THE RELATIONSHIP BETWEEN ERGONOMICS OF THE OFFICE WORKSTATION AND RELATED MUSCULOSKELETAL DISORDERS IN LIBRARY ADMINISTRATIVE STAFF AT THE DURBAN UNIVERSITY OF TECHNOLOGY

By

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Dissertation submitted in partial compliance with the requirements for the Master's Degree in Technology: Chiropractic at the

Durban University of Technology

I, Cherise Levy, do declare that this dissertation is representative of my own work in both conception and execution (except where acknowledgements indicate to the contrary).

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Reference Declaration

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Do declare that in respect of the following dissertation/thesis:

The relationship between the office workstation and related musculoskeletal disorders in library administrative staff at the Durban University of Technology

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Abstract

Musculoskeletal disorders (MSDs) are the most common health complaints in the working population and the advancement in technology is a big contributor. Many offices and work spaces have been revolutionised with technological advances, most notably through computer usage, which has become an integral part of life. Intensive use of computers has shown to result in MSDs. The aim of this study was to examine the occurrence of MSDs in a library setting at a University of Technology with the objectives of: determining the prevalence of MSDs in the library staff, to describe the workstations of the staff, and to describe any associations between the workstations and MSDs.

This was a cross sectional study at two libraries at a University of Technology with a sample of 59 library staff. The study involved a two part process in which an observational assessment of the library staff was conducted by the researcher with each staff member individually, followed by a questionnaire completed by each participant. The observational checklist was used as a means to assess the ergonomic environment of the library staff. The questionnaire included demographic information, pain-related questions, psychosocial questions, and perception-based questions regarding the participants' work environment. Statistical analysis was performed using SPSS (version 24), including descriptive and inferential statistics. Statistics included frequencies, measures of central tendency, and variance and measures of association for example chi-square, Cronbach's alpha and correlation statistics.

The study indicated a prevalence of 96% for some kind of MSD. One out of every two participants had reported that the MSDs or pain interferes with their work. Certain risk factors were evident from the study, namely: inappropriate desk height, reaching for items in the work place, noise, inappropriate chairs and inadequate leg room. The most commonly reported MSDs related to neck (55.9%), shoulders/upper arm (55.9%), head (49.2%), and knees/legs (49.2%). The significant associations that were present included head and neck MSDs with noise and upper arm positioning in worker posture and hand pain.

Significant rates of MSDs were reported by the participants with half of them reporting that pain caused interference with their work and only a small portion of participants seeking treatment for these conditions. It would be beneficial for the library staff to become more aware of MSDs and their ergonomic environments both at work and privately and to take corrective action to better equip themselves to mitigate MSDs and seek treatment when needed.

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Definitions

Musculoskeletal disorders (MSDs): MSDs are common to various occupations and work groups and may affect different body locations or tissues. Therefore, MSDs are sometimes collectively referred to as cumulative trauma disorders, repetitive strain injuries, overuse syndromes or repetitive trauma disorders (Armstrong et al., 1993). Subtle differences with regards to this terminology may exist and will be used in the literature.

Ergonomics (or human factors): Ergonomics is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance as defined by the International Ergonomics Association (IEA, 2003).

Library administrative staff: For the purposes of this study, administrative refers to full time employed persons who work in the library and are given designated functions in their capacity to enable library function.

Workstation: A computer workstation is an ergonomically designed area that accommodates a desktop computer and all of its peripherals (Asaolu and Itsekor, 2014).

Causal relationship: A relationship where change in one variable (the dependent variable) is shown to result from change in another (the independent variable), and where the direction of such change can be predicted (Bless, Higson-Smith and Sithole, 2004: 153).

Correlational relationship: Correlational relational is the relationship between two variables where change in one variable is accompanied by predictable change in another variable. Correlational relationships are not necessarily causal relationships (Bless, Higson-Smith and Sithole, 2004: 153).

Correlational research: Social research with the primary aim of establishing correlational relationships between variables (Bless, Higson-Smith and Sithole, 2004: 153).

Cross-sectional design: A research design where all data is collected at a single point in time. Since this term does not relate to a specific design, it is also referred to as a cross-sectional study (Bless, Higson-Smith and Sithole, 2004: 153).

Pilot study: A small study conducted prior to a larger piece of research to determine whether the methodology, sampling, instruments and analysis are adequate and appropriate (Bless, Higson-Smith and Sithole, 2004: 155).

Validity: The degree to which a study actually measures what it purports to measure (Bless, Higson-Smith and Sithole, 2004: 157).

Chapter 1

1.1 Introduction

1.2 Background to the study

Discussion on ergonomics in the work place is an interesting subject within the South African context because while it is a developing country, there are many offices and work spaces that are technologically advanced, including a number of South African universities, which is the location for this study. Musculoskeletal disorders (MSDs) are commonly reported by office workers worldwide (Habib, Yesmin and Moniruzzaman, 2015) and make up the largest category of occupational ailments in developed countries, or the global north (EuroStat 2010). The World Health Organisation (2003) describes MSDs as health problems relating to the locomotor apparatus i.e. muscles, tendons, ligaments and nerves of the human body. The resulting MSDs occur due to the wear and tear of the muscles, tendons and nervous tissue without allowing sufficient time for self-repair. These MSDs may lead to a number of conditions, chronic discomfort, pain and possibly functional impairment (Goodman, Kovach, Fisher, Elsesser, Bobinski and Hansen, 2012; Noack-Cooper, Sommerich, and Mirka, 2005). Computer use, both professionally and recreationally, has become an integral part of life and has been linked to increased risk for MSDs as a result of frequent sustained and repetitive movement (Bohr, 2000; Goodman et al., 2012). Studies have shown that office workers, in a variety of contexts, experience MSDs, and that intensive computer use can lead to joint and muscle stress and strain (Collins, Janse Van Rensburg and Patricios, 2011., Mirmohammadi, Mehrparvar, Oila and Mirmohammadi, 2012; Akodu, Akinfeleye, Atanda and Giwa, 2015). The discomfort may be the result of poor ergonomic design, prolonged hours of computer usage, sustained awkward postures, psychosocial environments and high work demands (Akodu et al., 2015; Mirmohammadi et al., 2012).

The major contributing causes of MSDs are frequent, repetitive movements that cause micro lesions in musculoskeletal structures such as in the muscles, tendons, ligaments and joint capsules. The accumulation of muscle lesions in the affected musculoskeletal structures often leads to movement related pain. This poses significant harm to physical well-being (Klussmann, Gebhardt, Liebers and Rieger, 2008). Risk factors include various environmental factors, work procedures, equipment, as well as organisational factors. Sedentary tasks include repetition, force, prolonged and uncomfortable postures and infrequent rest periods (Dale, 2004). Environmental factors such as time constraints can result in increased biomechanical pressure, which stems from careless loading, decreased rest between movements, as well as the combination of bad postures and movements, repetitive motions, force and vibrations (Fisher, Konkel and Harvey, 2004).

1.3 Problem statement

There is a high risk of developing work-related musculoskeletal disorders (WRMSDs) among library staff since their work is sedentary and the majority of their work day involves sitting in front of a computer which exposes them to a number of ergonomic risk factors. This is the nature of work in academic libraries around the world (Chandra, Gosh, Barman and Chakravati, 2009). No previous research has been done on ergonomic factors in the DUT libraries. This study has contributed to an understanding of the prevalence and risk factors of MSDs in the DUT libraries. The focus of this study is on MSDs and their relationship to the work environment as opposed to using the term WRMSDs.

1.4 Context of the study

This study looks at one group of participants in a University of Technology in South Africa. The participants were not selected according to particular demographics, but rather, the study focused on a particular ergonomic environment at the Durban University of Technology (DUT).

The library is said to be one of the “hubs”, or the centre of the university as it is accessible to all students and staff. The library has adapted to the needs of the broader university in line with technological advancements and computerisation of the many administrative tasks required as a department of DUT. The library staff within this university setting tend to sit at a computer for the majority of the working day. Although there are a variety of roles in the DUT libraries, the sedentary working environment may be a contributing factor to musculoskeletal pain. It is for this reason that the work environment for administrative library staff may help provide an indication of the impact of an ergonomic setting on the physical bodies of those staff members, and whether or not such an impact is related to the possible occurrence of MSDs.

The library is a unique setting with a variety of job descriptions and roles. The roles vary from working at the circulation desks, postgraduate librarians, subject librarians, the information technology (IT) library staff, the library managers and assistants, central administration library staff and the shelving staff who are responsible for packing shelves and offering relief work to the circulation desk staff or who take on any other tasks within the library as required. The workstations for the staff vary from open plan office settings to enclosed office spaces. Most office related problems that cause harm to the body are caused by awkward postures stemming from poor habitual postures or poor workstation design. Computers or laptops are placed in a position which the individual assumes to be the most comfortable. The staff therefore may unknowingly expose themselves to occupational risk factors for WRMDSs through these harmful positions (Tayyari and Smith 1997: 369). The library circulation desk staff also share desks as they replace one another for the various shifts assigned to them. The circulation desk staff therefore assume the setup of other staff members without adjusting the working station to suit their own specific anthropometric needs. Poor posture can lead to fatigue and discomfort in the shoulders, hands, wrists, thighs, knees ankles and/or feet (Tayyari and Smith, 1997:369).

