linked with midwives' attributes that will be discussed in section 5.5.5.

5.5.4.2 Psychological work challenges

Two of the interviewees commented on the psychological challenges of the midwifery work. For example:

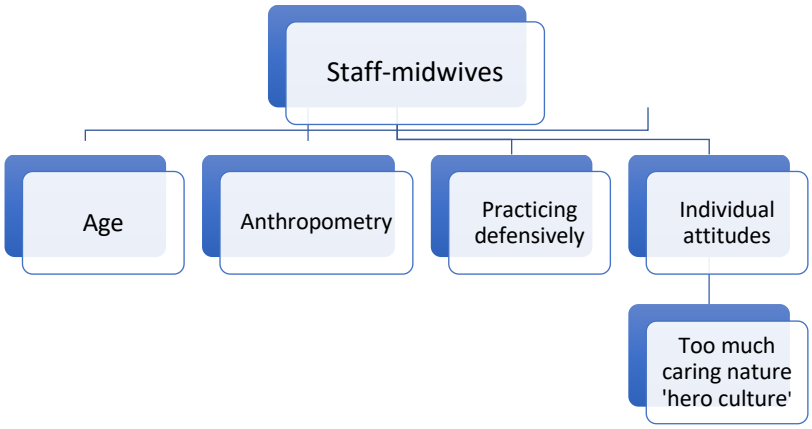
> *"I do think that it affects my wellbeing even psychologically." (M08)*

Another interviewee thought that encouraging mothers is more exhausting than physical work, as quoted below:

"If you have got something that requires a lot emotional encouragement as well as looking after, that is harder than to deal with physical stuff and emotionally exhausting." (M07)

5.5.5 Staff – Midwives

Table 5.5: Staff - midwives thematic analysis from interviews (n=15)



This theme related injury occurrence to the role of midwives' characteristics or attitudes. A variety of perspectives were expressed mainly in relation to age, anthropometry, individual attributes.

5.5.5.1 Age

The ageing effect on MSD has been widely discussed for nurses being as a detrimental or protective factor (Tinubu *et al.*, 2010; Ribeiro *et al.*, 2017). In the present study, some interviewees thought that ageing had a detrimental effect with older midwives tending to have more injuries, while others argued that younger ones were more likely to get injury for different reasons. For example, interviewees commented that younger colleagues feeling empathy with the mothers' preferences, but older midwives are able to negotiate a suitable compromise;

"They all seem very much wanting to do everything for the woman whereas I think the older and more experienced midwives would think nothing of doing and saying to the lady 'no, I am not going to pick you up, you can move' and things like that." (M02)

"I am older and sort of more experienced in life and can talk to other people more. I will be more inclining to protect myself, whereas they (youngers are

more inclining - they don't do upset anybody, they don't want to get in trouble" (M03)

These quotes also identify communication problems among younger midwives. This was also highlighted by Hignett (1996), under the theme of 'negotiations'. Although the ability to negotiate with mothers regarding examination positions, delivery and/or breast-feeding is not always related to age or experience, the interviewees expressed their views that it is an issue among midwives;

"[They feel like] I can't talk and hurt myself, because that is what I want to do for the benefit of the patient." (M10)

"Do always speak up. If you are not comfortable to do something, I would say lots will probably just do if they have been told." (M14)

This also reflects feeling less confident to say that they have limitations to support a certain position.

It was mentioned by many interviewees that reduced manual handling training and not having class-based, face to face training, may have contributed to newly qualified midwives injuring themselves.

"You are trying to see on your students and your peers, and say 'look you should not be doing that' you know." (M01)

It was also suggested that having experience helps midwives know how best to look after themselves.

"I think generally especially junior midwives they don't but I do; it has just been automatic get the bed up, get the end of the bed out, you just constantly work on this situation." (M12)

Another reported reason was limited knowledge of their rights in an organisation, so younger midwives were worried about complaints.

"If the lady complains because you did not lift her out of the bed, the trust will support you on that score – they are not going to turn out and say we were in the wrong'. And I think that is what probably worries them. If your patient falls, from a trust manual handling point of view you just let her fall – you

don't try and catch her. And uncertainly the newly qualifieds are very much 'you can't let her fall' – no you can really let her fall because you are more likely to cause more damage both two you and them." (M02)

Overall, midwives expressed their thoughts about age relatedness and junior midwives' being prone to have more injuries. On the other hand, one interviewee suggested that the older generation could handle pain more than younger generation.

"Maybe they class a little twinge quite painful. Whereas if I had the same I would be like 'ugh, it is fine, I can just manage it'." (M11)

5.5.5.2 Practicing defensively

A key theme from the interviews was concern about complaints from mothers which could result in a culture where midwives practice defensively, as quoted below;

"I think we tend to accept that what the patient wants the patient gets because should the patient then complain we would be seem to be fault." (M10)

Defensive practice may lead midwives to do much more than they should;

"*They say 'help me move'; actually I am not meant to help to move. You feel awful by saying - if you just do it by yourself. It is not always nice to say - you do it because I am not meant to hurt myself. That makes you look not caring."* (M07)

In order to protect against potential complaints, the interviewees reported practicing defensively. This was one of the most interesting emergent findings from the interviews. Defensive practice has previously been discussed among health professionals, linked to poor staff health, both physically and psychologically, and impact on patient safety (Symon, 2000; Passmore and Leung, 2002; Surtees, 2010). A study of over 2,000 UK midwives and obstetricians (Symon, 2000) showed that defensive practice resulted in changes in maternity clinical practice, with performing more caesarean sections, more often monitoring, more investigation

and more documentations. The increases of such practices were argued that it did not necessarily indicate the increase of quality of care.

In 2008, in the case of Joshua (died at nine days of age due to neonatal sepsis in Morecambe Bay) the midwives looking after him were accused not caring for this high risk mother and missing the signs of infection. However it was argued that caring for both the mother and the baby for a 12.5 hour shift with limited breaks may have made them open to mistakes. In a study of more than 1,300 midwives, half of the participants reported that they were worried about making a mistake at work due to being exhausted (Royal College of Midwives, 2016a). After Joshua's death, many actions were taken indirectly, Royal College of Midwives *Normal Birth Campaign (http://www.rcmnormalbirth.net/)*, and *Better Births Initiative* (http://betterbirths.rcm.org.uk/).

5.5.5.3 Individual attitudes

Caring nature - 'hero culture'

Personal behaviours and attributes of staff were agreed to have an impact on injuries. It was an agreed concern that prioritising the patient and not caring for themselves were common faults. However, many indicated that they could not put the mother second.

> *"We are all guilty of trying to do the best for woman that we are looking after. We are thinking of 'ohh really, she should not use me', but all about the baby is coming it is fine." (M02)*

> *"I think we have to be aware that to become a healthcare professional in itself means that you will probably one of those people who is very much about other people, you want to care." (M10)*

> *"Midwives are in a very caring nature, I think the individual that goes forward is in midwife – it is that caring nature." (M12)*

Midwives have been advised to protect themselves regarding obvious hazardous actions at work, such as allowing a mother to put her foot on the midwife's hip and push against it or putting mother's arms around midwife's neck (UK Government,

1974; Royal College of Midwives, 1999). However, these actions can still be observed in labour wards despite many guidelines advising not to do so. Although it is accepted as a mistake by the midwives, they reported that they do it in practice as part of the caring nature.

5.5.5.4 Anthropometry

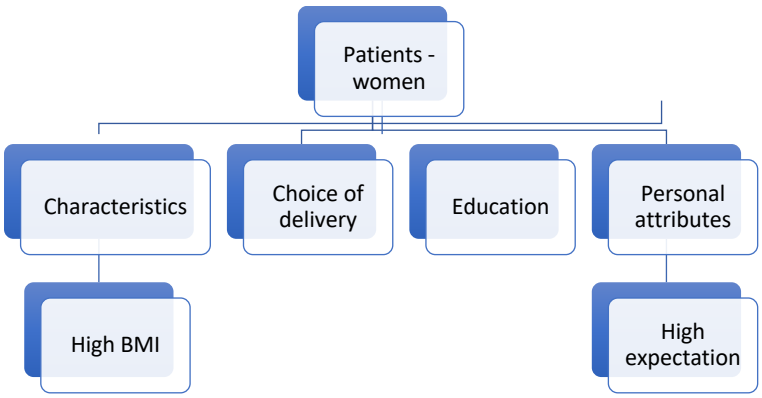
A small number of interviewees suggested that younger midwives might be smaller and less fit, and this could be contributing to MSD. Obesity rates are also increasing among midwives, which puts extra pressure on musculoskeletal system, as mentioned;

> *"When you think of the activity that they are doing, why are they so over-weighting? Well, the problem is because they are not getting breaks, they are not having regular eating or sleeping patterns and you and I know all contributes weight gain." (M12)*

5.5.6 Patients – Mothers

A common view amongst interviewees was that patient-related factors had a key role on the occurrence of injuries. Four main subthemes emerged under this theme:

Figure 5.5: Patients – women thematic analysis from interviews (n=15)



5.5.6.1 Characteristics – High BMI

Many of the interviewees commented on the burden of caring for high BMI mothers during tasks such as moving to/on the beds and getting their legs in the lithotomy position;

"I had a lady very recently who had a very very high BMI. She needed an instrumental delivery. But her legs were open to lithotomy; her thighs were still together because she was so big. We needed to physically hold to them. And the doctor was trying to suture – she could not see so we had to get the whole skin over." (M07)

"I think women are much more they have lots more comorbidities particularly obesity. So you are lifting and sort of doing much more heavy patients." (M12)

"The BMI profile for service users has gradually increased over time so when women are supported or assisted to move there is an additional burden on the musculoskeletal system." (M15)

There is a lack of information about how to care or support obese (bariatric) mothers by maternity professionals. Schmied *et al.* (2011) called this theme '*feeling in the dark'* in their qualitative study exploring midwives' and obstetricians' experiences of caring for women with over 30 BMI scores. This could lead to midwives facing difficulties in providing appropriate and safe care, for example; examination of fetal position/heartrate through the thicker adipose tissue in women's abdomen or positioning heavier legs. The Manual Handling Operations Regulations 1992 do not specify a weight limit to be lifted by health professionals; instead an ergonomic assessment is advised to minimise the risk for carers those who cannot avoid lifting as part of their jobs. Hoists have been designed for the healthcare staff to reduce/prevent manual lifting. However, it is argued that hoists are not designed for maternity requirements such as pulling or retracting (Schmied *et al.*, 2011). Furthermore, the interviewees also mentioned availability problems for hoists, particularly in emergency situations; as they might be in a different area in the hospital. Another equipment-related difficulty with obese women was highlighted by Heslehurts *et al.* (2007) in a qualitative study with 33 participants in North East England. Theatre tables for obese mothers requiring caesarean section are limited or even not available in some Trusts, and the ones that are available are permanent and not mobile. In general, midwives described the difficulties in caring for bariatric mothers, and they were aware of the risks on their musculoskeletal symptom. They would benefit from specific support regarding regulations and guidelines to minimise the risks.

5.5.6.2 Choice of delivery methods

The quotes below illustrate the interviewees' views on the impact of mothers' choice of delivery positions.

> *"Years ago, women were confined to the bed, now women are encouraged to remain mobile in labour and adopt different positions. This means midwives are having to get into awkward positions themselves." (M09)*

> *"Some women would like to go on the floor – I really really struggle. But because you want to let the woman what she wants to do, you just do it." (M04)*

> *"You can't deny somebody using the pool because of your back." (M02)*

The mothers are given information about delivery places (home or hospital) and options (birth pool, epidural, etc.) in the antenatal period, and in the UK they have right to make an informed choice discussed with the midwife. The semi recumbent position (mother lying on her back on the bed) on a hospital setting is the most common birth position applied in the UK (49%, n=929) (Royal College of Midwives, 2010). The reason behind this result is not clearly stated in the report, whether it is related to equipment, environment or staff related (as this was a survey study exploring the prevalence of the positions), yet there is evidence that midwives find the supine position more comfortable when both providing care and dealing with emergency situations (De Jonge *et al.*, 2008). The interviewees reported that mothers in labour mostly relied on midwives' advice so there is a possibility that midwives can influence the mother's choices for their own comfort. One interviewee commented that some midwives tended to discourage the mother from choosing a position which they could not support. This finding is consistent with a previous study where midwives said that they used some 'tricks' to manipulate the mother to be in a position that is comfortable for midwives, for instance they asked women to get into bed for an examination just before the birth so they are giving birth on the bed (De Jonge *et al.*, 2008). A possible explanation may be a lack of training in other than supine positions on the bed such as for squatting, using the birth pool etc. This could lead to midwives being less confident about the other birth positions. However, the majority of the interviewees reported

that they supported the mothers in their choice of positions despite their own discomfort.

5.5.6.3 Education

One interviewee argued that mothers were being given less antenatal education. She thought that more education before delivery would ease their work, especially for breast feeding, positions and mobility during the birth.

> *"If women knew more antenatally then that might help them be able to do things. Even in labour – positions and things." (M07)*

5.5.6.4 Personal attributes

The views about mothers' expectations varied. Many interviewees expressed their opinion that recently mothers are requiring more support compared to the past, which may be due to the increase in epidurals and caesarean section (C-section), making them less mobile and needing more care. Carolan-Olah *et al.* (2015) found that women's expectations had an influence on the interventions such as epidural during the labour. They also reported that mothers' knowledge about the birth, positions and possible interventions was related with this theme. Therefore, the lack of antenatal education was argued to result in fear and enhanced expectation from midwives and other staff. Therefore, the importance of education is consisted with the literature in terms of increasing participation of women in labour process and lowering anxiety (Svensson *et al.*, 2009; Fisher *et al.*, 2012).

5.5.7 What has changed?

The interviewees were asked about changes over the years in maternity services which might impact on MSD. Their views included;

- Awareness of injury is higher.
- Staff are getting younger.
- Midwives are taught more 'hands off' caring.
- There is an increasing knowledge about better work practices.
- There is much more equipment for lifting or moving.

- The work load is harder with more births.
- There are less staff per mother.
- There are fewer breaks.
- The women have more co-morbidities, particularly obesity.
- Shift hours are longer.
- Patients' expectations are higher – they want more, in past they were less demanding.
- There is an increase in use of epidural and C-section, which makes women less able to mobilise themselves.
- There is more encouragement of being more mobile during birth, whereas before women were confined to the bed.
- Delivery options are wider in a hospital.
- Manual handling training is not face to face anymore.
- NHS has reduced resources to provide care but more episodes of care that adds to the additional stress burden.
- Recent midwives are qualified only for midwifery, whereas before they also qualified as a nurse.

It was stated by RCM (2016c) that the number of midwives in England had increased by 1,500 since 2010, but that still does not meet the demand with a calculated shortage of around 3,500 midwives. The number of midwives over 50 years of age rose by 1,500 since 2010, with one third of the midwives reported to be over 50 years old. Similar to the midwives, the mothers' profile is also ageing. There were over 80,000 more births for women aged 30+ years since 2001. It is argued that older mothers require more care and support during the labour, and they are more prone to complexities leading to more staff support (Luke and Brown, 2007). It was also reported that the increased rate of obesity was another contributory factors to the demands from the maternity services. Another profile stated in the report was the number births, that significantly increased by around 100,000 from 2000 to 2015.

5.5.8 Validation of the Findings

A confirmatory focus group was conducted following the completion of the individual interviews in order to validate the findings and to receive feedback about the study overall. This additional data collection was carried out to confirm that the saturation of themes had occurred.

The focus group recruited a new sample of midwives who were not the original interviewees to provide an opportunity to assess transferability of the findings with different interviewees' experiences (LoBiondo-Wood and Haber, 2006). The attendants of the Multidisciplinary Obstetrics Training (MOT) organised by University Hospitals of Leicester (UHL) NHS Trust were invited to the focus group. Seven midwives were the participants of the focus group (Table 5.6).

Table 5.6: Interviewee characteristics of the focus group

Interviewee no	Age	Practice year	Current work situation	Current work role	Place of working	MSD
1	55	17	Full time	Community midwife	Community	Low back pain Knee pain Shoulder
2	51	17	Full time	Deputy manager maternity assessment unit midwife	Maternity unit in a hospital	Previous knee injury
3	52	28	Full time	Community midwife team lead	Community	No
4	37	11	Part time	Community midwife	Community	No
5	27	7	Full time	Midwife on ward	Maternity unit	No
6	27	5	Full time	Band 6 midwife	Maternity unit	No
7	36	10	Part time	Midwife	Maternity unit	No

A focus group question guide was produced including the main questions in the initial interviews (Appendix 5.1). Most of the themes from the initial interviews were addressed in the focus group. For example, interviewees discussed the changes in midwifery that might impact on staff's poor musculoskeletal health. 12.5 hours shift length was reiterated in the focus group, with similar findings; some

were happy with 12.5 hour shifts for the benefit of longer days off, while others thought that it has negative impact on their health.

The interviewees talked about manual handling training not being specific for maternity and/or realistic. Furthermore, they commented that the recently applied e-learning trainings (replacing face to face training) were not helpful.

Some organisational factors regarding equipment and environment were discussed in the focus group; for example, the chairs and desks used for paperwork were not comfortable. They mentioned that the lamps used for suturing were not adjustable and sometimes hard to fix in position. This was not mentioned in the initial interviewees.

Bariatric mothers were identified as one of the physical challenges by midwives in the interviews. This was supported by the focus group; interviewees expressing their thoughts that there was no training about how to deal with bariatric mothers.

In terms of the work challenges, the birthing pool was one of the main challenges mentioned; others included supporting a mother who wants to deliver in standing or kneeling positions where the midwife is mainly on the floor.

The focus group raised additional themes that were not directly related to this thesis; but might be important for future research, for example community midwives (who are caring for mothers at home).

Overall there were no new themes from the focus group. Therefore, it was confirmed that the saturation of the themes had been achieved and the results had been validated.

5.6 Limitations

Although participation was open to all midwives having a role in the UK maternity services, the interviewees who responded were mostly from the local Trust. Telephone interviews were used for those who responded from remote places, but these were not very effective due to the limitations of telephone interviews

including lack of insight and visual context (Robson and McCartan, 2016). Therefore the sample group was limited to the local Trusts although this might make the findings less generalisable to all midwives in the UK. However, the sample size included a variety of midwives in terms of age, years of experience and roles which allowed insights from a wide range of perspectives and limited potential bias.

The interviews were recorded using a voice recorder. The interviewees were informed that their names' would not be identified with anything they said, as this might limit them from talking openly about certain topics, particularly organisational factors. However, it was observed during the interviews that some interviewees lowered their voices while talking about lack of organisational support. In order to minimise this, prompts were used to encourage the interviewees to speak more unreservedly and to create an environment as natural as possible.

5.7 Summary

The aim of this study was to explore midwives' experiences about WRMSD and contributory factors. The findings support the following conclusions:

- Midwives experience MSD with almost all of these being attributed to their work; including working tasks, equipment (pool, chair, lamp), environment (room size), mothers' characteristics (bariatric, high expectations, active birth) and staff related factors (age, experience, defensive practice, hero culture).
- MSD result in limitations on midwifery caring activities. However, many midwives felt that their limitations did not impact on patient care or safety. In order to maintain this, they either remained at work providing care despite their symptoms or called for help.
- Midwives are fully aware of their responsibility for protecting themselves from musculoskeletal risks. However, despite this, they reported hardly thinking of themselves in caring activities.
- Midwives do not benefit from the standardised manual handling training conducted regularly by Trusts. They believe that for training to be effective it

must be specific to midwifery caring activities with maternity specific equipment and for real practice. Based on midwives' suggestions, there is a need for a face to face (rather than e-learning) and clinic based training.

- Midwives feel that the work conditions are heavy with 12.5-hour shifts, irregular eating patterns, limited breaks and fewer staff.
- A number of very extreme physical work challenges are accountable for causing MSD.

The objectives of the interview study have been achieved. The midwives have expressed their experiences about WRMSD and thoughts about how they have been affected by the symptoms. In addition, it has been possible to gain an understanding of the potential risk factors and level of awareness of those as well as prevention strategies. The most common extreme work challenges have been identified and rated for the level of discomfort. These extreme and frequent tasks will be further assessed in the following chapter (Chapter 6).

6. Study 3: An Ergonomic Evaluation of Midwifery Tasks

6.1 Introduction

The majority of the participants from the survey (Chapter 4) and interview (Chapter 5) studies attributed their discomforts to work related physical activities. Excessive and awkward positions at work have been widely associated with the high prevalence of MSD more than other factors (Long *et al.*, 2012). To measure this, working tasks and postures need to be analysed to assess regarding exposure for the individual musculoskeletal system.

6.2 Aim and Objectives

The aim of this study was to analyse the most frequent, extreme and work related challenges with regard to physical exposure on the musculoskeletal system. The objectives are:

1. To identify typical working positions for midwives associated risks of MSD
2. To analyse to what extend working postures could contribute to the risk of MSD

6.3 Methods

A biomechanical imbalance develops when the internal force required to greater than the capacity of person attempting it (Vanwonterghem *et al.*, 2012). This imbalance increases the chance of MSD. In addition to self-reported methods such as survey and interviews, an observational biomechanical measurement for posture analysis is useful to assess the exposure of working tasks on musculoskeletal system.

The risk of MSD associated with physical working challenges was evaluated using the posture analysis observational method. Rapid Entire Body Assessment (REBA) was used to assess the posture and exposure to work activity related risk factors. REBA is a postural analysis tool developed by Hignett and McAtamney (2000) to meet the purpose of a postural analysis tool that is sensitive for assessing postures

adapted in healthcare and other service industries (Appendix 6.1). It has been widely used in various working groups such as vehicle operators (Koushik Balaji and Alphin, 2016; Safitri *et al.*, 2016), industry workers (Punchihewa and Gyi, 2009; Cordeiro *et al.*, 2015; Deros *et al.*, 2016) and healthcare staff (Rafeemanesh *et al.*, 2013; Ratzon *et al.*, 2016; Salmani Nodooshan *et al.*, 2017) to assess the risk of injury associated with the work postures.

In this tool, each body part (except the foot and ankle) is scored individually according to the position. Initially two scores are obtained: Score A and Score B, for the analysis of neck, trunk and legs (Score A); and the arm and wrist (Score B). The final REBA score shows the level of risk as: Negligible (1), Low (2-3), Medium (4-7), High (8-10), or Very High (11-15) as shown in Table 6.1.

Event or time-based sampling techniques can be used to select the postures for assessment. Event sampling was utilised in this study. It allows analysing the most common, extreme and/or awkward targeted postures with high sensitivity and less complexity.

Table 6.1: REBA action levels (Hignett and McAtamney, 2000)

Action level	REBA score	Risk level	Action (including further assessment)
0	1	Negligible	None necessary
1	2-3	Low	May be necessary
2	4-7	Medium	Necessary
3	8-10	High	Necessary soon
4	11-15	Very high	Necessary NOW

Within the extensively used observational postural analysis tools such as Ovako Working posture Analysis System (OWAS) (Karhu *et al.*, 1977), Quick Exposure Check (QEC) (Li and Buckle, 1998) and Posture Activity Tools and Handling (PATH) (Buchholz *et al.*, 1996), the REBA tool was selected for its appropriateness to the scope of the study as well as its reliability and validity in a variety of positions. There was a 62-85% agreement within 14 coders during the development of the tool, except upper arm (Hignett and McAtamney, 2000). Although OWAS is widely used

for assessing whole body posture adapted for dynamic tasks; it lacks evaluation of the positions of neck, elbows and wrists, which are commonly affected in health professionals. PATH was developed based on OWAS and added items that involve neck positions and more trunk variations; however, it is also limited for detailed assessment of the wrist and elbow positions.

The REBA has the advantage of including a scoring system evaluating the risks of a task involving different body parts at the same time. For example it records dynamic, static and rapidly changing postures; applied force/load; and handling of the load with hands or another part of the body. Another advantage is that body parts are coded individually based on the position or range of movement, thus the most affected body part can be identified. The final result gives an action score indicating the urgency level for assessment and change. The duration of the task is not included, so this was recorded additionally.

Janowits *et al.* (2006) modified REBA to address non-patient care activities such as laboratory work and computer-based works, in addition to patient care activities. The modifications include a new scoring protocol by dividing the body into two segments: upper extremity (neck, shoulder, elbows, and wrists) and trunk/lower extremity (trunk, legs) rather than calculating a whole body score. It also includes items for sedentary tasks from University of California Computer Use checklists (Janowitz *et al.*, 2002). The overall inter-rater agreement between two observers was 54% for upper body and 66% for trunk/lower body. Since midwives are mostly involved in patient-care activities, this modified version was not considered for this study.

6.3.1 Participants

The target sample group was midwives with an active clinical role at University Hospitals of Leicester NHS Trust (Leicester General Hospital). An open invitation was sent to midwives through the Head of the Midwifery and the Lead Consultant of the Delivery Suite. Those who were volunteer to take part in the study directly contacted the researcher. Snowball sampling was also used for recruitment during the data collection, over a 5-day period.

6.3.2 Research Approvals

Ethical approval was granted by Loughborough University, University of Hospitals of Leicester, Research and Innovation (UHL R&I) and Health Research Authority (HRA) (28th April 2017).

6.3.3 Procedures

The 6 REBA steps were followed; starting with observing the task including work layout, environment and equipment; selecting the postures for assessment; scoring the postures; processing the scores; and establishing a REBA score and action level (McAtamney and Hignett, 2005).

The setting

Due to the unpredictability of collecting data during observed practice in real clinical scenarios, it was decided to analyse simulations of the specified tasks. The key activities were the same, and the data could be collected without distractions. Although real time observations can be preferred (Ohlendorf *et al.,* 2015), simulation has been found to be appropriate for observing daily work routine rather than specific working tasks. For example, Nowotny-Czupryna *et al.* (2012) used simulation to examine common activities in midwifery using the OWAS technique.

The tasks were performed by the participants with a model (a woman acting as a mother) in a delivery suite room to give the same environment and equipment as real practice. The participants were encouraged to carry out the tasks the way they felt comfortable in a real practice. The data were recorded by three cameras from different angles (Figure 6.1). The cameras were moved depending on the position of the participant during the task.

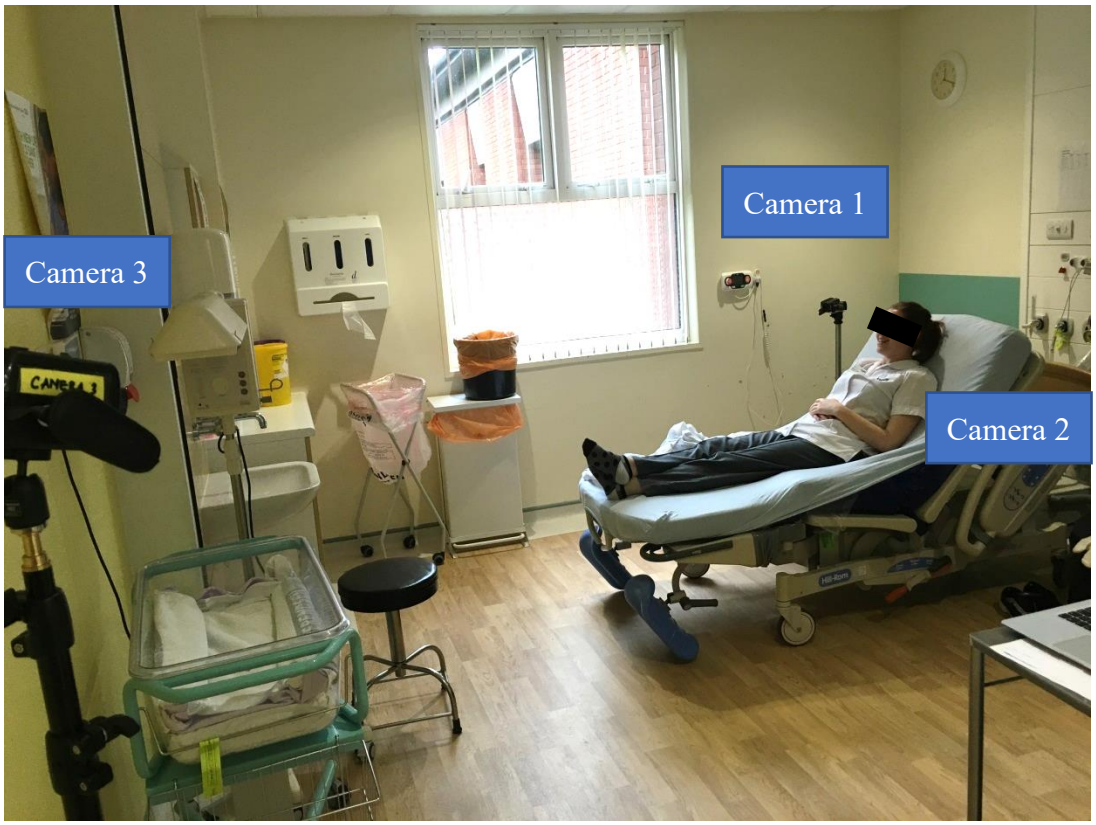


Figure 6.1: The layout of the delivery room and position of cameras

Pen and paper based observational assessment tools have been reviewed and limitations have been identified to lack precision and to be prone to observer variabilities (Li and Buckle, 1999). The multi-directional video recording in this study avoided the estimation of range of motions (the angles were measured by a goniometer), which minimised the lack of accuracy.

Selecting the postures for assessment

The most frequent, extreme or awkward working tasks, and those causing discomfort were identified from the interviews (Chapter 5, Section 5.5.4.1). These were rated by interviewees from 0 to 10, with 0 representing 'not a challenge at all' and 10 representing 'extremely difficult' (Table 6.2).

Table 6.2: Physical challenges identified by the interviewees (Chapter 5, Section 5.5.4.1)

Physical challenges	**Mean rates (0-10)**
Vaginal examination / Artificial Rupture of Membrane (ARM)	9
Supporting mother with breast-feeding	8.3
Suturing	7
Delivery positions (mother standing/kneeling)	6.3
Placing the mothers' legs into lithotomy	5.4
Taking out the end of bed and putting it back in	5.3
Obstetrics emergencies - Shoulder dystocia, cord prolapse	4.87
Delivery positions in birth pool	N/A
Moving beds through doors	N/A

These figures are in agreement with those obtained by Thompson (2000), who asked midwives (n=110) about the causes of their back symptoms; supporting mother with breast feeding (49%) and birth positions (33%) were the most commonly reported activities.

Birth pool related tasks were not included in this study as the pools had previously been evaluated and redesigned (Hignett, 1996). The task of 'moving beds through doors' were also omitted because it is not specific to midwives.

The highly rated top four tasks were:

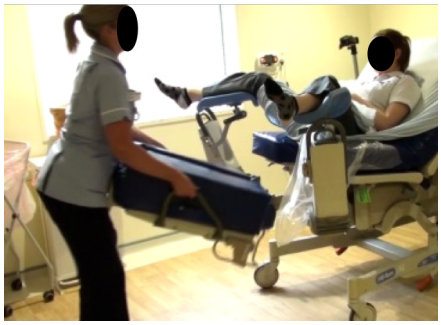
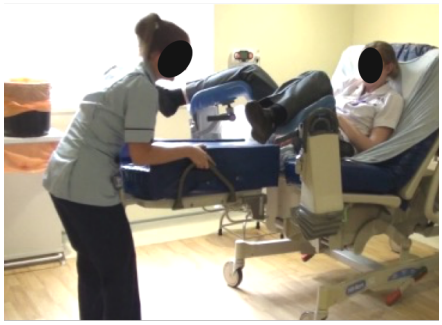
- Vaginal examination (VE) /Artificial Rupture of Membrane (ARM)
- Delivery positions with mother standing or kneeling
- Suturing, including:
    - Placing the mothers' legs in lithotomy
    - Taking out the end of the bed and putting it back in
- Supporting breast-feeding

These tasks were divided into 9 tasks for analysis. Table 6.3 presents the description and reason for selection with example pictures.

Table 6.3: Tasks chosen for analysis with description and reason for selection

	Picture	Description	Reason for selection
1		**Vaginal examination (VE) / ARM** VE is an essential care activity that midwives involved frequently to assess the progress of labour. In early stages of the labour, ARM can be applied to induce labour, following VE. A midwife commonly sits on the edge of the bed and turns her face to the mother and carries out the procedure using both hands with an amnihook (if necessary), as shown in the picture. ARM is applied only once and the procedure lasts about 10 minutes depending on the mother's cooperation and comfort.	Reported to cause discomfort
2		**Delivery positions with mother standing** This task involves a midwife caring with a mother in standing labour position. The caring activities include listening the fetal heart (auscultation), vaginal examination and grabbing the new born baby. A midwife commonly carries out the procedures on the floor with bending and upper arm flexed and/or abducted position. The overall labour duration is unpredictable; however a midwife is in this position to monitor fetal heart rate or vaginal examination once every 15 minutes for 60 seconds in the first stage; after every contraction or every 5 minutes in the second stage of the labour.	Reported to cause discomfort Extreme, awkward

3		**Delivery positions with mother kneeling on the floor** In this position, a mother is in a kneeling and bending forward position, and a midwife is mostly on her knees with excessive trunk flexion and twisting to carry out the procedures at least once every 15 minutes.	Reported to cause discomfort Extreme, awkward
4		**Delivery positions with mother kneeling on the bed** A mother can kneel on the bed during the labour, so a midwife works in standing position. She carries out regular vaginal examination, auscultation and grabs the new born baby in this position with bending over to reach and see. The frequency varies, but a midwife gets this position at least once every 15 minutes for caring activities.	Reported to cause discomfort
5		**Placing the legs into lithotomy before suturing** A midwife starts to prepare a mother for perineal suturing after labour. In this task, a midwife lifts a mother's legs lying on the bed and places them into lithotomy. This picture shows a midwife grabbing the both legs from the ankles and lifting at the same time with trunk flexion. Considering the average weight of a leg to be 12 kg and mother not being cooperated or tired after delivery, this task requires a great muscle force.	Reported to cause discomfort Requiring great muscular activity/ forces

6		**Detaching the end of the bed before suturing** The bed needs to be prepared for suturing process. After placing the legs into lithotomy, the end of the bed (with a separate mattress part) is taken out in order to get closer. The detachable part in this picture weights around 6 kg. A midwife lifts and then places it on the floor to attach it later.	Reported to cause discomfort
7		**Suturing process** This task requires midwives to sit on a chair, get the equipment ready on a tray near them, place the source of light (mostly left/right back of the midwife) and carry out the procedure, which lasts 20-30 minutes.	Reported to cause discomfort Sustained long duration
8		**Attaching the end of the bed after suturing** After the completion of the suturing, the detachable part is lifted from the floor and placed into the attachment points in the bed. The detachable part in this picture weights around 6 kg.	Reported to cause discomfort
9		**Supporting mother with breast feeding** After the labour, mothers are supported for breast feeding. A midwife is on the side of the bed standing and bending to see clearly the feeding pattern and support by hand from baby's head if necessary. The duration of this task depends on the mother and baby's cooperation, but on average it takes 30 minutes.	Reported to cause discomfort Sustained long duration

Each participant carried out all 9 tasks in sequence, starting with vaginal examination and ending with supporting a mother with breast feeding, with data collection taking about 30 mins for each midwife. At the end of the tasks, each participant completed a questionnaire with questions about their demographics (age, height, weight and dominant hand) and work situation (clinical experience, work pattern).