The ergonomic environments within the DUT libraries may not be equipped to adapt quickly enough to change and advancement of technologies. Furthermore, no formal education based programmes have been implemented and the information provided to staff on how to adapt to the changes in the workplace is limited (Asaolu and Itsekor, 2014). This kind of ergonomic support and awareness is necessary to protect employees from job injuries and diseases caused by any changing technological advancements. Ergonomic design and awareness is important as it provides a holistic approach to the prevention of disease processes.

There are two main approaches to explore that help indicate musculoskeletal disorders as a result of ergonomic environments. Firstly, the direct impact of ergonomic risk factors can be measured against physical indicators through a variety of objective mechanisms. Alternatively, self-reported physical discomforts also indicate the prevalence of MSDs. Bias occurs in both the objective and subjective measurements as members or participants are not limited to singular ergonomic environments. Psychosocial, psychological, physiological and environmental elements all contribute to the ability to measure MSDs relating to the work place. For the purposes of this study, which reported a point prevalence analysis of MSDs, a combination of subjective and objective measurement tools have been utilised in the description of associations between MSDs and ergonomic risk factors in the library work place (Punnet and Wegman, 2004).

1.5 Aims and objectives

The aim of the study was to examine the occurrence of self-reported musculoskeletal disorders among library staff at the DUT, as well as to describe any possible association between the workstation and musculoskeletal disorders. The objectives of the study were:

- To describe the workstation of library staff at the Durban University of Technology.
- To determine self-reported prevalence of any musculoskeletal pain.
- To determine any associations between the workstation and the prevalence of musculoskeletal disorders.

1.6 Significance of the study

Ergonomics and occupational risk factors need to be addressed at both the personal and professional levels of an employee. Institutions and companies need to contribute to awareness and the development of protocols to reduce ergonomic stress on the employees in their employ (EuroStat, 2010). It is not uncommon for employees to be unaware of the impact and implications of poor ergonomics in the workplace (EuroStat, 2010). As a result of changing environments and technological advancements, social responsibility is required in order to mitigate possible risk. An individual needs to consistently work towards reducing ergonomic stressors and take cognisance of occupational protocols. In this regard, employees and organisations can benefit from increased comfort of the employee, as risk mitigating protocols may lead to improved productivity in the workplace.

Awareness and knowledge of the relationship between computer usage and MSDs are essential for preventing physical disorders from becoming more severe (Mahmud, Kenny, Zein and Hassan, 2011). Ergonomics can play a significant role in improving and enriching working conditions and work practices, or as Scott (2009: ix) argues, “humanizing” working lives can reduce physical and mental stress, minimising drudgery, optimising creativity and facilitating initiative (Scott, 2009).

1.7 Conclusion

MSDs are the largest contributors to the occupational disease burden and are largely related to ergonomic factors found in the workplace (EuroStat, 2010). As evidenced in a variety of ergonomic studies, the work place has not adapted to the changing technological advances (Akodu et al., 2015). As a result, employees work in environments which are not comfortable and therefore contribute to the high burden of MSDs. This chapter has outlined the context, significance, and objectives of this study. The study proposes that there is a high risk of developing musculoskeletal disorders among library staff since their work is sedentary and the majority of their work day involves sitting in front of a computer.

Chapter 2 : Literature review

> *Ergonomics can be defined as "that branch of science that is concerned with the achievement of optimal relationships between workers and their work environment." It deals with the assessment of the human's capabilities and limitations (biomechanics and anthropometry), work and environmental stresses (work physiology and industrial psychology), static and dynamic forces on the human body structure (biomechanics), vigilance (industrial psychology), fatigue (work physiology and industrial psychology), design simulation and training, and design of workstations and tools (anthropometry and engineering). Therefore, ergonomics draws heavily from many areas of science and engineering.*
>
> Tayyari and Smith (1997: 1)

2.1 Introduction

This chapter sets out to explore some of the available literature on the relationship between ergonomics and musculoskeletal disorders (MSDs). Following a general discussion on ergonomic associations to MSDs, the chapter outlines a few of the major studies that have already been conducted. Studies from different countries within the global arena, studies from the African context, and studies that have taken place in South Africa have all been included in this chapter. However, these studies are not comparable as various methodologies were used to collect the data. Rather, the literature from various contexts has been drawn upon to explore the prevalence of the subject of this study, which is the relationship between ergonomics and MSDs. Finally, risk factors and indicators are explored relating to both ergonomics and MSDs.

2.2 Defining ergonomics

Ergonomics promotes a holistic, human-centred approach to work systems design in which cognitive, environmental, organisational, physical, social and other factors are considered (Karwowski, 2012: 3). There are three goals described by Chandra, Gosh, Barman and Chakravati (2009) for a human-centred design in helping people and technology work together in achieving operational objectives, namely:

1. To enhance human capabilities.

2. To overcome human limitations.
3. To foster user acceptance.

There are a variety of factors to be considered in the design of an ergonomic work space including: work surfaces, chairs, accessories, shelving; environmental factors such as the use of colours, lighting, acoustics, space, air quality; thermal factors; and psychosocial factors such as work stress, pressure to meet deadlines and work within time frames, social factors, time off duty and regular rest periods.

Workstations have been revolutionised with technological advances, most notably through computer usage, which has become an integral part of life. Intensive use of computers has been shown to result in joint and muscle stress and strain due to the repetitive and continuous nature of the associated movements (Akodu et al., 2015).

As already noted in Chapter 1, computer usage has been linked to increased exposure to musculoskeletal injuries associated with frequent, sustained and repetitive movement (Goodman et al., 2012). MSDs occur when wear and tear of muscles, tendons and nervous tissue exceed their ability to heal themselves (Noack-Cooper et al., 2005). This does not necessarily result in one specific condition, but a collection of musculoskeletal disorders (MSDs), which may lead to chronic discomfort, pain and possible functional impairment. Musculoskeletal disorders are commonly reported by office workers worldwide (Mahmud et al., 2011) and involve nonfatal and/or non-traumatic injuries to the neck, back, trunk, upper extremity and lower extremity. MSDs are described as pathological entities affecting the function of the musculoskeletal system, or disturbed or abnormal symptoms in bodily function.

Work-related musculoskeletal disorders are defined by the connection (hypothetical or proven) of disorders and diseases with a work-related causal component. Work-related musculoskeletal disorders are characterised as work-related diseases as opposed to occupational diseases for which there is a direct cause-effect relationship between hazard and disease. Work-related musculoskeletal disorders are multifactorial in the causation of the disease. In this case, the noted condition could be partially caused by working conditions, exacerbated by workplace exposures and may impair work capacity (Armstrong, Buckle, Fine, Hagberg, Jonsson, Kilborn, Kuorinka, Silverstein, Sjogaard and Viikara-Juntura, 1993). It must also be noted that WRMSDs are common to various occupations and work groups and may affect different body locations or tissues. Therefore, MSDs are sometimes collectively referred to as cumulative trauma disorders, repetitive strain injuries, overuse syndromes or repetitive trauma disorders (Armstrong, Buckle, Fine, Hagberg, Jonsson, Kilborn, Kuorinka, Siverstein, Sjogaard and Viikara-Juntura, 1993). Subtle differences with regards to this terminology may exist and be used in the literature. Musculoskeletal disorders will be the term used for this study.

2.3 Pathophysiology of MSDs

Prolonged isometric contractions cause constant increases in endomuscular pressure resulting in constriction of blood vessels and, therefore, ischaemia and pain as a consequence (Grieco and Molteni, 2003, 21:2). The pain is dependent on the relative oxygen deficiency, irritating metabolites, lactic acid accumulation, and reduced intracellular potassium (Grieco and Molteni, 2003, 21:2). Muscular degeneration may occur as a result of localised hypoxemia, which may also be exacerbated by a fibrotic reaction of the muscle and the surrounding tissue (Grieco and Molteni, 2003, 21:2). Increases in blood supply to a muscle occur with isometric contractions for up to 20% of the maximum voluntary contraction. Thereafter, there is a decrease in the blood supply above the 20% and hypoxemia begins to occur. These isometric contractions are common in sedentary computer users. For instance, this may occur in the trapezius muscle and muscles involved with arm elevation during typing, especially when the upper limbs are unsupported. This may lead to pain or discomfort in the short term, and possible disease states and long term soft tissue alterations (Grieco and Molteni, 2003: 21:3). There are also biomechanical aspects of the spine itself in which bending forward in a seated position can cause the anterior aspects of the vertebral bodies to move closer together and the intervertebral discs to protrude posteriorly in the lumbar spine. This may increase the stress on the spinal tissue. Another aspect to consider is the nutritional supply of the intervertebral discs, which is by avascular means. Nutritional supply takes place through diffusion of substances from adjacent tissues, through osmotic pressures and hydrostatic pressures. The optimal intervertebral disc nutrition is maintained through the constant alternation between the conditions of loading and unloading of the disc itself. Prolonged fixed postures can therefore obstruct nutritional exchange. This may result in a long-term effect that can induce degeneration processes of the intervertebral discs (Grieco and Molteni, 2003: 21:3). For these reasons, taking regular breaks to change position and move from the workstation is essential.