The most extreme postures adopted by participants during the tasks were extracted from the video data, with event sampling. Three cameras positioned in the room (See Figure 6.1) enabled to ensure the body angles were captured properly. These camera records for the each same posture were assessed in order to ensure the best view to measure the range of motion. Using REBA, each participant's posture angles of trunk, neck, legs, upper arms, lower arms and wrist were assessed. An example of body positions with angles is illustrated in Figure 6.2. A goniometer was used to measure the range of motions for each posture.

Figure 6.2: An example of the measurement of body angles

A score was assigned according to REBA sheet with the measured range of motions. In addition, twisting or side flexion of the trunk and neck; weight bearing on the legs; abduction, rotation, shoulder elevation, support or gravity assistance of the upper arms; and deviation or twisting of the wrist were scored. The position of grip, load being carried and the activity were also considered and rated. Then, the scores

for each part were combined to generate a final REBA score indicating the degree of MSD risk (action category, Table 6.1). Descriptive statistical tests were used to present the summary of demographics and REBA scores.

6.3.4 Inter-rater Reliability

An inter-rater reliability exercise was conducted on the REBA assessments. Approximately 7% of the data (n=10 postures) were assessed and rated independently by 14 trained raters (including the researcher). The level of agreement between the 'raters' was quantified by using Intraclass Correlation Coefficient (ICC) for the final REBA scores. ICC is a measure of agreements of ratings and the values of the correlation can be interpreted as follows:

- < 0.5 = poor,
- 0.5-0.75 = moderate,
- 0.75-0.9 = good,
- > 0.9 = excellent agreement (Koo and Li, 2016).

Single measures are used to answer the question of 'How accurate would a single rater be in assessing the images using REBA tool?' Table 6.4 shows the analysis results for the final REBA scores. The single measure was found 0.779, which is 'good' according to the interpretation of values (Koo and Li, 2016).

Table 6.4: Intraclass correlation coefficient analysis results

Intraclass Correlation Coefficient

	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.779[a]	.499	.981	56.518	3	39	.000
Average Measures	.980[c]	.933	.999	56.518	3	39	.000

Two-way mixed effects model where people effects are random and measures effects are fixed.

a. The estimator is the same, whether the interaction effect is present or not.

b. Type A intraclass correlation coefficients using an absolute agreement definition.

c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

6.4 Results

This section starts presenting the characteristics of the participants, and then the results of the REBA analysis.

6.4.1 Study Population

22 midwives were recruited to perform the identified tasks in a maternity unit setting. Their characteristics are presented in Table 6.5.

Table 6.5: Characteristics of the participants (n=22)

Characteristics	n (%) or mean (SD)	Range
Age	34.73 (8.4) mean(SD)	25-58
Height (m)	1.68 (0.8) mean(SD)	1.48-1.80
Weight (kg)	71.36 (18.6) mean(SD)	45-130
BMI (kg/m^2)	25.1 (6.3) mean(SD)	15.6 – 48.3
Dominant hand Right Left	 19 (86.4) n (%) 3 (13.6) n (%)	 N/A
Years practicing in midwifery	6.41 (6.02) mean(SD)	1-21
Work pattern Full time Part time	 18 (81.8) n (%) 4 (18.2) n (%)	 N/A

The participants were aged between 25 and 58, with a mean age of 34.7 years (SD=8.4). The average height and weight of the participants were 1.68 metres (SD=0.8) and 71.36 kilograms (SD=18.6), respectively. The BMI of each participant was calculated and the average BMI was 25.1 (SD=6.3). The majority of the participants (64%, n=14) were in normal weight group, with only one participant underweight. The remainder were either over weight (23%, n=5) or obese (13%, n=3). The participants' mean years practicing in midwifery was 6.4 years (SD=6.02) with a range of 1-21. The majority (81.8%, n=18) were full time workers.

6.4.2 REBA Scores

A total of 141 positions that belonged to each midwife for each task were identified from the video recordings with the three cameras placed in different angles. Table 6.6 shows the analysis of the postures using the REBA worksheet.

Table 6.6: Postural analysis results with REBA scores

Task no	Number of participants performed the task	Body parts in the most extreme position	Mean REBA score (SD)	Range	Action level	Risk level	Action
1	20	Trunk Neck Wrist	7.2 (1.2)	6-9	2	Medium	Necessary
2	17	Legs Trunk Neck	10.2 (1.2)	8-12	3	High	Necessary soon
3	15	Legs Trunk Neck	10.8 (0.7)	9-12	4	Very high	Necessary NOW
4	12	Trunk Neck	7.9 (1.8)	5-11	3	High	Necessary soon
5	14	Upper-arm Trunk	6.6 (1.2)	5-9	2	Medium	Necessary
6	16	Trunk	5.3 (2.2)	3-9	2	Medium	Necessary
7	14	Trunk Neck	4.8 (1.1)	2-7	2	Medium	Necessary
8	15	Trunk Neck	5.6 (1.3)	3-7	2	Medium	Necessary
9	17	Trunk Neck	5.8 (1.6)	4-10	2	Medium	Necessary

It was observed during data collection that there were differences in working postures for the same task. Although the environment, equipment and the model were the same, each participant had slightly different caring strategies so the REBA scores varied for the same tasks. Illustrations of postures for each task are presented below.

Task 1 – Vaginal examination / ARM for mother on the bed (n=20)

Vaginal examination process was the highest rated physically challenging task by the interviewees (Chapter 5). During this task, all participants sat on the edge of the bed and turned to the mother's face for the examination (Figure 6.3). The most affected body parts in this position were trunk, neck and wrist. The trunk movement was mostly >20^{o} (either flexion or extension), with twisting/side flexion; neck flexion was >20^{o} with twisting/side flexion; wrist was >15^{o} flexion/extension with deviation. The midwives were static in this position for about 5 minutes, which added more pressure in the musculoskeletal system. The mean REBA score was 7.2

giving an action level of 2 (medium risk) and the recommendation that action is necessary to further assess this task.

Figure 6.3: Posture of a participant involved in vaginal examination / ARM (right and left front views)

Task 2 – Delivery positions with mother standing (n=17)

There were a variety of adaptations for this task by the participants. The majority preferred to kneel on the floor; a few stood and bent forward to care for mother, or squatted. The body parts in most extreme position were the legs (particularly knees), trunk and neck. The weight bearing on legs was mostly bilateral, but knees were mostly >60^{o} flexed position (Figure 6.4). The amount of time in this position is unpredictable; so the midwives kneel during the labour (maybe 1-2 hours) or for examination. Trunk and neck positions were extreme with movement for both body parts of >20^{o} flexion with twisting/side flexion. The mean REBA score was 10.2 with an action level of 3, indicating a high risk of injury and the recommendation that action is necessary soon including further assessment.

Figure 6.4: Postures of two participants involved in delivery with mother standing

Task 3 – Delivery positions with mother kneeling on the floor (n=15)

Similar to Task 2, the most extreme body parts were legs (particularly knees), trunk and neck. All participants had to kneel for this task (Figure 6.5). The knees were again >60^{o} flexed position. This task had higher mean total REBA score (10.8) than standing position delivery. This score is an action level 4, indicating a very high injury risk for midwives and the recommendation that action is necessary NOW including changing or avoiding this position.

Figure 6.5: Posture of a participant involved in delivery with mother kneeling on the floor

Task 4 – Delivery positions with mother kneeling on the bed (n=12)

When the mother is on the bed, midwives are mostly stood for the caring activities; therefore in this task, the trunk and the neck were the highest scored body parts as participants were bending from the side of the bed for caring or regular assessments, resulted in trunk flexion with twisting and neck extension with side flexion/twisting (Figure 6.6). The positions in this task gave a 7.9 mean REBA score and action level of 3. This indicates a high injury risk for midwives and the recommendation that action is necessary soon including further assessment.

Figure 6.6: Posture of a participant involved in delivery with mother kneeling on the bed:

Task 5 – Placing the mothers' legs into lithotomy before suturing (n=14)

This task involves midwives lifting the mother's legs and placing them in the lithotomy position (Figure 6.7). There were varieties within the participants with the majority of them lifting both legs at the same time (each leg was hold by each hand of the midwife) and placing into the lithotomy. Others either preferred to get help from a second person to hold one leg (therefore, each person lifted one leg from the side of the bed and moved together) or place the legs separately (first, one leg was placed, then the other one). The most extreme positions during this task were scored in upper arms and trunk. The upper arms were mostly >45^{o} flexed and abducted position, with sometimes shoulders were elevated. The trunk was >20^{o} flexed position. Considering the weight of a leg being >5 kg, this lifting position resulted in a mean total REBA score of 6.6 (action level of 2), indicating a medium injury risk for midwives and the recommendation that action is necessary for further assessment.

Figure 6.7: Postures of two participants placing the mother's legs into lithotomy

Task 6 – Detaching the end of the bed before suturing (n=16)

This task causes the trunk to be in the most extreme position with lifting >5 kg in a trunk >20^{o} flexed position (Figure 6.8). Not having handles on the sides also resulted in more bending to grip the detachable part. The mean total REBA score for this task was 5.3 (action level of 2), which indicates a medium risk level and the recommendation that action is necessary for further assessment.

Figure 6.8: Posture of a participant detaching the end of the bed

Task 7 – Suturing process (n=14)

The midwives sat on a chair (Figure 6.9), and turned to get equipment from the tray to carry out the suturing process. The most extreme body parts for this task were the trunk and the neck, as the participants had trunk and neck in >20^{o} flexed positions, with constant twisting to get equipment from the adjacent tray. It was

also observed that the source of light caused midwives to adjust their position (trunk side flexed) to avoid shadow. Therefore, the total REBA score was 4.8 (action level of 2) that indicates medium risk level and the recommendation that action necessary for further assessment of this task.

Figure 6.9: Postures of two participants involved in suturing

Task 8 – Attaching the end of the bed after suturing (n=15)

The suturing process was completed with attaching the end of the bed (Figure 6.10). The most extreme positions for this task were observed in the trunk and neck. Similar to detaching (Task 6), the trunk was >20^{o} flexed position with >5 kg load. But additionally participants were searching for the attachment point of the bed and this resulted in neck side bending. Therefore, the mean REBA score was slightly higher at 5.6 (action level of 2) indicating medium injury risk level and the recommendation that action is necessary for further assessment.

Figure 6.10: Positions of two participants attaching the end of the bed

Task 9 – Supporting mother with breast feeding (n=17)

Supporting a mother with breast feeding was the second highest physically challenging midwifery task reported by the interviewees (Chapter 5). This task puts the trunk and neck in extreme positions. Participants mostly stood near the bed and bent over the mother (Figure 6.11), with the trunk and neck movement >20^{o} flexion. Only one participant preferred to sit on the edge of the bed and turned to mother and baby with trunk flexion and twisting movement (Figure 6.12). The time spent in this task varies in real practice, but on average it lasts 30 minutes. The static and flexed movement in the trunk and neck for participants resulted in a mean total REBA score of 5.8 (action level of 2). This indicates medium risk level and the recommendation that action is necessary.

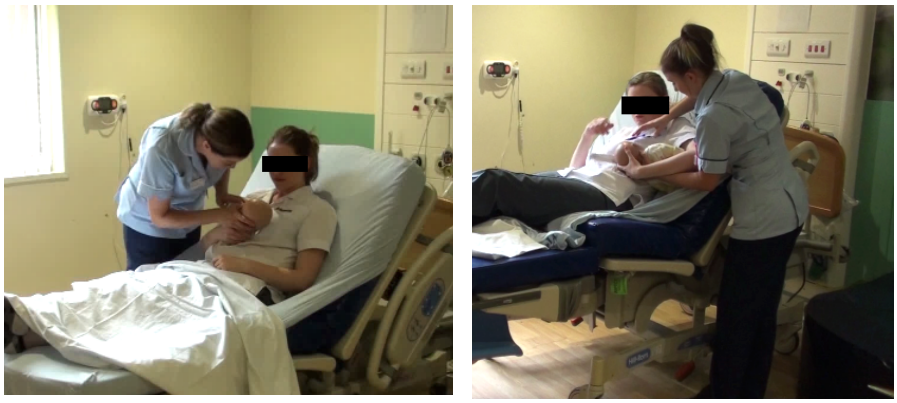


Figure 6.11: Postures of two participants involved in supporting mother with breast feeding (standing)

Figure 6.12: Posture of a participant involved in supporting mother with breast feeding (sitting)

6.5 Discussion

The size of working postures has been well documented for exploring the risk of developing MSDs, but there is little evidence for investigating working positions of midwives. Nowotny-Czupryna *et al.* (2012) assessed exposure on the musculoskeletal system (only spinal line; neck, upper back and lower back) of midwifery caring tasks with a mother delivering supine position on the bed. However, in the UK over 20 years, mothers have been encouraged to be more mobile during delivery including kneeling, standing, sitting and getting into birth pools, unless there is a risk for mother or baby. The increased variety of delivery options requires midwives to be capable of supporting mothers in different positions. This study addressed not only the different delivery positions but also other midwifery tasks reported to cause MSD including breast feeding support (Thompson, 2000) and perineal suturing steps.

The REBA analysis categorised the MSD risks for commonly adapted midwifery tasks. All the postures showed a medium to very high REBA risk levels with action categories ≥2 indicating that change is definitely necessary. Of these, immediate action is required for the delivery positions where the mother is kneeling on the floor; and action is necessary soon for the delivery positions where the mother is standing on the floor and where the mother is kneeling on the bed. Trunk and neck positions were observed to be affected in all midwives' postures with a range of motion mostly >20^{o} and twisted or lateral flexed positions. This result is consistent with that of Nowotny-Czupryna *et al.* (2012) who found the lower back to be the most affected body part (the second was neck) during a basic delivery position with the mother is supine on the bed. They measured the exposure on the back, neck and upper back with an ultrasonic device and OWAS; however, the authors stated that OWAS did not provide specific results as it was not sensitive enough for the range of motion angles.

Vaginal examination or ARM caused midwives discomfort with wrists, trunk and neck due to the sitting in a twisted position. The knees were found to be at risk of injury for delivery positions on the floor due to long duration sustained knee flexion. The task of 'detaching the end of the bed' in the suturing process was observed to affect midwives' upper back as well as their lower back due to carrying >5 kg load flexed. Although some suturing steps such as lifting the end of the bed and replacing it after suturing are not midwifery specific tasks (as lifting is a common activity in almost all sectors), the bed and room/ equipment is specific to midwives. In addition, the exposure from the each task may be cumulative.

There were differences in REBA risk levels, which might partly due to the diversity of midwives' characteristics, e.g., experience, age, height and weight. Although the data was not suitable for statistical analysis, the observation of data suggests that the height of midwives impacted the caring positions. For example, taller participants had extreme trunk and/or neck flexion movements, and shorter participants had higher degrees of upper arm movements for lifting tasks such as placing the legs into lithotomy and detaching the end of the bed.

Training is another factor that might affect variation in risk levels. The lack of guidelines and midwifery focussed manual handling trainings (including different delivery and caring positions) may result in midwives developing ways to feel comfortable, which may not always be safe. The only guideline is from the Royal College of Midwives (RCM) (Royal College of Midwives, 1999), but there have been many changes in practices, equipment and mothers' characteristics over the last 20 years. For example,

- The end of the bed is detached and attached with its mattress during the suturing process. Some participants preferred to separate them before moving, which lowered the abduction and flexion degree for the upper arm.
- The task of 'placing the mothers' legs into lithotomy' was difficult and exacerbated if mother had an epidural or high BMI. There were differences in practice: some moved them together with an over stretching of back, which puts extreme pressure on back and upper backs; others put them separately from the side of the bed, which is less likely to affect body parts.

Another example from the observations addressing the differences in practice was using the equipment properly, particularly beds. The height of the bed size can be adjusted to a certain level according to the midwife's comfort. A bed being too low during breast feeding support caused midwife to bend more than she should, which resulted in higher scores for back in the analysis; or a bed being too high during placing the legs into lithotomy caused midwife to have larger upper arm movements with a >10 kg load.

In addition, there was a minor difference in 'suturing process' task which lowered the trunk scoring levels. Some participants put the equipment tray on their knees in the sitting position thus they did not need to twist and side flex to reach. However, this application has safety risk as there are sharp tools on the tray. Therefore, in general, the knowledge and ability of using the equipment properly might decrease the level of risk. It is not clear from this study whether the differences in practice

have any association between participants' education/training levels or demographics. Nowotny-Czupryna *et al.* (2012)'s study also compared the body positions of senior midwives who have been practicing in midwifery >7 years aged 30-50 and junior midwives aged 21-23 during the delivery with a mother supine position on the bed. The results did not show significant differences; only in thoracic region juniors had larger movement range than seniors.

6.6 Limitations

This study was limited by the absence of real practice observations as the tasks were performed with a model, not with a childbearing mother. That might have resulted in missing some other factors occurring in real practice such as mothers with minimal cooperation and/or resistance with mothers pushing the midwife away.

It is possible that the participants did not show the postures that are used in a real practice. They might have been more careful about their positions, even though they were encouraged to perform the tasks normally. Performing with a model had the advantage of creating a controlled environment, with minimal concerns about the mother and baby's safety. The presence of an external observer (and cameras) might have distracted the midwives and influenced the patient care activities and safety. Moreover, video recording in a real patient care setting would be problematic with regards to privacy and would take a long process to gain ethical approvals. Apart from the real work, other conditions (environment, equipment, staff and organisation) were the same as in an actual practice, for example midwives' were wearing their uniforms to reflect any potential activity limitations. The time required to performance certain tasks was reduced. This was another limitation of the study. This is difficult to predict as nature of delivery varies depending on the mother and baby's conditions.

Although the multi directional filming provided an advantage for recording postures and movements from different angles, some drawbacks were identified. For example, the small size of the delivery room led to difficulties for setting up the

camera tripods; recording a moving dynamic target (midwife) required frequent adjustments of the camera angles for the best images, which caused disruption between the tasks.

Although the REBA assessed many aspects of the midwifery working tasks, one issue that was not addressed was the slippery or wet surfaced load, which might have affected the holding force or pressure in the body parts, mainly when the new born baby is held by the midwife.

The number of the participants and the diversity was a strength of this study. However there is a lack of information about the combination of the risk levels for one task applied by different participants, therefore, it was difficult to weight the risk level of each task to midwives' musculoskeletal system, and the range of the REBA risk levels was quite wide for certain tasks. This makes results less generalisable. However, it should be noted that the diversity in participants' characteristics, practice and ability of adapting the positions provided information for future actions and recommendations.

6.7 Summary

This study aimed to analyse the midwifery working tasks with regards to risks of MSD to midwives. REBA enabled a detailed risk analysis of the most commonly identified extreme awkward positions. The findings support the following conclusions:

- The REBA action levels were ≥2 indicating that changes are definitely necessary to reduce MSD for midwifery specific working postures.
- The trunk is the most affected body part; it had high REBA scores in all observed tasks.
- The neck is the second most affected body part with seven tasks (out of nine) resulting the neck in an awkward position.
- The upper arms and wrist had the highest REBA scores indicating extreme positions when placing the mothers' legs into lithotomy and vaginal examination/ARM position (with midwife sitting on the edge of the bed).

- The REBA scores varied for a same task performed by different midwives. It was also observed that there were slight differences in practice which were recorded in the REBA scoring. This indicates that midwives' characteristics (e.g., age, height, weight), training levels and ability using the equipment might impact on the risk of MSD.

7. Discussion

7.1 Introduction

This chapter will combine the results and generate insights from the three studies. There has been a wealth of research evidencing the MSD risks associated with manual handling and lifting in healthcare; this issue is particularly well documented for nurses (Smedley and Coggon, 1994; Hignett and Richardson, 1995; Smedley *et al.*, 2003). The review of the literature (Chapter 2) about maternity professionals caring for women in labour, namely midwives and obstetricians, has shown that to date there has been only limited focus on investigating MSD in these particular occupational groups. As previously discussed, each health profession has its own working patterns and equipment, and therefore have different risk levels for MSD; it is also clear that specific management strategies are required for each profession. The research for this thesis is crucial and forms an evidence base from which to develop strategies to reduce MSD in midwives.

This chapter begins with a summary of key results and messages. It is followed with a discussion of the main themes from this research. Finally, interventions to reduce MSDs will be briefly described and discussed.

7.2 Summary of Key results and Messages

Over 20 years ago, the focus of research was mostly on exploring the risk associated with developing MSD, and guidelines were published by each organisation relating to their own practice to address the issue (Chartered Society of Physiotherapy, 1998; Royal College of Midwives, 1999; Royal College of Nursing, 2003). There have been no updates since the manual handling guideline was first published in 1999 relating to midwifery practice, despite data (Chapter 2, mostly from RCM) showing an increase in birth rates with more women pregnant at older ages resulting in greater complexity during pregnancy and childbirth. In the absence of any real data being reported in relation to this issue over the last 20 years, gaining an essential understanding of risk factors via different methods is critical to the development of management strategies to reduce MSD in this occupational group.

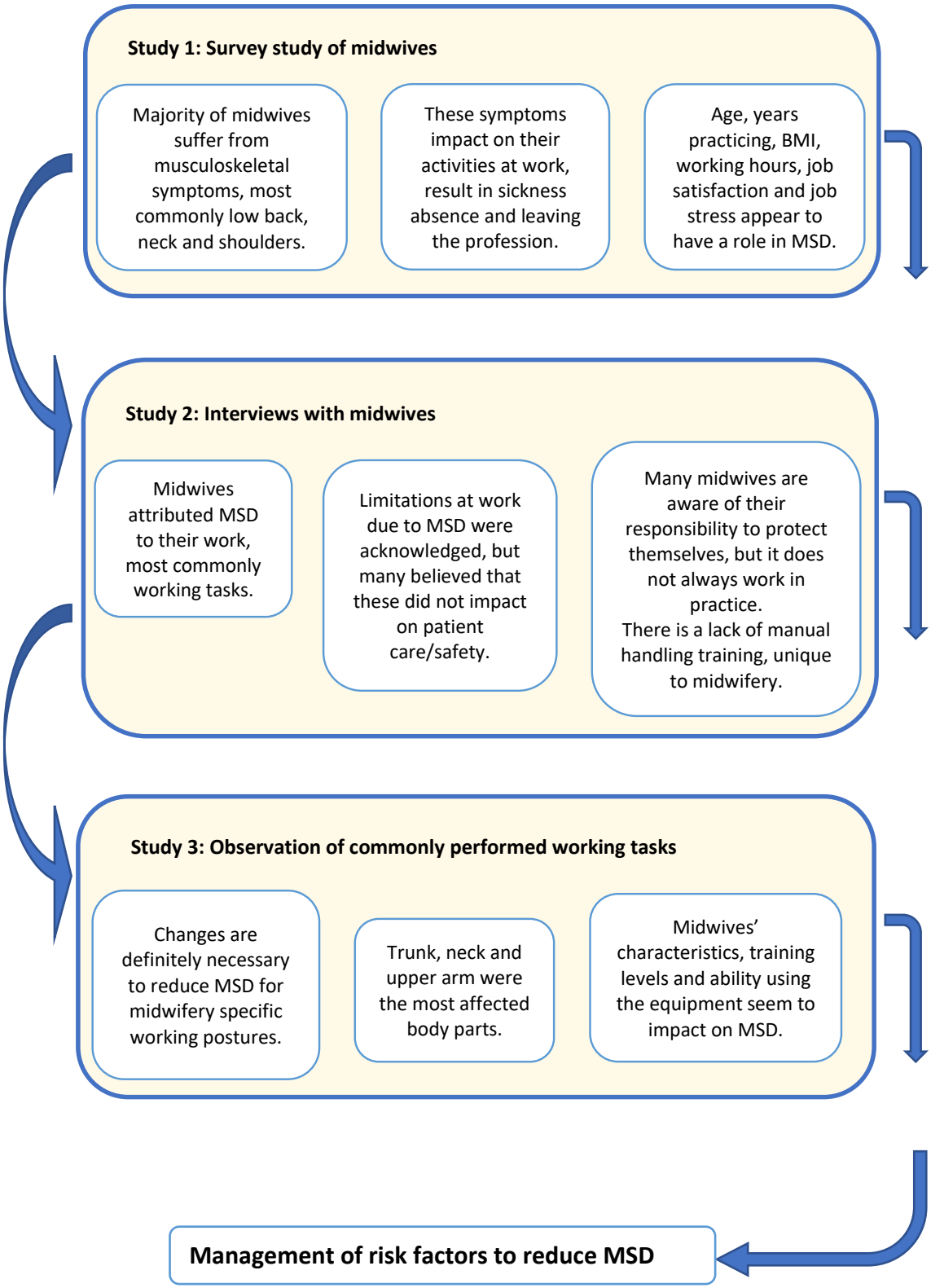
Study 1 explored the prevalence and contributory factors to MSD in midwives via a survey study (Chapter 4). The findings showed a very high prevalence within a large sample group of midwives (n=635). The most commonly injured body parts were the lower back (71%), neck (45%) and shoulders (45%) within a 12-month period. More than half of the participants attributed their symptoms to work-related activities. The consequences and impact of these symptoms were recorded in sickness absence rates (30%), reduction/limitations in normal activities at work/leisure (50%) and changing job/duties (45%) due to symptoms. The survey results highlighted significant issues with very high MSD reporting; these symptoms have an impact on working activities, with age and years of experience being inversely associated with the prevalence of MSD.

Study 2 (Chapter 5) used interviews to explore the issues highlighted in the survey results and also to determine the level of awareness of health and safety issues amongst midwives and any prevention strategies used. Interviews were conducted with 15 midwives and a further confirmation focus group with seven midwives. The majority of the interviewees had some degree of MSD; only three did not report any symptoms. Many attributed their symptoms to work-related activities. They did not find manual handling training useful due to the lack of content specific to current midwifery practice. These findings corroborated the data from the survey; however, they also raised questions about the nature of midwifery working tasks and working positions.

Study 3 (Chapter 6) was an observational postural analysis study of the most commonly reported working postures that could contribute to the risk of developing MSD. The evaluation used REBA postural analysis, with 22 midwives performing nine tasks. The findings suggested that working postures play a significant part in midwives developing MSD as all the postures had a very high to medium risk levels that most commonly affected the trunk, neck and upper arms.

The key results for the three studies are summarised in Figure 7.1.

Figure 7.1: Key results and flow between the research studies



The overall research findings suggest a number of key messages:

- The prevalence of MSD is high in midwifery and has an impact on caring activities due to staff shortages, sickness-related absences and functional limitations. It is important to maintain healthy ageing at work and to support staff practicing longer working lives in midwifery.
- Organisations have a key role in reducing MSD. Midwifery practice has changed over the last 20 years with longer shift hours, fewer staff, higher numbers of more complex cases with mothers, and a generally less supportive culture. These factors contribute significantly to the risk of developing MSD. Participatory ergonomics may be an effective approach to the reduction of MSD amongst healthcare staff through the development of management strategies.
- The current manual handling training is not conducive to the reduction of MSD. The associated guidelines, however, have not been updated for 20 years and so cannot reasonably be said to be applicable in current midwifery practice.

7.3 Discussion of the Main Themes

The results and key messages from the three studies are presented as main themes for discussion:

- Professional culture
- Organisational culture
- MSD in 2018

These three themes will locate the empirical research from this thesis in the context of both the literature and contextual changes in the NHS over the last 20 years.

7.3.1 Professional Culture

Results from the interview study showed that midwives have the appropriate knowledge and awareness of good practice for general manual handling operations such as holding the load closer to the body, avoiding lifting and stooping, but find it hard to apply these methods in practice. This links to the postural analysis findings with all postures being classified at very high to medium risk levels with action

categories indicating that change is definitely necessary. Observations of practice (22 midwives) identified differences in, for example caring positions and equipment usage, which changed the REBA risk levels.

Overall, these findings support the conclusion that professional guidelines cannot be applied in practice. For example, despite the regulations advising no lifting in caring facilities (Health and Safety Executive, 2016), midwives described manually lifting women's legs into lithotomy (even bariatric women). In certain circumstances (e.g., a woman not being cooperative and wanting to be moved as well as inability or lack of knowledge as to how to use the equipment (hoists) when necessary), it is advised to use equipment or ask for staff/birth partner support. Another example specific to midwives is that delivering babies is focussed on the woman and her needs/decisions/choices (Cumberlege, 2016). This results in midwives potentially having to adopt awkward positions including twisting, over neck and back flexion and kneeling; it is hard to avoid these positions in a low-risk delivery (where the woman is less likely to be on the bed), as illustrated in the postural analysis study (Chapter 6). This supports the position that standards or guidelines are not reasonably practicable in a real-world situations for this particular occupational group. It is stated that *'providing information and training alone will not ensure safe manual handling - the manual handling operations should be designed to be as safe as practicable'* (Health and Safety Executive, 2016). This also involves improvement of tasks, equipment and environment.

This issue has also highlighted the importance of integrating guidelines into practice. Fallentin *et al.* (2000) reviewed and evaluated twenty-four physical workload standards and guidelines representing a variety of international professional bodies, including the International Ergonomics Association (IEA), National Institute for Occupational Safety and Health (NIOSH) and the (United States) Occupational Safety and Health Administration (OSHA), with regards to scientific coherency, efficacy and usability. They concluded that there is a need for more user friendly guidelines to improve implementation in practice. An evaluation process was suggested for the effectiveness and development of the regulations,

with the adaptation of an *'integrated ergonomics program approach'* being suggested as most beneficial to developing the regulations to combat MSD.

The Manual Handling Operations Regulations (1992) and Guidance were evaluated in both 1997 and 2001 within various sectors including agriculture, construction, healthcare, transport and finance (Tesh *et al.*, 1997; Lancaster *et al.*, 2001). The associated survey of 5,000 employers (Tesh *et al., 1997)* showed that one third of these sectors had implemented the regulations. A survey of 10,000 employers by Lancaster et al. (2001) reported that 67% of organisations had taken any action to ensure the appropriate management of manual handling risks. Lancaster et al. (2001) also interviewed professionals and national bodies. Their findings supported the perception that the regulations will result in '*expenditure in equipment and new processes'*. It has been suggested by some organisations (e.g., the Royal College of Nurses) that the guidance should be implemented in manual handling training. Each professional body was advised to generate their own guidelines, specific to occupational requirements. For risk assessment, the documents were criticised for being unclear with too much variability, resulting in confusion and avoidance. Fear of compensation claims and enforcement were the most common motivations for organisations to implement the regulations. In general, the main negative aspects of guidance were those of being unclear about training, lack of a systemic approach and lack of worker involvement.

The latest guidance from the RCM was published in 1999. This included situations and activities which are unique to midwives and are particularly hazardous, including delivery (water birth, sitting or kneeling on the bed, standing or kneeling on the floor), supporting mothers in breastfeeding, caring for high dependency and disabled mothers, home births and handling of equipment (RCM, 1999).

It is surprising that no update has been published since then, despite the many changes in maternity services including mother and staff profiles, new technology and improvements in the birthing process (Chapter 2). Reasons for the lack of updates were suggested by the RCM representatives to be (1) staff can easily access advice via organisations' occupational health or human resources departments, (2)

the RCM has health and safety representatives who are trained to support midwives in the Trusts (Boxall, 2012), and (3) manual handling training has been mandatory for staff since 1999, so midwives have been assumed to gain benefit and support from this training.

Manual handling training is designed to provide workers with knowledge about the risks associated with manual handling and to support their skills in practice (Health and Safety Executive, 2016). The interview study (Chapter 5) found that midwives were aware of risks and prevention strategies and that they had a responsibility to protect themselves, but they expressed the idea that it was not always possible to think about themselves while working. This correlates with evidence from a recent systematic review (Hogan *et al.*, 2014) that workers' reports of understanding and awareness levels do not always result in behavioural changes in practice. Additionally, a lack of manual handling training or guidelines specific to midwifery-related tasks was frequently highlighted by midwives; almost all agreed that the manual handling training did not meet the requirements of midwifery-related tasks and equipment.

> *I think we have come a long way with our manual handling training and training we get. I think in the situation we forget, it just goes out the window because you are just thinking about the woman and just giving her the care, so all that training you get… Or it might be that you get basic training as in moving a patient from a bed to chair, whatever, but actually nobody concentrates on maternity sort of manual handling. When we do our manual handling training, because I am a manual handling trainer, it is very focussed on, you know, older people or sick people - not on sort of maternity. And if you mentioned the odd thing like, 'we have an evacuation from a birthing pool, what would you do?', they would be like 'well, you know – we will have to find it out for you… I don't think there is anything specific to maternity. Maybe that is something that we need to look at more so." (M04)*

UK health care staff attend regular mandatory manual handling training sessions. However, these are mostly targeted towards nursing-related tasks, such as

transferring a patient from bed to bed, bed to chair, sit to stand; use of hoists; safe lifting principles (keeping the object close to the body, less bending instead kneeling). This thesis confirmed that midwives have not benefited from this compulsory training in the sense of reducing their MSD risk. This is consistent with previous systematic reviews (Hignett, 2003; Dawson *et al.*, 2007; Clemes *et al.*, 2009; Verbeek *et al.*, 2011; Hogan *et al.*, 2014) which suggest that manual handling training has no impact on reducing MSD.

In general, it is a problem that manual handling training is rarely tailored to a particular occupation or task. For example, McDermott *et al.* (2012) investigated the effectiveness of manual handling training practices with 120 organisations and 30 training consultancies, finding that the majority of organisations used classroom-based generic training comprising non-specific tasks. It was suggested that for manual handling training to be effective it should be task- and occupation-specific.

7.3.2 Organisational Culture

This thesis found an association between working patterns and MSD, with working hours associated with increased shoulder symptoms, and that midwives doing long shifts of more than eight hours were more likely to report lower back symptoms. The results also showed that lower back symptoms were reported more frequently with lower job satisfaction levels, and that over-commitment (intrinsic work stress) was a risk factor for neck and shoulder symptoms (Chapter 4, Section 4.7.4).

Over the last 20 years, midwifery practice has changed with longer shift hours, fewer staff, a higher number of expecting mothers, greater demands by mothers, and more complex births. This research has found that these organisation-related factors have a particularly significant impact on the risk of developing MSD because of heavier physical and psychological working demand, including:

- Higher dependency of mothers due to an increased number of instrumental deliveries and C-sections
- More complicated and risky cases, due to increased age and BMI of mothers
- Higher expectations on the part of mothers with regards to care

- Busier wards resulting in fewer breaks

As previously mentioned, the guidelines or manual handling training is not appropriate and do not meet the real current practice demands which has been changing over the years with respect to responsibilities, workload, tasks, methods and expectations. This results in a difference between '*work as imagined*' (WAI), by policy makers, regulators, managers, and authorities and '*work as done'* (WAD), in real clinical practice. Hollnagel (2015) described this gap by analogy to a triangle shape with '*the sharp end'* referring to the people who are working in the actual workplace and '*the blunt end'* representing the people who influence how work is done, in terms of safety, roles, responsibilities and resource management within an organisation. People at the sharp end can understand the process because they actively take part in the work, but those at the blunt end can only indirectly experience it and get filtered information in the form of reports, statistics, trends, etc. The distance between these ends represents delays in information and responses or feedback from the blunt end to the sharp end.

The WAI and WAD concept has been considered in healthcare for infection prevention during surgical procedures (Franklin and Stein, 2017) and emergency departments (Back *et al.*, 2017; Razak *et al.*, 2018). The gaps between WAI and WAD are suggested to result in errors and act as a barrier to best practice, for example in operation rooms for cleaning protocols and in guidelines defining staff roles (Back *et al.*, 2017).

When the protocols and guidelines lack specification or are underspecified, the people at the sharp end adjust to the situation to carry out work through (1) creating or maintaining, (2) compensating or (3) avoiding (Hollnagel, 2015). These adjustments could be in terms of time, work capacity, workload, equipment and data. Due to the unpredictability of cases and changes in the nature of the work, equipment, users, organisational culture, etc., in healthcare, frontline staff need to be able to provide appropriate care and make decisions quickly and in accordance with the situation at hand. Thus, it is called performance adjustment rather than error or violation.

For this thesis there is evidence pertaining to the WAI-WAD gaps with examples of performance adjustments to maintain best care and patient safety, which most commonly have an impact on MSD risk. One example is that in a busy ward with time pressure with regards to caring, midwives chose to skip steps to save time such as raising a bed to avoid bending and, accordingly, lower back strain (Chapter 5).

Hollnagel (2015) suggests solutions to reduce the gap between WAI and WAD with appropriate efforts from both the sharp and blunt ends:

- Reduce delays in getting information about WAD
- Precisely describe WAI and include detailed information
- People at the sharp end should be more mindful while doing their work.
- Overcome communication barriers stemming from roles, hierarchical structure, positions, tradition, etc.

Organisational culture has been linked to healthcare quality and performance (Scott *et al.*, 2003; Mannion *et al.*, 2005), and musculoskeletal health and safety (Hignett, 2001). It is simply defined as 'the way the things are done'; representing the common values, beliefs, attitudes and behavioural norms of the workers, and the effects of tasks, individuals and management strategy (Mannion *et al.*, 2004).

One of the interesting factors expressed by the midwives as having an impact on developing MSD was defensive practice (Chapter 5). There was concern about the complaints from patients, which creates an environment where midwives practice in a defensive manner. This leads them to do much more than they should, with increased muscle strain or adoption of awkward positions. This could also be linked to the survey finding that it is younger midwives who more commonly experience MSD (Chapter 4), as it was reported that younger midwives have a greater fear of litigation and accordingly just do what the women requests, even when they should not. Also, younger midwives have less experience in negotiation with the mother about positions and/or her requirements, and awareness of their working rights within the organisation. It is of interest that this is in agreement with the findings of a study of midwives in England conducted over 20 years ago (Hignett, 1996).

The definition of violence in the workplace includes physical or non-physical assault, abuse, threat, harassment, and bullying from colleagues, supervisors or clients (Di Martino, 2002). Healthcare staff are commonly reported to be exposed to violence (mostly non-physical) from patients (Estryn-Behar *et al.*, 2008; Magnavita and Heponiemi, 2012), and at a higher rate than in other sectors (Elliott, 1997) resulting in psychological disorders, lack of confidence, intention to leave and sick leave (Jackson *et al.*, 2002; Camerino *et al.*, 2008). Camerino *et al.* (2008) reported the results of the Nurses' Early Exit (NEXT) study from eight European countries involving over 34,000 nurses. Consistent with the findings of this thesis, this large study found that younger nurses are exposed to a higher number of incidences of various types of violence, mostly from patients and their relatives. Another finding from the NEXT study was that being exposed to violence resulted in hesitation in clinical practice and poor communication with patients and their relatives. This accords with the findings of the interview data (Chapter 5); increased physical activity in practice was a consequence of fear of litigation.

A supportive culture in an organisation has a key role in not only reducing the risk of MSD but also in increasing the success of organisations' MSD management procedures (Hignett, 2001; Barling *et al.*, 2002). For example, in a culture where workers feel properly supported and trusted, they will be more open about reporting their symptoms and limitations without fear of litigation or losing their jobs. It is well known that early identification of symptoms is crucial to avoiding cumulative effects and inevitable injuries (Vanwonterghem *et al.*, 2012).

Oakman *et al.* (2016) found in a large food company that the perception of a poor workplace culture by workers, particularly younger staff, was associated with a higher risk of MSD. This agrees with the findings of this thesis in the sense that younger midwives had the perception of less support from organisations/managers in terms of minimising the risks of MSD. The findings of a study of more than 5,000 workers from the general UK adult population working in sectors where they are paid according to their rate of work (e.g., clothes industry, agriculture) showed that limited supervisor support and job control can be associated with an increased risk

of MSD (Lacey *et al.*, 2007). It would be beneficial to train managers/supervisors in effective safety leadership (Barling *et al.*, 2002; Eatough *et al.*, 2012). Organisations have been encouraged to consider the contribution of psychosocial factors at work to MSD, and to develop strategies to improve such factors using the participatory ergonomics approach in which workers are actively involved in feedback about working conditions (Eatough *et al.*, 2012). This would develop communication between managers/supervisors and workers, and would improve the associated occupational culture (Cole *et al.*, 2005).

7.3.3 MSD in 2018

MSD has always been an issue for health professionals, particularly for nurses (Trinkoff *et al.*, 2002; Yassi and Lockhart, 2013). At the present time, epidemiological studies still report high rates of injuries leading to sickness-related absences, work disability and compensation costs (Ribeiro *et al.*, 2017; Office for National Statistics, 2018). As the survey study reported a very high prevalence of MSD in midwives (Chapter 4), one of the key messages from this research is that little has changed over the last 20 years; MSD was highlighted as being problematic for midwives in 1996.

The guidance offered by the competent professional bodies (Chartered Society of Physiotherapy, 1998; Royal College of Midwives, 1999; Royal College of Nursing, 2003) has focussed on technique training to prevent or reduce MSD; however this is known to have little or no impact on working practice or injury rates amongst healthcare staff (Hignett, 2003; Dawson *et al.*, 2007; Clemes *et al.*, 2009). The most recent systematic reviews also show that manual handling training and 'no-lifting' policies do not have significant effects on MSD amongst nurses (Richardson *et al.*, 2018; Van Hoof *et al.*, 2018). This was argued to be the case because manual handling training emphasises lifting and transferal tasks, but concentrates less on static and repetitive non-lifting tasks (e.g., bending, twisting) or cumulative stress-related discomfort (Van Hoof *et al*., 2018).

Richardson *et al.* (2018) and Van Hoof *et al.* (2018) both concluded that there is a dearth of evidence supporting interventions for treating or preventing lower back

symptoms in nurses. A person-centred approach, taken from a multidimensional biopsychosocial perspective that includes physical (e.g., working postures, workload exposure), psychological (e.g., stress, emotions, cognitions), social (e.g., culture, socioeconomic, work home environment), lifestyle (e.g., sleep, physical activity level) and demographics (e.g., gender, age, genetics) is key to ensuring interventions are effective, rather than applying interventions in general (Hignett, 2003; Richardson *et al.*, 2018; Van Hoof *et al.*, 2018). Interventions will be discussed further in section 7.4.

7.3.3.1 Ageing Workforce

There has been a rapid global population growth over the last 50 years, but high and medium income countries such as the USA, Canada, much of Europe, Japan and Russia are facing a decline in population growth rates (Ezeh *et al.*, 2012). This leads to an ageing demographic; for example, between 2010 and 2050, the proportion of people aged over 65 years is expected to increase from 16% to 27% in Europe, from 13% to 22% in the USA and Canada, and from 23% to 38% in Japan (United Nations, 2011). Parallel to this, the workforce is also ageing, and organisations want employees to work longer, with increases in retirement and pension ages. For midwifery, according to the NHS pension scheme (2015a), staff born after 1978 have a state pension age of 68, with penalties if they want to retire earlier.

It is well documented that ageing has effects on body functions such as decline in vision and hearing ability, decrease in bone mass (more prone to fractures) and decrease in muscle strength and flexibility (Frontera *et al.*, 1991; Glasser and Campbell, 1998; Saxon *et al.*, 2014). Related to these physiological consequences, productivity at work may also decrease as it becomes harder to handle certain tasks compared to younger workers. On the other hand, age and experience are positively associated with working ability in heavy industry, with older workers considered valuable due to their experience (Desmette and Gaillard, 2008; Chung *et al.*, 2015; Leaviss *et al.*, 2008). Working longer has another advantage for individual wellbeing by increasing cognitive function and financial income (Crawford *et al.*, 2010; Wickrama *et al.*, 2013).

The effects of ageing have been well documented in construction workers, with physical workload resulting in early retirement and lower quality of life after retirement due to chronic musculoskeletal, cardiovascular or immune system disorders (Arndt *et al.*, 1996; Deacon *et al.*, 2005; LeMasters *et al.*, 2006).

The effect of population demographic changes is also being seen in the NHS. Midwifery is known to be demanding due to its workload (with longer shifts, recent higher levels of birth rates and more complicated deliveries of babies) and the nature of its physical and psychological work challenges. However, contrary to the detrimental effect of ageing, the survey in this thesis found that lower back symptoms decreased with age (Chapter 4, Section 4.7.4). This agrees with a review of 63 longitudinal and cohort studies that found a causal relationship between younger age and MSD for workers in different sectors: industry, automotive, textile, forestry (da Costa and Vieira, 2010). There were only two studies from healthcare related to nursing (Venning *et al.*, 1987; Smedley *et al.*, 2003) and neither found any correlation between age and MSD. Possible explanations for this could be the '*survivor effect*' (Bork *et al.*, 1996) or '*healthy worker effect*' (Li and Sung, 1999), or older workers being assigned less physically demanding roles at work.

This result of decreased age and lower back pain/injury agrees with the findings of Engkvist *et al.* (1992), Tibunu *et al.* (2010), Chung *et al.* (2013) and Heiden *et al.* (2013). For example, Chung *et al.*'s (2013) study assessed the age-specific incidence of MSD in Taiwanese nurses and reported average age-specific incidences of lower back pain being highest in the 20-24 year-old age group. Younger workers in general have been considered as being at higher risk of manual handling injuries due to having less developed muscle strength and being less skilled in handling techniques or the work pace. So, it seems that a manual handling risk assessment specifically for younger workers should be considered, while it is essential for older workers to consider their requirements and to design tasks accordingly (Health and Safety Executive, 2016).

The detrimental effect of aging was observed for knee symptoms in the current study. The statistical analysis (Chapter 4, Section 4.7.2.2) showed significant

differences by age for knee symptoms within a 12-month period (attributed to floor level positions during delivery, Chapter 5). This was also reported by Cromie *et al.*'s (2000b) study for physiotherapists where increased age was related to knee symptoms. Bork *et al.* (1996) also found knee symptoms to be higher in paediatric therapists who most commonly work in kneeling or couching positions.

The ageing workforce raises the importance of support for employee's health at work and the management of chronic conditions. RCM members were asked about what could be done to make the '*working longer scheme'* more feasible. More than half found it useful to be deployed in less physically and mentally demanding environments such as antenatal clinics, which excludes shift work and delivery of babies (RCM, 2013).

Potential interventions have been explored to ease the physical workload of older workers in order to prevent, or at least limit, early retirement (Leaviss *et al*., 2008); their suggestions include:

a) Increasing awareness of health and safety with behavioural changes: older workers who accept MSD as part of the job are less likely to follow safe practices such as wearing personal protective equipment.
b) Trade-specific suggestions in construction included equipment using nail guns instead of hammers for joiners; avoiding heavy materials and using manual handling aides for bricklayers; and using alternative materials to reduce the amount of wet plaster for plasterers.
c) Managers can use the older workers to complete more skilled and less physically demanding work such as training younger workers.
d) More inclusive design for tools and equipment.
e) Further additional solutions regarding organisational culture to keep the older workers in construction work included: 'more labourers; more direct labour; pay by day rate; shorter working hours; reorganising the way the work is carried out; flexible working patterns; loading out gangs; self-selection; provision of medical care such as osteopathy; work rotation

systems to avoid repetitive exposure; improved sick pay; and company partnering' (Leaviss *et al.,* 2008).

Further suggestions for the ageing workforce were considered based on a qualitative study of nurses aged over 50 which explored their decision to stay in or leave the NHS (Andrews *et al.*, 2005):

a) More flexibility in working hours and availability of part-time work.
b) Physical and psychological working demands should be assessed and redesigned for older workers.
c) Considering the pace of technological change, relevant skills required should be maintained and updated regularly.

This research found that younger midwives are more prone to the risk of MSD than older and more experienced staff. This may result in staff shortages, early retirement or leaving work. Prevention of work-related MSD may change individuals' life trajectories and, considering all the positive and negative effects of ageing at work, individuals should be empowered to work as long as they wish to. It is an organisational responsibility to provide for the needs of each worker and create more favourable environments for its ageing workforce. Also, individuals have a responsibility to maintain safe practices in order to have longer working lives.

7.3.3.2 Risks to Mothers and Babies

The negative impacts of MSD have been well described in terms of staff wellbeing, quality of life, job satisfaction, high costs due to sickness-related absences and management procedures, and productivity at work. In healthcare, it is highly possible that limitations in productivity or functionality at work will influence patient care and safety. This thesis provides evidence about midwives experiencing limitations in their normal activities at work due to MSD (Chapter 4), and has explored the effects on patient safety due to such limitations in Chapter 5.

It is very clear that, because of the caring nature of midwives, no-one goes to work to risk mothers' and babies' lives. Yet, anything going wrong can cost the life of the mother/baby or cause critical and chronic damage. It was reported that 921 babies (out of almost 800,000) were lost or had severe brain damage due to something going wrong during labour in 2015 (RCOG, 2016), and 1,123 babies (of nearly 700,000) in 2016 (RCOG, 2018). Maternity claims due to preventable deaths or injuries constitute a significant share (48%) of the total claims against the NHS, for example the amount of such claims was £2.1 billion for the period 2017-2018 (NHS Resolution, 2018). In October 2018, the NHS paid £37 million to a 6-year old boy for causing a catastrophic brain damage due to delayed treatment following his birth (Francesca, 2018).

Staff shortages have been an issue in midwifery due to various factors such as recruitment, increased work demand and increased sick leave (RCM, 2016c). The research in this thesis found that one-third of participants were absent from work due to musculoskeletal symptoms at some point over a 12-month period. Lack of staff may increase workload for the remainder of the workforce. Studies have shown that the transition from an eight-hour to a twelve-hour shift increases the potential for job-related failures (Griffiths *et al.*, 2014; RCM, 2016d), despite the aim of improving quality by increasing continuity of care with two shift handovers instead of three in a day.

The interview study (Chapter 5) found that there was little tendency to report MSD at work or request sick leave on this basis. This was confirmed by the survey, as sick leave prevalence was far lower than the prevalence of MSD and its severity (limitation in normal activities). The reason for not taking sick leave was suggested to be related to feeling overly responsible for patients and colleagues (feeling guilty about their colleagues covering their absence). So, they are motivated to go to work due to team responsibility (Bierla *et al.*, 2013), emotional attachment to the patients, and continued attendance while not feeling well (sickness presenteeism) despite limitations, which could put mothers' and babies' lives at risk. A systematic

review of longitudinal studies showed that this is also a risk factor for future sickness absence and self-reported health issues (Skagen and Collins, 2016).

Sickness presenteeism is particularly common in healthcare compared to other sectors (Aronsson *et al.*, 2000; Plant and Coombes, 2003) and this highlights the question of 'How well can a sick person perform their job?' This question refers to work disability/instability (WI), which is defined as the inconsistency between staff functional or cognitive ability and work demands (Gilworth *et al.*, 2003). WI, in the context of MSD, was explored in nursing and an occupation-specific tool (Nurse-Work Instability Scale) was developed to assess sickness-related absence and work retention problems (Gilworth *et al.*, 2007). This tool plays a critical role in the early identification of risks and appropriate referrals.

Overall, there are many MSD-related factors that contribute to detrimental results in healthcare including working patterns, communication, training, staffing, resources, fatigue, team-work and culture. These can be represented by the Human Factors model, which is also called the 'Swiss Cheese Model' (Reason, 2000), where sequential and concurrent minor hazards result in major damage, by lining up the 'cheese' holes. In order to improve care in maternity and decrease avoidable deaths and injuries, the importance of Human Factors has been recently emphasised (CIEHF, 2018; Ledger *et al.*, 2018). For example, birthing pools were poorly designed in the 1990s, resulting in difficulties for mothers to get into, or out of, them in an emergency. And also, midwives had to adopt awkward postures to perform caring activities. As a solution, birthing pools were re-designed in cooperation with user needs. The new design included steps and rails to assist entry and exit, a concave shape to provide knee room for midwives and to support the mother, and a seat inside the pool to allow for rapid evacuation in an emergency. This, therefore, improved the safety and wellbeing of the mother, baby and midwife.

7.4 Interventions to Reduce MSD

There have been many approaches to reduce or prevent MSD for healthcare staff. The most common interventions are manual handling training and guidelines,

physiotherapy approaches that include exercises and stretching, and multidimensional interventions. Manual handling training and guidelines have been discussed widely earlier (Section 7.3.1).

Physiotherapy is used for the treatment and prevention of MSDs, with personalised assessment, using various treatment approaches and most importantly '*patient involvement through education, awareness and participation'* at the centre of the management approach (Chartered Society of Physiotherapy, 2013). Individuals at work can benefit from early and rapid access to physiotherapy as part of occupational health services to reduce sickness absence days and recurrent symptoms, and support return to work management. Many NHS Trusts provide physiotherapy services as part of the occupational health provision. However, this research found that healthcare staff reported that they did not benefit from this service primarily due to long referral times and/or appointment processes (waiting lists).

Multidimensional interventions such as education, training, equipment and/or environment redesign, practice changes, policy changes and physical exercises have been researched in various combinations. Hignett (2003) identified the seven most commonly used interventions included in generic programmes to reduce MSDs related to patient handling: equipment provision/purchase, education and training, risk assessment, policies and procedures, a patient assessment system, and work environment redesign, work organisation/practice changing. As stated earlier (Section 7.3.3), multidimensional interventions based on a risk assessment programme targeting the specific priorities are most likely to be effective in reducing the risk of MSD relating to manual handling of patients, so a risk assessment process should be performed on the basis of management intervention strategies.

Participatory ergonomic (PE) approaches have been suggested to be successful for reducing MSD (Silverstein and Clark, 2004; Rivilis *et al.*, 2008), and have been implemented in a variety of sectors: healthcare (Evanoff *et al.*, 1999; Hignett, 2001; Rasmussen *et al.*, 2015), manufacturing (Liker *et al.*, 1989; St-Vincent *et al.*, 2001;

Cantley *et al.*, 2014), construction (de Jong and Vink, 2002; Dale *et al.*, 2016), and service delivery (Vink *et al.*, 1995). PE is defined as "*involvement of people in planning and controlling a significant amount of their own work activities, with sufficient knowledge and power to influence both processes and outcomes to achieve desirable goals"* (Wilson, 1995). Workers (as experts in their work and environment) should have a role in addressing problematic issues and improving them. This is recommended in the European guidelines for prevention of lower back pain at work (Burton *et al.*, 2006): *"to be successful, a physical ergonomics programme would need an organisational dimension and involvement of the workers".*

7.5 Summary

There is a lack of research about midwives related to MSD risks and interventions for the management. The findings of three studies highlighted three key messages to locate the research findings in:

- Professional culture
- Organisational culture
- MSD in 2018

In today's ageing workforce, it is essential to support staff health and wellbeing into older age. Professional bodies and organisations have critical role for the management of MSD, and indeed in staff and patient safety.

8. Conclusion

This chapter will present the implications and recommendations from this research and suggest opportunities for future research.

The initial research idea came from the observation of midwives in labour wards in an NHS Trust. It was realised that there were many staff complaining about musculoskeletal pain and taking time off due to symptoms. This has a negative impact on junior staff for future career planning; with fewer joining obstetrics and midwifery.

Midwives are at risk of developing MSD due to working conditions and the need to adopt awkward positions at work. The last studies in this issue were conducted over 20 years ago in the UK, and highlighted the manual handling risk factors in midwifery as well as suggesting some management strategies to reduce the risk of individuals developing MSD. Since then, there have been many changes and developments in the UK maternity services including equipment, environment, staff and/or mother profile and work demands. However there seems to have been no improvement, as prevalence rates for MSD remain high.

The research in this thesis also confirmed that there are more mothers suffering from co-morbidities, particularly obesity, more epidural and C-sections, having higher expectations and being less confined to bed, than compared to 20 years ago. In addition, maternity care facilities have changed with new technology, more personalised delivery options and birth techniques (Cumberlege, 2016). It is highly likely that these changes have impacted on the musculoskeletal health of midwives. Therefore further research and additional guidelines are needed to target these issues.

8.1 Restating the Aims

This research has investigated MSD and its impact, and explored the factors associated with them. Three studies were conducted to address these aims: a survey of midwives exploring the scope of musculoskeletal disorders, interviews

with midwives to further explore risk factors, and postural analyses of common midwifery tasks.

- Aim 1: Investigate musculoskeletal symptoms with impact and management strategies:
  - Distribution, prevalence and severity of symptoms were explored (Chapter 4).
  - Impact of MSD on work or leisure activities was understood (Chapters 4, 5).
  - Level of awareness and support about health and safety and MSD prevention strategies were explored (Chapter 5).

- Aim 2: Explore factors associated with musculoskeletal symptoms:
  - Individual, psychosocial and occupational factors associated with MSD were identified (Chapter 4, 5).
  - Working positions were analysed with regards to physical exposure of musculoskeletal system and the level of risk (Chapter 6).

8.2 Summary of Findings

A mixed method approach was applied to triangulate the findings of each study. There was consistency between the results from each study, demonstrating that the triangulation increased external validity.

The survey study (Study 1) showed a high prevalence of MSD reports and impacts on sickness-related absence, normal activities at work, and job/duty changes. Age, practice years, BMI, working hours, job satisfaction and job stress were identified as risk factors for MSD, with age and practice years being inversely associated with MSD itself.

An in-depth exploration of the main issues through interviews (Study 2) showed that MSDs could be strongly correlated to work related factors including work schedule, work load and working positions. Manual handling training was found not to be useful for this group. Individual awareness of level of health and safety was

high, but the application of such procedures was not possible in a real working environment.

The postural analysis study (Study 3) showed that midwifery working postures have very high to medium risk levels, mostly for the back, neck and upper arms. This indicates that immediate action is required to reduce the risk with further assessment.

8.3 Recommendations

The findings indicate that there are several possibilities for reducing MSD in midwives, and the following suggestions have the potential to improve the health and wellbeing of midwives to enable them to continue working for as many years as they wish. These are grouped into two main areas:

- General recommendations
- Recommendations for working positions (at delivery and post-delivery: suturing, breast feeding support)

8.3.1 General Recommendations

Behaviour

The findings of Study 1 and Study 2 indicated that presenteeism (being present at work despite having symptoms rather than taking time off) is very common among midwives. There is evidence that sickness 'presenteeism' has the potential to result in more wide-ranging and serious consequences to organisations than sickness 'absenteeism', due to reduction in productivity, higher potential for errors, and the associated risks to patient safety (Grinyer and Singleton, 2000; Demerouti *et al.*, 2009). Therefore, midwives should be encouraged to talk openly and report the symptoms and limitations stemming from these symptoms to the managers and related departments. It is also important for the staff to receive support from the organisations, as noted in a report into MSD.

It was highlighted in Study 2 that midwives have a good level of awareness about protecting themselves at work, but there are still some perceptions (e.g., '*MSD is a*

part of work' and *'what woman (patient) wants, she gets')* that prevent them from applying these in practice. These perceptions result in making excessive effort in practice and even avoiding obviously hazardous actions (e.g., allowing a mother to put her foot on the midwife's hip and push against). In addition, junior midwives in particular, with their more limited communication skills, end up overworking activities (Chapter 5). Training should aim to increase staff communication skills, confidence, and awareness about rights within an organisation to avoid too much unnecessary caring. This would be particularly beneficial for junior midwives.

Study 1 and Study 2 provided evidence about staff and their behaviour-related factors which might have an impact on MSD. For example, midwives of all ages experience musculoskeletal symptoms, but younger and less experienced midwives are more likely to experience lower back symptoms and where an alternative explanation for the association between inexperience and MSD is suggested to be the result of 'survivor effect' (Bork *et al.,* 1996) in which older and experienced midwives have the knowledge and strategies to protect themselves at work. Therefore older, experienced midwives should share their experiences about MSD and associated prevention or coping strategies with younger, junior midwives.

BMI is another predictor for lower back symptoms in this research; therefore, a healthy and balanced diet should be encouraged to maintain a normal BMI in midwives. Regarding this, RCM has provided some advice for healthy diet and tips for easy preparation that are given by the Slimming World Food Optimising Association (RCM, 2016). These and other applications should be applied and popularised among midwives.

Low levels of physical activity are associated with the prevalence of MSD in the hips, knees and feet in this research, but no further information supports physical activity being a protective factor against MSD (it was not significant in logistic regression analyses). However, there are reports in the literature showing that physical activity is, in fact, protective (Hildebrandt *et al.*, 2000). Therefore midwives should be encouraged to be more physically active depending on their interest and availability. Physical fitness activity programmes can be incorporated into work.

Organisation

> *'It is often easier to change the things around people than to change the people themselves.'* (CIEHF, 2018)

Midwives commonly attributed their symptoms to increased workload (Chapter 5) and the findings of Study 1 showed that increased working hours per week was a risk factor for shoulder symptoms (Chapter 4). Workload can also be decreased by employing additional staff, more rotations to allow staff to spread their workloads, providing more frequent breaks and fewer hours in each shift. Additionally, in order to lighten the workload on midwives, more maternity support workers who provide many care methods with training such as supporting mothers with breast feeding, or assisting the midwife as a second person when there is no birth partner, can be utilised. In addition, midwives should develop their skills to employ maternity support workers, birth partners and the appropriate equipment for best and safe practice. Moreover, midwives have other work to record all the procedures; this requires considerable amounts of documentation/paperwork in addition to physical caring, so assistants could be assigned to deal with such administrative tasks.

Midwives reported not getting any benefit from the mandatory manual handling training. It would be more useful to have training involving midwifery-specific working tasks and equipment, and also scenarios in a real-world work environment.

Mothers being cooperative with midwives will eventually reduce the workload. On this basis, antenatal education for positions during delivery and after delivery (e.g., breast feeding) should be improved.

8.3.2 Recommendations for Working Positions

The basic manual handling principles for this occupational group to prevent injuries include adjusting the height of the equipment (e.g., bed), and getting closer to avoid stretching and bending (e.g., midwives should get closer to the mother, particularly for regular examinations during the delivery) (Health and Safety Executive, 2016).

Positions at Floor Level Delivery

Floor level delivery positions (e.g., delivery positions with mother standing and delivery positions with mother kneeling on the floor) resulted in a very high risk of the midwife developing MSD, mostly affecting the legs, trunk and neck (Chapter 6). These delivery positions need urgent consideration to reduce the risk to midwives. Possible changes might include:

- Knees should be supported with a kneeling pad, mat or cushion. Midwives with knees at >60^{o} flexion are at increased risk, therefore pillows or kneeling chairs can be used to maintain a safe range of motion and decrease the pressure on joints.
- Unless there is a certain benefit for mother/baby, mothers choosing to deliver in a kneeling position should be encouraged to be on the bed instead of on the floor as the midwife providing care for the mother will be at lower risk of developing MSD than with a mother kneeling on the floor.

Positions at Suturing

Suturing activities, which include placing the legs into lithotomy and attaching/detaching the end of the bed, resulted in a medium risk of injury in midwives, and changes are clearly necessary (Chapter 6). The following specific recommendations are suggested for suturing:

- Placing the mothers' legs into lithotomy should be performed by two people, with each person lifting one leg from the side of the bed, holding at the same time and placing them into lithotomy. Midwives should avoid lifting both legs by themselves, and should ask for help with this task.
- The end of the bed is prepared for suturing by detaching and then re-attaching it after suturing. Before detaching or re-attaching, the height of the bed should be lowered to avoid excessive upper body movements. First, the mattress part of the end of the bed should be separated, and then the metal part should be detached or attached. This would decrease the risk to

the upper arm and avoid side bending to find the attachment point. Handles on the sides of the end of the bed should be used where provided.

- During the suturing process, midwives should sit in front of the mother and raise the bed to the best position and avoid bending. The chair should have a height adjustment mechanism and swivel to avoid the midwife twisting to retrieve the equipment from the tray placed next to them. The source of light can be provided via a head torch on the midwife's head to prevent trunk side flexion to avoid shadow. The beds should be designed to consider suturing requirements, including a foot rest and an attachable part to place the tray in front of the midwife.

Positions at Supporting Breast Feeding

Assisting a mother with breast feeding was the second most commonly reported physical challenge by the interviewees (Chapter 5) and has a medium injury risk. In order to reduce the biomechanical load:

- Baby and mother should be positioned so as to require minimal support from the midwife.
- Adjustment of the bed height is important to avoid unnecessary bending or over-stretching.
- Midwives should change their positions regularly.

8.4 Key Messages and Conclusions

MSD are crucial problems within today's workforce. Compared to over 20 years ago, there have been no improvements in numbers of reported incidences of MSD from midwives. The associated risks remain and there are even more contributing factors due to changes in practice and workload. The harmful effects of MSD have been recorded in the forms of staff shortages, sickness-related absences, functionality, and patient care and safety. Moreover, there is an ageing workforce resulting in the necessity for staff to work for longer. These issues highlight a need for immediate action to reduce MSD amongst midwives involving the use of a comprehensive evidence-based risk assessment.

Professional bodies (e.g., the Royal College of Midwives) have an important role to guide the occupational groups in terms of work-related requirements with more effective and practicable approaches. Organisations generally need to adopt an increased focus on staff health and wellbeing.

8.5 Contribution to Knowledge

There is a wealth of research evidencing the scale and magnitude of, factors contributing to MSD amongst health professionals, particularly nurses. However, a gap in the literature was identified in relation to midwives and their work (which is unique and different from nurses and others) and the changes in the profession over the last 20 years. This thesis contributes new evidence about MSD from three studies.

The survey study (Chapter 4) established quantitative evidence relating to the scale of incidences of MSD amongst midwives. This is the first survey of MSD in UK midwives to be derived from a national cohort of participants. The findings reported have already been of interest to the Royal College of Midwives (RCM) and local NHS Trust (University Hospitals of Leicester, UHL). RCM highlighted the study to their members through their official website and Twitter account (RCM, 2016a). The UHL NHS Trust requested a workshop to inform their staff about MSD and work-related contributory risk factors. In addition, the NMQ questionnaire raised awareness about midwives' musculoskeletal health, which is supported by RCM (2016a) and linked to their 'Caring For You' campaign. The Health and Safety Executive (HSE) has also expressed an interest in the study with personal communication as evidence for HSE to plan actions about MSD in midwives.

The research also provides the first comprehensive investigation of risk factors using a biopsychosocial model for individual, occupational, psychosocial and postural factors in this population, and demonstrates how these factors are related to MSDs. There is evidence that the traditional biomedical/biomechanical approach has not been effective in the prevention of MSD (Burton *et al.*, 2006). The consideration of psychosocial stressors is contrary to many epidemiological studies

as it has been showed that stressors such as workload/demand, high stress levels, low job satisfaction, low support are linked to an increased risk of MSD (Eatough *et al.*, 2012; Edwards *et al.*, 2016).

It is worth noting that MSD and risk factors are very unique to a specific population, and therefore this type of occupation-specific study is crucial to reduce injury rates by developing appropriate management strategies rather than technique training (Hignett, 2003). The most significant contribution is to inform the design of evidence-based risk management strategies which will help to improve curricula, and educational and training programmes.

8.6 Further Research Opportunities

There are opportunities for future research to develop and contribute to this area. The research aimed to target maternity professionals, particularly obstetricians and midwives, however due to a limited response from obstetricians in the first study, the population group was restricted to midwives. However, the results from the small sample (n=49) showed that obstetricians' reports of injury rates and severity are high (see Appendix 4.3). So, research is needed into the work (tasks) performed by obstetricians.

Within the UK health system, there are two different work based roles for midwives; hospital and community. Community midwives, who support home births and provide post-natal care at home, did not fall within the scope of this thesis due to different working patterns, environments and equipment. Future research should be undertaken to explore the risk factors in community midwives.

The survey (Chapter 4) study presented the consequences of MSDs for functional limitations at work. The interviews (Chapter 5) further explored the impacts of these limitations on patient care and safety from midwives' perspectives. It was found that midwives do not allow their symptoms to affect the care they provide; they either negotiate with mothers or try to find help from colleagues to maintain patient safety and meet the mothers' expectations. However, there was still concern and fear about meeting the mothers' expectations and providing continuity

of care. These findings provide the insight required for future research into mothers' expectations, their perceptions of quality of care, and attitudes to negotiations with midwives.

Midwives' experiences of the management process for their symptoms were well defined (e.g., less tendency for reporting, mostly self-management, long referral processes) in Chapter 5. This research has not explored the policies and procedures for occupational health departments and human resources in the event of MSD. Future research could explore this area and compare the experience of management with expectations and return to work procedures. It would also help organisations to assess the practicability or implementation of return to work procedures (Hignett et al., 2007).