Research also suggests that muscle tension can be induced by mental stress thereby increasing the prevalence of musculoskeletal symptoms (Juul-Kristensen and Jensen, 2004; Janwantanakul, Pensri, Jiamjarasrangsi and Sinsongsook, 2010). Under stressful conditions, the muscles contract more than usual and the body is less relaxed. This leads to the development of metabolic waste due to the decreased blood circulation in those areas of the body. Therefore, increased workload, working under pressure, and time constraints, may increase mental pressure. This, together with physical pressure such as more forceful typing when under increased workload etc., increases the likelihood of developing MSDs (Chim., 2014).

Posture also plays a major role in the development of MSDs. There are three types of muscle fibres which are distributed and recruited for various muscle activities:

1. Slow oxidative fibres which are also known as postural muscles (the slow twitch fibres);
2. Fast glycolytic fibres (the fast twitch fibres); and,
3. Fast-oxidative-glycolytic fibres which are an intermediate between the other two types of fibres.

All three types of the muscle fibres occur in each muscle. However, the proportion varies dependent on the type of muscle and its function (Tortora and Derrickson, 2011: 352). In an upright posture, postural muscles are the main support for the body. In standing and sitting positions, postural muscles can be active for long periods of time. Fatigue takes longer to occur within the postural muscles if the body is centred in an upright position (Dimberg, Laestadius, Ross and Dimberg, 2015). Muscles of the shoulders and arms are predominantly of the fast gylcolytic muscle fibre type for which the primary function allows for rapid, intense movements of short duration and which fatigue quickly (Tortora and Derrickson, 2011: 353). Therefore, if the body is unstable, for instance if the posture is “stooped”, the fast glycolytic muscle fibres are activated. These muscles, such as the shoulder girdle musculature, fatigue easily and accumulate lactic acid leading to discomfort, pain, and stiffness (Dimberg et al., 2015).

2.4 Incidence and prevalence

Prevalence is a measure of morbidity based on current levels of disease in a population which can be estimated over a specified time period. This measure is referred to as period prevalence or a specific point in time, which is referred to as point prevalence (Oxford

University Press, 2010). Incidence, alternatively, is a measure of morbidity of new cases or new episodes of an illness arising in a population over a period of time (Oxford University Press, 2010). Thus, incidence conveys information about the risk of contracting the disease, whereas prevalence indicates how widespread the disease is. Incidence and prevalence have been used to measure MSDs within a number of studies in the medical field. Highlighted below are a few of the prominent studies that provide statistics of MSDs of particular populations within the international community.

2.4.1 A Global perspective

Globally, MSDs are a cause for concern and include the varying conditions that result from a variety of diverse work environments. Numerous measurements of perceived cause and effect have been monitored over the years to observe trends in the research. Findings are further complicated by the changes constantly occurring in diverse work environments.

Statistics in Great Britain showed a general decreasing trend in the occurrence of MSDs up until 2011/2012, after which it plateaued. In Great Britain MSDs still remain a significant burden on employees and employers and account for 41% of ill health (Statistics Great Britain, 2016). Research indicated that there was an incidence of 550 per 100 000 over the previous five years (Statistics Great Britain, 2016). Musculoskeletal disorders accounted for 34% of all working days lost due to work-related ill health. This resulted in an average of 16 days lost per case in 2015/2016. In this report by Statistics Great Britain (2016), the MSDs were divided into three categories, with MSDs of the upper limb accounting for 36%, MSDs affecting the back and neck accounting for 39%, and MSDs of the lower limb accounting for 26% of the musculoskeletal disorders reported.

According to the Bone and Joint Initiative of the United States of America (2016), one out of every two American adults reported being diagnosed with a MSD in 2012. This statistic revealed MSDs as being twice as common as any other medical condition. Arthritis was the most commonly reported ailment and it was predicted that by 2030 it would affect 25% of the population.

A Norwegian study reported that 18% of men and 27% of women reported MSDs lasting six months or more according to the Survey of Health and Living Conditions of 2012 (Kinge, Knudson, Skirkbekk and Vollset, 2015). Primary healthcare re-imbursements were reported at 37% for women and 30% for men. This percentage was obtained from the complete population based on the national administrative register data for 2012 listing the re-imbursement of primary care physicians, physiotherapists and chiropractors.

Results of a study conducted at a government institute in Turkey are shown in Table 2.1. The survey included 395 office workers and focused on work-related computer-user musculoskeletal system discomfort for the most significantly affected areas of the body. The study also provided percentages of work interference for each of these affected body parts (Ardahan and Simsek., 2016).

Table 2.1: Summary of the findings in a study of office workers in prevalence of musculoskeletal discomfort of the upper body

Musculoskeletal discomfort	% in last week	Work interference
Neck	67.85	33.6%
Upper back	66.33	28.5%
Lower back	59.49	30.6%
Right shoulder	45.32	31.3%
Left shoulder	43.54	31.9%

Source: Ardahan and Simsek(2016)

2.4.2 An African perspective

The extent of the burden of musculoskeletal conditions not due to injury is not well determined in sub-Saharan Africa (Zungu and Ndaba, 2009; Parker and Jelsma, 2010). Adebajo and Gabriel (2010) report that huge health disparities occur within the countries of Africa. They argue that musculoskeletal health has been neglected for most of sub-Saharan Africa due to competition for scarce resources. Other communicable diseases such as malaria, tuberculosis, human immunodeficiency virus, to name a few, are endemic. These communicable diseases put a large strain on healthcare resources in Africa. Disability due to MSDs was estimated to have increased in sub-Saharan Africa by 45% from 1990 to 2010 with osteoarthritis being responsible for the largest increases as a result of the rise in sedentary behaviour, aging and obesity being on the rise (Hoy et al., 2014).

A review of the literature related to prevalence of arthritis in Africa by Usenbo et al. (2015) revealed a wide range of prevalence between the studies and the different countries within Africa. These differences could have occurred due to the diversity of culture and related practices or lifestyles, the geographical nature of Africa, as well as the methodological differences between the studies. Differences also exist between the urban and rural areas within some of these countries. For instance, rheumatoid arthritis has a prevalence of 2.5% in urban South Africa and 0.7% in rural areas within South Africa. Osteoarthritis is the most prevalent form of arthritis and therefore the most prevalent MSD in South Africa at 55.1% within the urban setting (Usenbo et al., 2015). Thus, while the studies do provide incidence and prevalence indicators, the relationship between cause and effect are more complicated to detect and require further study.

2.4.3 A South African perspective

A study conducted in South Africa by Zungu and Ndaba (2009), on MSDs in hospital administrative staff, revealed that 76.1% of staff had been absent from work due to reported MSDs. These MSDs were aggravated or caused by repetitive movements of the upper limbs, wrist extension during keyboard use and forceful movements (Zungu and Ndaba, 2009). Another South African study (Peek, 2005) was completed in a corporate banking environment. This study focused on non-secretarial computer users and indicated a lifetime incidence of neck and shoulder pain of82% and 54% respectively; and a point prevalence of 39% for the neck and 23% for the shoulder (Peek, 2005).

In another study, conducted by Panwalkar (2008), it was found that 71.9% of the administrative staff in a South African university suffered from neck pain, and revealed a higher prevalence of neck pain in females (70.3%) than males (29.7%). The study also revealed higher prevalence of neck pain in the older age category of 53 to 65 years of age (Panwalkar, 2008).

A significant rate of low back pain was reported among sedentary employees (59.6%) in a large South African automotive production company (Raad, 2012). While the symptoms may differ in nature, and the subject groups work in different environments, it is evident that ergonomic studies conducted in South Africa do provide a clear association between employee work environments and the presence of MSDs.

2.5 Risk factors

As noted in the case studies listed above, there are various risk factors that need to be considered when exploring the relationship between ergonomics in the workplace and MSDs. A risk factor, within the medical field, can be described as any attribute, characteristic or exposure of an individual that increases the likelihood of developing an illness. Risk factors are distinguished from a causal agent as the relationship is one of probability (Oxford Medical Dictionary, 2010).