Although recommendations were stated in terms of work place environments and equipment design (particularly beds not being suitable for the suturing procedure) based on midwives' experiences (Chapter 5) and observations (Chapter 6), further assessment is required to design safer work environments and equipment.

Finally, there needs to be a risk management strategy to reduce and prevent MSD in midwives. The findings from the three studies (Chapters 4, 5 and 6) in this thesis contribute to addressing this aim. Further research is needed to determine the effectiveness of these intervention strategies.

8.7 Closing Statement

Midwifery is one of the oldest professions. Midwives have always been needed to support mothers in bringing their babies into the world safely. The research in this thesis has focussed on the musculoskeletal problems amongst UK midwives in order to support this precious occupational group in maintaining good health in their work. In the absence of new data over the last 20 years, this research has found that practicing as a midwife is still a high-risk profession in terms of developing MSD, despite the related regulations and guidelines. The prevalence rates are high, with serious impacts on working activities, sickness-related absence rates and individuals leaving the profession. Age, practicing years in the profession, BMI,

working hours, job stress, job satisfaction and physical working postures have a role in developing MSD. Research to manage these risk factors can contribute to an overall reduction and prevention of such disorders.

References

Abate, M., Vanni, D., Pantalone, A. and Salini, V. (2013) 'Cigarette smoking and musculoskeletal disorders', *Muscles, ligaments and tendons journal*. CIC Edizioni internazionali, 3(2), p. 63.

Alexopoulos, E. C., Burdorf, A. and Kalokerinou, A. (2003) 'Risk factors for musculoskeletal disorders among nursing personnel in Greek hospitals', *International archives of occupational and environmental health*. Springer, 76(4), pp. 289–294.

Anderson, S. P. and Oakman, J. (2016) 'Allied Health Professionals and Work-Related Musculoskeletal Disorders: A Systematic Review', *Safety and Health at Work*. Elsevier Ltd, 7(4), pp. 259–267. doi: 10.1016/j.shaw.2016.04.001.

Ando, S., Ono, Y., Shimaoka, M., Hiruta, S., Hattori, Y., Hori, F. and Takeuchi, Y. (2000) 'Associations of self estimated workloads with musculoskeletal symptoms among hospital nurses', *Occupational and environmental medicine*. BMJ Publishing Group Ltd, 57(3), p. 211.

Andrews, J., Manthorpe, J. and Watson, R. (2005) 'Employment transitions for older nurses: a qualitative study', *Journal of advanced nursing*. Wiley Online Library, 51(3), pp. 298–306.

Arndt, V., Rothenbacher, D., Brenner, H., Fraisse, E., Zschenderlein, B., Daniel, U., Schuberth, S. and Fliedner, T. M. (1996) 'Older workers in the construction industry: results of a routine health examination and a five year follow up.', *Occupational and environmental medicine*. BMJ Publishing Group Ltd, 53(10), pp. 686–691.

Aronsson, G., Gustafsson, K. and Dallner, M. (2000) 'Sick but yet at work. An empirical study of sickness presenteeism', *Journal of Epidemiology & Community Health*. BMJ Publishing Group Ltd, 54(7), pp. 502–509.

Atkinson, G. and Davenne, D. (2007) 'Relationships between sleep, physical activity and human health', *Physiology & behavior*. Elsevier, 90(2), pp. 229–235.

Auerbach, C. and Silverstein, L. B. (2003) *Qualitative data: An introduction to coding and analysis*. NYU press.

Aysun, K. and Bayram, Ş. (2017) 'Determining the level and cost of sickness presenteeism among hospital staff in Turkey', *International journal of occupational safety and ergonomics*. Taylor & Francis, 23(4), pp. 501–509.

Back, J., Ross, A. J., Duncan, M. D., Jaye, P., Henderson, K. and Anderson, J. E. (2017) 'Emergency department escalation in theory and practice: a mixed-methods study using a model of organizational resilience', *Annals of emergency medicine*. Elsevier, 70(5), pp. 659–671.

Ball J, Maben J, Murrells T, Day T, Griffiths P (2014) '12-hour shifts: prevalence,

views and impact'. National Nursing Research Unit, King's College London.

Balogh, I., Ørbæk, P., Ohlsson, K., Nordander, C., Unge, J., Winkel, J., Hansson, G.-Å. and Group, M. S. S. (2004) 'Self-assessed and directly measured occupational physical activities—influence of musculoskeletal complaints, age and gender', *Applied ergonomics*. Elsevier, 35(1), pp. 49–56.

Barbosa, R. E. C., Assunção, A. Á. and de Araújo, T. M. (2013) 'Musculoskeletal pain among healthcare workers: An exploratory study on gender differences', *American journal of industrial medicine*. Wiley Online Library, 56(10), pp. 1201–1212.

Barling, J., Loughlin, C. and Kelloway, E. K. (2002) 'Development and test of a model linking safety-specific transformational leadership and occupational safety.', *Journal of applied psychology*. American Psychological Association, 87(3), p. 488.

Bartys, S. (2003) *Psychosocial factors at work, musculoskeletal disorders and the implementation of guidelines principles*. University of Huddersfield.

Bassey, E. J. (1998) 'Longitudinal changes in selected physical capabilities: muscle strength, flexibility and body size', *Age and Ageing*. Oxford University Press, 27(suppl_3), pp. 12–16.

Bendix, T. O. M. and Hagberg, M. (1984) 'Trunk posture and load on the trapezius muscle whilst sitting at sloping desks', *Ergonomics*. Taylor & Francis, 27(8), pp. 873–882.

Benson, B. W. and Shulman, J. D. (2005) 'Inclusion of tobacco exposure as a predictive factor for decreased bone mineral content', *Nicotine & tobacco research*. Society for Research on Nicotine and Tobacco, 7(5), pp. 719–724.

Bergström, G., Bodin, L., Hagberg, J., Aronsson, G. and Josephson, M. (2009) 'Sickness presenteeism today, sickness absenteeism tomorrow? A prospective study on sickness presenteeism and future sickness absenteeism', *Journal of Occupational and Environmental Medicine*. LWW, 51(6), pp. 629–638.

Bernal, D., Campos-Serna, J., Tobias, A., Vargas-Prada, S., Benavides, F. G. and Serra, C. (2015) 'Work-related psychosocial risk factors and musculoskeletal disorders in hospital nurses and nursing aides: a systematic review and meta-analysis', *International journal of nursing studies*. Elsevier, 52(2), pp. 635–648.

Bierla, I., Huver, B. and Richard, S. (2013) 'New evidence on absenteeism and presenteeism', *The International Journal of Human Resource Management*. Taylor & Francis, 24(7), pp. 1536–1550.

Black, C. D. and Frost, D. (2011) *Health at work-an independent review of sickness absence*. The Stationery Office.

Blaikie, N. (2007) *Approaches to social enquiry: Advancing knowledge*. Polity.

Bongers, P. M., de Winter, C. R., Kompier, M. A. J. and Hildebrandt, V. H. (1993) 'Psychosocial factors at work and musculoskeletal disease', *Scandinavian journal of work, environment & health*. JSTOR, pp. 297–312.

Bonzini, M., Veronesi, G., Conti, M., Coggon, D. and Ferrario, M. M. (2015) 'Is musculoskeletal pain a consequence or a cause of occupational stress? A longitudinal study', *International archives of occupational and environmental health*. Springer, 88(5), pp. 607–612.

Boorman, S. (2009) 'NHS Health and Well Being. Final Report', *London: Department of Health*.

Borg, J. H., Westerståhl, M., Lundell, S., Madison, G. and Aasa, U. (2016) 'Longitudinal study exploring factors associated with neck/shoulder pain at 52 years of age', *Journal of pain research*. Dove Press, 9, p. 303.

Bork, B. E., Cook, T. M., Rosecrance, J. C., Engelhardt, K. A., Thomason, M.-E. J., Wauford, I. J. and Worley, R. K. (1996) 'Work-related musculoskeletal disorders among physical therapists', *Physical therapy*. Oxford University Press, 76(8), pp. 827–835.

Bowling, A. (2014) *Research methods in health: investigating health and health services*. McGraw-Hill Education (UK).

Boxall, N. (2012) 'Hard to handle: why student midwives should avoid risky manual handling', *Royal College of Midwives, London*. Available at: https://www.rcm.org.uk/content/hard-to-handle-why-student-midwives-should-avoid-risky-manual-handling.

Bryman, A. (2006) 'Integrating quantitative and qualitative research: how is it done?', *Qualitative research*. Sage Publications Sage CA: Thousand Oaks, CA, 6(1), pp. 97–113.

Buchholz, B., Paquet, V., Punnett, L., Lee, D. and Moir, S. (1996) 'PATH: a work sampling-based approach to ergonomic job analysis for construction and other non-repetitive work', *Applied ergonomics*. Elsevier, 27(3), pp. 177–187.

Buckle, P. W. and Devereux, J. J. (2002) 'The nature of work-related neck and upper limb musculoskeletal disorders', *Applied ergonomics*. Elsevier, 33(3), pp. 207–217.

Burdorf, A. and van Riel, M. (1996) 'Design of strategies to assess lumbar posture during work', *International Journal of Industrial Ergonomics*. Elsevier, 18(4), pp. 239–249.

Bureau of Labour Statistics (2015) *Employer-Reported Workplace Injuries and Illnesses – 2014*.

Burton, A. K. (1997) 'Back injury and work loss: biomechanical and psychosocial influences', *Spine*. LWW, 22(21), pp. 2575–2580.

Burton, A. K., Balagué, F., Cardon, G., Eriksen, H. R., Henrotin, Y., Lahad, A., Leclerc, A., Müller, G. and Van Der Beek, A. J. (2006) 'Chapter 2 European guidelines for prevention in low back pain', *European Spine Journal*. Springer, 15, pp. s136–s168.

Buscher, A., Sivertsen, B. and White, J. (2010) 'Nurses and Midwives: A Force for health: Survey on the situation of nursing and midwifery in the Member States of the European Region of the World Health Organization 2009', *WHO Regional Office for Europe Google Scholar*.

Camerino, D., Cesana, G. C., Molteni, G., Vito, G. De, Evaristi, C. and Latocca, R. (2001) 'Job strain and musculoskeletal disorders of Italian nurses', *Occupational ergonomics*. IOS Press, 2(4), pp. 215–223.

Camerino, D., Estryn-Behar, M., Conway, P. M., van Der, B. I. J. M. and Hasselhorn, H.-M. (2008) 'Work-related factors and violence among nursing staff in the European NEXT study: a longitudinal cohort study', *International journal of nursing studies*. Elsevier, 45(1), pp. 35–50.

Cantley, L. F., Taiwo, O. A., Galusha, D., Barbour, R., Slade, M. D., Tessier-Sherman, B. and Cullen, M. R. (2014) 'Effect of systematic ergonomic hazard identification and control implementation on musculoskeletal disorder and injury risk', *Scandinavian journal of work, environment & health*. NIH Public Access, 40(1), p. 57.

Capodaglio, P., Castelnuovo, G., Brunani, A., Vismara, L., Villa, V. and Maria Capodaglio, E. (2010) 'Functional limitations and occupational issues in obesity: a review', *International Journal of Occupational Safety and Ergonomics*. Taylor & Francis, 16(4), pp. 507–523.

Carolan-Olah, M., Kruger, G. and Garvey-Graham, A. (2015) 'Midwives ′experiences of the factors that facilitate normal birth among low risk women at a public hospital in Australia', *Midwifery*. Elsevier, 31(1), pp. 112–121.

Carpenter, C. and Suto, M. (2008) *Qualitative research for occupational and physical therapists: A practical guide*. Oxford: Blackwell.

Chartered Society of Physiotherapy (1998) *Moving and Handling for Chartered Physiotherapists*. London: Chartered Society of Physiotherapy.

Chartered Society of Physiotherapy (2013) 'Fit enough for patients. An audit of workplace health and wellbeing services for NHS staff'.

Chin, D. L., Nam, S. and Lee, S.-J. (2016) 'Occupational factors associated with obesity and leisure-time physical activity among nurses: A cross sectional study', *International journal of nursing studies*, 57, pp. 60–69. doi: 10.1016/j.ijnurstu.2016.01.009.

Chung, J., Park, J., Cho, M., Park, Y., Kim, D., Yang, D. and Yang, Y. (2015) 'A study on the relationships between age, work experience, cognition, and work ability in older employees working in heavy industry', *Journal of physical therapy science*. The

Society of Physical Therapy Science, 27(1), pp. 155–157.

Chung, Y.-C., Hung, C.-T., Li, S.-F., Lee, H.-M., Wang, S.-G., Chang, S.-C., Pai, L.-W., Huang, C.-N. and Yang, J.-H. (2013) 'Risk of musculoskeletal disorder among Taiwanese nurses cohort: a nationwide population-based study', *BMC musculoskeletal disorders*. BioMed Central, 14(1), p. 144.

CIEHF (2018) *Human Factors for Health and Social Care, White Paper*.

Clemes, S. A., Haslam, C. O. and Haslam, R. A. (2009) 'What constitutes effective manual handling training? A systematic review', *Occupational medicine*. Oxford University Press, 60(2), pp. 101–107.

Coenen, P., Kingma, I., Boot, C. R. L., Twisk, J. W. R., Bongers, P. M. and van Dieën, J. H. (2013) 'Cumulative low back load at work as a risk factor of low back pain: a prospective cohort study', *Journal of occupational rehabilitation*. Springer, 23(1), pp. 11–18.

Cole, D., Rivilis, I., Van Eerd, D., Cullen, K., Irvin, E. and Kramer, D. (2005) 'Effectiveness of participatory ergonomic interventions: a systematic review', *Toronto: Institute for Work & Health*.

Cordeiro, A., Arezes, P. and Pinho, E. (2015) 'Ergonomic analysis in a food packaging workplace', *Occupational Safety and Hygiene SHO2015-Proceedings book*. Portuguese Society of Occupational Safety and Hygiene (SPOSHO), pp. 332–334.

Crawford, J. O., Graveling, R. A., Cowie, H. A. and Dixon, K. (2010) 'The health safety and health promotion needs of older workers', *Occupational Medicine*. Oxford University Press, 60(3), pp. 184–192.

Cromie, J. E., Robertson, V. J. and Best, M. O. (2000a) 'Before starting the analyses, the data were screened in terms of errors and missing variables. It was not the case that all participants answered all questions.', *Physical therapy*. Oxford University Press, 80(4), pp. 336–351.

Cromie, J. E., Robertson, V. J. and Best, M. O. (2000b) 'Work-related musculoskeletal disorders in physical therapists: prevalence, severity, risks, and responses', *Physical therapy*. Oxford University Press, 80(4), pp. 336–351.

Cumberlege, J. (2016) 'Better Births. Improving outcomes of maternity services in England', *National Maternity Review*, p. 25. Available at: https://www.england.nhs.uk/wp-content/uploads/2016/02/national-maternity-review-report.pdf.

da Costa, B. R. and Vieira, E. R. (2010) 'Risk factors for work-related musculoskeletal disorders: a systematic review of recent longitudinal studies', *American journal of industrial medicine*. Wiley Online Library, 53(3), pp. 285–323.

Dale, A. M., Jaegers, L., Welch, L., Gardner, B. T., Buchholz, B., Weaver, N. and

Evanoff, B. A. (2016) 'Evaluation of a participatory ergonomics intervention in small commercial construction firms', *American journal of industrial medicine*. Wiley Online Library, 59(6), pp. 465–475.

David, G. C. (2005) 'Ergonomic methods for assessing exposure to risk factors for work-related musculoskeletal disorders', *Occupational medicine*. Oxford University Press, 55(3), pp. 190–199.

Davis, K. G. and Heaney, C. A. (2000) 'The relationship between psychosocial work characteristics and low back pain: underlying methodological issues', *Clinical biomechanics*. Elsevier, 15(6), pp. 389–406.

Davis, K. G. and Kotowski, S. E. (2015) 'Prevalence of musculoskeletal disorders for nurses in hospitals, long-term care facilities, and home health care: a comprehensive review', *Human factors*. SAGE Publications Sage CA: Los Angeles, CA, 57(5), pp. 754–792.

Dawson, A. P., McLennan, S. N., Schiller, S. D., Jull, G. A., Hodges, P. W. and Stewart, S. (2007) 'Interventions to prevent back pain and back injury in nurses: a systematic review.', *Occupational and environmental medicine*. BMJ Publishing Group Ltd, 64(10), pp. 642–650.

de Jong, A. M. and Vink, P. (2002) 'Participatory ergonomics applied in installation work', *Applied ergonomics*. Elsevier, 33(5), pp. 439–448.

De Jonge, A., Teunissen, D. A. M., Van Diem, M. T., Scheepers, P. L. H. and Lagro-Janssen, A. L. M. (2008) 'Women's positions during the second stage of labour: views of primary care midwives', *Journal of Advanced Nursing*. Wiley Online Library, 63(4), pp. 347–356.

Deacon, C., Smallwood, J. and Haupt, T. (2005) 'The health and well-being of older construction workers', in *International Congress Series*. Elsevier, pp. 172–177.

Demerouti, E., Le Blanc, P. M., Bakker, A. B., Schaufeli, W. B. and Hox, J. (2009) 'Present but sick: a three-wave study on job demands, presenteeism and burnout', *Career Development International*. Emerald Group Publishing Limited, 14(1), pp. 50–68.

Department of Health (2011) *Healthy Staff, Better Care for Patients. Realignment of Occupational Health Services to the NHS in England*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/216379/dh_128814.pdf.

Deros, B. M., Ali, M. H., Mohamad, D. and Daruis, D. D. I. (2016) 'Ergonomic risk assessment on oil palm industry workers', *Iranian Journal of Public Health*. Dr Ali Akbari Sari, Director of The Commission for Accreditation & Improvement of Iranian Medical Journals, 45(1), p. 44.

Descatha, A., Roquelaure, Y., Chastang, J.-F., Evanoff, B., Melchior, M., Mariot, C.,

Ha, C., Imbernon, E., Goldberg, M. and Leclerc, A. (2007) 'Validity of Nordic-style questionnaires in the surveillance of upper-limb work-related musculoskeletal disorders', *Scandinavian journal of work, environment & health*. Inserm, 33(1), p. 58.

Desmette, D. and Gaillard, M. (2008) 'When a "worker" becomes an "older worker" The effects of age-related social identity on attitudes towards retirement and work', *Career Development International*. Emerald Group Publishing Limited, 13(2), pp. 168–185.

Eatough, E. M., Way, J. D. and Chang, C.-H. (2012) 'Understanding the link between psychosocial work stressors and work-related musculoskeletal complaints', *Applied ergonomics*. Elsevier, 43(3), pp. 554–563.

Edwards, R. R., Dworkin, R. H., Sullivan, M. D., Turk, D. C. and Wasan, A. D. (2016) 'The role of psychosocial processes in the development and maintenance of chronic pain', *The Journal of Pain*. Elsevier, 17(9), pp. T70–T92.

Elliott, P. P. (1997) 'Violence in health care', *Nursing management*. Springhouse Corporation, 28(12), p. 38.

Engel, G. L. (1997) 'From biomedical to biopsychosocial: Being scientific in the human domain', *Psychosomatics*. Elsevier, 38(6), pp. 521–528.

Engkvist, I.-L., Hjelm, E. W., Hagberg, M., Menckel, E. and Ekenvall, L. (2000) 'Risk indicators for reported over-exertion back injuries among female nursing personnel', *Epidemiology*. JSTOR, pp. 519–522.

Estryn-Behar, M., Van Der Heijden, B., Camerino, D., Fry, C., Le Nezet, O., Conway, P. M. and Hasselhorn, H.-M. (2008) 'Violence risks in nursing—results from the European "NEXT"Study', *Occupational medicine*. Oxford University Press, 58(2), pp. 107–114.

Evanoff, B. A., Bohr, P. C. and Wolf, L. D. (1999) 'Effects of a participatory ergonomics team among hospital orderlies', *American journal of industrial medicine*. Wiley Online Library, 35(4), pp. 358–365.

Evans, J. D. (1996) *Straightforward statistics for the behavioral sciences*. Brooks/Cole.

Evans, K., Roll, S. and Baker, J. (2009) 'Work-related musculoskeletal disorders (WRMSD) among registered diagnostic medical sonographers and vascular technologists: a representative sample', *Journal of Diagnostic Medical Sonography*. Sage Publications Sage CA: Los Angeles, CA, 25(6), pp. 287–299.

Ezeh, A. C., Bongaarts, J. and Mberu, B. (2012) 'Global population trends and policy options', *The Lancet*. Elsevier, 380(9837), pp. 142–148.

Fallentin, N., Kilbom, Å., Viikari-Juntura, E. and Wærsted, M. (2000) 'Evaluation of

physical workload standards/guidelines from a Nordic perspective', in *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*. SAGE Publications Sage CA: Los Angeles, CA, pp. 6–429.

Feathers, D., Pavlovic-Veselinovic, S. and Hedge, A. (2013) 'Measures of fit and discomfort for elementary school children in Serbia', *Work*. IOS Press, 44(Supplement 1), pp. 73–81.

Fell-Carlson, D. (2007) *Working safely in health care: a practical guide*. Cengage Learning.

Feng, B., Liang, Q., Wang, Y., Andersen, L. L. and Szeto, G. (2014) 'Prevalence of work-related musculoskeletal symptoms of the neck and upper extremity among dentists in China', *BMJ Open*, 4(12). Available at: http://bmjopen.bmj.com/content/4/12/e006451.abstract.

Fisher, C., Hauck, Y., Bayes, S. and Byrne, J. (2012) 'Participant experiences of mindfulness-based childbirth education: a qualitative study', *BMC pregnancy and childbirth*. BioMed Central, 12(1), p. 126.

Fountain, I., Curzio, J. and Hunt, J. (1996) 'Issues involved in introducing the 12-hour shift', *NT Research*. Sage Publications Sage CA: Thousand Oaks, CA, 1(5), pp. 349–357.

Franklin, E. and Stein, L. (2017) 'Human Factors Analysis of Infection Prevention Practices in the Anesthesia Work Environment', in *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*. SAGE Publications Sage CA: Los Angeles, CA, pp. 639–642.

Fransen, M., Woodward, M., Norton, R., Coggan, C., Dawe, M. and Sheridan, N. (2002) 'Risk factors associated with the transition from acute to chronic occupational back pain', *Spine*. LWW, 27(1), pp. 92–98.

Frontera, W. R., Hughes, V. A., Lutz, K. J. and Evans, W. J. (1991) 'A cross-sectional study of muscle strength and mass in 45-to 78-yr-old men and women', *Journal of applied physiology*, 71(2), pp. 644–650.

Gatchel, R. J., Peng, Y. B., Peters, M. L., Fuchs, P. N. and Turk, D. C. (2007) 'The biopsychosocial approach to chronic pain: scientific advances and future directions.', *Psychological bulletin*. American Psychological Association, 133(4), p. 581.

Gilworth, G., Bhakta, B., Eyres, S., Carey, A., Anne Chamberlain, M. and Tennant, A. (2007) 'Keeping nurses working: development and psychometric testing of the Nurse-Work Instability Scale (Nurse-WIS)', *Journal of Advanced Nursing*. Wiley Online Library, 57(5), pp. 543–551.

Gilworth, G., Chamberlain, M. A., Harvey, A., Woodhouse, A., Smith, J., Smyth, M. G. and Tennant, A. (2003) 'Development of a work instability scale for rheumatoid

arthritis', *Arthritis Care & Research*. Wiley Online Library, 49(3), pp. 349–354.

Glasser, A. and Campbell, M. C. W. (1998) 'Presbyopia and the optical changes in the human crystalline lens with age', *Vision research*. Elsevier, 38(2), pp. 209–229.

Glover, W. (2002) 'Work-related Strain Injuries in Physiotherapists: Prevalence and prevention of musculoskeletal disorders', *Physiotherapy*. Elsevier, 88(6), pp. 364–372.

Glover, W., McGregor, A., Sullivan, C. and Hague, J. (2005) 'Work-related musculoskeletal disorders affecting members of the Chartered Society of Physiotherapy', *Physiotherapy*. Elsevier, 91(3), pp. 138–147. doi: 10.1016/j.physio.2005.06.001.

Gopinadh, A., Devi, K. N. N., Chiramana, S., Manne, P., Sampath, A. and Babu, M. S. (2013) 'Ergonomics and musculoskeletal disorder: as an occupational hazard in dentistry', *The journal of contemporary dental practice*. Jaypee Brothers Medical Publishers Ltd., 14(2), p. 299.

Griffiths, P., Dall'Ora, C., Simon, M., Ball, J., Lindqvist, R., Rafferty, A.-M., Schoonhoven, L., Tishelman, C. and Aiken, L. H. (2014) 'Nurses' shift length and overtime working in 12 European countries: the association with perceived quality of care and patient safety', *Medical care*. Wolters Kluwer Health, 52(11), p. 975.

Grinyer, A. and Singleton, V. (2000) 'Sickness absence as risk-taking behaviour: a study of organisational and cultural factors in the public sector', *Health, Risk & Society*. Taylor & Francis, 2(1), pp. 7–21.

Gustafsson, S. (2001) 'Optimal age at motherhood. Theoretical and empirical considerations on postponement of maternity in Europe', *Journal of population economics*. Springer, 14(2), pp. 225–247.

Hammell, K. W., Carpenter, C. and Dyck, I. (2000) *Using qualitative research: A practical introduction for occupational and physical therapists*. Churchill Livingstone Edinburgh.

Hampton, G. M. and Hampton, D. L. (2004) 'Relationship of professionalism, rewards, market orientation and job satisfaction among medical professionals: The case of Certified Nurse–Midwives', *Journal of business research*. Elsevier, 57(9), pp. 1042–1053.

Han, K., Trinkoff, A. M., Storr, C. L. and Geiger-Brown, J. (2011) 'Job stress and work schedules in relation to nurse obesity', *Journal of Nursing Administration*. LWW, 41(11), pp. 488–495.

Hannah, R. E., Foort, J., Cousins, S. J. and Cooper, D. (1979) 'Gait analysis and the CARS-UBC Electrogoniometer', in *International Electrical and Electronics Conference*.

Hauke, A., Flintrop, J., Brun, E. and Rugulies, R. (2011) 'The impact of work-related psychosocial stressors on the onset of musculoskeletal disorders in specific body regions: A review and meta-analysis of 54 longitudinal studies', *Work & Stress*. Taylor & Francis, 25(3), pp. 243–256.

Hayes, M. J., Cockrell, D. and Smith, D. R. (2009) 'A systematic review of musculoskeletal disorders among dental professionals', *International journal of dental hygiene*. Wiley Online Library, 7(3), pp. 159–165.

Health and Safety Executive (2016) *Manual Handling Operations Regulations 1992*, *Regulation*. London. Available at: http://www.hse.gov.uk/pubns/priced/l23.pdf.

Health and Social Care Information Centre (2015) 'NHS Sickness Absence Rates - January 2015 to March 2015 and Annual Summary 2009 - 10 to 2014 - 15', (1), pp. 1–17.

Health Safety Executive (2006) 'Managing shiftwork - Health and safety guidance', *HSE books*, pp. 1–45.

Heslehurst, N., Lang, R., Rankin, J., Wilkinson, J. R. and Summerbell, C. D. (2007) 'Obesity in pregnancy: a study of the impact of maternal obesity on NHS maternity services', *BJOG: An International Journal of Obstetrics & Gynaecology*. Wiley Online Library, 114(3), pp. 334–342.

Hignett, S. (1996) 'Manual handling risks in midwifery: identification of risk factors', *British Journal of Midwifery*. MA Healthcare London , 4(11), pp. 590–596. doi: 10.12968/bjom.1996.4.11.590.

Hignett, S. (2001) 'Embedding ergonomics in hospital culture: top-down and bottom-up strategies', *Applied ergonomics*. Elsevier, 32(1), pp. 61–69.

Hignett, S. (2003) 'Intervention strategies to reduce musculoskeletal injuries associated with handling patients: a systematic review', *Occupational and environmental medicine*. BMJ Publishing Group Ltd, 60(9), pp. e6–e6.

Hignett, S., Griffiths, P., Murdey, I. D. and Lee, S. L. (2007) 'Assessing management of musculoskeletal disorders in the ambulance service', *Occupational Medicine*. Oxford University Press, 57(4), pp. 270–276.

Hignett, S. and McAtamney, L. (2000) 'Rapid entire body assessment (REBA)', *Applied ergonomics*. Elsevier, 31(2), pp. 201–205.

Hignett, S. and Richardson, B. (1995) 'Manual handling human loads in a hospital: an exploratory study to identify nurses' perceptions', *Applied Ergonomics Vol*, 26(3), pp. 221–226.

Hildebrandt, V. H., Bongers, P. M., Dul, J., Van Dijk, F. J. H. and Kemper, H. C. G. (2000) 'The relationship between leisure time, physical activities and musculoskeletal symptoms and disability in worker populations', *International*

archives of occupational and environmental health. Springer, 73(8), pp. 507–518.

Hirshkowitz, M., Whiton, K., Albert, S. M., Alessi, C., Bruni, O., DonCarlos, L., Hazen, N., Herman, J., Katz, E. S. and Kheirandish-Gozal, L. (2015) 'National Sleep Foundation's sleep time duration recommendations: methodology and results summary', *Sleep Health: Journal of the National Sleep Foundation*. Elsevier, 1(1), pp. 40–43.

Hogan, D. A. M., Greiner, B. A. and O'Sullivan, L. (2014) 'The effect of manual handling training on achieving training transfer, employee's behaviour change and subsequent reduction of work-related musculoskeletal disorders: a systematic review', *Ergonomics*. Taylor & Francis, 57(1), pp. 93–107.

Hollnagel, E. (2015) 'Why is work-as-imagined different from work-as-done?', in Wears, R. L., Hollnagel, E., and Braithwaite, J. (eds) *Resilient Health Care: the resilience of everyday clinical work*. Surrey: CRC Press, pp. 249–264.

Holzapfel, G. A. (2001) 'Biomechanics of soft tissue', *The handbook of materials behavior models*. Academic Boston, MA, 3(1), pp. 1049–1063.

Homer, C., Brodie, P. and Leap, N. (2008) *Midwifery Continuity of Care-E-Book: A Practical Guide*. Elsevier Health Sciences.

IEA. (2001). International Ergonomics Association. Full version of Core Competencies in Ergonomics: Units, elements, and performance criteria. Retrieved from https://iea.cc/project/2_Full Version of Core Competencies in Ergonomics Units Elements and Performance Criteria October 2001.pdf

Jackson, D., Clare, J. and Mannix, J. (2002) 'Who would want to be a nurse? Violence in the workplace–a factor in recruitment and retention', *Journal of nursing management*. Wiley Online Library, 10(1), pp. 13–20.

Janga, D. and Akinfenwa, O. (2012) 'Work-related repetitive strain injuries amongst practitioners of obstetric and gynaecological ultrasound worldwide', *Archives of gynecology and obstetrics*. Springer, 286(2), pp. 353–356.

Janowitz, I. L., Gillen, M., Ryan, G., Rempel, D., Trupin, L., Swig, L., Mullen, K., Rugulies, R. and Blanc, P. D. (2006) 'Measuring the physical demands of work in hospital settings: design and implementation of an ergonomics assessment', *Applied ergonomics*. Elsevier, 37(5), pp. 641–658.

Janowitz, I., Stern, A., Morelli, D., Vollowitz, E., Hudes, M. and Rempel, D. (2002) 'Validation and field testing of an ergonomic computer use checklist and guidebook', in *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*. SAGE Publications Sage CA: Los Angeles, CA, pp. 1007–1011.

Jellad, A., Lajili, H., Boudokhane, S., Migaou, H., Maatallah, S. and Frih, Z. B. S. (2013) 'Musculoskeletal disorders among Tunisian hospital staff: Prevalence and risk factors', *The Egyptian Rheumatologist*. Elsevier, 35(2), pp. 59–63.

Jensen, J. N., Holtermann, A., Clausen, T., Mortensen, O. S., Carneiro, I. G. and Andersen, L. L. (2012) 'The greatest risk for low-back pain among newly educated female health care workers; body weight or physical work load?', *BMC musculoskeletal disorders*. BioMed Central, 13(1), p. 87.

Jones, A. (2018) *Manual handling risks to midwives associated with birthing pools : literature review and incident analysis Prepared by the Health and Safety Executive RR1132*. Available at: http://www.hse.gov.uk/research/rrhtm/rr1132.htm?utm_content=&utm_medium=email&utm_name=research-4-may&utm_source=govdelivery&utm_term=.

Kanchanomai, S., Janwantanakul, P., Pensri, P. and Jiamjarasrangsi, W. (2011) 'Risk factors for the onset and persistence of neck pain in undergraduate students: 1-year prospective cohort study', *BMC public health*. BioMed Central, 11(1), p. 566.

Karasek, R., Brisson, C., Kawakami, N., Houtman, I., Bongers, P. and Amick, B. (1998) 'The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics.', *Journal of occupational health psychology*. Educational Publishing Foundation, 3(4), p. 322.

Karhu, O., Kansi, P. and Kuorinka, I. (1977) 'Correcting working postures in industry: a practical method for analysis', *Applied ergonomics*. Elsevier, 8(4), pp. 199–201.

Keyserling, W. M., Brouwer, M. and Silverstein, B. A. (1992) 'A checklist for evaluating ergonomic risk factors resulting from awkward postures of the legs, trunk and neck', *International Journal of Industrial Ergonomics*. Elsevier, 9(4), pp. 283–301.

Koneru, S. and Tanikonda, R. (2015) 'Role of yoga and physical activity in work-related musculoskeletal disorders among dentists', *Journal of International Society of Preventive & Community Dentistry*. Medknow Publications, 5(3), p. 199.

Koo, T. K. and Li, M. Y. (2016) 'A Guideline of Selecting and Reporting Intraclass Correlation Coefficients for Reliability Research', *Journal of Chiropractic Medicine*. Elsevier, 15(2), pp. 155–163. doi: 10.1016/j.jcm.2016.02.012.

Koushik Balaji, K. and Alphin, M. S. (2016) 'Computer-aided human factors analysis of the industrial vehicle driver cabin to improve occupational health', *International journal of injury control and safety promotion*. Taylor & Francis, 23(3), pp. 240–248.

Krämer, T., Schneider, A., Spieß, E., Angerer, P. and Weigl, M. (2016) 'Associations between job demands, work-related strain and perceived quality of care: a longitudinal study among hospital physicians', *International Journal for Quality in Health Care*. Oxford University Press, 28(6), pp. 824–829.

Kumar, S. (2001) 'Theories of musculoskeletal injury causation', *Ergonomics*. Taylor & Francis, 44(1), pp. 17–47.

Kuorinka, I., Jonsson, B., Kilbom, A., Vinterberg, H., Biering-Sørensen, F., Andersson,

G. and Jørgensen, K. (1987) 'Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms', *Applied ergonomics*. Elsevier, 18(3), pp. 233–237.

Lacey, R. J., Lewis, M. and Sim, J. (2007) 'Piecework, musculoskeletal pain and the impact of workplace psychosocial factors', *Occupational Medicine*, 57(6), pp. 430–437. Available at: http://dx.doi.org/10.1093/occmed/kqm048.

Laisné, F., Lecomte, C. and Corbière, M. (2013) 'Biopsychosocial determinants of work outcomes of workers with occupational injuries receiving compensation: a prospective study', *Work*. IOS Press, 44(2), pp. 117–132.

Lamy, S., De Gaudemaris, R., Lepage, B., Sobaszek, A., Caroly, S., Kelly-Irving, M. and Lang, T. (2013) 'The Organizational Work Factors' Effect on Mental Health Among Hospital Workers Is Mediated by Perceived Effort–Reward Imbalance: Result of a Longitudinal Study', *Journal of occupational and environmental medicine*. LWW, 55(7), pp. 809–816.

Lancaster, R., Maher, C. J. and Alder, A. (2001) *Second evaluation of the Manual Handling Operations Regulations (1992) and guidance*. Great Britain, Health and Safety Executive. Available at: http://www.hse.gov.uk/research/crr_pdf/2001/crr01346.pdf.

Lang, J., Ochsmann, E., Kraus, T. and Lang, J. W. B. (2012) 'Psychosocial work stressors as antecedents of musculoskeletal problems: a systematic review and meta-analysis of stability-adjusted longitudinal studies', *Social science & medicine*. Elsevier, 75(7), pp. 1163–1174.

Ledger, S., Hindle, G. and Smith, T. (2018) *Mind the Gap 2018: An Investigation into Maternity Training for Frontline Professionals Across the UK (2017/2018)*. Available at: http://babylifeline.org.uk/home/wp-content/uploads/2014/07/Mind-the-Gap-2018-Investigation-into-Maternity-Training-Final-ELECTRONIC-VERSION-Final-v2.pdf.

Lee, S., Lee, J. H. and Gershon, R. R. M. (2015) 'Musculoskeletal symptoms in nurses in the early implementation phase of california's safe patient handling legislation', *Research in nursing & health*. Wiley Online Library, 38(3), pp. 183–193.

Lee, S., Lee, J. H., Gillen, M. and Krause, N. (2014) 'Job stress and work-related musculoskeletal symptoms among intensive care unit nurses: a comparison between job demand-control and effort-reward imbalance models', *American journal of industrial medicine*. Wiley Online Library, 57(2), pp. 214–221.

LeMasters, G., Bhattacharya, A., Borton, E. and Mayfield, L. (2006) 'Functional impairment and quality of life in retired workers of the construction trades', *Experimental aging research*. Taylor & Francis, 32(2), pp. 227–242.

Lerner, H. (2004) 'Shoulder dystocia, facts Evidence and conclusions'. Advanced Life Support in Obstetrics.[Online] Available at: http://www. also. org. uk/download/shoulder% 20dystocia% 20review. pdf.

LeVeau, B. F. (2010) *Biomechanics of Human Motion: Basics and Beyond for the Health Professions*. Slack Incorporated.

Li, C.-Y. and Sung, F.-C. (1999) 'A review of the healthy worker effect in occupational epidemiology', *Occupational medicine*. Oxford University Press, 49(4), pp. 225–229.

Li, G. and Buckle, P. (1998) 'The development of a practical method for the exposure assessment of risks to work-related musculoskeletal disorders', *General report to the HSE (Contract No. R3408), Robens Centre for Health Ergonomics, European Institute of Health and Medical Sciences, University of Surrey*.

Li, G. and Buckle, P. (1999) 'Current techniques for assessing physical exposure to work-related musculoskeletal risks, with emphasis on posture-based methods', *Ergonomics*. Taylor & Francis, 42(5), pp. 674–695.

Li, J., Yang, W. and Cho, S. (2006) 'Gender differences in job strain, effort-reward imbalance, and health functioning among Chinese physicians', *Social science & medicine*. Elsevier, 62(5), pp. 1066–1077.

Liker, J. K., Nagamachi, M. and Lifshitz, Y. R. (1989) 'A comparative analysis of participatory ergonomics programs in US and Japan manufacturing plants', *International Journal of Industrial Ergonomics*. Elsevier, 3(3), pp. 185–199.

Lin, T.-H., Liu, Y. C., Hsieh, T.-Y., Hsiao, F.-Y., Lai, Y.-C. and Chang, C.-S. (2012) 'Prevalence of and risk factors for musculoskeletal complaints among Taiwanese dentists', *Journal of dental sciences*. Elsevier, 7(1), pp. 65–71.

Lipscomb, J. A., Trinkoff, A. M., Geiger-Brown, J. and Brady, B. (2002) 'Work-schedule characteristics and reported musculoskeletal disorders of registered nurses', *Scandinavian journal of work, environment & health*. JSTOR, pp. 394–401.

LoBiondo-Wood, G. and Haber, J. (2006) 'Nursing research St', *Louis, MO: Mosby Elsevier*.

Loebl, W. Y. (1967) 'Measurement of spinal posture and range of spinal movement', *Rheumatology*. Oxford University Press, 9(3), pp. 103–110.

Long, M. H., Bogossian, F. E. and Johnston, V. (2013a) 'Functional consequences of work-related spinal musculoskeletal symptoms in a cohort of Australian midwives', *Women and Birth*. Elsevier, 26(1), pp. e50–e58.

Long, M. H., Bogossian, F. E. and Johnston, V. (2013b) 'Midwives' Experiences of Work-Related Shoulder Musculoskeletal Problems', *International Journal of Childbirth*. Springer Publishing Company, 3(1), pp. 52–64.

Long, M. H., Johnston, V. and Bogossian, F. (2012) 'Work-related upper quadrant musculoskeletal disorders in midwives, nurses and physicians: a systematic review of risk factors and functional consequences', *Applied ergonomics*. Elsevier, 43(3), pp. 455–467.

Long, M. H., Johnston, V. and Bogossian, F. E. (2013) 'Helping women but hurting ourselves? Neck and upper back musculoskeletal symptoms in a cohort of Australian Midwives', *Midwifery*. Elsevier, 29(4), pp. 359–367.

Ludewig, P. M. and Braman, J. P. (2011) 'Shoulder impingement: biomechanical considerations in rehabilitation', *Manual therapy*. Elsevier, 16(1), pp. 33–39.

Luke, B. and Brown, M. B. (2007) 'Elevated risks of pregnancy complications and adverse outcomes with increasing maternal age', *Human reproduction*. Oxford University Press, 22(5), pp. 1264–1272.

Magnavita, N. and Heponiemi, T. (2012) 'Violence towards health care workers in a Public Health Care Facility in Italy: a repeated cross-sectional study', *BMC health services research*. BioMed Central, 12(1), p. 108.

Mannion, R., Davies, H. and Marshall, M. (2004) *Cultures for performance in health care*. McGraw-Hill Education (UK).

Mannion, R., Davies, H. T. O. and Marshall, M. N. (2005) 'Cultural characteristics of "high" and "low" performing hospitals', *Journal of health organization and management*. Emerald Group Publishing Limited, 19(6), pp. 431–439.

Marras, W. S., Fathallah, F. A., Miller, R. J., Davis, S. W. and Mirka, G. A. (1992) 'Accuracy of a three-dimensional lumbar motion monitor for recording dynamic trunk motion characteristics', *International Journal of Industrial Ergonomics*. Elsevier Science, 9(1), pp. 75–87.

Di Martino, V. (2002) 'Workplace violence in the health sector', *Country case studies Brazil, Bulgaria, Lebanon, Portugal, South Africa, Thailand and an additional Australian study. Ginebra: Organización Internacional del Trabajo*.

McAtamney, L. and Corlett, E. N. (1993) 'RULA: a survey method for the investigation of work-related upper limb disorders', *Applied ergonomics*. Elsevier, 24(2), pp. 91–99.

McDermott, H., Haslam, C., Clemes, S., Williams, C. and Haslam, R. (2012) 'Investigation of manual handling training practices in organisations and beliefs regarding effectiveness', *International Journal of Industrial Ergonomics*. Elsevier, 42(2), pp. 206–211.

McQueen, R. A. and Knussen, C. (2002) *Research methods for social science: A practical introduction*. Pearson Education.

Mehlum, I. S., Veiersted, K. B., Wærsted, M., Wergeland, E. and Kjuus, H. (2009) 'Self-reported versus expert-assessed work-relatedness of pain in the neck, shoulder, and arm', *Scandinavian journal of work, environment & health*. JSTOR, pp. 222–232.

Melzack, R. and Wall, P. D. (1967) 'Pain mechanisms: a new theory.', *Survey of*

Anesthesiology. LWW, 11(2), pp. 89–90.

Mitchell, R. J. and Williamson, A. M. (2000) 'Evaluation of an 8 hour versus a 12 hour shift roster on employees at a power station', *Applied ergonomics*. Elsevier, 31(1), pp. 83–93.

Moody, A. and Neave, A. (2016) 'Health Survey for England 2015. Adult overweight and obesity'. London, UK.

Morgan, D. L. (2007) 'Paradigms lost and pragmatism regained: Methodological implications of combining qualitative and quantitative methods', *Journal of mixed methods research*. Sage Publications, 1(1), pp. 48–76.

Neale, J. (2008) *Research methods for health and social care*. Palgrave Macmillan.

Nelson, A., Matz, M., Chen, F., Siddharthan, K., Lloyd, J. and Fragala, G. (2006) 'Development and evaluation of a multifaceted ergonomics program to prevent injuries associated with patient handling tasks', *International journal of nursing studies*. Elsevier, 43(6), pp. 717–733.

Neumann, D. A. (2013) *Kinesiology of the musculoskeletal system: foundations for rehabilitation*. Elsevier Health Sciences.

NHS (2011a) 'Moving to 12-hour shift patterns : to increase continuity and reduce costs Quality and Productivity : Case Study', pp. 1–6. Available at: http://www.evidence.nhs.uk/qipp.

NHS (2011b) *Start Active , Stay Active*, *Report*. doi: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/216370/dh_128210.pdf.

NHS Employers (2015a) *2015 NHS Pension Scheme*. Available at: http://www.nhsemployers.org/your-workforce/pay-and-reward/pensions/new-2015-scheme#one.

NHS Employers (2015b) *Nottingham University Hospitals NHS Trust Excellence in Employee Wellbeing*.

Nowotny-Czupryna, O., Naworska, B., Brzęk, A., Nowotny, J., Famuła, A., Kmita, B. and Bąk, K. (2012) 'Professional experience and ergonomic aspects of midwives' work', *International journal of occupational medicine and environmental health*. Springer, 25(3), pp. 265–274.

O'Brien, C. and Paradise, M. G. A. (1976) 'The development of a portable non-invasive system for analysing human movement', in *Proceedings of the Human Factors Society Annual Meeting*. SAGE Publications Sage CA: Los Angeles, CA, pp. 390–392.

Oakman, J., Macdonald, W. and Wells, Y. (2014) 'Developing a comprehensive

approach to risk management of musculoskeletal disorders in non-nursing health care sector employees', *Applied ergonomics*. Elsevier, 45(6), pp. 1634–1640.

Oakman, J., Neupane, S. and Nygård, C.-H. (2016) 'Does age matter in predicting musculoskeletal disorder risk? An analysis of workplace predictors over 4 years', *International archives of occupational and environmental health*. Springer, 89(7), pp. 1127–1136.

Office for National Statistics (2014) *Full Report: Sickness Absence in the Labour Market, February 2014*.

Office for National Statistics (2018) *Sickness absence in the UK labour market*. Available at: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/sicknessabsenceinthelabourmarket.

Okuyucu, K., Jeve, Y. and Doshani, A. (2017) 'Work-related musculoskeletal injuries amongst obstetrics and gynaecology trainees in East Midland region of the UK'. Springer© The Author (s).

Ørhede, E., Hottinen, V., Skogstad, A., Knardahl, S., Elo, A.-L., Dallner, M. and Gamberale, F. (2000) *User's guide for the QPSNordic: General Nordic Questionnaire for psychological and social factors at work*. Nordic Council of Ministers.

Oswald, A. and Gardner, J. (2001) 'What has been happening to job satisfaction in Britain', *Warwick University*.

Page, L. (1988) 'The midwife's role in modern health care', *The Midwife Challenge. London: Pandora*.

Pallant, J. (2013) *SPSS survival manual*. McGraw-Hill Education (UK).

Palmer, K. T., Walker-Bone, K., Griffin, M. J., Syddall, H., Pannett, B., Coggon, D. and Cooper, C. (2001) 'Prevalence and occupational associations of neck pain in the British population', *Scandinavian journal of work, environment & health*. JSTOR, pp. 49–56.

Pandis, N., Pandis, B. D., Pandis, V. and Eliades, T. (2007) 'Occupational hazards in orthodontics: A review of risks and associated pathology', *American Journal of Orthodontics and Dentofacial Orthopedics*. Elsevier, 132(3), pp. 280–292.

Papageorgiou, A. C., Croft, P. R., Ferry, S., Jayson, M. I. V and Silman, A. J. (1995) 'Estimating the prevalence of low back pain in the general population: evidence from the South Manchester Back Pain Survey.', *Spine*. LWW, 20(17), pp. 1889–1894.

Park, W., Singh, D. P., Levy, M. S. and Jung, E. S. (2009) 'Obesity effect on perceived postural stress during static posture maintenance tasks', *Ergonomics*. Taylor & Francis, 52(9), pp. 1169–1182.

Parupalli, S., Pinto, A., Neal, N. and O'Mahony, F. (2012) 'Obstetrician injury whilst managing a shoulder dystocia: A case report'. Scientific Research Publishing.

Passmore, K. and Leung, W. C. (2002) 'Defensive practice among psychiatrists: a questionnaire survey', *Postgraduate Medical Journal*. The Fellowship of Postgraduate Medicine, 78(925), pp. 671–673.

Pensri, P., Janwantanakul, P. and Chaikumarn, M. (2010) 'Biopsychosocial risk factors for musculoskeletal symptoms of the spine in salespeople', *International journal of occupational and environmental health*. Taylor & Francis, 16(3), pp. 303–311.

Perreault, N., Brisson, C., Dionne, C. E., Montreuil, S. and Punnett, L. (2008) 'Agreement between a self-administered questionnaire on musculoskeletal disorders of the neck-shoulder region and a physical examination', *BMC musculoskeletal disorders*. BioMed Central, 9(1), p. 34.

Pike, I., Russo, A., Berkowitz, J., Baker, J. P. and Lessoway, V. A. (1997) 'The prevalence of musculoskeleta disorders among diagnostic medical sonograhers', *Journal of Diagnostic Medical Sonography*. Sage Publications Sage CA: Thousand Oaks, CA, 13(5), pp. 219–227.

Plant, M. and Coombes, S. (2003) 'Primary care nurses' attitude to sickness absence: a study', *British journal of community nursing*. MA Healthcare London, 8(9), pp. 421–427.

Pluye, P., Robert, E., Cargo, M., Bartlett, G., O'Cathain, A., Griffiths, F., Boardman, F., Gagnon, M. P. and Rousseau, M. C. (2011) 'Mixed methods appraisal tool (MMAT) version 2011', *Proposal: A mixed methods appraisal tool for systematic mixed studies reviews, McGill University, Department of Family Medicine*.

Praemer, A., Furner, S., Rice, D. P. and Kelsey, J. L. (1992) 'Musculoskeletal conditions in the United States'. American Academy of Orthopaedic Surgeons.

Pugh, J. D., Gelder, L., Williams, A. M., Twigg, D. E., Wilkinson, A. M. and Blazevich, A. J. (2015) 'Validity and reliability of an online extended version of the Nordic Musculoskeletal Questionnaire (NMQ-E2) to measure nurses' fitness', *Journal of clinical nursing*. Wiley Online Library, 24(23–24), pp. 3550–3563.

Punchihewa, H. K. G. and Gyi, D. E. (2009) 'Development of a QFD based collaborative design approach to reduce work-related musculoskeletal disorders (MSDs)'. © Common Ground.

Punnett, L. and Wegman, D. H. (2004) 'Work-related musculoskeletal disorders: the epidemiologic evidence and the debate', *Journal of Electromyography and Kinesiology*, 14(1), pp. 13–23. doi: 10.1016/j.jelekin.2003.09.015.

Rafeemanesh, E., Jafari, Z., Kashani, F. O. and Rahimpour, F. (2013) 'A study on job postures and musculoskeletal illnesses in dentists', *International journal of*

occupational medicine and environmental health. Springer, 26(4), pp. 615–620.

Rafie, F., Zamani Jam, A., Shahravan, A., Raoof, M. and Eskandarizadeh, A. (2015) 'Prevalence of upper extremity musculoskeletal disorders in dentists: symptoms and risk factors', *Journal of environmental and public health*. Hindawi Publishing Corporation, 2015.

Rasmussen, C. D. N., Holtermann, A., Bay, H., Søgaard, K. and Jørgensen, M. B. (2015) 'A multifaceted workplace intervention for low back pain in nurses' aides: a pragmatic stepped wedge cluster randomised controlled trial', *Pain*. Wolters Kluwer Health, 156(9), p. 1786.

Ratzon, N. Z., Bar-Niv, N. A. and Froom, P. (2016) 'The effect of a structured personalized ergonomic intervention program for hospital nurses with reported musculoskeletal pain: An assigned randomized control trial', *Work*. IOS Press, 54(2), pp. 367–377.

Razak, S., Hignett, S., Barnes, J. and Hancox, G. (2018) 'Applying Human Factors Methods to Explore "Work as Imagined"and "Work as Done"in the Emergency Departments Response to Chemical, Biological, Radiological, and Nuclear Events', in *Congress of the International Ergonomics Association*. Springer, pp. 102–110.

RCM (2013) 'Response to the NHS Working Longer Review Call for Evidence', (August), pp. 1–47.

RCM (2015) 'State of Maternity Services Report 2015', pp. 1–16. Available at: https://www.rcm.org.uk/sites/default/files/RCM State of Maternity Services Report 2015.pdf%5Cnhttp://www.rcm.org.uk/college/policy-practice/government-policy/state-of-maternity-services/.

RCM (2016a) *Musculoskeletal injuries survey*. Available at: https://www.rcm.org.uk/news-views-and-analysis/news/musculoskeletal-injuries-survey.

RCM (2016b) 'Position Statement Continuity of midwife-led care'. Available at: https://www.rcm.org.uk/sites/default/files/Continuity of midwife-led care.pdf.

RCM (2016c) 'State of Maternity Services Report 2016', pp. 1–20. Available at: https://www.rcm.org.uk/sites/default/files/SoMS Report 2016_New Design_aw.pdf.

RCM (2016d) *Why midwives leave -revisited*. Available at: https://www.rcm.org.uk/sites/default/files/Why Midwives Leave Revisted - October 2016.pdf.

RCOG (2015) 'RCOG Census Report 2013', (February). Available at: https://www.rcog.org.uk/globalassets/documents/careers-and-training/census-workforce-planning/census-report-2013.pdf.

RCOG (2016) *Each Baby Counts: key messages from 2015*, *Royal College of Obstetricians and Gynaecologists*. London. Available at: https://www.rcog.org.uk/globalassets/documents/guidelines/research--audit/rcog-each-baby-counts-report.pdf.

RCOG (2018) *Each Baby Counts: 2018 Progress Report*, *Royal College of Obstetricians and Gynaecologists*. Available at: https://www.rcog.org.uk/globalassets/documents/guidelines/research--audit/each-baby-counts/each-baby-counts-report-2018-11-12.pdf.

Reason, J. (2000) 'Human error: models and management', *Bmj*. British Medical Journal Publishing Group, 320(7237), pp. 768–770.

Ribeiro, T., Serranheira, F. and Loureiro, H. (2017) 'Work related musculoskeletal disorders in primary health care nurses', *Applied Nursing Research*. Elsevier, 33, pp. 72–77.

Richardson, A., McNoe, B., Derrett, S. and Harcombe, H. (2018) 'Interventions to prevent and reduce the impact of musculoskeletal injuries among nurses: A systematic review', *International journal of nursing studies*. Elsevier, 82, pp. 58–67.

Rivilis, I., Van Eerd, D., Cullen, K., Cole, D. C., Irvin, E., Tyson, J. and Mahood, Q. (2008) 'Effectiveness of participatory ergonomi1. Rivilis I, Van Eerd D, Cullen K, Cole DC, Irvin E, Tyson J, et al. Effectiveness of participatory ergonomic interventions on health outcomes: a systematic review. Appl Ergon. 2008;39(3):342–58. c interventions on ', *Applied ergonomics*. Elsevier, 39(3), pp. 342–358.

Robson, C. and McCartan, K. (2016) *Real world research*. John Wiley & Sons.

Rogers, A. E., Hwang, W.-T., Scott, L. D., Aiken, L. H. and Dinges, D. F. (2004) 'The working hours of hospital staff nurses and patient safety', *Health affairs*. Project HOPE-The People-to-People Health Foundation, Inc., 23(4), pp. 202–212.

Royal College of Midwives (1999) *Handle with Care: A Midwife's Guide to Preventing Back Injury*. London: Royal College of Midwives. Available at: https://books.google.co.uk/books?id=a04bNQAACAAJ.

Royal College of Midwives (2010) *The Royal College of Midwives Survey of Positions used in Labour and Birth*. London: RCM.

Royal College of Midwives (2016a) 'Caring for You Campaign: Survey Results RCM campaign for healthy workplaces delivering high quality care'. Available at: file:///C:/Users/pn2049/Desktop/Caring for You - Survey Results 2016 A5 84pp_5 spd.pdf.

Royal College of Midwives (2016b) *Getting the midwifery workforce right*. Available at: https://www.rcm.org.uk/sites/default/files/Getting the Midwifery Workforce Right A5 24pp_2_1.pdf.

Royal College of Nursing (2003) *Safer staff, better care: RCN manual handling training guidance*. London.

Russo, A., Murphy, C., Lessoway, V. and Berkowitz, J. (2002) 'The prevalence of musculoskeletal symptoms among British Columbia sonographers', *Applied Ergonomics*. Elsevier, 33(5), pp. 385–393.

Safitri, D. M., Azmi, N., Singh, G. and Astuti, P. (2016) 'Redesign of Transjakarta Bus Driver's Cabin', in *IOP Conference Series: Materials Science and Engineering*. IOP Publishing, p. 12086.

Salmani Nodooshan, H., Choobineh, A., Razeghi, M. and Shahnazar Nezhad Khales, T. (2017) 'Designing, prototype making and evaluating a mechanical aid device for patient transfer between bed and stretcher', *International Journal of Occupational Safety and Ergonomics*. Taylor & Francis, 23(4), pp. 491–500.

Sandall, J., Soltani, H., Gates, S., Shennan, A. and Devane, D. (2016) 'Midwife-led continuity models versus other models of care for childbearing women', *The Cochrane Library*. Wiley Online Library.

Saunders, M., Lewis, P. and Thornhill, A. (2009) 'Research Methods for Business Students (5th edn)'. Pearson Education.

Saxon, S. V, Etten, M. J. and Perkins, E. A. (2014) *Physical change and aging: A guide for the helping professions*. Springer Publishing Company.

Schmied, V. A., Duff, M., Dahlen, H. G., Mills, A. E. and Kolt, G. S. (2011) '"Not waving but drowning": A study of the experiences and concerns of midwives and other health professionals caring for obese childbearing women', *Midwifery*. Elsevier, 27(4), pp. 424–430. doi: 10.1016/j.midw.2010.02.010.

Scott, T., Mannion, R., Marshall, M. and Davies, H. (2003) 'Does organisational culture influence health care performance? A review of the evidence', *Journal of health services research & policy*. SAGE Publications Sage UK: London, England, 8(2), pp. 105–117.

Serranheira, F., Cotrim, T., Rodrigues, V., Nunes, C. and Sousa-Uva, A. (2012) 'Nurses' working tasks and MSDs back symptoms: results from a national survey', *Work*. IOS Press, 41(Supplement 1), pp. 2449–2451.

Sharples, S. and Wilson, J.R., 2015. *Evaluation of human work.* CRC Press.

Siegrist, J. (1996) 'Adverse health effects of high-effort/low-reward conditions.', *Journal of occupational health psychology*. Educational Publishing Foundation, 1(1), p. 27.

Siegrist, J., Li, J. and Montano, D. (2013) 'Psychometric properties of the effort-reward imbalance questionnaire', *Duesseldorf University: Department of Medical Sociology FoM*.

Siegrist, J., Starke, D., Chandola, T., Godin, I., Marmot, M., Niedhammer, I. and Peter, R. (2004) 'The measurement of effort–reward imbalance at work: European comparisons', *Social science & medicine*. Elsevier, 58(8), pp. 1483–1499.

Siegrist, J., Wege, N., Pühlhofer, F. and Wahrendorf, M. (2009) 'A short generic measure of work stress in the era of globalization: effort–reward imbalance', *International archives of occupational and environmental health*. Springer, 82(8), p. 1005.

Silverstein, B. and Clark, R. (2004) 'Interventions to reduce work-related musculoskeletal disorders', *Journal of Electromyography and Kinesiology*. Elsevier, 14(1), pp. 135–152.

Simon, M., Tackenberg, P., Nienhaus, A., Estryn-Behar, M., Conway, P. M. and Hasselhorn, H.-M. (2008) 'Back or neck-pain-related disability of nursing staff in hospitals, nursing homes and home care in seven countries—results from the European NEXT-Study', *International journal of nursing studies*. Elsevier, 45(1), pp. 24–34.

Sissons, P., Barnes, H. and Stevens, H. (2011) *Routes onto Employment and Support Allowance*. Department for Work and Pensions.

Skagen, K. and Collins, A. M. (2016) 'The consequences of sickness presenteeism on health and wellbeing over time: a systematic review', *Social Science & Medicine*. Elsevier, 161, pp. 169–177.

Smedley, J. and Coggon, D. (1994) 'Will the manual handling regulations reduce the incidence of back disorders?', *Occupational Medicine*. Oxford University Press, 44(2), pp. 63–65.

Smedley, J., Inskip, H., Trevelyan, F., Buckle, P., Cooper, C. and Coggon, D. (2003) 'Risk factors for incident neck and shoulder pain in hospital nurses', *Occupational and Environmental Medicine*. BMJ Publishing Group Ltd, 60(11), pp. 864–869.

Smith, D. R., Mihashi, M., Adachi, Y., Koga, H. and Ishitake, T. (2006a) 'A detailed analysis of musculoskeletal disorder risk factors among Japanese nurses', *Journal of safety research*. Elsevier, 37(2), pp. 195–200.

Smith, D. R., Wei, N., Zhang, Y.-J. and Wang, R.-S. (2006b) 'Musculoskeletal complaints and psychosocial risk factors among physicians in mainland China', *International Journal of Industrial Ergonomics*. Elsevier, 36(6), pp. 599–603.

Smith, D. R., Wei, N., Zhao, L. and Wang, R.-S. (2004) 'Musculoskeletal complaints and psychosocial risk factors among Chinese hospital nurses', *Occupational Medicine*. Soc Occupational Med, 54(8), pp. 579–582.

Smith, L., Folkard, S., Tucker, P. and Macdonald, I. (1998) 'Work shift duration: a review comparing eight hour and 12 hour shift systems.', *Occupational and environmental medicine*. BMJ Publishing Group Ltd, 55(4), pp. 217–229.

Soper, D. (no date) *A-priori Sample Size Calculator for Multiple Regression [Software]*, *2017*. Available at: http://www.danielsoper.com/statcalc.

Sperandei, S. (2014) 'Understanding logistic regression analysis', *Biochemia medica: Biochemia medica*. Medicinska naklada, 24(1), pp. 12–18.

Spielholz, P., Silverstein, B., Morgan, M., Checkoway, H. and Kaufman, J. (2001) 'Comparison of self-report, video observation and direct measurement methods for upper extremity musculoskeletal disorder physical risk factors', *Ergonomics*. Taylor & Francis, 44(6), pp. 588–613.

St-Vincent, M., Lortie, M. and Chicoine, D. (2001) 'Participatory ergonomics training in the manufacturing sector and ergonomic analysis tools', *Relations industrielles/Industrial Relations*, 56(3), pp. 491–515.

Steele, D. and Stubbs, D. (2002) 'Measuring working postures of midwives in the healthcare setting', *CONTEMPORARY ERGONOMICS*. TAYLOR AND FRANCIS, pp. 39–44.

Steven Moore, J. and Garg, A. (1995) 'The strain index: a proposed method to analyze jobs for risk of distal upper extremity disorders', *American Industrial Hygiene Association Journal*, 56(5), pp. 443–458.

Stichler, J. F., Feiler, J. L. and Chase, K. (2012) 'Understanding risks of workplace injury in labor and delivery', *Journal of Obstetric, Gynecologic, & Neonatal Nursing*. Wiley Online Library, 41(1), pp. 71–81.

Stone, P. W., Du, Y., Cowell, R., Amsterdam, N., Helfrich, T. A., Linn, R. W., Gladstein, A., Walsh, M. and Mojica, L. A. (2006) 'Comparison of nurse, system and quality patient care outcomes in 8-hour and 12-hour shifts', *Medical care*. LWW, 44(12), pp. 1099–1106.

Straus, A. and Corbin, J. (1998) 'Basics of qualitative research: Techniques and procedures for developing grounded theory'. Thousand Oaks, CA: Sage.

Stubbs, B. (2009) 'The manual handling of the aggressive patient: a review of the risk of injury to nurses', *Journal of psychiatric and mental health nursing*. Wiley Online Library, 16(4), pp. 395–400.

Surtees, R. (2010) '"Everybody expects the perfect baby… and perfect labour… and so you have to protect yourself": discourses of defence in midwifery practice in Aotearoa/New Zealand', *Nursing inquiry*. Wiley Online Library, 17(1), pp. 82–92.

Svensson, J., Barclay, L. and Cooke, M. (2009) 'Randomised-controlled trial of two antenatal education programmes', *Midwifery*. Elsevier, 25(2), pp. 114–125.

Swerts, M., Westhof, E., Bogaerts, A. and Lemiengre, J. (2016a) 'Supporting breast-feeding women from the perspective of the midwife: A systematic review of the literature', *Midwifery*. Elsevier, 37, pp. 32–40.

Swerts, M., Westhof, E., Bogaerts, A. and Lemiengre, J. (2016b) 'Supporting breast-feeding women from the perspective of the midwife: A systematic review of the literature', *Midwifery*. Elsevier, 37, pp. 32–40.

Symon, A. (2000) 'Litigation and defensive clinical practice: quantifying the problem', *Midwifery*. Elsevier, 16(1), pp. 8–14.

Szeto, G. P. Y., Ho, P., Ting, A. C. W., Poon, J. T. C., Cheng, S. W. K. and Tsang, R. C. C. (2009) 'Work-related musculoskeletal symptoms in surgeons', *Journal of occupational rehabilitation*. Springer, 19(2), pp. 175–184.

Takala, E.-P., Pehkonen, I., Forsman, M., Hansson, G.-Å., Mathiassen, S. E., Neumann, W. P., Sjøgaard, G., Veiersted, K. B., Westgaard, R. H. and Winkel, J. (2010) 'Systematic evaluation of observational methods assessing biomechanical exposures at work', *Scandinavian journal of work, environment & health*. JSTOR, pp. 3–24.

Takekawa, K. S., Goncalves, J. S., Moriguchi, C. S. and COURY, H. J. C. G. (2015) 'Can a self-administered questionnaire identify workers with chronic or recurring low back pain?', *Industrial health*. National Institute of Occupational Safety and Health, 53(4), pp. 340–345.

Tashakkori, A. and Teddlie, C. (2003) 'Handbook of mixed methods in social and behavioral research.', *Thousand Oaks, CA: CA*.

Teddlie, C. and Tashakkori, A. (2009) *Foundations of mixed methods research: Integrating quantitative and qualitative approaches in the social and behavioral sciences*. Sage.

Tesh, K. M., Lancaster, R. J., Hanson, M. A., Ritchie, P. J., Donnan, P. T. and Graveling, R. A. (1997) 'Evaluation of the manual handling operations regulations 1992 and guidance', *Institute of Occupational Medicine*. Available at: http://www.hse.gov.uk/research/crr_pdf/1997/crr97152.pdf.

Thomas, R. M. (2003) *Blending qualitative and quantitative research methods in theses and dissertations*. Corwin Press.

Thompson, E. (2000) 'Safer birthing positions. A choice for mother and midwife', *The Column*, 12(2), pp. 17–22.

Tinubu, B. M. S., Mbada, C. E., Oyeyemi, A. L. and Fabunmi, A. A. (2010) 'Work-related musculoskeletal disorders among nurses in Ibadan, South-west Nigeria: a cross-sectional survey', *BMC Musculoskeletal disorders*. BioMed Central, 11(1), p. 12.

Todd, C., Robinson, G. and Reid, N. (1993) '12-hour shifts: job satisfaction of nurses', *Journal of nursing management*. Wiley Online Library, 1(5), pp. 215–220.

Trinkoff, A. M., Le, R., Geiger-Brown, J., Lipscomb, J. and Lang, G. (2006)

‘Longitudinal relationship of work hours, mandatory overtime, and on-call to musculoskeletal problems in nurses’, *American journal of industrial medicine*. Wiley Online Library, 49(11), pp. 964–971.

Trinkoff, A. M., Lipscomb, J. A., Geiger-Brown, J., Storr, C. L. and Brady, B. A. (2003) ‘Perceived physical demands and reported musculoskeletal problems in registered nurses’, *American journal of preventive medicine*. Elsevier, 24(3), pp. 270–275.

Trinkoff, A. M., Lipscomb, J. A., Geiger-Brown, J. and Brady, B. (2002) ‘Musculoskeletal problems of the neck, shoulder, and back and functional consequences in nurses’, *American journal of industrial medicine*. Wiley Online Library, 41(3), pp. 170–178.

Turner, C., Bain, C., Schluter, P. J., Yorkston, E., Bogossian, F., McClure, R., Huntington, A. and Group, N. and M. e-C. (2008) ‘Cohort Profile: The Nurses and Midwives e-Cohort Study—a novel electronic longitudinal study’, *International Journal of Epidemiology*. Oxford University Press, 38(1), pp. 53–60.