Individual factors include poor prolonged awkward postures, poor workstation design, and psychosocial environments, which can lead to symptoms of musculoskeletal discomfort (Akodu et al., 2015). Individual risk factors include cerebral paresis, visual and hearing impairments, as well as illness and injuries that cause some individuals to be more susceptible to MSDs, that otherwise healthy individuals might not notice (Dimberg et al., 2015).

The risk factors concerning MSDs were divided into three broad categories for the purposes of this research: individual factors, psychosocial factors, and biomechanical factors.

2.5.1 Individual factors

Multivariate analysis reveals important predictors of severe pain as including chronic disease, medical aid insurance, lower education levels and psychological distress (Anderson, Green and Payne, 2009). Individual factors are factors relating directly to the person such as age, gender, ethnicity and exercise, and will be highlighted in this section.

2.5.1.1 Age

Age is extremely relevant to design considerations in human factor research and practice. The numbers of older working adults is increasing, especially in developed countries. The proportion of older adults within the global workforce is increasing steadily and it has been established that age-related differences between younger and older adults do necessitate specific environmental design considerations (Boot et al, 2012: 1444). According to CSA International's Guideline on Office Ergonomics (CSA International, 2000: 59), there are two types of ageing, namely, primary ageing and secondary ageing. Primary ageing is genetic and unalterable and due to physical capabilities that are altered with age. For instance, individuals may develop stiffness of the eye lenses with ageing (older than 40 years of age) that are often associated with focusing problems. Individuals may need to consider getting glasses and having more light in the work area (Dimberg et al., 2015). Secondary ageing is attributable to social, lifestyle and environmental factors. Exercise for instance, a lifestyle factor, may have a big impact on ageing and health concerns, and may reduce absenteeism and increase a perceived sense of well-being (CSA International, 2000: 59). Muscular weakness and fatigue may contribute to poor postures which occurs with a high percentage of older workers (CSA International, 2000: 61). Reduced joint flexibility, reduced strength, reduced cardiovascular function and less elastic tissue also occur with increased age. Older adults tend to compensate for the primary and secondary ageing changes behaviourally. For example, older workers may screw up their eyes to see, thereby putting strain on the neck and shoulder musculatures or sitting closer to their monitor and therefore adopting awkward postures. All these "risk factors" can be minimised through good workplace design (CSA International, 2000: 59).

2.5.1.2 Ethnicity

Armstrong et al. (1993) state that, "A worker's willingness to report musculoskeletal problems may be strongly related to cultural differences which influence their perception and willingness to tolerate pain." Anderson, Green and Payne (2009) conducted a critical review of the literature which revealed that non-Hispanic Blacks and Hispanics had higher risks of severe pain than non-Hispanic Whites. A study conducted by Van Der Meulen (1997) found the prevalence of low back pain in Black South Africans was 53.1%. The author notes that the residents in the region where the study took place experience a great burden of socioeconomic and psychosocial stresses and that low back pain prevalence in low socioeconomic classes tends to be higher than in upper socioeconomic classes.

Another South African study compared the prevalence of low back pain between the Coloured and Indian communities in South Africans which revealed a prevalence of 45% among Indian South Africans, and 32.6% prevalence in Coloured South Africans (Docrat, 1999). In a White South African population, Dyer (2012) found the prevalence of low back pain to be 48%. The reasons for the difference in prevalence could be cultural, racial or genetic (Docrat, 1999). A critical review supports this statement as genetic factors may play a role in pain because temperature sensitivity, as well as how medications taken for pain are metabolised, are influenced by genetic factors. Furthermore, many of the pain medications and treatment protocols have been designed for Whites (Anderson, Green and Payne, 2009).

2.5.1.3 Gender

A number of studies have found women to be at higher risk of work-related musculoskeletal symptoms than men (Ekman et al., 2000; Wahlstrom, 2005; Widanarko et al., 2011). In their study of musculoskeletal symptoms in the Swedish workforce who used computers and a desktop mouse, Ekman et al. (2000), found that the prevalence of musculoskeletal disorders was far greater in women than men for all occupation groups. It was suggested that gender could be a confounder on non-work-related factors or differences. The proposed factors included household work, childcare, work situation differences, and constitutional differences (Ekman et al., 2000; Wahlstrom, 2005). Anthropometric differences may also cause women to work in more extreme postures or use higher relative muscle forces than men, which could result in greater mechanical stress (Titoranonda, Burastero and Rempel, 1999).

2.5.1.4 Exercise

Sitthipornvorakul, Janwantanakul and Lohsoonthorn(2015) noted that increasing daily walking steps by 1000 reduced the risk of neck pain by 14%. The same study revealed no association between daily walking steps and low back pain. Another study found that female workers with higher physical activity levels had higher odds of recovery time for persistent neck pain than those who were sedentary (Rittig-Rassmussen., 2013).

Automation, technological advancement and growth of passive forms of leisure and recreation have led to a decrease in habitual physical inactivity (Fourie, Steyn and Temple, 2006; Owen et al., 2010; Akodu, 2015). The sedentary behaviours of modern life have become a trend in developing countries with many of the chronic diseases associated with the developed world becoming more evident in these countries (Fourie, Steyn and Temple, 2006; Yang and Collidtz, 2014). Fourie, Steyn and Temple (2006) stated that the South African population has moved towards a disease profile similar to that of developed countries. Sedentary lifestyles pose many health risks and South Africa has one of the highest rates of inactivity in the world (Thompson et al., 2013). Approximately 50% of all South African adults live sedentary lifestyles according to Thompson et al, (2013). The global range of adults who are physically inactive is between 17% and 43% with an average of 31.1% (Hallal et al., 2012).

Sedentary comes from the Latin word “sedere” which translated means “to sit”. Sedentary behaviours have emerged as new focus areas for research on physical activity and health as too much sitting is distinct from too little exercise (Owen et al., 2010). Sedentary behaviours can be related to the energy expenditure of Metabolic Equivalents (METs) which are multiples of the metabolic rates. The energy expenditure of sitting ranges between 1.0 and 1.5 METs, of light activities such as standing and light ambulation movement is below 2.9 METs, and moderate to vigorous activity is between 3 and 8 METs (Owen et al., 2010). Accelerometer measurement studies conducted by Owen et al. (2010) found that breaks in sedentary time had beneficial associations with metabolic biomarkers. These breaks included transitions from seated positions to standing or transitions from standing to walking.

Sedentary behaviour refers to extended periods of physical inactivity such as sitting at a work desk all day and is known to have a negative impact on health similar to smoking cigarettes. Diet is another factor, as the number of kilojoules consumed is not decreasing as fewer kilojoules are burnt, leading to obesity and other related disease states. Individuals with sedentary lifestyles have an increased predisposition to low back pain (Raad, 2012) and neck pain (Sitthipornvorakul,Janwantanakul and Lohsoonthorn, 2015; Rittig-Rassmussen., 2013). On the contrary, individuals who exercise and report good health appear more conscious of their diet and weight resulting in less stress and more energy for daily job activities and quality of life (Raad, 2012). Dimberg et al. (2015: 38-56) state: “It is critical however to understand that our bodies are designed for movement and sitting in a single body position for long periods of time, however neutral, is most likely not physiologically recommended. We need constantly to vary our positions, but form a basic neutral baseline”.

Research has been focused on sitting time in relation to health in recent years as sitting requires very low energy expenditure. It is associated with sedentary behaviour (less than 1.5 metabolic equivalents used per sitting), and has been linked to biomarkers of diabetes mellitus and cardiovascular disease. Sedentary behaviour is linked to higher risks of obesity, cardiovascular diseases, and some cancers, all of which increase mortality (Yang and Colditz, 2014). Schmid and Leitzmann (as cited by Yang and Colditz, 2014) reported a meta-analysis in which it was observed that increased sitting time was related to increases in colon cancer and endometrial cancer. The risk increases with every two hour increase in sitting time per day. A relationship also existed between overall higher sedentary behaviour and lung cancer (Yang and Colditz, 2014). Breast, ovarian and prostate cancers and non-Hodgkin’s lymphomas showed no significant direct relationships to sitting time, but may still be indirectly related through obesity, especially for breast cancer and renal cancer (Yang and Colidtz, 2014). Inactivity is considered a risk factor for many chronic disorders independent of gender, age, and race and health status (Handschin and Spiegleman, 2008). There are many possible clinical consequences affecting the different body systems including the musculoskeletal system, shorter life expectancy and reduced quality of life may also be consequences of physical inactivity. Low back pain, osteoarthritis, rheumatoid arthritis, osteoporosis and related fractures can all be linked to physical inactivity (Handschin and Spiegelman, 2008).