Tveten, K. M. and Morken, T. (2015) ‘Decision-making in job attendance within health care—a qualitative study’, *Occupational Medicine*. Oxford University Press UK, 66(3), pp. 247–251.

UK Government (1974) *Health and Safety at Work Act 1974*, *Employment Law and Occupational Health: …*. doi: 10.1108/eb022382.

United Nations (2011) *World population prospects: The 2010 Revision*, *New York: United Nations*.

Urquhart, D. M., Kelsall, H. L., Hoe, V. C. W., Cicuttini, F. M., Forbes, A. B. and Sim, M. R. (2013) ‘Are psychosocial factors associated with low back pain and work absence for low back pain in an occupational cohort?’, *The Clinical journal of pain*. LWW, 29(12), pp. 1015–1020.

Uz, T. S. and Yeldan, İ. (2012) ‘Is physical inactivity associated with musculoskeletal disorders?’, *Agri: Agri (Algoloji) Dernegi’nin Yayin organidir= The journal of the Turkish Society of Algology*, 25(4), pp. 147–155.

Van Hoof, W., O’Sullivan, K., O’Keeffe, M., Verschueren, S., O’Sullivan, P. and Dankaerts, W. (2018) ‘The efficacy of interventions for low back pain in nurses: A systematic review’, *International journal of nursing studies*. Elsevier, 77, pp. 222–231.

Van Mechelen, W., Hlobil, H. and Kemper, H. C. G. (1992) ‘Incidence, severity, aetiology and prevention of sports injuries’, *Sports medicine*. Springer, 14(2), pp. 82–99.

Vanwonterghem, K., Yoopat, P. and Maes, C. (2012) ‘Musculoskeletal disorders: a new approach’, *Work*. IOS Press, 41(Supplement 1), pp. 2293–2298.

Venning, P. J., Walter, S. D. and Stitt, L. W. (1987) 'Personal and job-related factors as determinants of incidence of back injuries among nursing personnel.', *Journal of occupational medicine.: official publication of the Industrial Medical Association*, 29(10), pp. 820–825.

Verbeek, J. H., Martimo, K., Karppinen, J., Kuijer, P. P., Viikari-Juntura, E. and Takala, E. (2011) 'Manual material handling advice and assistive devices for preventing and treating back pain in workers.'

Viikari-Juntura, E., Rauas, S., Martikainen, R., Kuosma, E., Riihimäki, H., Takala, E.-P. and Saarenmaa, K. (1996) 'Validity of self-reported physical work load in epidemiologic studies on musculoskeletal disorders', *Scandinavian journal of work, environment & health*. JSTOR, pp. 251–259.

Vink, P., Peeters, M., Gründemann, R. W. M., Smulders, P. G. W., Kompier, M. A. J. and Dul, J. (1995) 'A participatory ergonomics approach to reduce mental and physical workload', *International Journal of Industrial Ergonomics*. Elsevier, 15(5), pp. 389–396.

Vo, N., Wang, D., Sowa, G., Witt, W., Ngo, K., Coelho, P., Bedison, R., Byer, B., Studer, R. and Lee, J. (2011) 'Differential effects of nicotine and tobacco smoke condensate on human annulus fibrosus cell metabolism', *Journal of Orthopaedic Research*. Wiley Online Library, 29(10), pp. 1585–1591.

Wang, J., Cui, Y., He, L., Xu, X., Yuan, Z., Jin, X. and Li, Z. (2017) 'Work-related musculoskeletal disorders and risk factors among Chinese medical staff of obstetrics and gynecology', *International journal of environmental research and public health*. Multidisciplinary Digital Publishing Institute, 14(6), p. 562.

Waters, T. R. (2010) 'Introduction to ergonomics for healthcare workers', *Rehabilitation Nursing*. Wiley Online Library, 35(5), pp. 185–191.

Waters, T. R., Putz-Anderson, V., Garg, A. and Fine, L. J. (1993) 'Revised NIOSH equation for the design and evaluation of manual lifting tasks', *Ergonomics*. Taylor & Francis, 36(7), pp. 749–776.

Wells, R., Norman, R., Neumann, P., Andrews, D., Frank, J., Shannon, H. and Kerr, M. (1997) 'Assessment of physical work load in epidemiologic studies: common measurement metrics for exposure assessment', *Ergonomics*. Taylor & Francis, 40(1), pp. 51–61.

Weyers, S., Peter, R., Boggild, H., Jeppesen, H. J. and Siegrist, J. (2006) 'Psychosocial work stress is associated with poor self-rated health in Danish nurses: a test of the effort–reward imbalance model', *Scandinavian journal of caring sciences*. Wiley Online Library, 20(1), pp. 26–34.

Whiting, W. and Zernicke, R. (2008) 'Biomechanics of Musculoskeletal Injury. Human kinetic USA'.

Whysall, Z., Bowden, J. and Hewitt, M. (2018) 'Sickness presenteeism: measurement and management challenges', *Ergonomics*. Taylor & Francis, 61(3), pp. 341–354.

Wickham, S. (2009a) 'Hands-off midwifery and the art of balance', *Birthspirit Midwifery Journal*, 1, pp. 21–24.

Wickham, S. (2009b) 'Hands-off midwifery and the art of balance', *Birthspirit Midwifery Journal*, 1, pp. 21–24.

Wickrama, K., O'Neal, C. W., Kwag, K. H. and Lee, T. K. (2013) 'Is working later in life good or bad for health? An investigation of multiple health outcomes', *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*. Oxford University Press US, 68(5), pp. 807–815.

Wilson, J. R. (1995) 'Ergonomics and participation', *Evaluation of human work: A practical ergonomics methodology*. Taylor & Francis London, 2, pp. 1071–1096.

World Health Organisation (1985) *Identification and control of work-related diseases: report of a WHO expert committee*. World Health Organization.

World Health Organization (2018) *Obesity and overweight*. Available at: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight (Accessed: 10 August 2018).

Yassi, A. and Lockhart, K. (2013) 'Work-relatedness of low back pain in nursing personnel: a systematic review', *International journal of occupational and environmental health*. Taylor & Francis, 19(3), pp. 223–244.

Yazdani, A., Neumann, W. P., Imbeau, D., Bigelow, P., Pagell, M. and Wells, R. (2015) 'Prevention of musculoskeletal disorders within management systems: A scoping review of practices, approaches, and techniques', *Applied ergonomics*. Elsevier, 51, pp. 255–262.

Yoong, W., Sanchez-Crespo, J., Rob, J., Parikh, M., Melendez, J., Pillai, R. and Opriou, D. (2008) 'Sticks and stones may break my bones: work-related orthopaedic injuries sustained during obstetrics and gynaecology training', *Journal of Obstetrics and Gynaecology*. Taylor & Francis, 28(5), pp. 478–481.

Appendices

Appendix 2.1: Critical appraisal of papers researching MSD in maternity professional

Author(s)	Title	Main aim	Design	Sample	Main findings	Critique & MMAT score (25%* - 100%****)
Hignett (1996)	Manual handling risks in midwifery: identification of risk factors	To identify the factors contributing to MSD and to explore and develop solutions to specific problems	Qualitative approach – literature review, observations, focus groups and interviews	12 maternity specialists (senior sisters, sisters, newly qualified and students) were interviewed. 42 midwives participated for member checking.	Midwives care for two loads (mother and baby) at the same time. Delivery is mother-centred; may not be comfortable for midwife. Midwives work independently with minimal assistance. They have tendency to prioritise mother regardless of their own health. Birthing pool related problems were spotted and suggestions were given for redesign.	Well specified aim. Clear definition of methodology, participant selection and procedure. The findings were related to the context regardless of the setting/location. (****)
Steele and Stubbs (2002)	Measuring working postures of midwives in the healthcare setting	To measure working postures and related musculoskeletal discomfort when supporting the mother to breast feed the baby	Focus groups, Quick Exposure Check (QEC), Self-reporting of pain with body map and Borg scale	14 midwives were participants for two focus groups. 30 midwives were observed using QEC.	Back and neck were common. Predisposing factors included behavioural (failing to adjust the bed), environmental (lack of space) and working postures. Sitting on the side of the bed is likely to result in neck symptoms due to twisting for a long time.	Clear aim. Mixed methods enriching the findings. Sample from three different location, good representativeness. Limited information about the characteristics, moderate generalisability. (***)

Nowotny - Czupryna et al. (2012)	Professional experience and ergonomic aspects of midwives' work	To identify postural hazards of midwives while attending childbirth and differences between senior and junior midwives	Ovako Working Posture Analysis System (OWAS), Measurement of spinal alignment (SonoSens ultrasonic device), Survey.	95 midwives aged 21-50	Lumbar spine flexion in the sagittal plane (front/back) was the most significant unnatural spinal position observed. The cervical spine was moderately affected, while the thoracic spine was less over-stressed. 67.3% (n: 64) of all participants suffered from 'any spinal pain'. Subjects reporting spinal pain were able to achieve their maximal movement range.	Clear aim. Good sample size. The postural analysis (OWAS) technique is not sensitive enough to measure back posture. (***)
Long et al. (2013)	Helping women but hurting ourselves? Neck and upper back musculoskeletal symptoms in a cohort of Australian Midwives	To determine the prevalence of neck and upper back musculoskeletal symptoms in a group of Australian midwives and explore individual characteristics and workplace exposures associated with these symptoms.	Cross-sectional online survey (NMQ, JCQ, SF-36, IPAQ, Depression-10).	1388 qualified Australian midwives, aged 23-70. >98% female. Data were collected in 2006-2008.	The neck (40.8%) and the upper back (24.5%) injuries were common in Australian midwives. Age was not associated with symptoms. Physically active midwives were less likely to report upper back MSD. Midwives previously diagnosed with anxiety were at risk of neck MSD. Awkward postures were significantly associated with neck and upper back MSD.	Clear aim. Nationally representative. Relatively large sample. Low response rate (<5%), but acceptable considering the population. Self-reporting of physical exposures is open to biases. Validated commonly used measurement tools - allowing comparison. (****)

Long et al. (2013a)	Functional consequences of work-related spinal musculoskeletal symptoms in a cohort of Australian midwives	To explore the risk factors that are associated with sick leave and functional incapacity among midwives with spinal MSD	Cross-sectional online survey (NMQ, JCQ, SF-36, IPAQ, Depression-10).	729 qualified Australian midwives. Mean age 46. >98% female. Data were collected in 2006-2008.	The annual sick leave prevalence rates: 21% (neck), 17% (upper back) and 24% (lower back). The annual functional limitation (unable to carry normal activities): 50% (neck), 48% (upper back) and 59% (lower back). Pain severity was associated with both outcomes. Age was inversely associated with sick leave.	Well defined aim. Validated commonly used measurement tools - allowing comparison. (****)
Long et al. (2013b)	Midwives' experiences of work-related shoulder musculoskeletal problems	To gain understanding of midwives' experiences with work related shoulder problems	Semi-structured interviews	11 qualified Australian midwives	Midwives attributed the symptoms to working postures and manual handling of patients and equipment. Analgesics were most frequently reported with minimum or no sick leave. Fitness/sport related management strategies were commonly applied in the long term. The impact was on sleep disturbances, functional limitations at home and sports activities, and mental health problems. The protection strategies involved having less hands-on activities, leaving the profession or reducing the working hours with more flexible schedules.	Source of qualitative data is relevant to address the research objective. Clear form of data. Participants from diverse age and working experience group. (****)

Yoong et al. (2008)	Sticks and stones may break my bones: Work-related orthopaedic injuries sustained during obstetrics and gynaecology training	To explore WRMSD among obstetrics and gynaecology (O&G) trainees in the London area	Questionnaire	97 O&G trainees, female to male ratio of 3:1	28 of trainees (29%) experienced injuries in the shoulder and neck (n:9), wrist (n:7), low back (n:6), forearm (n:4), thumb (n:3), elbow (n:2), hands (n:1) and ankle (n:1). These were during caesarean sections (n=8), forceps deliveries (n=8), assisting at cervical cerclage (n=1) and running to a delivery (n=1). A total of 80 days was taken as time off work	Clear aim. Low response rate (23%). Clear questions, but the questionnaire is not valid or standard – not allowing comparison. Participants limited to one region – less generalisability. Self-reports – open to biases. (**)
Okuyucu et al. (2017)	Work-related musculoskeletal injuries amongst obstetrics and gynaecology trainees in East Midland region of the UK	To determine the prevalence, severity and characteristics of WRMSI amongst O&G trainees in East Midland region of the UK	Questionnaire	59 O&G trainees, Age varied 24-44.	50 participants (88%) reported any MSD: the back (n:21), shoulders (n:13) and upper limbs (n:13). Many attributed their injuries (63%) to work related activities. Six participants needed time off.	Clear aim. Clear questions, but the questionnaire is not valid or standard – not allowing comparison. Participants limited to one region – less generalisability. Self-reports – open to biases. Relatively small sample size. Good response rate (76%). (***)

Parupalli et al. (2012)	Obstetrician injury whilst managing a shoulder dystocia: A case report	No clearly defined aim or objective	Case report	An obstetrician	The injury occurred during the management of a shoulder dystocia, when trying to deliver the posterior arm of the baby with her hand. The treatment process lasted four months, and impact on colleagues was reported due to long term sick leave.	No clearly defined aim. Limited detail about the participant's characteristics. One participant cannot be generalised. Detailed information and the procedure and in-depth review of the consequences. (**)
Wang et al. (2017)	Work-Related Musculoskel etal Disorders and Risk Factors among Chinese Medical Staff of Obstetrics and Gynaecology	To investigate prevalence and risk factors of work-related musculoskelet al disorders among obstetrics and gynaecology department in China	Survey study (developed referring to NMQ, JCQ, REBA, and validated)	Obstetrics staff (n:928) including; obstetricians (n:330), gynaecologists (n:288) and midwives (n:310)	85.5 % of the participants experienced any MSD in the last 12 months with shoulders (62%), followed by neck (60.3%), low back (54.3%), hand/wrist (40.3%), upper back (35.6%), knees (28.1%) and elbows (20.2%). Shoulder symptoms were associated with the length of employment in their occupation, neck symptoms with uncomfortable posture and job stress, low back symptoms with keeping the same posture for a long time.	Very high response rate (91%). Relatively large sample size. Validated tool. Self-reports – open to biases. The findings were not divided into occupation groups – cannot be combined. (***)

Appendix 4.1: Musculoskeletal health of maternity professionals survey (paper version)

N.B. This is the paper version of the questionnaire. The questions are the same in the online version but the design was different.

Musculoskeletal Health Survey in Maternity Professionals

You are being invited to take part in a research study. This survey is being conducted to provide insight into musculoskeletal problems experienced by maternity professionals working in the UK. The aim is to identify the prevalence and predisposing factors to musculoskeletal injuries.

The survey should take only **5 minutes** of your time.

We would appreciate it if you could kindly complete the questionnaire even if you have not experienced any musculoskeletal problems, as this will help us to understand the conditions that lead to these injuries in whom it occurs.

We aim to use this data to develop strategies in the future to help prevent these injuries.

The survey has been designed in a manner that does not permit identification of respondents. Your answers are completely anonymous.

If you have already completed the online survey then thank you for your contribution and please do not fill this survey.

University Hospitals of Leicester NHS Trust

NHS

University of Leicester

Further information
This study has been conducted by Kubra Arslan as part her PhD research program. Academic supervisors, sponsor representatives and ethics committee from University of Leicester have reviewed the study.
The results of the study will be disseminated through your professional bodies RCM and RCOG and other maternity networks. Unfortunately as the survey is anonymous we are unable to provide individual information on the results. However if you wish further information in the future please contact the study investigator on email ka273@le.ac.uk.

If you wish to take part in this research study, please tick "agree" box. If you do not wish to participate, please decline participation by clicking on the "disagree" box.

- **Agree**
- **Disagree**

If you wish to fill the survey online instead of this paper version of it, please just scan the QR code with your smartphone to go directly to the survey

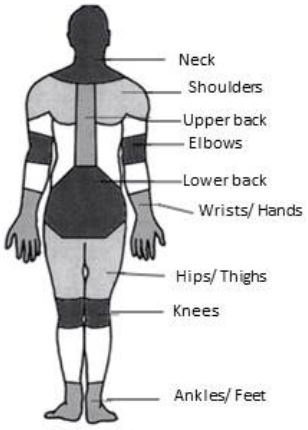
Don't have QR reader? Search your phone`s app store and get a free QR reader now.

Section A: About You

1. Are you	☐ Obstetrician ☐ Midwife
1a. What year of training are you in? (Obstetricians only)	☐ ST1 ☐ ST2 ☐ ST3 ☐ ST4 ☐ ST5 ☐ ST6 ☐ ST7 ☐ Subspecialty training ☐ Non-training trade ☐ Consultant ☐ Research fellow
2. Are you	☐ Male ☐ Female
3. How old are you?	……..
4. How many years have you been doing your present type of work? (If less than 1 year, please write 1)	……. years
5. On average, how many hours a week do you work?	……. hours a week
6. How much do you weigh?	……. kilograms / ……. stones
7. How tall are you?	……. meters / ……. feet
8. Are you left-handed or right-handed?	☐ Left-handed ☐ Right-handed ☐ Both

Section B: Your Experiences of Musculoskeletal Injuries

In the picture below, you can see the approximate position of the parts of the body referred to in the survey. Limits are not sharply defined, and certain parts overlaps. You should decide for yourself in which part you have or have had trouble (if any).



Back View

9. **Have you ever had trouble (ache, pain or discomfort) in any body area showed in the picture?**

☐ No ☐ Yes **IF NO, GO TO SECTION C,**

If yes, please tick as many as apply.

Neck	Shoulders	Upper back	Elbows	Wrists/ Hands	Low back	Hips/ Thighs	Knees	Ankles/ Feet
☐	☐ Right ☐ Left	☐	☐ Right ☐ Left	☐ Right ☐ Left	☐	☐ Right ☐ Left	☐ Right ☐ Left	☐ Right ☐ Left

10. **Have you ever been hospitalised because of the trouble?**

☐ No ☐ Yes

If Yes, please tick as many as apply.

Neck	Shoulders	Upper back	Elbows	Wrists/ Hands	Low back	Hips/ Thighs	Knees	Ankles/ Feet
☐	☐	☐	☐	☐	☐	☐	☐	☐

11. **Have you ever had to change jobs or duities because of the trouble (even temporarily)?**

☐ No ☐ Yes

If Yes, please tick as many as apply.

Neck	Shoulders	Upper back	Elbows	Wrists/ Hands	Low back	Hips/ Thighs	Knees	Ankles/ Feet
☐	☐	☐	☐	☐	☐	☐	☐	☐

12. Have you had trouble (ache, pain or discomfort) during the last 12 months?

☐ No ☐ Yes

IF NO, GO TO SECTION C,

13. What is the total length of time that you have had the trouble during the last 12 months?

Please only answer according to your injured body part.

Neck	Shoulders	Upper back	Elbows	Wrists/ Hands	Low back	Hips/ Thighs	Knees	Ankles/ Feet
□ 1-7 days □ 8-30 days □ More than 30 days, but not every day □ Every day	□ 1-7 days □ 8-30 days □ More than 30 days, but not every day □ Every day	□ 1-7 days □ 8-30 days □ More than 30 days, but not every day □ Every day	□ 1-7 days □ 8-30 days □ More than 30 days, but not every day □ Every day	□ 1-7 days □ 8-30 days □ More than 30 days, but not every day □ Every day	□ 1-7 days □ 8-30 days □ More than 30 days, but not every day □ Every day	□ 1-7 days □ 8-30 days □ More than 30 days, but not every day □ Every day	□ 1-7 days □ 8-30 days □ More than 30 days, but not every day □ Every day	□ 1-7 days □ 8-30 days □ More than 30 days, but not every day □ Every day

14. Has the trouble caused you to reduce your activity during the last 12 months?

Please only answer according to your injured body part.

Neck	Shoulders	Upper back	Elbows	Wrists/ Hands	Low back	Hips/ Thighs	Knees	Ankles/ Feet
□ None □ Work activity □ Leisure activity	□ None □ Work activity □ Leisure activity	□ None □ Work activity □ Leisure activity	□ None □ Work activity □ Leisure activity	□ None □ Work activity □ Leisure activity	□ None □ Work activity □ Leisure activity	□ None □ Work activity □ Leisure activity	□ None □ Work activity □ Leisure activity	□ None □ Work activity □ Leisure activity

15. What is the total length of time that you have taken sick leave from work/studies because of the trouble during the last 12 months?

Please only answer according to your injured body part.

Neck	Shoulders	Upper back	Elbows	Wrists/ Hands	Low back	Hips/ Thighs	Knees	Ankles/ Feet
☐ 0 days ☐ 1-7 days ☐ 8-30 days ☐ More than 30 days	☐ 0 days ☐ 1-7 days ☐ 8-30 days ☐ More than 30 days	☐ 0 days ☐ 1-7 days ☐ 8-30 days ☐ More than 30 days	☐ 0 days ☐ 1-7 days ☐ 8-30 days ☐ More than 30 days	☐ 0 days ☐ 1-7 days ☐ 8-30 days ☐ More than 30 days	☐ 0 days ☐ 1-7 days ☐ 8-30 days ☐ More than 30 days	☐ 0 days ☐ 1-7 days ☐ 8-30 days ☐ More than 30 days	☐ 0 days ☐ 1-7 days ☐ 8-30 days ☐ More than 30 days	☐ 0 days ☐ 1-7 days ☐ 8-30 days ☐ More than 30 days

16. Have you been seen by a doctor, physiotherapist, chiropractor or other health professionals because of the trouble during the last 12 months?

☐ No ☐ Yes

If Yes, please tick as many as apply

Neck	Shoulders	Upper back	Elbow	Wrists/ Hands	Low back	Hips/ Thighs	Knees	Ankles/ Feet
☐	☐	☐	☐	☐	☐	☐	☐	☐

17. **Have you at any time taken medication because of the trouble during the last 12 months?**

Please only answer according to your injured body part.

Neck	Shoulders	Upper back	Elbow	Wrists/ Hands	Low back	Hips/ Thighs	Knees	Ankles/ Feet
□ None □ Simple pain killers e.g. paracetamol □ Anti-inflammatory drugs e.g. ibuprofen □ Stronger pain killers e.g. morphine □ Injections e.g. steroid or local	□ None □ Simple pain killers e.g. paracetamol □ Anti-inflammatory drugs e.g. ibuprofen □ Stronger pain killers e.g. morphine □ Injections e.g. steroid or local	□None □Simple pain killers e.g. paracetamol □Anti-inflammatory drugs e.g. ibuprofen □Stronger pain killers e.g. morphine □ Injections e.g. steroid or local	□ None □ Simple pain killers e.g. paracetamol □ Anti-inflammatory drugs e.g. ibuprofen □ Stronger pain killers e.g. morphine □ Injections e.g. steroid or local	□ None □ Simple pain killers e.g. paracetamol □ Anti-inflammatory drugs e.g. ibuprofen □ Stronger pain killers e.g. morphine □ Injections e.g. steroid or local	□ None □ Simple pain killers e.g. paracetamol □ Anti-inflammatory drugs e.g. ibuprofen □ Stronger pain killers e.g. morphine □ Injections e.g. steroid or local	□ None □ Simple pain killers e.g. paracetamol □ Anti-inflammatory drugs e.g. ibuprofen □ Stronger pain killers e.g. morphine □ Injections e.g. steroid or local	□ None □ Simple pain killers e.g. paracetamol □ Anti-inflammatory drugs e.g. ibuprofen □ Stronger pain killers e.g. morphine □ Injections e.g. steroid or local	□ None □ Simple pain killers e.g. paracetamol □ Anti-inflammatory drugs e.g. ibuprofen □ Stronger pain killers e.g. morphine □ Injections e.g. steroid or local

18. How do you think you were injured during the last 12 months?

Please only answer according to your injured body part.

Neck	Shoulders	Upper back	Elbows	Wrists/ Hands	Low back	Hips/ Thighs	Knees	Ankles/ Feet
☐ Work related ☐ Leisure activity ☐ Combination of both ☐ Other related e.g. fall, motor vehicle accident ☐ Not sure	☐ Work related ☐ Leisure activity ☐ Combination of both ☐ Other related e.g. fall, motor vehicle accident ☐ Not sure	☐ Work related ☐ Leisure activity ☐ Combination of both ☐ Other related e.g. fall, motor vehicle accident ☐ Not sure	☐ Work related ☐ Leisure activity ☐ Combination of both ☐ Other related e.g. fall, motor vehicle accident ☐ Not sure	☐ Work related ☐ Leisure activity ☐ Combination of both ☐ Other related e.g. fall, motor vehicle accident ☐ Not sure	☐ Work related ☐ Leisure activity ☐ Combination of both ☐ Other related e.g. fall, motor vehicle accident ☐ Not sure	☐ Work related ☐ Leisure activity ☐ Combination of both ☐ Other related e.g. fall, motor vehicle accident ☐ Not sure	☐ Work related ☐ Leisure activity ☐ Combination of both ☐ Other related e.g. fall, motor vehicle accident ☐ Not sure	☐ Work related ☐ Leisure activity ☐ Combination of both ☐ Other related e.g. fall, motor vehicle accident ☐ Not sure

19. How did you manage your injury?

Please only answer according to your injured body part.

Neck	Shoulders	Upper back	Elbows	Wrists/ Hands	Low back	Hips/ Thighs	Knees	Ankles/ Feet
☐ Self-management ☐ Seen by GP ☐ Seen by Physiotherapist / Occupational therapist	☐ Self-management ☐ Seen by GP ☐ Seen by Physiotherapist / Occupational therapist	☐ Self-management ☐ Seen by GP ☐ Seen by Physiotherapist / Occupational therapist	☐ Self-management ☐ Seen by GP ☐ Seen by Physiotherapist / Occupational therapist	☐ Self-management ☐ Seen by GP ☐ Seen by Physiotherapist / Occupational therapist	☐ Self-management ☐ Seen by GP ☐ Seen by Physiotherapist / Occupational therapist	☐ Self-management ☐ Seen by GP ☐ Seen by Physiotherapist / Occupational therapist	☐ Self-management ☐ Seen by GP ☐ Seen by Physiotherapist / Occupational therapist	☐ Self-management ☐ Seen by GP ☐ Seen by Physiotherapist / Occupational therapist

19a. If you were seen by GP, what was the diagnosis? Please write

…………………

20. During the last 7 days, have you had any trouble?

☐ No ☐ Yes

If Yes, please tick as many as apply.

Neck	Shoulders	Upper back	Elbow	Wrists/ Hands	Low back	Hips/ Thighs	Knees	Ankles/ Feet
☐	☐	☐	☐	☐	☐	☐	☐	☐

Section C: About Your Work

21. How much of your working time is involved in actively involved delivering?

…….. days in a week.

22. What is your work place setting?

- ❘❘ Maternity unit in a hospital
- ❘❘ Midwife-led unit in a hospital
- ❘❘ Standalone midwifery unit
- ❘❘ Home birth

23. How many babies are delivered in your unit?

…… in a year

24. What proportion of your shift is night shift in a month?

- ❘❘ 0%
- ❘❘ 25%
- ❘❘ 50%
- ❘❘ 75%
- ❘❘ 100%

25. How long is a normal shift?

- ❘❘ Less than 8 hours
- ❘❘ 8 hours – up to 12 hours
- ❘❘ More than 12 hours

26. Do you feel that you are given sufficient breaks during work?

- ❘❘ Yes, always
- ❘❘ Yes, most of the time
- ❘❘ Sometimes
- ❘❘ No, hardly ever
- ❘❘ No, never

27. Have you attended manual handling training?

- ❘❘ Never
- ❘❘ Every year
- ❘❘ Every 3 years
- ❘❘ When I started the job and never since
- ❘❘ I can't remember

27a. **How useful was the session?**

Please rate from 0 to 10, 0 representing "not at all" and 10 representing "a lot".

0 1 2 3 4 5 6 7 8 9 10
Not at all — A lot

28. If you take consideration of your work routines, job satisfaction, training opportunities, how satisfied are you with your job?

Please rate from 0 to 10, 0 representing "not satisfied at all" and 10 representing "completely satisfied".

0 1 2 3 4 5 6 7 8 9 10
Not at all — A lot

29. The following items refer to your present occupation. For each of the following statements, please indicate whether you "strongly disagree", "disagree", "agree", or "strongly agree".	Strongly disagree	Disagree	Agree	Strongly agree
1. I have constant time pressure due to a heavy work load.				
2. I have many interruptions and disturbances while performing my job.				
3. Over the past few years, my job has become more and more demanding.				
4. I receive the respect I deserve from my superior or a respective relevant person.				
5. My job promotion prospects are poor.				
6. I have experienced or I expect to experience an undesirable change in my work situation.				
7. My job security is poor.				
8. Considering all my efforts and achievements, I receive the respect and prestige I deserve at work.				
9. Considering all my efforts and achievements, my job promotion prospects are adequate.				
10. Considering all my efforts and achievements, my salary / income is adequate.				
11. I get easily overwhelmed by time pressures at work.				
12. As soon as I get up in the morning I start thinking about work problems.				
13. When I get home, I can easily relax and 'switch off' work.				
14. People close to me say I sacrifice too much for my job.				
15. Work rarely lets me go, it is still on my mind when I go to bed.				
16. If I postpone something that I was supposed to do today I'll have trouble sleeping at night.				

Section D: More About You

30. Are you?

- **Single, never married**
- **Married or domestic partnership**
- **Widowed, divorced, separated**

31. Do you look after, or give any help or support to any children or adults?

Child
- No
- Yes, 1 - 19 hours a week
- Yes, 20 - 49 hours a week
- Yes, 50 or more hours a week

Adult
- No
- Yes, 1 - 19 hours a week
- Yes, 20 - 49 hours a week
- Yes, 50 or more hours a week

32. Do you smoke?

- Formerly / Never smoked
- Currently a smoker

33. On average, how many hours do you sleep in 24-h period?

- Less than 8 hours
- 8 hours or more

34. Do you have difficulty in sleeping?

- No
- Yes, rarely
- Yes, sometimes
- Yes, most of the time

35. What is your physical activity level? Please tick the level based on the explanations.

Moderate activities refer to activities that take moderate physical effort and make you breathe faster and feel warmer like carrying light loads, bicycling at a regular pace, doubles tennis (not walking). One way to tell if you are exercising at a moderate level is if you still talk, but you can't sing the words to a song.

Vigorous activities refer to activities that take hard physical effort and make you breathe hard and fast like heavy lifting, digging, aerobics and fast bicycling. If you're working at this level, you won't be able to say more than a few words without pausing for breath.

Low level ☐	Medium level ☐	High level ☐
Less than 150 min/week of moderate activity (or 75 min/week of vigorous activity)	150-300 min/week of moderate activity (or 75-150 min/week of vigorous activity)	More than 300 min/week of moderate activity (or 150 min/week of vigorous activity)

36.	**What is your ethnic group?** Please select one to best describe your ethnic group or background.	☐ White British ☐ White Irish ☐ Any other White Background ☐ White & Black Caribbean ☐ White & Black African ☐ White and Asian ☐ Any other Mixed background ☐ Indian ☐ Pakistani ☐ Bangladeshi ☐ Chinese ☐ Any other Asian background ☐ African ☐ Caribbean ☐ Any other Black background ☐ Arab ☐ Any other ethnics ground ☐ Prefer not to say
37.	**Which country do you work in?**	☐ England ☐ Northern Island ☐ Scotland ☐ Wales

Thank you for your contribution!

Appendix 4.2: Strategies and materials used to publicise the survey

UNIVERSITY OF LEICESTER

University Hospitals of Leicester NHS
NHS Trust

Does delivering babies increase your risk of muscle & joint injuries?

Tell us about your Musculoskeletal Health

Help us understand how we can minimise the injuries.

Complete the survey online

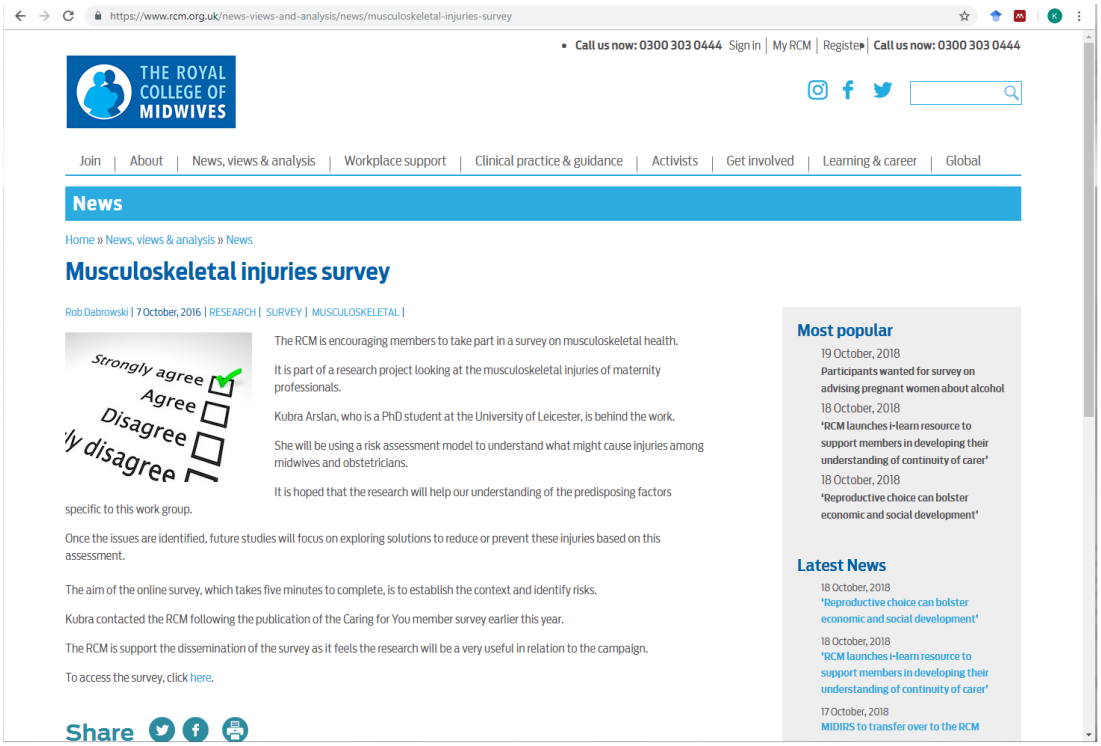
https://leicester.onlinesurveys.ac.uk/musculoskeletal-health-of-maternity-professionals

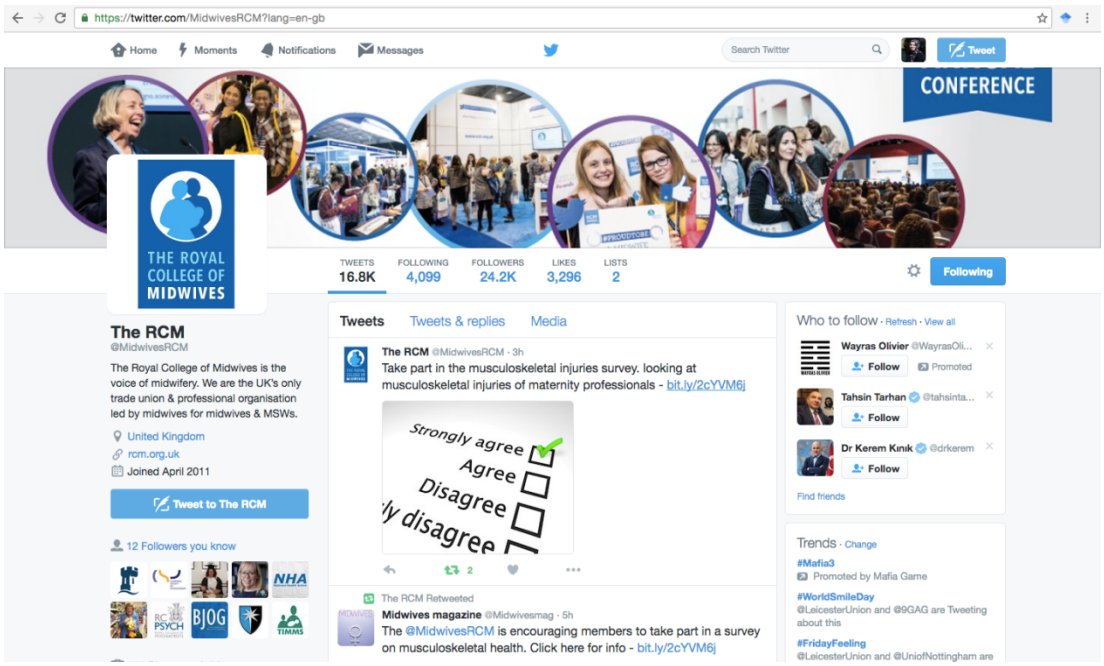
It only takes about 5 minutes.