2.5.2 Psychosocial factors

Psychosocial work factors are defined by Hagberg and Silverstein (1995) as being the subjective aspects of work organisation and the manner in which they are perceived by workers and managers. Aspects of psychosocial work factors that have been extensively investigated include perceptions of workload, job satisfaction, co-worker support, monotony of work, co-worker interactions, and clarity of worker roles. Stress, both work-related and non-work-related, is consistently linked with MSDs. One of the hypotheses linking psychological and physiological pathways is that job stress may increase static muscle activity. Static muscle activity may lead to lack of nutrients and build-up of lactic acid if prolonged, resulting in insufficient time for muscles to recover from fatigue and therefore increase pain (Grieco and Molteni, 2003: 21-4). Grieco and Molteni (2003: 21-4) noted that computer usage under stress and time pressures may lead to awkward postures being assumed or intensify the force used when typing or performing activities at higher levels of repetitiveness.

2.5.3 Biomechanical factors

Biomechanical factors include the desk setup or layout in relation to bodily movements and involve awkward postures. These include: awkward static and dynamic worker positions, forceful exertions, repetitive motion, work pace, non-neutral body postures and vibrations (Punnet and Wegman, 2004). The design and layout of the workstation needs to allow for the optimal “fit” between the needs and characteristics of the employees and the task requirements in which all furniture, computer and its peripherals accommodate to the individual worker. This good “fit” is especially important for employees who spend large proportions of their work day at a computer and for those who share workstations (Canadian Standards Association (CSA) International, 2000: 149). Organisational design is important for adjustability and flexibility of worker positions in the workplace to encourage postural changes. For instance, an adjustable office chair allows for the individual to adopt postural changes and avoid static postures that can be harmful and which can limit blood flow to the muscles leading to muscle fatigue and pain (CSA International, 2000: 49). A common example of static posture is holding the arm far out when using the computer mouse for long periods. It is therefore important to have the mouse close to the body when the work requires long durations of use of the mouse, and frequent rest periods or alterations to movements.

Dynamic sitting postures should be encouraged. Dynamic sitting postures are defined as the changing of body positions of the limbs or other parts of the body in relation to each other, or in relation to a fixed object that is being utilised in the work space (CSA International, 2000: 237). A dynamic sitting posture therefore requires optimal space and arrangement of workspace that should also allow for optimal leg room and appropriate foot support.

Knowledge of the employees in terms of ergonomics may therefore be essential in reducing the impact of MSDs. One way to achieve this would be by encouraging employees to make individual changes to the work environment that suit their needs. In this way, participatory ergonomics can be utilised to benefit each individual.

Participatory ergonomics is the active involvement of the employee in the implementation of ergonomic knowledge and procedures in the shared workplace, creating a two-way information flow (Noro, 2007:2-1). It is essential for staff members in an ergonomic workspace to have increased awareness of the effects of their office environment in order to establish an awareness of the effects of the environment on their own personal health and well-being. This helps staff members identify postural constraints in the workplace so that they are able to take measures to correct them (Montreuil et al., 2006). Participatory ergonomics are frequently used for MSDs and can be a successful method to develop and prioritise ergonomic measures to prevent low back pain and neck pain (Driessen et al., 2010).

2.6 General rules and guidelines regarding an administrative workstation

As Kroemer, Kroemer and Kroemer-Elbert (1994: 421) state: “Fit the job to the person and not the person to the job.” The following section provides certain guidelines for office ergonomics in terms of body positioning, lighting and acoustics, thermal factors, and air quality.

Kroemer, Kroemer and Kroemer-Elbert (1994: 420) argue that tasks should be performed and designed to allow the wrists to be in alignment with the forearm, without wrist deviations. The arms and wrists should not be twisted or deviated and the elbow angle should be varied. The upper arms should hang at the sides of the body and the head should be held fairly erect and the trunk should not be rotated. It is important to have enough space for the legs and feet and for varied postures of the different body segments throughout the working day (Kroemer, Kroemer and Kroemer-Elbert, 1994: 420).

Not only desk posture, but the setup of a computer can also contribute to ergonomic well-being. The monitor positioning should be approximately 45cm or arm's length from the eyes. The monitor should also have a ten degree tilt and the top of the screen should be level with the eyes to prevent the individual from flexing or extending the neck in awkward postures (Dimberg et al., 2015). The surroundings of the monitor should be checked so as to avoid annoying flickering on the monitor, glare, brightness of the screen, and to avoid placing the monitor directly in front of a wall to allow the eyes to focus around the room to distant objects when not focused on the monitor.

Adequate lighting is important for appropriate focus of the eyes. It is also important to have good air flow or air quality and have appropriate room temperatures. Cold environments in general, or sitting directly under an air conditioner, can trigger muscle contraction especially in the upper trapezius muscle regions. Not all office environments can be altered; however, precautionary measures can be utilised in order to improve the working environment such as using a thin scarf to form a barrier between the skin and the cold air.

The sitting posture is of great importance as many activities, especially in the work place, are completed in the sitting position. No one single theory about how one should sit at the office prevails as was the case in the nineteenth century where the advice was to sit in the upright posture motivated by the notion that "sitting with an upright trunk means sitting healthily" (Kroemer, Kroemer and Kroemer-Elbert, 1994: 440). More recently it has been established that many postures can be comfortable depending on the individual, the work activities, preferences and anthropometries. Furniture should allow for postural variations and easy adjustment because, for instance, seat height and backrest position may affect the comfort of an individual (Kroemer, Kroemer and Kroemer-Elbert, 1994: 440). However, as a general rule, the 90 degree guideline should be applied with the hips above or in line with the knees, feet supported and the arms flexed to allow for the forearms to rest parallel to the floor with the forearms supported and the arms close to body (Queensland Government, 2012).

2.7 Conclusion

The above guidelines mitigate the risks for MSDs. This study explores the relationship between a particular ergonomic work space and the possible effects on the physical well-being of employees who utilise that workspace. This chapter highlighted the ergonomic factors that may cause or exacerbate MSDs. The next chapter will focus on the methodology of this study in order to measure possible MSDs relating to the workspace of library staff at the DUT.

Chapter 3 : Methodology

3.1 Introduction

The focus of this chapter is on the methods and instruments used to conduct the study. The purpose of this study was a) to examine the occurrence of self-reported musculoskeletal disorders (MSDs) among library staff at the DUT; and b) to describe any possible association between the workstation and MSDs. Two methods were used to collect data, namely: an observational checklist, and a questionnaire. The data was collected to measure the workstation and to report the occurrence of MSDs. Statistical analysis was conducted in order to determine if there was any association between the workstation and reported MSDs. The study design, the collection of data, and methods of data analysis are outlined and discussed in this chapter, which concludes with a discussion on the validity of the study.

3.2 Study design and methodology

The study was cross-sectional in design as all data was collected by the researcher in a single face-to-face consultation. Cross-sectional research designs are referred to as “in-time” studies and involve the collection of data within one time period (Daniel, 2012: 15). When conducting cross-sectional studies, all data is collected within a relatively short period of time or at a single point in time and there is no follow-up for data collection (Daniel, 2012:15; Gerstman, 1998: 96).

Two methods were used to collect data for this cross-sectional study: an observational checklist and a questionnaire. The observational checklist was completed by the researcher at the participant’s workstation with the participant in a working posture. The participant position was measured and recorded by the researcher. The questionnaire was designed to determine the prevalence of perceived musculoskeletal pain and associated risk factors. Prevalence is a proportion that expresses the relative frequency of a condition or a disease at a particular time (Gerstman, 2003: 96).

In order to determine prevalence, participants do not need to share the same demographics, nor do they need to share the variable of interest, but may share other characteristics such as socioeconomic status or context (Daniel, 2012: 15). In the case of this study, participants did not belong to a particular demographic group but all participants shared the same work space.

The research was a quantitative study which combined descriptive and correlational investigations in order to obtain the objectives of the study, namely:

- To describe the workstation of the library staff at the Durban University of Technology.
- To determine self-reported prevalence of any musculoskeletal pain.
- To describe any association between the workstation and prevalence of musculoskeletal disorders.

The positivist paradigm utilised in this research is based on exploring social reality using observation and reason as a means of understanding human behaviour. The scientific method is essential in obtaining true knowledge through the experience of senses and observation (Golfshani, 2003). The quantitative, positivist approach utilises scientific methods at the ontological level to objectively measure and quantify knowledge using instrumentation that is independent of the researcher (Golfshani, 2003). The combination of the two methods, scientific (objective measurement of ergonomic space) and subjective (self-reporting) is utilised in this study in order to provide a more holistic approach to the research.

Descriptive studies are based on observations. One of the objectives of this study was to describe the workstation of the participants, which was achieved through the observational checklist (Appendix L). The study also aimed to find any association between workstation and musculoskeletal pain in the different body locations, i.e. the head, neck shoulders/upper arms, upper back, midback/chest, lower back, elbow and forearm region, wrist/hand, hips/buttocks/thighs, knees/legs and ankles/feet. For the purposes of this study, collectively, these body locations will be referred to as the MSD variables. Correlational studies examine the relationship between variables through naturally occurring data. For the purposes of this study, the MSD variables were correlated with the biographical data variables, exercise variables and worker posture variables. These variables are listed in Appendix T. The questionnaire (Appendix M) was utilised in conjunction with the observational checklist (Appendix L). The results of these assessments were correlated in order to determine if there were any associations between the library workstations and the self-reported MSDs.