Just scan the QR code with your smartphone to go directly to the survey

Don't have QR reader? Search your phone`s app store and get a free QR reader now.

If you require further information or have any questions, please contact with Kubra Arslan on ka273@le.ac.uk


https://www.rcm.org.uk/news-views-and-analysis/news/musculoskeletal-injuries-survey
Call us now: 0300 303 0444 Sign in | My RCM | Register | Call us now: 0300 303 0444
THE ROYAL COLLEGE OF MIDWIVES
Join | About | News, views & analysis | Workplace support | Clinical practice & guidance | Activists | Get involved | Learning & career | Global
News
Home » News, views & analysis » News
Musculoskeletal injuries survey
Rob Dabrowski | 7 October, 2016 | RESEARCH | SURVEY | MUSCULOSKELETAL |
Strongly agree
Agree
Disagree
ly disagree
The RCM is encouraging members to take part in a survey on musculoskeletal health.
It is part of a research project looking at the musculoskeletal injuries of maternity professionals.
Kubra Arslan, who is a PhD student at the University of Leicester, is behind the work.
She will be using a risk assessment model to understand what might cause injuries among midwives and obstetricians.
It is hoped that the research will help our understanding of the predisposing factors specific to this work group.
Once the issues are identified, future studies will focus on exploring solutions to reduce or prevent these injuries based on this assessment.
The aim of the online survey, which takes five minutes to complete, is to establish the context and identify risks.
Kubra contacted the RCM following the publication of the Caring for You member survey earlier this year.
The RCM is support the dissemination of the survey as it feels the research will be a very useful in relation to the campaign.
To access the survey, click here.
Share
Most popular
19 October, 2018
Participants wanted for survey on advising pregnant women about alcohol
18 October, 2018
'RCM launches i-learn resource to support members in developing their understanding of continuity of carer'
18 October, 2018
'Reproductive choice can bolster economic and social development'
Latest News
18 October, 2018
'Reproductive choice can bolster economic and social development'
18 October, 2018
'RCM launches i-learn resource to support members in developing their understanding of continuity of carer'
17 October, 2018
MIDIRS to transfer over to the RCM


https://twitter.com/MidwivesRCM?lang=en-gb
Home
Moments
Notifications
Messages
Search Twitter
Tweet
CONFERENCE
THE ROYAL COLLEGE OF MIDWIVES
TWEETS 16.8K
FOLLOWING 4,099
FOLLOWERS 24.2K
LIKES 3,296
LISTS 2
Following
The RCM
@MidwivesRCM
The Royal College of Midwives is the voice of midwifery. We are the UK's only trade union & professional organisation led by midwives for midwives & MSWs.
United Kingdom
rcm.org.uk
Joined April 2011
Tweet to The RCM
12 Followers you know
Tweets
Tweets & replies
Media
The RCM @MidwivesRCM · 3h
Take part in the musculoskeletal injuries survey. looking at musculoskeletal injuries of maternity professionals - bit.ly/2cYVM6j
Strongly agree
Agree
Disagree
ly disagree
The RCM Retweeted
Midwives magazine @Midwivesmag · 5h
The @MidwivesRCM is encouraging members to take part in a survey on musculoskeletal health. Click here for info - bit.ly/2cYVM6j
Who to follow · Refresh · View all
Wayras Olivier @WayrasOli...
Follow
Promoted
Tahsin Tarhan @tahsinta...
Follow
Dr Kerem Kınık @drkerem
Follow
Find friends
Trends · Change
#Mafia3
Promoted by Mafia Game
#WorldSmileDay
@LeicesterUnion and @9GAG are Tweeting about this
#FridayFeeling
@LeicesterUnion and @UniofNottingham are


Does delivering babies increase your risk of muscle & joint injuries?
Tell us about your Musculoskeletal Health
Help us understand how we can minimise the injuries.
Complete the survey online
It only takes about 5 minutes.
Musculoskeletal Health Survey in Maternity Professionals
Please fill and leave here

Appendix 4.3: Demographics, working and life-style characteristics, and MSD prevalence rates of the participants (obstetrics doctors only) (n=49)

Characteristics	N of participants completing the item	n (%) or mean (SD)	Range
Training year	49		N/A
ST1		4 (8.2) n (%)	
ST2		7 (14.3) n (%)	
ST3		5 (10.2) n (%)	
ST4		2 (4.1) n (%)	
ST5		2 (4.1) n (%)	
ST6		3 (6.1) n (%)	
ST7		1 (2.0) n (%)	
Non-training grade		6 (12.2) n (%)	
Consultant		17 (34.7) n (%)	
Research fellow		2 (4.1) n (%)	
Missing		0 (0) n (%)	
Gender	49		N/A
Female		39 (79.6) n (%)	
Male		10 (20.4) n (%)	
Missing		0 (0) n (%)	
Age	49	38.41 (9.96) mean(SD)	23-60
BMI	49	26.47 (6.52) mean(SD)	18.5-47.8
Dominant hand	49		N/A
Right-hand		46 (93.9) n (%)	
Left-hand		3 (6.1) n (%)	
Both		0 (0) n (%)	
Missing		0 (0) n (%)	
Practice years in obstetrics	49	10.47 (9.75) mean(SD)	1-31
Working hours in a week	48	44.33 (10.78) mean(SD)	10-77
Working time involved delivering (days in a week)	47	1.70 (1.21) mean(SD)	0-5
Proportion of night shift in a month	45		N/A
0%		7 (14.3) n (%)	
25%		36 (73.5) n (%)	
50%		2 (4.1) n (%)	
75%		0 (0) n (%)	
100%		0 (0) n (%)	
Missing		4 (8.2) n (%)	
Normal shift duration	47		N/A
< 8 hours		0 (0) n (%)	
8 hours – up to 12 hours		38 (77.6) n (%)	
> 12 hours		9 (18.4) n (%)	
Missing		2 (4.1) n (%)	
Sufficient breaks given	46		N/A
Yes, always		4 (8.2) n (%)	
Yes, most of the time		6 (12.2) n (%)	
Sometimes		19 (38.8) n (%)	
No, hardly ever		13 (26.5) n (%)	
No, never		4 (8.2) n (%)	
Missing		3 (6.1) n (%)	

Number of babies delivered in the unit a year	46	6061 (2571) mean(SD)	50-11000
Manual handling training attendance Never Every year Every 3 years When started the job Not remember Missing	47	 3 (6.1) n (%) 17 (34.7) n (%) 11 (22.4) n (%) 12 (24.5) n (%) 4 (8.2) n (%) 2 (4.1) n (%)	N/A
Beneficialness of the manual handling training (0-10)	42	4.88 (2.52) mean(SD)	0-11
Marital status Single, never married Married or domestic partnership Widowed, divorced, separated Missing	47	 14 (28.6) n (%) 33 (67.3) n (%) 0 (0) n (%) 2 (4.1) n (%)	N/A
Carer for children No Yes, 1-19 hours a week Yes, 20-49 hours a week Yes, > 50 hours Missing	47	 26 (53.1) n (%) 8 (16.3) n (%) 2 (4.1) n (%) 11 (22.4) n (%) 2 (4.1) n (%)	N/A
Carer for adult No Yes, 1-19 hours a week Yes, 20-49 hours a week Yes, > 50 hours Missing	47	 42 (85.7) n (%) 5 (10.2) n (%) 0 (0) n (%) 0 (0) n (%) 2 (4.1) n (%)	N/A
Smoking Formerly/Never Currently a smoker Missing	47	 47 (95.9) n (%) 0 (0) n (%) 2 (4.1) n (%)	N/A
Sleeping < 8 hours ≥ 8 hours Missing	47	 41 (83.7) n (%) 6 (12.2) n (%) 2 (4.1) n (%)	N/A
Sleep difficulty No Yes, rarely Yes, sometimes Yes, most of the time Missing	47	 25 (51) n (%) 5 (10.2) n (%) 14 (28.6) n (%) 3 (6.1) n (%) 2 (4.1) n (%)	N/A
Physical activity level Low Medium High Missing	47	 15 (30.6) n (%) 27 (55.1) n (%) 5 (10.2) n (%) 2 (4.1) n (%)	N/A
Country England Northern Island Scotland Wales UK Islands Missing	47	 47 (95.9) n (%) 0 (0) n (%) 0 (0) n (%) 0 (0) n (%) 0 (0) n (%) 2 (4.1) n (%)	N/A
Job satisfaction (0-10)	47	7.72 (1.72) mean(SD)	3-11
Effort Reward Score	46	1.22 (0.33) mean(SD)	0.71-2.00
Over commitment	45	13.89 (3.31) mean(SD)	8-24

MSD Prevalence rates of obstetrics doctors

	Point prevalence (during last 7 days) (n=46)	Period prevalence (last 12 months) (n=49)	Life time prevalence (n=49)	Severity prevalence (normal activity reduction)
Neck	15.2 %	44.9 %	51 %	14.3 %
Shoulders	17.4 %	42.9 %	49 %	18.4 %
Upper back	10.9 %	34.7 %	32.7 %	10.2 %
Elbows	2.2 %	8.2 %	14.3 %	4.1 %
Wrists/hands	13 %	30.6 %	44.9 %	14.3 %
Low back	13 %	51 %	49 %	12.2 %
Hips/thighs	4.3 %	8.2%	6.1 %	6.1 %
Knees	8.7%	24.5 %	28.6 %	10.2 %
Ankles/feet	2.2 %	8.2 %	8.2 %	0 %

Appendix 4.4: Demographics, working and life-style characteristics of the participants (midwives only) (n=635)

Characteristics	N of participants completing the item	n (%) or mean (SD)	Range
Gender Female Male Missing	614	 613 (96.5) n (%) 1 (0.2) n (%) 21 (3.3) n (%)	N/A
Age	630	42.76 (11.46) mean(SD)	19-67
BMI	610	27.73 (5.53) mean(SD)	16.7-47.8
Dominant hand Right-hand Left-hand Both Missing	628	 568 (89.4) n (%) 51 (8) n (%) 9 (1.4) n (%) 7 (1.1) n (%)	N/A
Practice years in midwifery	627	14.88 (11.10) mean(SD)	1-46
Working hours in a week Full-time Part-time	635	32.52 (8.05) mean(SD) 357 (56.2) n (%) 278 (43.8) n (%)	
Working time involved delivering (days in a week)	607	2 (1.62) mean(SD)	0-7
Work place setting Maternity unit in a hospital Midwife-led unit in a hospital Standalone midwifery unit Home birth Missing	619	 421 (66.3) n (%) 50 (7.9) n (%) 26 (4.1) n (%) 122 (19.2) n (%) 16 (2.5) n (%)	N/A
Proportion of night shift in a month 0% 25% 50% 75% 100% Missing	625	 217 (34.2) n (%) 171 (26.9) n (%) 156 (24.6) n (%) 54 (8.5) n (%) 27 (4.3) n (%) 10 (1.6) n (%)	N/A
Normal shift duration < 8 hours 8 hours – up to 12 hours > 12 hours Missing	629	 100 (15.7) n (%) 280 (44.1) n (%) 249 (39.2) n (%) 6 (0.9) n (%)	N/A
Sufficient breaks given Yes, always Yes, most of the time Sometimes No, hardly ever No, never Missing	625	 13 (2) n (%) 124 (19.5) n (%) 217 (34.2) n (%) 222 (35) n (%) 49 (7.7) n (%) 10 (1.6) n (%)	N/A
Number of babies delivered in the unit a year	595	4802 (2885.91) mean(SD)	0-14000
Manual handling training attendance Never Every year Every 3 years When started the job Not remember Missing	632	 2 (0.3) n (%) 416 (65.5) n (%) 153 (24.1) n (%) 53 (8.3) n (%) 8 (1.3) n (%) 3 (0.5) n (%)	N/A
Beneficialness of the manual handling training (0-10)	626	5.14 (2.5) mean(SD)	0-10

Marital status Single, never married Married or domestic partnership Widowed, divorced, separated Missing	630	 110 (17.3) n (%) 463 (72.9) n (%) 57 (9) n (%) 5 (0.8) n (%)	N/A
Carer for children No Yes, 1-19 hours a week Yes, 20-49 hours a week Yes, > 50 hours Missing	632	 344 (54.2) n (%) 70 (11) n (%) 41 (6.5) n (%) 177 (27.9) n (%) 3 (0.5) n (%)	N/A
Carer for adult No Yes, 1-19 hours a week Yes, 20-49 hours a week Yes, > 50 hours Missing	632	 504 (79.4) n (%) 92 (14.5) n (%) 17 (2.7) n (%) 19 (3) n (%) 3 (0.5) n (%)	N/A
Smoking Formerly/Never Currently a smoker Missing	630	 596 (93.9) n (%) 34 (5.4) n (%) 5 (0.8) n (%)	N/A
Sleeping < 8 hours ≥ 8 hours Missing	631	 512 (80.6) n (%) 119 (18.7) n (%) 4 (0.6) n (%)	N/A
Sleep difficulty No Yes, rarely Yes, sometimes Yes, most of the time Missing	632	 99 (15.6) n (%) 90 (14.2) n (%) 300 (47.2) n (%) 143 (22.5) n (%) 3 (0.5) n (%)	N/A
Physical activity level Low Medium High Missing	632	 314 (49.4) n (%) 282 (44.4) n (%) 36 (5.7) n (%) 3 (0.5) n (%)	N/A
Country England Northern Island Scotland Wales UK Islands Missing	629	 532 (83.8) n (%) 12 (1.9) n (%) 51 (8) n (%) 26 (4.1) n (%) 8 (1.3) n (%) 6 (0.9) n (%)	N/A
Job satisfaction (0-10)	626	6.2 (2.27) mean(SD)	0-10
Effort Reward Score	614	1.28 (0.43) mean(SD)	0.29-3.11
Over commitment	618	16.49 (3.34) mean(SD)	6-24

Appendix 4.5: Full settings of comparison analyses

Age

The comparison of age by musculoskeletal symptoms Yes and No groups during last 7 days

Body area	Mean age years (SD)		t	Significance level
	Yes	No		
Neck	43.09 (11.55)	42.66 (11.39)	0.35	p=0.7
Shoulders	43.56 (11.26)	42.50 (11.45)	0.97	p=0.3
Upper back	38.62 (12.17)	43.25 (11.22)	-3.20	p=0.001**
Elbows	47.31 (9.70)	42.49 (11.45)	2.33	p=0.02*
Wrists/hands	44.81 (11.34)	42.48 (11.40)	1.61	p=0.1
Low back	41.75 (11.78)	43.50 (11.07)	-1.89	p=0.05
Hips/thighs	44.47 (10.80)	42.39 (11.51)	1.77	p=0.07
Knees	46.05(11.35	42.20 (11.34)	2.93	p=0.003**
Ankles/feet	48.43(10.22)	41.97(11.35)	5.03	p<0.0001***

The comparison of age by musculoskeletal symptoms Yes and No groups during last 12months

Body area	Mean age years (SD)		t	Significance level
	Yes	No		
Neck	42.16 (11.43)	43.17 (11.45)	-1.09	p=0.2
Shoulders	42.68 (11.22)	42.73 (11.64)	-0.53	p=0.9
Upper back	39.33(11.41)	44.13(11.17)	-4.89	p<0.0001***
Elbows	43.96 (11.18)	42.54 (11.48)	1.02	p=0.3
Wrists/hands	42.87 (11.54)	42.66 (11.42)	0.2	p=0.8
Low back	41.71(11.41)	45.23(11.16)	-3.51	p<0.0001***
Hips/thighs	43.76 (11.61)	42.28 (11.36)	1.47	p=0.1
Knees	44.24(11.30)	42.00(11.45)	2.29	p=0.02*
Ankles/feet	44.15 (11.79)	42.28 (11.31)	1.71	p=0.08

The comparison of age by severity of musculoskeletal symptoms

Body area	Mean age years (SD)		t	Significance level
	Yes	No		
Neck	42.74 (10.81)	42.76 (11.61)	-0.15	p=0.9
Shoulders	43.01 (11.01)	42.67 (11.61)	0.32	p=0.7
Upper back	39.16 (10.87)	43.36 (11.45)	-3.25	p=0.001**
Elbows	49.06 (9.03)	42.40 (11.48)	4.11	p<0.0001***
Wrists/hands	44.91 (11.44)	42.43 (11.430	1.83	p=0.06
Low back	42.57 (11.62)	42.95 (11.30)	-0.42	p=0.6
Hips/thighs	44.43 (11.58)	42.35 (11.40)	1.81	p=0.07
Knees	45.62 (10.96)	42.03 (11.48)	3.18	p=0.03*
Ankles/feet	45.49 (11.87)	42.28 (11.33)	2.5	p=0.01*

BMI

The comparison of BMI by musculoskeletal symptoms Yes and No groups

Criteria	Mean BMI (SD)		t	Significance level
	Yes	No		
Neck point prevalence	27.90 (5.55)	27.71 (5.55)	0.32	p=0.7
Shoulders point prevalence	28.38 (5.64)	27.56 (5.51)	1.52	p=0.1
Upper back point prevalence	28.16 (5.98)	27.69 (5.49)	0.64	p=0.5
Elbows point prevalence	28.36 (6.99)	27.71 (5.46)	0.63	p=0.5
Wrists/hands point prevalence	29.07 (5.59)	27.57 (5.52)	2.10	p=0.03*
Low back point prevalence	28.24 (5.48)	27.36 (5.57)	1.93	p=0.05
Hips/thighs point prevalence	28.79 (5.82)	27.54 (5.47)	2.05	p=0.04*
Knees point prevalence	29.35 (6.15)	27.49 (5.41)	2.59	p=0.01*
Ankles/feet point prevalence	30.41 (6.63)	27.38 (5.29)	3.69	p<0.0001***
Neck period prevalence	27.98 (5.62)	27.51 (5.47)	1.03	p=0.3
Shoulders period prevalence	27.80 (5.43)	27.66 (5.63)	0.29	p=0.7
Upper back period prevalence	27.76 (5.90)	27.71 (5.38)	0.09	p=0.9
Elbows period prevalence	28.17 (6.54)	27.66 (5.39)	0.62	p=0.5
Wrists/hands period prevalence	28.17 (5.73)	27.57 (5.47)	1.16	p=0.2
Low back period prevalence	28.00 (5.55)	27.05 (5.47)	1.91	p=0.05
Hips/thighs period prevalence	28.21 (5.78)	27.54 (5.44)	1.34	p=0.1
Knees period prevalence	28.67 (5.95)	27.30 (5.29)	2.72	p=0.007**
Ankles/feet period prevalence	29.74 (6.13)	27.12 (5.21)	4.59	p<0.0001***
Neck severity prevalence	28.18 (5.59)	27.62 (5.51)	0.95	p=0.3
Shoulders severity prevalence	28.15 (5.99)	27.59 (5.37)	1.07	p=0.2
Upper back severity prevalence	27.41 (5.69)	27.78 (5.50)	-0.57	p=0.5
Elbows severity prevalence	27.10 (6.29)	27.76 (5.49)	-0.65	p=0.5
Wrists/hands severity prevalence	28.38 (5.62)	27.62 (5.51)	1.15	p=0.2
Low back severity prevalence	28.30 (5.38)	27.14 (5.62)	2.60	p=0.009**
Hips/thighs severity prevalence	28.47 (6.03)	27.55 (5.40)	1.60	p=0.1
Knees severity prevalence	29.09 (6.02)	27.38 (5.35)	3.07	p=0.002**
Ankles/feet severity prevalence	30.03 (6.35)	27.34 (5.29)	3.79	p<0.0001***

Practice Year

The comparison of practice year in midwifery by musculoskeletal symptoms Yes and No groups

Criteria	Mean years of practice in midwifery (SD)		t	Significance level
	Yes	No		
Neck point prevalence	15.46 (10.69)	14.76 (11.17)	0.59	p=0.5
Shoulders point prevalence	15.59 (11.31)	14.68 (11.02)	0.84	p=0.3
Upper back point prevalence	10.60 (9.37)	15.47 (11.25)	-3.91	p<0.0001***
Elbows point prevalence	17.50 (10.59)	14.75 (11.10)	1.34	p=0.1
Wrists/hands point prevalence	16.72 (11.56)	14.66 (11.01)	1.45	p=0.1
Low back point prevalence	14.34 (10.86)	15.31 (11.24)	-1.07	p=0.2
Hips/thighs point prevalence	16.42 (10.70)	14.58 (11.14)	1.55	p=0.1
Knees point prevalence	17.36 (11.98)	14.55 (10.99)	2.17	p=0.03*
Ankles/feet point prevalence	18.74 (12.04)	14.43 (10.95)	3.13	p=0.002**
Neck period prevalence	14.50 (10.70)	15.13 (11.41)	-0.71	p=0.4
Shoulders period prevalence	14.50 (10.37)	15.12 (11.64)	-0.69	p=0.4
Upper back period prevalence	11.89 (9.38)	16.15 (11.62)	-4.8	p<0.0001***
Elbows period prevalence	15.81 (10.83)	14.71 (11.13)	0.81	p=0.4
Wrists/hands period prevalence	14.88 (11.25)	14.84 (11.05)	0.04	p=0.9
Low back period prevalence	14.11 (10.87)	16.87 (11.69)	-2.8	p=0.005**
Hips/thighs period prevalence	16.10 (11.32)	14.33 (10.97)	1.81	p=0.06
Knees period prevalence	16.02 (11.50)	14.30 (10.87)	1.81	p=0.07
Ankles/feet period prevalence	15.73 (11.06)	14.59 (11.01)	1.08	p=0.2
Neck severity prevalence	15.88 (10.83)	14.65 (11.16)	1.07	p=0.2
Shoulders severity prevalence	14.93 (10.65)	14.86 (11.25)	0.06	p=0.9
Upper back severity prevalence	11.16 (9.1)	15.50 (11.29)	-4.02	p<0.0001***
Elbows severity prevalence	20.02 (10.42)	14.59 (11.08)	2.74	p=0.006**
Wrists/hands severity prevalence	16.68 (11.36)	14.61 (11.05)	1.57	p=0.1
Low back severity prevalence	15.11 (10.91)	14.63 (11.31)	0.54	p=0.5
Hips/thighs severity prevalence	17.62 (11.29)	14.21 (10.97)	3.07	p=0.002**
Knees severity prevalence	17.47 (12.03)	14.22 (10.77)	2.76	p=0.006**
Ankles/feet severity prevalence	16.52 (11.70)	14.59 (10.98)	1.53	p=0.1

Working hours

The comparison of working hours by musculoskeletal symptoms Yes and No groups

Criteria	Mean working hours in a week (SD)		t	Significance level
	Yes	No		
Neck point prevalence	32.87 (8.07)	32.42 (8.04)	0.54	p=0.5
Shoulders point prevalence	33.72 (7.61)	32.15 (8.14)	2.04	p=0.04*
Upper back point prevalence	34.41 (6.58)	32.26 (8.15)	2.39	p=0.01*
Elbows point prevalence	30.37 (10.85)	32.62 (7.86)	-1.53	p=0.1
Wrists/hands point prevalence	32.05 (8.17)	32.56 (8.03)	-0.49	p=0.6
Low back point prevalence	32.62 (8.26)	32.41 (7.88)	0.31	p=0.7
Hips/thighs point prevalence	33.01 (8.26)	32.40 (8.00)	0.71	p=0.4
Knees point prevalence	31.52 (9.56)	32.66 (7.77)	-1.05	p=0.2
Ankles/feet point prevalence	30.14 (10.61)	32.82 (7.59)	-2.11	p=0.03*
Neck period prevalence	33.24 (7.72)	31.94 (8.26)	2.02	p=0.04*
Shoulders period prevalence	33.42 (7.42)	31.81 (8.44)	2.51	p=0.01*
Upper back period prevalence	33.51 (7.54)	32.12 (8.21)	2.05	p=0.04*
Elbows period prevalence	31.74 (9.07)	32.64 (7.89)	-0.92	p=0.3
Wrists/hands period prevalence	32.39 (7.94)	32.58 (8.08)	-0.24	p=0.8
Low back period prevalence	32.74 (7.96)	32.00 (8.23)	1.04	p=0.2
Hips/thighs period prevalence	32.07 (8.76)	32.72 (7.73)	-0.91	p=0.3
Knees period prevalence	31.97 (8.04)	32.79 (8.03)	-1.19	p=0.2
Ankles/feet period prevalence	31.75 (9.17)	32.76 (7.66)	-1.32	p=0.1
Neck severity prevalence	32.54 (8.19)	32.51 (8.03)	0.03	p=0.9
Shoulders severity prevalence	32.97 (7.57)	32.37 (8.20)	0.80	p=0.4
Upper back severity prevalence	34.18 (7.05)	32.24 (8.18)	2.38	p=0.01*
Elbows severity prevalence	29.78 (10.31)	32.67 (7.88)	-1.60	p=0.1
Wrists/hands severity prevalence	31.67 (7.69)	32.65 (8.10)	-1.02	p=0.3
Low back severity prevalence	32.64 (8.04)	32.40 (8.06)	0.37	p=0.7
Hips/thighs severity prevalence	32.22 (8.46)	32.59 (7.95)	-0.46	p=0.6
Knees severity prevalence	31.75 (8.48)	32.71 (7.93)	-1.20	p=0.2
Ankles/feet severity prevalence	31.85 (9.50)	32.63 (7.78)	-0.86	p=0.3

Shift length

The prevalence of musculoskeletal symptoms by shift length (hours)

Criteria	< 8 hours	8 hours – up to 12 hours	≥ 12 hours	Significance level
Neck point prevalence	15.8%	43.0%	41.2%	p=0.9
Shoulders point prevalence	13.5%	35.5%	51.1%	p=0.008**
Upper back point prevalence	2.9%	44.9%	52.2%	p=0.004**
Elbows point prevalence	6.3%	59.4%	34.4%	p=0.1
Wrists/hands point prevalence	11.6%	58.0%	30.4%	p=0.05
Low back point prevalence	12.6%	41.6%	45.7%	p=0.02*
Hips/thighs point prevalence	10.6%	45.2%	44.2%	p=0.2
Knees point prevalence	11.5%	47.1%	41.4%	p=0.4
Ankles/feet point prevalence	14.7%	57.3%	28%	p=0.04*
Neck period prevalence	14.3%	46.5%	39.2%	p=0.5
Shoulders period prevalence	14.2%	41.8%	44.0%	p=0.1
Upper back period prevalence	11.8%	42.8%	45.5%	p=0.07
Elbows period prevalence	12.8%	52.6%	34.6%	p=0.3
Wrists/hands period prevalence	12.5%	48.8%	38.8%	p=0.3
Low back period prevalence	14.1%	42.2%	43.8%	p=0.004**
Hips/thighs period prevalence	14.9%	40.3%	44.8%	p=0.2
Knees period prevalence	17.4%	43.8%	38.8%	p=0.7
Ankles/feet period prevalence	13.1%	46.9%	40.0%	p=0.5
Neck severity prevalence	13.8%	42.2%	44.0%	p=0.5
Shoulders severity prevalence	14.1%	39.1%	46.8%	p=0.1
Upper back severity prevalence	16%	41.7%	42.3%	p=0.02*
Elbows severity prevalence	11.8%	50.0%	38.2%	p=0.7
Wrists/hands severity prevalence	14.6%	43.9%	41.5%	p=0.9
Low back severity prevalence	16.0%	41.7%	42.3%	p=0.3
Hips/thighs severity prevalence	13.8%	43.1%	43.1%	p=0.6
Knees severity prevalence	19.5%	43.8%	36.7%	p=0.4
Ankles/feet severity prevalence	11.8%	44.1%	44.1%	p=0.4

Night shift

The prevalence of musculoskeletal symptoms by night shift (proportion) in a month

Criteria	0%	25%	50%	75%	100%	Significance level
Neck point prevalence	42.5%	22.1%	23.9%	8%	3.5%	p=0.3
Shoulders point prevalence	42.1%	17.1%	27.9%	10%	2.9%	p=0.01*
Upper back point prevalence	30.4%	18.8%	31.9%	13%	5.8%	p=0.2
Elbows point prevalence	50%	18.8%	15.6%	15.6%	0%	p=0.09
Wrists/hands point prevalence	53.6%	24.6%	14.5%	4.3%	2.9%	p=0.006**
Low back point prevalence	30.2%	26.5%	27.6%	10.1%	5.6%	p=0.1
Hips/thighs point prevalence	37.5%	20.2%	26.9%	10.6%	4.8%	p=0.4
Knees point prevalence	44.2%	22.1%	27.9%	5.8%	0%	p=0.05
Ankles/feet point prevalence	46.7%	14.7%	25.3%	9.3%	4%	p=0.06
Neck period prevalence	37.2%	25.6%	23.5%	10.2%	3.5%	p=0.3
Shoulders period prevalence	35.9%	24.6%	26%	10%	3.6%	p=0.4
Upper back period prevalence	33.9%	25.3%	28%	10.2%	2.7%	p=0.4
Elbows period prevalence	47.4%	17.9%	23.1%	9%	2.6%	p=0.09
Wrists/hands period prevalence	38.8%	26.9%	20.6%	10%	3.8%	p=0.5
Low back period prevalence	32.7%	27.5%	25.3%	9.6%	4.9%	p=0.3
Hips/thighs period prevalence	38.3%	25.6%	24.4%	8.9%	2.8%	p=0.6
Knees period prevalence	41.5%	20%	27%	8.5%	3%	p=0.02*
Ankles/feet period prevalence	42.4%	19.4%	22.9%	11.8%	3.5%	p=0.03*
Neck severity prevalence	40.5%	25%	19%	12.1%	3.4%	p=0.2
Shoulders severity prevalence	35.3%	24.4%	28.2%	10.3%	1.9%	p=0.2
Upper back severity prevalence	30.8%	27.5%	31.9%	8.8%	1.1%	p=0.2
Elbows severity prevalence	44.1%	23.5%	23.5%	8.8%	0%	p=0.6
Wrists/hands severity prevalence	42.7%	28%	17.1%	8.5%	3.7%	p=0.3
Low back severity prevalence	34.6%	25.5%	25.2%	10.1%	4.7%	p=0.6
Hips/thighs severity prevalence	34.1%	26%	25.2%	10.6%	4.1%	p=0.9
Knees severity prevalence	41.7%	21.3%	26%	8.7%	2.4%	p=0.2
Ankles/feet severity prevalence	37.6%	22.6%	23.7%	11.8%	4.3%	p=0.6

Actively involved in deliveries

The comparison of actively delivery involved days in a week by musculoskeletal symptoms Yes and No groups

Criteria	Mean actively delivery involved days in a week (SD)		t	Significance level
	Yes	No		
Neck point prevalence	1.87 (1.56)	2.04 (1.63)	-0.98	p=0.3
Shoulders point prevalence	1.87 (1.52)	2.05 (1.65)	-1.16	p=0.2
Upper back point prevalence	2.31 (1.69)	1.97 (1.61)	1.56	p=0.1
Elbows point prevalence	1.77 (1.76)	2.02 (1.61)	-0.83	p=0.4
Wrists/hands point prevalence	1.53 (1.65)	2.07 (1.61)	-2.60	p=0.009**
Low back point prevalence	2.15 (1.65)	1.90 (1.59)	1.84	p=0.06
Hips/thighs point prevalence	2.00 (1.66)	2.01 (1.61)	-0.06	p=0.9
Knees point prevalence	1.86 (1.52)	2.03 (1.64)	-0.92	p=0.3
Ankles/feet point prevalence	1.69 (1.55)	2.06 (1.63)	-1.80	p=0.07
Neck period prevalence	2.04 (1.67)	1.98 (1.57)	0.45	p=0.6
Shoulders period prevalence	2.02 (1.61)	1.99 (1.63)	0.20	p=0.8
Upper back period prevalence	2.12 (1.64)	1.95 (1.60)	1.17	p=0.2
Elbows period prevalence	1.73 (1.83)	2.04 (1.58)	-1.55	p=0.1
Wrists/hands period prevalence	1.80 (1.59)	2.07 (1.62)	-1.82	p=0.06
Low back period prevalence	2.04 (1.64)	1.90 (1.55)	0.97	p=0.3
Hips/thighs period prevalence	1.98 (1.68)	2.01 (1.59)	-0.19	p=0.8
Knees period prevalence	1.99 (1.61)	2.01 (1.62)	-0.14	p=0.8
Ankles/feet period prevalence	2.01 (1.69)	2.00 (1.60)	0.03	p=0.9
Neck severity prevalence	1.99 (1.55)	2.00 (1.63)	-0.06	p=0.9
Shoulders severity prevalence	2.13 (1.60)	1.96 (1.62)	1.16	p=0.2
Upper back severity prevalence	2.37 (1.69)	1.94 (1.60)	2.29	p=0.02*
Elbows severity prevalence	1.78 (2.01)	2.01 (1.59)	-0.78	p=0.4
Wrists/hands severity prevalence	1.63 (1.57)	2.05 (1.62)	-2.16	p=0.03*
Low back severity prevalence	2.10 (1.64)	1.89 (1.59)	1.60	p=0.1
Hips/thighs severity prevalence	2.12 (1.73)	1.97 (1.59)	0.94	p=0.3
Knees severity prevalence	1.90 (1.61)	2.03 (1.62)	-0.80	p=0.4
Ankles/feet severity prevalence	1.99 (1.62)	2.00 (1.62)	-0.07	p=0.9