3.3 Data collection tools

Two methods were used to collect data in order to determine if there were any associations between the workstation and the possible prevalence of MSDs. Firstly, the workspace of each participant was observed and measured according to desirable ergonomics and risk factors using an observational checklist (Appendix L). Secondly, participants completed a questionnaire (Appendix M) in which they self-reported any experiences or prevalence of musculoskeletal pain.

The observational checklist from Bohr (2000) was chosen to provide a measurement tool for the study of the ergonomic workspace of the library staff. The original quantitative survey and observational checklist from Bohr (2000) had been validated in previous studies and permission was obtained from the author (Appendix Q). Goodman et al. (2012) rated the original article by Bohr (2000) which utilised the above measurement tools s high quality with a rating of 90.91% following systematic review. The original observational checklist from Bohr (2000) was utilised in this study.

A self-reported questionnaire was formulated by the researcher specific to the library staff at the DUT. The questionnaire of Raad (2012) and the Nordic Questionnaire were consulted in the formulation of the newly developed questionnaire (Appendix M), after an extensive search of the literature in the following databases:

- Academic search complete;
- Cinahl Plus;
- Eric;
- Medline with full text;
- Health Source;
- Nursing Academic Complete; and
- Masterfile.

The questions in the newly formulated questionnaire involved demographic data, lifestyle questions, pain related questions and questions pertaining to the work environment of the participants, as well as perceived levels of work and pain.

These research tools, the observational checklist and questionnaire (Appendices L and M) were validated through a focus group and pilot study.

The observational checklist (Appendix L) was completed by the researcher at the participant's workstation with the participant in working posture. The researcher observed and recorded the workstation configuration and worker posture. The questionnaire was given to participants directly after the observational checklist had been completed.

Participants were reminded of the objectives of the study, outlined in the Letter of Information (Appendix J) which had been sent to them via email, and consent forms were signed with the researcher in person. The observational assessment between researcher and participant, if convenient for the participant, followed immediately after the signing of the consent form. Participants were observed in their natural work environment adopting a working posture and the observational checklist was completed by the researcher. The observational checklists for all participants were completed by the researcher alone to provide consistency. The questionnaire was purposefully given to the participants to complete straight after the observational checklist had been completed by the researcher. This was to ensure that participants did not attempt, intentionally or not, to alter their posture after having read the questionnaire. It was also important that the researcher not explain any of the observational findings or answer any posture-related questions until the questionnaire was completed to avoid the participants from acquiring any extra knowledge before completing the questionnaire. Following the questionnaire, the researcher was able to answer questions and provide information on how participants might improve their position and posture at their workstation. For further queries, and access to information on ergonomic guidelines, participants were invited to contact the researcher at any time following the scheduled consultation.

3.4 Context and inclusion perimeters for participant selection

This cross-sectional survey took place at the DUT libraries. The study looked at a broad demographic group, but in a shared ergonomic workplace, all participants being staff members working at the DUT libraries.

3.4.1 Study location

The study was conducted in two of the DUT libraries, the Alan Pittendrigh Library (Steve Biko Campus) and BM Patel Library (ML Sultan Campus). At the time of the study, there were 64 full-time staff employed between these two libraries. The DUT libraries are traditional, academic libraries used by the DUT students and staff. There are rows of shelves with books which are easily accessible to the library users. Also available are some electronic holding areas, open spaces for study groups and self-study. It is a quiet environment with artificial light. The staff working in these libraries have a variety of workstation designs, some in open spaces and some in individual, small, closed offices. The workstations have different dynamics and differences were expected to occur in terms of risk factors that cause musculoskeletal pain.

3.4.2 Advertising, participant recruitment and permission

No advertising was necessary as permission was sought from the library directorate (Appendix N) who contacted the relevant library managers via email. The approval of the study was on provision that the research was approved by the Institutional Research and Ethics Committee. The library managers informed the library staff of the study, also via email. The Letter of Information (Appendix J) was attached to email correspondence sent by the library managers prior to the commencement of the study. Arrangements were made between the researcher and library managers for appropriate data collection according to a schedule that was suitable to library managers and staff members. The researcher then approached the participants in person to request participation in the study. Each participant was then given a hard copy of the Letter of Information (Appendix J) to read and the Informed Consent form (Appendix K). Signed consent forms were necessary for individual participant consent.

3.4.3 Study population

The study population consisted of 64 full-time staff employed between the two libraries. The population consisted of men and women across the racial categories. The workstation designs differ between the staff as do the roles of each of the staff members. The common denominator for all the library staff are that their work is sedentary in nature and they sit at a desk in front of a computer for the majority of their work day.

3.4.4 Sampling

Non-probability consecutive sampling was utilised in this study as every person who met the inclusion and exclusion criteria for the sample, within the duration of the data collection time frame, was included in the study (Daniel, 2012: 91; Polit and Beck, 2012: 278).

3.4.5 Sample size

The sample size consisted of 61 staff members in the two libraries who provided consent to participate in the study and met the inclusion criteria and exclusion criteria of the study. Three staff members of the population of 64 were unavailable as participants, and two checklists and questionnaires were excluded as these participants spent less than two hours a day working on a computer. The final number of participants was 59, a response rate 92% of the population.

3.4.6 Sample characteristics

Inclusion criteria:

- Participants were 18 years of age and older.
- Participants were all full-time library staff employed at DUT.
- Participants read and signed the Letter of Information and Informed Consent form (Appendices J and K).
- To be sedentary, the participants were all office bound and worked at their desk for the majority of their working day (minimum of two hours per day).

Exclusion criteria:

- Members of the focus group or pilot study.
- Participants under the age of 18.

3.5 Feasibility evaluation and ethical considerations

The following methodology and sample selections and feasibility evaluations were conducted.

3.5.1 Focus group

A focus group session was conducted once ethical clearance (as per DUT Institutional Research Committee) had been obtained. All participants in the focus group were required to provide face validity to the newly constructed questionnaire (Appendix D) to establish any ambiguities, and to provide recommendations for possible changes to the questionnaire and observational checklist. The focus group was conducted by the researcher and study supervisor. The focus group included two full-time administrative staff employed by DUT, one participant with research experience, one practising Chiropractor, one participant with a specialisation in ergonomics and two DUT students. The participation in the focus group was voluntary and the participants were required to read the Letter of Information (Appendix A), and to sign an Informed Consent form (Appendix B), and the confidentiality statement (Appendix C). The focus group discussion was recorded and treated as confidential. The electronic data was password protected on the researcher's private electronic device and the signed documents were stored in a separate folder for confidentiality. All hard copy documents will be stored for five years in a locked cupboard in the Chiropractic Department and destroyed thereafter. Recommended adjustments to the questionnaire and observational checklist were implemented and can be viewed in Appendix I.

3.5.2 Pilot group

Four full-time administrative staff employed by DUT were invited to participate in the pilot study in order to validate the questionnaire after changes as per focus group recommendations had been made, both to the questionnaire (Appendix D) and the observational checklist (Appendix E). The participation in the pilot study was voluntary and the participants were required to read the Letter of Information (Appendix F), and sign the an Informed Consent form (Appendix G). The participants of the pilot study were given a pre-test evaluation form (Appendix H) at the end of their participation to provide information on the quality of the questionnaire, as well as to highlight any problem areas observed in the research tools that were to be utilised. All the signed documents were stored in a separate folder for confidentiality. All hard copy documents will be stored for five years in a locked cupboard in the Chiropractic Department and destroyed thereafter. Recommendations were implemented as necessary as stipulated in Appendix I.

All changes to the questionnaire and observational checklist were implemented prior to the main research data collection as per the information and recommendations provided by the focus group and pilot study. These changes implemented from both the focus group and pilot study were recorded and can be viewed in the letter to the Institutional Research and Ethics Committee (IREC) chairperson in Appendix I.

3.5.3 Ethical considerations

The following ethical guidelines were followed during the research process. Permission was sought from the DUT research directorate, library directorate, library managers and library staff. The IREC provisional approval for the research was provided before the focus group and pilot study took place. Once all the changes and recommendations had been implemented, the IREC's full approval was obtained and can be viewed in Appendix S. The IREC approval was granted through the research directorate, which provided "gatekeeper" permission for the study to be conducted at DUT provided IREC ethical guidelines were followed. Once the library directorate received IREC approval, they made contact with the relevant library managers informing them of the study. The email correspondence contained the attached Letter of Information (Appendix O). The researcher then approached the library managers directly and arranged appropriate schedules for the study to be conducted. The library managers emailed all the library staff informing them of the study and attached the Letter of Information (Appendix J) and Informed Consent form (Appendix K),informing them that the researcher would approach them for their participation in the study. The researcher received direct approval from each participant in person following these emails at a time convenient to the participants. A hard copy of the Informed Consent form (Appendix J) was signed by each participant with the researcher present directly before the commencement of the observational checklist and questionnaire.

The four ethical principles of autonomy, justice, beneficience and non-maleficence were
Autonomy was observed and participants were given the freedom to participate in the study and gave informed consent. The data collected was anonymous and confidential. Anonymity exists when the participant cannot be linked to the responses, even by the researcher (Burns and Grove, 2005: 278).
Justice is the participants' right to privacy and fair treatment (Polit and Beck, 2012: 155). In this study, all participants were given an equal opportunity to participate.
Benificience and non-malficence are the maximizing of benefits and minimizing of harm to the participants (Polit and Beck, 2012: 152-153). Although participants might not experience direct benefit, the results of the study could benefit library staff in the future.

3.6 Study procedure and data collection

In order to conduct the study, which consisted of 59 participants, ethical protocols as administered by the IREC were followed. The study procedure and data collection process was as follows:

- A formal letter was sent to the library directorate (Appendix N) and to the research directorate (Appendix R) requesting permission to conduct the study at the DUT with the library staff.

- Provisional approval to conduct the research study was provided by IREC, which granted permission to conduct the focus group and pilot study, but not the main study.
- The focus group and pilot study then took place.
- Once all the necessary changes had been implemented to the research tools, the data collection commenced. The changes to the research tools are recorded in Appendix I and were emailed to the IREC.
- Full ethical approval was then granted by IREC (Appendix S).
- An email was sent to all potential participants via the library managers informing them of the study with the attached Letter of Information (Appendix J) attached tothe email.
- The researcher approached the participants directly as per the inclusion/exclusion criteria informing them of the study and asking them to participate in the study. Any participant that met the inclusion criteria and who had agreed to participate in the study was given a hard copy of the Letter of Information (J) to read before signing the Informed Consent form (Appendix K). The signed Informed Consent form was placed in a sealed folder labelled “C”.
- The participants were asked to be seated in their working position at their workstation while the researcher completed the observational checklist (Appendix L).
- The participants were then required to complete the self-reported questionnaire (Appendix M).
- All completed questionnaires and observational checklists were placed in separate and sealed folders marked “A” and “B” respectively.
- During the data collection process, the participants were asked to record their email address for the researcher only if they wanted an ergonomic brochure emailed to them with extra information regarding good office ergonomics guidelines. This was optional for the participants. This also allowed the participants the opportunity to email the researcher if they had any questions regarding the ergonomics of their workstation.
- The researcher was available for any queries during the duration of the data collection process and was in the vicinity while the participants were completing the questionnaires as the participants were encouraged to complete the questionnaires immediately. It must be noted that the researcher approached the participants respectfully at a time convenient to them.

- Participants were also encouraged to not communicate their experience with the study to their colleagues during the data collection process as it could contaminate the results of the study.
- The following link was emailed on request to participants if they wanted further guidelines on office ergonomics.
- http://www.barbre-ergonomics.com/files/office_ergo_brochure_9-2015.pdf
- Not all participants chose to write down their email address for the extra information.
- On completion of the data collection process, the researcher created an electronic SPSS data set of the information contained in the completed questionnaires. Statistics were computed on SPSS version 24.
- These research tools were selected in order to meet the criteria of the research questions and objectives.

3.7 Data analysis

Statistical analysis was performed using SPSS (version 24), including both descriptive and inferential statistics. Statistics included frequencies, measures of central tendency and variance and measures of association for example chi-square and correlation statistics. The Cronbach's alpha test was used for the one Likert scale question that constituted the questionnaire. The Cronbach's alpha is a reliability coefficient for which a value of 0.7 or higher is considered "acceptable". A chi-square goodness of fit test was completed in order to determine whether the scoring patterns per statement were significantly different per option. The null hypothesis claimed that similar numbers of participants scored across each option for each statement (one statement at a time). The alternative stated that there was a significant difference between the levels of agreement and disagreement. A significant value (p-value) of less than 0.05 indicated significance and implied that the distributions were not similar. A chi-square association test was performed to determine if there were significant relationships between the variables. The null hypothesis stated that there was no association between the two variables measured and the alternative hypothesis indicated that there was an association between the two variables measured. The statistics were presented in the forms of graphs, cross-tabulations and other formats (see Chapter 4). As stated by the Head of the Department of Physics, Singh, a p-value of <0.05 was considered as statistically significant for the Fisher's Exact Test Exact Significance 2-sided which was the second chi-squared test described above as indicated in an email communication on 11 April 2017. The Cronbach's alpha was computed in SPSS to determine the reliability of the research tools utilised in this study.

3.8 Validity and reliability

It is essential to measure the reliability and validity of the measurement tools utilised in a study to ensure the appropriateness, quality and accuracy of the research. The reliability and validity of these instruments influence the extent to which phenomena are learned and meaningful conclusions can be drawn from the data. The validity of the measurement instrument is the extent to which the instrument measures what it is intended to measure, and the reliability is the consistency with which a measurement instrument yields a certain result with no changes of the entity that is being measured (Leedy and Ormrod, 2010). Face and content validity provide a logical link between the research tools and the objectives of the study and relevance of the questions relating to the study which were strengthened through the pilot study and focus group (Kumar, 2011).

3.9 Conclusion

The study was conducted at two of the libraries of the DUT, the Alan Pittendrigh Library (Steve Biko Campus) and the BM Patel Library (ML Sultan Campus). The study involved a two-part process in which an observational assessment of the library staff was conducted by the researcher with each staff member (participant) individually followed by a questionnaire to be completed by each participant. The observational checklist was used as a means to assess the ergonomic environment of the library work environment. The questionnaire included demographic information, pain-related questions, psychosocial questions and perception-based questions related to the participants' work environment.

Chapter 4 : Presentation of results

4.1 Introduction

This chapter presents the results obtained from the questionnaires and observational checklists completed by the researcher and participants in this study. The questionnaire and observational checklist were the primary tools used to collect data. In this chapter, the results are divided into two broad sections, Section A is a presentation of the data collected, and Section B deals with the correlation statistics and any associations between variables. The data collected from the responses was analysed with SPSS version 24.0. The results are presented through descriptive statistics in the form of graphs, tables and other figures in order to display the data that was collected. Inferential techniques include the use of correlations and chi-square test values, which are interpreted using a p-value of 0.05.

4.2 Sample realisation

In total, 61 observational checklists and questionnaires were completed of which 59 were available for inclusion in the results. The sample therefore consisted of N=59 full-time library staff members from the BM Patel Library and the Allen Pittendrigh Library at the DUT. Of the total population size of 64 employees, three were unavailable during the time of the study and two checklists and questionnaires were excluded as those participants worked less than two hours a day at a desk. Therefore, over 92% of the sample population was included in the study.

4.3 The data collection tools

The first data collection tool utilised in the study was the observational checklist. The second data collection tool utilised was the questionnaire. The observational checklist was further divided into variables relating to the work area configuration and the participants postures at their workstation. The data collection tools combined consisted of 77 variables measuring various themes. There were eight themes in total, as follows:

- Part 1 Biographical data.
- Part 2 Exercise related data.

- Part 3 Treatment sort for musculoskeletal disorders.
- Part 4 Self-reported pain questions for the various body regions.
- Part 5 Questions relating to mental state and stress.
- Part 6 Perceptions of appropriate work area / ergonomics.
- Part 7 Observational checklist was broken into work area configuration.
- Part 8 Worker postures.

4.4 Section A

In Section A, the data collected is presented as per the research questions. In this section, demographical information of the study sample is presented, as well as environmental, physical and psychosocial indicators. The self-reported MSDs are illustrated and employee perceptions of work environments. The themes Part 1 to Part 8 listed above are all included in Section A.

4.4.1 Part 1: Biographical data

The biographical characteristics of the respondents are summarised below indicating age, gender, ethnicity, duration of employment, hand dominance, and self-reported health status.

Table 4.1: Biographical characteristics of the participants

Biographical Characteristics	Frequency n =	Percentage (%)
Age (years)		
25 – 35	12	20.3
36 – 45	20	33.9
46– 55	20	33.9
>55	7	11.9
Gender		
Male	22	37.3
Female	37	62.7
Ethnicity		
Black	29	49.2
Coloured	4	6.8
Indian	22	37.3
White	4	6.8
Duration of employment		
<2 years	3	5.1
2 – 5 years	14	23.7
5 – 10 years	11	18.6
10 – 20 years	17	28.8
>20 years	14	23.7
Hand dominance		
Left handed	5	8.5
Right handed	54	91.5
Health rating		
Fair	9	15.3
Good	37	62.7
Excellent	13	22.0

The majority of the participants were within the age categories of 36 to 45 years and 46 to 55 years as depicted in Table 4.1.