Sleeping

The prevalence of musculoskeletal symptoms by sleeping hour groups

Criteria	< 8 hours	≥ 8 hours	Significance level
Neck point prevalence	81.4%	18.6%	p=0.9
Shoulders point prevalence	82%	18%	p=0.8
Upper back point prevalence	72.5%	27.5%	p=0.04*
Elbows point prevalence	93.5%	6.5%	p=0.07
Wrists/hands point prevalence	89.7%	10.3%	p=0.05
Low back point prevalence	82.3%	17.7%	p=0.5
Hips/thighs point prevalence	85.6%	14.4%	p=0.2
Knees point prevalence	83.7%	16.3%	p=0.5
Ankles/feet point prevalence	89.2%	10.8%	p=0.06
Neck period prevalence	82.9%	17.1%	p=0.2
Shoulders period prevalence	84.6%	15.4%	p=0.04*
Upper back period prevalence	81.7%	18.3%	p=0.7
Elbows period prevalence	86.8%	13.2%	p=0.1
Wrists/hands period prevalence	83.1%	16.9%	p=0.4
Low back period prevalence	82%	18%	p=0.3
Hips/thighs period prevalence	83.3%	16.7%	p=0.3
Knees period prevalence	86.5%	13.5%	p=0.01*
Ankles/feet period prevalence	88.9%	11.1%	p=0.006**
Neck severity prevalence	91.3%	8.7%	p=0.002**
Shoulders severity prevalence	90.3%	9.7%	p=0.001**
Upper back severity prevalence	84.8%	15.2%	p=0.3
Elbows severity prevalence	90.6%	9.4%	p=0.1
Wrists/hands severity prevalence	81.5%	18.5%	p=0.9
Low back severity prevalence	83.1%	16.9%	p=0.2
Hips/thighs severity prevalence	82.8%	17.2%	p=0.6
Knees severity prevalence	85%	15%	p=0.2
Ankles/feet severity prevalence	85.9%	14.1%	p=0.2

Carer for adult/child

The prevalence of musculoskeletal symptoms by being a carer for an adult/child

Criteria	Not adult carer	Adult carer	Significance level		Not child carer	Child carer	Significance level
Neck point prevalence	77.2%	22.8%	p=0.4		61.4%	38.6%	p=0.1
Shoulders point prevalence	78%	22%	p=0.6		63.8%	36.2%	p=0.01*
Upper back point prevalence	79.7%	20.3%	p=0.9		72.5%	27.5%	p=0.001**
Elbows point prevalence	68.8%	31.3%	p=0.1		68.8%	31.3%	p=0.09
Wrists/hands point prevalence	68.6%	31.4%	p=0.01*		50%	50%	p=0.4
Low back point prevalence	79%	21%	p=0.7		53.5%	46.5%	p=0.6
Hips/thighs point prevalence	76.9%	23.1%	p=0.4		48.1%	51.9%	p=0.1
Knees point prevalence	67.8%	32.2%	p=0.003**		51.7%	48.3%	p=0.5
Ankles/feet point prevalence	72%	28%	p=0.08		53.3%	46.7%	p=0.8
Neck period prevalence	76.7%	23.3%	p=0.08		57.5%	42.5%	p=0.1
Shoulders period prevalence	76.9%	23.1%	p=0.1		55.5%	44.5%	p=0.6
Upper back period prevalence	78.1%	21.9%	p=0.5		57.8%	42.2%	p=0.2
Elbows period prevalence	69.2%	30.8%	p=0.01*		60.3%	39.7%	p=0.2
Wrists/hands period prevalence	72.2%	27.8%	p=0.006**		52.5%	47.5%	p=0.5
Low back period prevalence	79.3%	20.7%	p=0.7		55.3%	44.7%	p=0.4
Hips/thighs period prevalence	75.1%	24.9%	p=0.07		49.2%	50.8%	p=0.09
Knees period prevalence	71.6%	28.4%	p=0.001**		55.2%	44.8%	p=0.7
Ankles/feet period prevalence	74.5%	25.5%	p=0.07		54.5%	45.5%	p=0.9
Neck severity prevalence	69%	31%	p=0.001**		51.7%	48.3%	p=0.5
Shoulders severity prevalence	71.2%	28.8%	p=0.002**		54.5%	45.5%	p=0.9
Upper back severity prevalence	75%	25%	p=0.2		57.6%	42.4%	p=0.5
Elbows severity prevalence	61.8%	38.2%	p=0.007**		61.8%	38.2%	p=0.3
Wrists/hands severity prevalence	68.7%	31.3%	p=0.007**		49.4%	50.6%	p=0.3
Low back severity prevalence	78.4%	21.6%	p=0.4		51.2%	48.8%	p=0.1
Hips/thighs severity prevalence	73.2%	26.8%	p=0.04*		46.3%	53.7%	p=0.04*
Knees severity prevalence	68%	32%	P<0.0001***		54.7%	45.3%	p=0.9
Ankles/feet severity prevalence	68.8%	31.2%	p=0.005**		57%	43%	p=0.5

Job satisfaction

Significance levels of differences in job satisfaction and musculoskeletal YES and NO groups

Criteria	Job satisfaction (0-10) (Median)		U	Significance level
	Yes	No		
Neck point prevalence	6.49	6.72	27691	p=0.5
Shoulders point prevalence	6.15	6.82	29642	p=0.02*
Upper back point prevalence	6.52	6.70	17390	p=0.4
Elbows point prevalence	6.81	6.66	9848	p=0.6
Wrists/hands point prevalence	6.27	6.74	17607	p=0.2
Low back point prevalence	6.06	7.07	36278	p<0.0001***
Hips/thighs point prevalence	5.85	6.79	22488	p=0.01*
Knees point prevalence	6.64	6.68	22979	p=0.8
Ankles/feet point prevalence	6.60	6.69	19298	p=0.4
Neck period prevalence	6.53	6.80	46316	p=0.3
Shoulders period prevalence	6.25	6.99	41876	p=0.004**
Upper back period prevalence	6.71	6.66	40876	p=0.8
Elbows period prevalence	6.86	6.65	21854	p=0.7
Wrists/hands period prevalence	6.38	6.79	34524	p=0.1
Low back period prevalence	6.36	7.28	31586	p<0.0001***
Hips/thighs period prevalence	6.19	6.84	35322	p=0.02*
Knees period prevalence	6.54	6.75	40482	p=0.3
Ankles/feet period prevalence	6.45	6.77	31624	p=0.09
Neck severity prevalence	6.05	6.84	24727	p=0.007**
Shoulders severity prevalence	5.91	6.94	29248	p<0.0001***
Upper back severity prevalence	6.38	6.74	21701	p=0.09
Elbows severity prevalence	7.05	6.65	11190	p=0.2
Wrists/hands severity prevalence	6.39	6.74	20782	p=0.2
Low back severity prevalence	6.14	7.17	37665	p<0.0001***
Hips/thighs severity prevalence	5.91	6.81	26595	p=0.01*
Knees severity prevalence	6.35	6.77	29200	p=0.1
Ankles/feet severity prevalence	6.40	6.74	22508	p=0.1

Effort Reward Imbalance

The comparison of ERI scores by musculoskeletal symptoms Yes and No groups

Criteria	ERI score (SD)		t	Significance level
	Yes	No		
Neck point prevalence	1.30 (0.45)	1.27 (0.43)	0.69	p=0.4
Shoulders point prevalence	1.36 (0.50)	1.25 (0.40)	2.59	p=0.01*
Upper back point prevalence	1.29 (0.37)	1.28 (0.44)	0.24	p=0.8
Elbows point prevalence	1.42 (0.41)	1.27 (0.43)	1.86	p=0.06
Wrists/hands point prevalence	1.39 (0.53)	1.26 (0.42)	1.92	p=0.05
Low back point prevalence	1.35 (0.46)	1.22 (0.40)	3.82	P<0.0001***
Hips/thighs point prevalence	1.41 (0.47)	1.25 (0.42)	3.42	p=0.001**
Knees point prevalence	1.30 (0.42)	1.27 (0.43)	0.59	p=0.5
Ankles/feet point prevalence	1.31 (0.54)	1.27 (0.41)	0.79	p=0.4
Neck period prevalence	1.28 (0.43)	1.27 (0.43)	0.34	p=0.7
Shoulders period prevalence	1.33 (0.47)	1.23 (0.39)	2.66	p=0.008**
Upper back period prevalence	1.27 (0.41)	1.28 (0.44)	-0.35	p=0.7
Elbows period prevalence	1.34 (0.41)	1.27 (0.43)	1.27	p=0.2
Wrists/hands period prevalence	1.32 (0.44)	1.26 (0.43)	1.60	p=0.1
Low back period prevalence	1.30 (0.43)	1.23 (0.42)	1.75	p=0.07
Hips/thighs period prevalence	1.32 (0.46)	1.26 (0.42)	1.72	p=0.08
Knees period prevalence	1.30 (0.43)	1.27 (0.43)	0.81	p=0.4
Ankles/feet period prevalence	1.33 (0.47)	1.26 (0.42)	1.69	p=0.09
Neck severity prevalence	1.32 (0.44)	1.27 (0.43)	1.19	p=0.2
Shoulders severity prevalence	1.37 (0.50)	1.25 (0.40)	2.77	p=0.006**
Upper back severity prevalence	1.34 (0.43)	1.27 (0.43)	1.47	p=0.1
Elbows severity prevalence	1.34 (0.47)	1.27 (0.43)	0.88	p=0.3
Wrists/hands severity prevalence	1.37 (0.48)	1.26 (0.42)	2.14	p=0.03*
Low back severity prevalence	1.34 (0.43)	1.21 (0.42)	3.79	P<0.0001***
Hips/thighs severity prevalence	1.37 (0.51)	1.26 (0.41)	2.19	p=0.03*
Knees severity prevalence	1.32 (0.47)	1.27 (0.42)	1.10	p=0.2
Ankles/feet severity prevalence	1.33 (0.53)	1.27 (0.41)	1.07	p=0.2

Over-commitment

The comparison of over-commitment scores by musculoskeletal symptoms Yes and No groups

Criteria	Over-commitment score (SD)		t	Significance level
	Yes	No		
Neck point prevalence	17.06 (3.64)	16.36 (3.27)	1.99	p=0.04*
Shoulders point prevalence	17.25 (3.58)	16.27 (3.24)	3.07	p=0.002**
Upper back point prevalence	16.94 (3.33)	16.44 (3.35)	1.15	p=0.2
Elbows point prevalence	17.16 (4.39)	16.45 (3.28)	1.14	p=0.2
Wrists/hands point prevalence	16.90 (3.33)	16.44 (3.35)	1.06	p=0.2
Low back point prevalence	16.78 (3.41)	16.27 (3.28)	1.86	p=0.06
Hips/thighs point prevalence	17.21 (3.44)	16.34 (3.31)	2.41	p=0.01*
Knees point prevalence	16.72 (3.50)	16.45 (3.32)	0.67	p=0.4
Ankles/feet point prevalence	16.78 (3.61)	16.45 (3.31)	0.80	p=0.4
Neck period prevalence	16.90 (3.40)	16.16 (3.27)	2.75	p=0.006**
Shoulders period prevalence	17.17 (3.26)	15.95 (3.32)	4.55	p<0.0001***
Upper back period prevalence	16.89 (3.60)	16.33 (3.22)	1.89	p=0.05
Elbows period prevalence	16.95 (3.54)	16.43 (3.32)	1.25	p=0.2
Wrists/hands period prevalence	16.76 (3.29)	16.40 (3.36)	1.16	p=0.2
Low back period prevalence	16.69 (3.30)	16.01 (3.42)	2.27	p=0.02*
Hips/thighs period prevalence	16.86 (3.48)	16.34 (3.28)	1.74	p=0.08
Knees period prevalence	16.62 (3.48)	16.44 (3.28)	0.62	p=0.5
Ankles/feet period prevalence	17.05 (3.53)	16.33 (3.28)	2.27	p=0.02*
Neck severity prevalence	17.42 (3.64)	16.29 (3.24)	3.02	p=0.003**
Shoulders severity prevalence	17.38 (3.54)	16.20 (3.22)	3.80	P<0.0001***
Upper back severity prevalence	17.19 (3.81)	16.38 (3.24)	2.13	p=0.03*
Elbows severity prevalence	16.69 (4.16)	16.48 (3.29)	0.33	p=0.7
Wrists/hands severity prevalence	16.85 (3.51)	16.44 (3.32)	1.02	p=0.3
Low back severity prevalence	16.90 (3.33)	16.08 (3.30)	3.06	p=0.002**
Hips/thighs severity prevalence	17.22 (3.61)	16.31 (3.25)	2.70	p=0.007**
Knees severity prevalence	16.68 (3.66)	16.44 (3.26)	0.70	p=0.4
Ankles/feet severity prevalence	17.11 (3.69)	16.39 (3.27)	1.91	p=0.05

Appendix 4.6: Full context of correlation co-efficient analysis between individual and work related factors

Factors	Co-efficient value (r/r_s)	Significance level (p)	Strength
Age*BMI	0.1	**0.002****	Weak
Age*physical activity level	-0.02	0.6	
Age*working hours	-0.2	**<0.0001*****	Weak
Age*shift length	-0.2	**<0.0001*****	Weak
Age*job satisfaction	-0.02	0.5	
Age*ERI score	0.03	0.3	
Age*over-commitment score	-0.02	0.6	
BMI*physical activity level	-0.2	**<0.0001*****	Weak
Physical activity level*working hours	-0.01	0.7	
Physical activity level*shift length	0.08	**0.04***	Weak
Shift length*job satisfaction	-0.1	**0.01***	Weak
Shift length*ERI score	0.1	**<0.0001*****	Weak
Shift length*over-commitment	0.09	**0.02***	Weak
Practice year*job satisfaction	-0.04	0.2	
Practice year*ERI score	0.04	0.3	
Practice year*over-commitment	-0.05	0.1	

*p<0.05; **p<0.01; ***p<0.001

Appendix 5.1: Interview schedule

Schedule of questions for interviews with interviewees who have had experiences of WRMD

Questions need not be covered in this order but rather the discussion should flow as freely and naturally as possible. The interviewer will prompt as appropriate with phrases such as 'can you tell me a little more about that' and 'can you give me an example of that'.

Introduction

Introduce myself
Re-cap of research (aims and what will happen)
Seek agreement to audio-record the interview.
Confirm consent and interviewee happy to continue.

Thank you for agreeing to be volunteer for the interview. Check whether he/she filled the survey. If not, then give/send him/her the survey to fill.
Ask him/her to introduce himself/herself using first name.
Capture demographic details –

- Age,
- Age at first symptoms,
- Currently working?
- Year of experience,
- Current work situation?
- Place of working

Question Guide:

I. WRMSD and management strategies
II. Support and actions undertaken by the organisation
III. Awareness of health and safety, and prevention strategies
IV. Perception of impact on patient care
V. Identification of working tasks that could accountable for injuries
VI. Suggestions for better care

I. <u>WRMSD and management strategies</u>

I will briefly explain what WRMD is, and present the results of the survey and ask their thoughts.

Thinking about your own injury, can you tell me about your musculoskeletal problems related to your job?

- Let her tell her problems and describe symptoms briefly.
- How did it occur, briefly?
- Do you think it is work related?

Thinking about the management of your symptoms, can you tell me about the process?

- How did you manage?
- Did you report?
- Do you know how to manage?
- What options have you considered? Let them list (e.g., self-management, seen by GP, seen by PT /OT)
- How was that decision made?
- Have you got benefit of it?

II. Support and actions undertaken by the organisation

- Do you think anything in your work place contribute in occurrence of injuries (environment, equipment)?
- Does your organisation support you giving different options for how you can work, adjust equipment might be useful etc.?
-

III. Awareness of health and safety, and prevention strategies

How do you protect yourself from getting WRMSD?

- What do you do to protect yourself at work?
- Have you done any changes in any stages of your practice?
- Have you heard anything from somewhere about prevention strategies?
- In terms of education & training? Have you attended manual handling training? Did you find it useful?
    - How much job specific advice given?
    - How problem solving is it?
    - Do you think over the years manual handling training has changed?

IV. Perception of impact on patient care

I would like to ask you how have you been affected during this process; can you tell me what the consequences of your injury were in terms of the care you provided?

- Do you influence the position that mother choices for the delivery based on the number of options given?
- While maintaining patient safety, do you feel that you have changed the options that you are able to support a mother?
- If the mother wants to deliver in a particular position that you don't feel able to support that, what do you do? Have you changed the way supporting the mother?

V. Identification of working tasks that could accountable for injuries

Can you tell me your experiences and perspective with work demand?

- How physically demanding is your job?

How do you think you were injured?

- Which working tasks do you think caused your problem?

I would like to finalise the interview now and talk to you about the next part. This would be an observational postural analysis study. Midwives' postures will be observed during their routine working tasks. We need to think through which tasks are the best to analyse. I would like to know which tasks you think involve most difficult postures / require more physical activity?

- Let her list and detail, and then ask why?
- Is it just for you, or what do you think other midwives think?
- Ask her to rate the tasks below from 0-10, 0 representing 'not a challenge at all' and 10 representing 'extremely challenging':
    - Breast-feeding
    - Internal examination – midwife sitting on the edge of the bed and twisting to assess
    - Woman preferring to deliver on standing or on kneeling position, and midwife positioning herself to provide the care
    - Obstetrics emergencies - Shoulder dystocia, cord prolapse
    - Putting women in lithotomy
    - Taking out the end of bed and putting it back in
    - Suturing – staying same position for a long time and unable to adjust light in that position

VI. <u>Suggestion for better care</u>

- What suggestions do you think would be helpful to prevent or reduce such injuries?

Anything not covered?

- Is there anything that we haven't covered that you think is important?

Closing and thanks – conclude by thanking for him/her time and contribution.

Schedule of questions for interviews with interviewees who have NOT had experiences of WRMD

Questions need not be covered in this particular order but rather the discussion should flow as freely and naturally as possible. The interviewer will prompt as appropriate with phrases such as 'can you tell me a little more about that' and 'can you give me an example of that'.

Introduction

Introduce myself
Re-cap of research (aims and what will happen)
Seek agreement to audio-record the interview.
Confirm consent and interviewee happy to continue.

Thank you for agreeing to be volunteer for the interview.
Ask him/her to introduce himself/herself using first name.
Capture demographic details –

- Age,
- Currently working?
- Year of experience,
- Current work situation?
- Place of working

Question Guide:

I. WRMSD and management strategies
II. Support and actions undertaken by the organisation
III. Awareness of health and safety, and prevention strategies
IV. Perception of impact on patient care
V. Identification of working tasks that could accountable for injuries
VI. Suggestions for better care

I. <u>WRMSD and management strategies</u>

I will briefly explain what WRMD is, and present the results of the survey and their thoughts.

Thinking about occupational injury and pain,

- What kinds of problems are mostly experienced in your occupation?
- How do you know an injury is work related?

Thinking about the management of the symptoms, can you tell me how the process should be?

- Do you know how to manage, if you had an occupational injury or pain?
- What options would you consider, if you had an injury? Let them list (e.g., self-management, seen by GP, seen by PT /OT)
- What would affect you to decide in that way?

II. Support and actions undertaken by the organisation

- Do you think anything in your work place contribute in occurrence of injuries (environment, equipment)?
- Does your organisation support you giving different options for how you can work, adjust equipment might be useful etc.?

III. Awareness of health and safety, and prevention strategies

How do you protect yourself from getting WRMSD?

- What do you do to protect yourself at work?
- Have you done any changes in any stages of your practice?
- Have you heard anything from somewhere about prevention strategies?
- In terms of education & training? Have you attended manual handling training? Did you find it useful?
    - How much job specific advice given?
    - How problem solving is it?
    - Do you think over the years manual handling training has changed?

IV. Perception of impact on patient care

- Do you influence the position that mother choices for the delivery based on the number of options given?
- While maintaining patient safety, do you feel that you have changed the options that you are able to support a mother?
- If the mother wants to deliver in a particular position that you don't feel able to support that, what do you do? Have you changed the way supporting the mother?

V. Identification of working tasks that could accountable for injuries

Can you tell me your experiences and perspective with work demand?

- How physically demanding is your job?
- Which working tasks are more likely to cause MSD?

I would like to finalise the interview now and talk to you about the next part. This would be an observational postural analysis study. Midwives' postures will be observed during their routine working tasks. We need to think through which tasks are the best to analyse. I would like to know which tasks you think involve most difficult postures / require more physical activity?

- Let her list and detail, and then ask why?
- Is it just for you, or what do you think other midwives think?
- Ask her to rate the tasks below from 0-10, 0 representing 'not a challenge at all' and 10 representing 'extremely challenging':
    - Breast-feeding
    - Internal examination – midwife sitting on the edge of the bed and twisting to assess

- Woman preferring to deliver on standing or on kneeling position, and midwife positioning herself to provide the care
- Obstetrics emergencies - Shoulder dystocia, cord prolapse
- Putting women in lithotomy
- Taking out the end of bed and putting it back in
- Suturing – staying same position for a long time and unable to adjust light in that position

VI. Suggestion for better care

What strategies do you think would help you to enable to continue working in your current role in a good health?

- What suggestions can you give to reduce such injuries?

Anything not covered?

- Is there anything that we haven't covered that you think is important?

Closing and thanks – conclude by thanking for him/her time and contribution.

Appendix 5.2: Consent form for Study 2 and Study 3

Loughborough University

University Hospitals of Leicester NHS
NHS Trust

Leicester General Hospital
Gwendolen Road
LE5 4PW
UK

Study number :
Participant Identification number for this trial:

CONSENT FORM

Study Title: Musculoskeletal injuries among obstetricians and midwives

Researcher: Kubra Arslan

Please initial each box

1. I confirm that I have read and understand the patient information sheet dated 23/03/2017 version 3 for the above study. I have had the opportunity to consider the information and ask questions. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason. ☐
3. I understand that the interview will be tape recorded. I give permission for this. ☐
4. I understand that the recordings will be transcribed anonymously and then they will be deleted. I give permission for this. ☐
5. I understand that the mocking up of the working positions will be recorded with a camera and these will be anonymised. I give permission for this. ☐
6. I agree to take part in the above study. ☐

_____	_____	_____
Name of Participant	Date	Signature
_____	_____	_____
Name of person taking consent if different from researcher	Date	Signature
_____	_____	_____
Researcher	Date	Signature

When completed: one copy for participant: one for researcher

Consent Form, Version 3, 23/03/2017

IRAS No: 210010

Appendix 5.3: Participant information form for Study 2 and Study 3

Loughborough University

University Hospitals of Leicester NHS
NHS Trust

Study title: Musculoskeletal injuries among obstetricians and midwives

Participant Information Sheet

Please read this information and feel free to ask any questions or to request further information.

Introduction

This is a research study being conducted as part of a PhD project at Loughborough University to investigate the work related musculoskeletal injuries among obstetricians and midwives working in the UK. We intend to increase our understanding the impact of these injuries and risk factors, and potentially lead future studies to develop intervention strategies.

What is the purpose of this study?

We would like to know more about musculoskeletal injuries experienced by these occupational groups, impact on their lives and predisposing factors. To do this, we are questioning obstetricians and midwives about their experiences, interpretations and perspectives on effects of these injuries. This information will help us understand how and why these injuries occur in these occupational groups.

Do I have to take part?

You have been invited to participate in this research because you are a maternity professional working in the UK. Your participation in this study is voluntary. You may choose not to participate; however, your participation is very valuable. If you decide to participate, you may withdraw at any time without saying why.

What will happen if I take part in this study?

We will arrange for you to come for an interview and a following subset interview including physical environment interacting analysis. It will last 45 minutes to one hour at a place convenient to you.

We would like to ask you some questions about work related musculoskeletal injuries, your perspective on impact and risk factors. We will take notes and a record using a digital voice recorder. The recording will then be typed out and stored on a computer, after which the tape will be erased. Your name will be changed in transcripts so you will not be identified from anything you said. After we ask these questions, we will ask you to mock up the most frequent, extreme and complex work challenged identified in the interview. During this procedure, we will take photos/videos, however your face will be covered in the records so that you will not be identified.

All information gathered will be treated as confidential by the researcher. The information we collect will be presented in meetings and journals, but no personal identification information such as names

will be used in any reports. Direct quotes and photos/videos from the records may also be used, but these will be anonymised.

Are there benefits to taking part in the study?

There will be no direct benefit to you from participating in this study. However, the information that you provide will help us understand your experiences and factors that might contribute in occurrence of musculoskeletal problems. That would lead future studies to prevent or reduce these injuries to help you and your colleagues to maintain your roles in a good health.

Who has reviewed the study?

Academic supervisors, sponsor representative from the Loughborough University, University of Leicester Ethics Committee, University Hospitals of Leicester R&I Team, Health Research Authority Team have reviewed the study.

Further information and contact details

If you have any questions about the research study, please contact Kubra Arslan on k.arslan@lboro.ac.uk.

Appendix 5.4: Invitation email for Study 2 and Study 3

Loughborough University

University Hospitals of Leicester NHS
NHS Trust

Leicester General Hospital
Gwendolen Road
LE5 4PW
UK

Invitation to join

Musculoskeletal injuries among midwives and obstetricians study

Dear Midwife,

I am writing to ask if you would be willing to take part in my research study.

My name is Kubra and I am a PhD student at Loughborough University. My research is based on exploring 'Musculoskeletal Injuries of Maternity Professionals' supervised by Prof Sue Hignett, Dr Diane Gyi and Dr Angie Doshani. I would like to know more about work related musculoskeletal injuries experienced by these occupational groups, and their perspective on impact and predisposing factors. To do this, I want to organise some interviews with midwives to ask them questions about their experiences of musculoskeletal problems and perspective on effects of these injuries. It would take 30-45 minutes of your time.

If you are interested to take part please reply to this email as saying that. I will contact you and arrange a convenient time.

If you would like more information please feel free to ask me on k.arslan@lboro.ac.uk

Thank you for your interest in my study.

Regards
Kubra

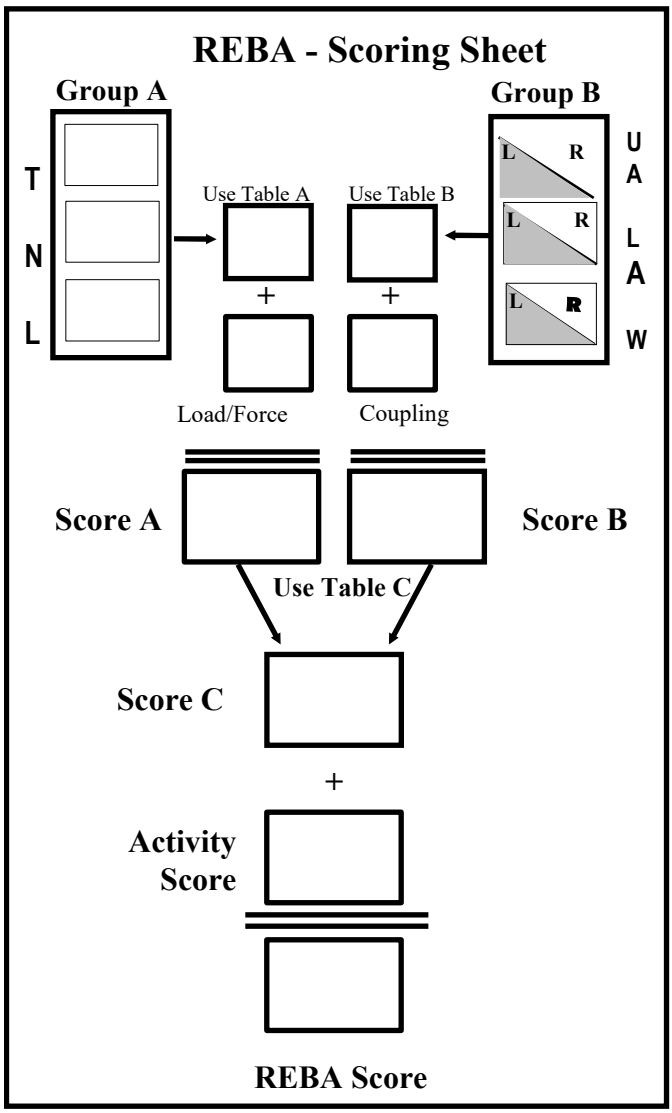
Kubra Arslan
Postgraduate Student

Loughborough University
Design School
k.arslan@lboro.ac.uk

Invitation Email, Version 2, 12/03/2017

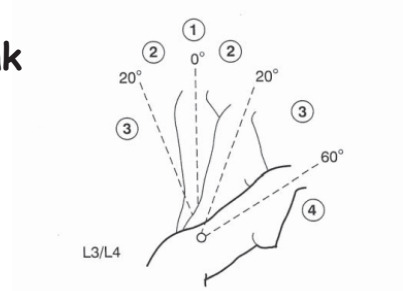
IRAS No: 210010

Appendix 6.1: Rapid Entire Body Assessment (REBA) tool (Hignett and McAtamney, 2000)



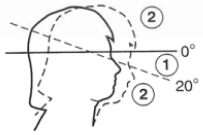
Group A

Trunk



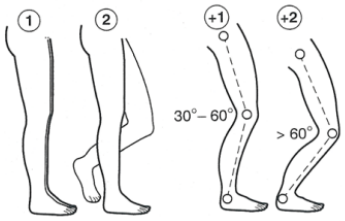
Movement	Score	Change score:
Upright	1	+1 if twisting or side flexed
0°-20° flexion 0°-20° extension	2	
20°-60° flexion > 20° extension	3	
> 60° flexion	4	

Neck



Movement	Score	Change score:
0°-20° flexion	1	+1 if twisting or side flexed
> 20° flexion or extension	2	

Legs



Position	Score	Change score:
Bilateral weight bearing, walking or sitting	1	+if knee(s) between 30° and 60° flexion +2 if knee(s) >60° flexion (N.B. not for sitting)
Unilateral weight-bearing, feather weight-bearing or an unstable posture	2	

Table A

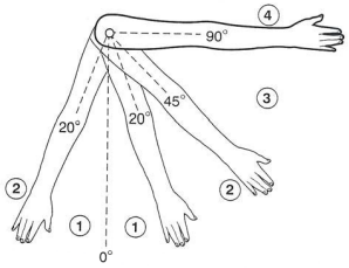
Trunk		Neck											
		1				2				3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
1		1	2	3	4	1	2	3	4	3	3	5	6
2		2	3	4	5	3	4	5	6	4	5	6	7
3		2	4	5	6	4	5	6	7	5	6	7	8
4		3	5	6	7	5	6	7	8	6	7	8	9
5		4	6	7	8	6	7	8	9	7	8	9	9

Load/Force

0	1	2	+1
< 5 kg	5 - 10 kg	> 10 kg	Shock or rapid build up of force

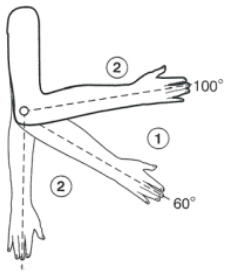
Group B

Upper Arms



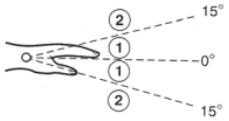
Position	Score	Change score: +1 if arm is: • abducted • rotated
20° extenion to 20° flexion	1	
> 20° extension 20° - 45° flexion	2	+1 if shoulder is raised
45°-90° flexion	3	-1 of leaning, supporting weight of arm or if posture is gravity assisted
> 90° flexion	4	

Lower Arms



Movement	Score
60°-100° flexion	1
<60° flexion > 100° flexion	2

Wrist



Movement	Score	Change score: +1 if wrist is deviated or twisted)
0°-15° flexion/extension	1	
>15° flexion/extension	2	

Table B

		Lower Arm					
Upper Arm		1			2		
	Wrist	1	2	3	1	2	3
1		1	2	2	1	2	3
2		1	2	3	2	3	4
3		3	4	5	4	5	5
4		4	5	5	5	6	7
5		6	7	8	7	8	8
6		7	8	8	8	9	9

Coupling

0 Good	1 Fair	2 Poor	3 Unacceptable
Well fitting handle and a mid-range power grip.	Hand hold acceptable but not ideal or coupling is acceptable via another part of the body	Hand hold not acceptable although possible.	Awkward, unsafe grip, no handles Coupling is unacceptable using other parts of the body

Table C

Score A	Score B											
		1	2	3	4	5	6	7	8	9	10	11	12
	1	1	1	1	2	3	3	4	5	6	7	7	7
	2	1	2	2	3	4	4	5	6	6	7	7	8
	3	2	3	3	3	4	5	6	7	7	8	8	8
	4	3	4	4	4	5	6	7	8	8	9	9	9
	5	4	4	4	5	6	7	8	8	9	9	9	9
	6	6	6	6	7	8	8	9	9	10	10	10	10
	7	7	7	7	8	9	9	9	10	10	11	11	11
	8	8	8	8	9	10	10	10	10	10	11	11	11
	9	9	9	9	10	10	10	11	11	11	12	12	12
	10	10	10	10	11	11	11	11	12	12	12	12	12
	11	11	11	11	11	12	12	12	12	12	12	12	12
	12	12	12	12	12	12	12	12	12	12	12	12	12

Activity Score

• **+1**	• 1 or more body parts are static e.g. held for longer than 1 minute
• **+1**	• Repeated small range actions e.g. repeated more than 4 times per minute (not including walking)
• **+1**	• Action causes rapid large range changes in posture or an unstable base