4.4.1.1 Age and gender

The majority, 62.7% (n = 37), of the participants were female with men making up a little more than a third, 37.3% (n = 22). Overall, the ratio of males to females was approximately 2:3 (37.3:62.7).Table 4.2 represents the age of the participants by gender.

Table 4.2: Gender distribution by age of the participants

			Gender		Total
			Male	Female	
Age of participants	**25-35 yrs**	n =	3	9	12
		% within Age of participants	25.0%	75.0%	100.0%
		% within Gender	13.6%	24.3%	20.3%
		% of Total	5.1%	15.3%	20.3%
	36-45 yrs	n =	12	8	20
		% within Age of participants	60.0%	40.0%	100.0%
		% within Gender	54.5%	21.6%	33.9%
		% of Total	20.3%	13.6%	33.9%
	46-55 yrs	n =	6	14	20
		% within Age of participants	30.0%	70.0%	100.0%
		% within Gender	27.3%	37.8%	33.9%
		% of Total	10.2%	23.7%	33.9%
	Older than 55yrs	n =	1	6	7
		% within Age of participants	14.3%	85.7%	100.0%
		% within Gender	4.5%	16.2%	11.9%
		% of Total	1.7%	10.2%	11.9%
Total		n =	22	37	59
		% within Age of participants	37.3%	62.7%	100.0%
		% within Gender	100.0%	100.0%	100.0%
		% of Total	37.3%	62.7%	100.0%

It is noteworthy that within the age category of 36 to 45 years, 60% were male. Within the category of males only, 54.5% were between the ages of 36 to 45 years. The category of males between 36 to 45 years formed 20.3% of the total population. All other age categories were dominated by females with the most significant being in the older age category of over 55 years of age making up 85.7% of the sample population.

4.4.1.2 Race

The majority of the population were black Africans (49.2%) and Indian (37.3%) followed by an equal distribution of Coloured and White at 6.8% in each category. These distributions are depicted in the graph below.

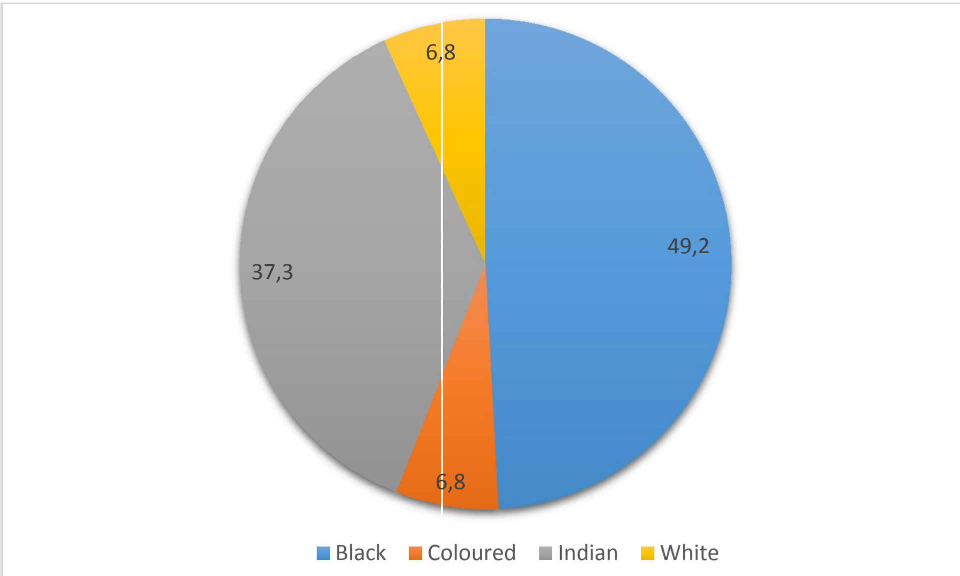

Figure 4.1: Racial distribution of participants

4.4.1.3 Hand dominance

The majority of respondents 91.5% (n = 54) were right-hand dominant and only 8.5% (n = 5) were left hand dominant.

4.4.1.4 Pregnancy and children

None of the participants were pregnant. The question was included as pregnancy could contribute to a variety of musculoskeletal conditions. The females reported “no” to this particular question and males reported “not applicable”.

Most participants (79.7%, n = 47) reported having had children, the majority of whom were over the age of six years. The number of children or having children at all can contribute to musculoskeletal pain, especially when under the age of three, due to constantly picking them up or breast feeding for the women. For this reason, these questions were included in the questionnaire. Table 4.3 summarises the results of the ages of the children of the participants and how many of the participants, both men and women, had children.

Table 4.3: The age categories of the children of participants

Ages of children	Frequency n =	Percent
No children	12	20.3%
0-3 years	7	11.9%
4-6 years	9	15.3%
Older than 6 years	31	52.5%
Total	59	100.0%

4.4.1.5 Perceptions of general health

The self-reported health rating of the participants was mostly of good health (62.7%, n = 37), followed by excellent health (22.0%, n = 13) and then fair health (15.3%, n = 9). No participants reported poor health and therefore, the 0% was omitted from Table 4.4.

Table 4.4: Frequency of self-reported health rating

Health rating	Frequency n =	Percent
Fair	9	15.3%
Good	37	62.7%
Excellent	13	22.0%
Total	59	100.0%

4.4.1.6 Duration of employment

The majority of participants had been employed at the library for over ten years. Figure 4.2 illustrates the duration of employment of the participants.

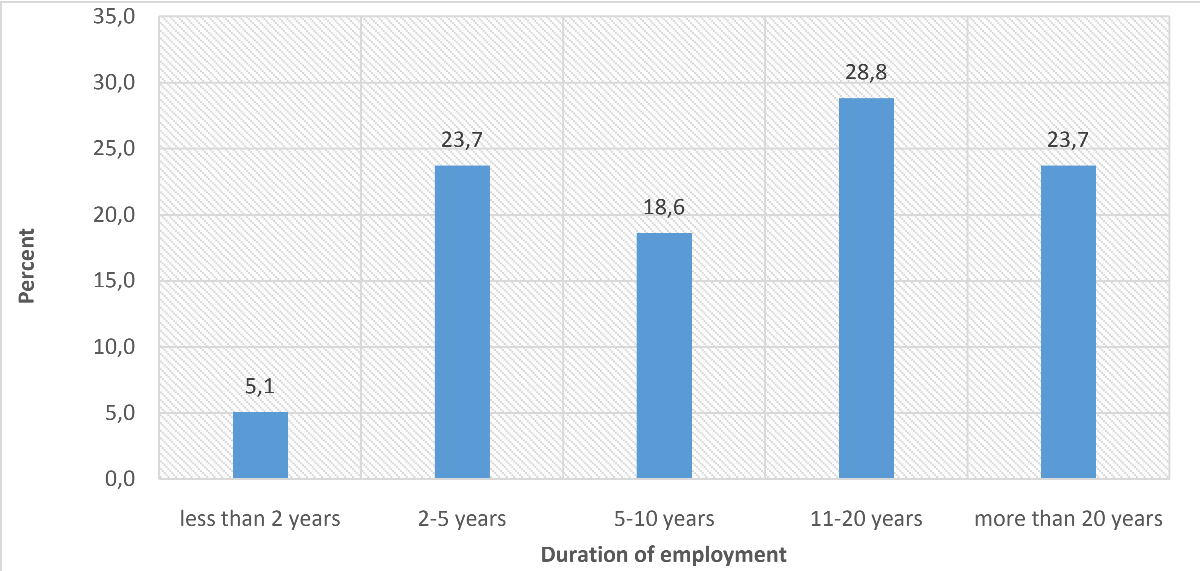

Figure 4.2: Duration of employment of the library staff at the DUT

4.4.1.7 Stress level rating of the participants

The participants were asked to rate the stress levels on a scale between zero and ten, with zero being no stress and ten being the most stress or extreme stress. Moderate stress was reported by the participants overall with the reported levels of stress widely varying across the ranges with a mean stress level of 5.48, as summarised in Table 4.5.

Table 4.5: Stress level rating of participants indicating the minimum, maximum, mean and standard deviation

	N	Minimum	Maximum	Mean	± Standard Deviation
Stress level rating scale	58	1.00	11.00	5.4828	2.57177

4.4.1.8 Cronbach's alpha score

The two most important aspects of precision are reliability and validity. Reliability is computed by taking several measurements on the same subjects. In an email communication on 13 April 2017, The Head of the Physics Department at DUT indicated that a reliability coefficient of 0.70 or higher is considered to be "acceptable". The Cronbach's alpha score for the one Likert scale question that constituted the questionnaire is summarised in Table 4.6, and was derived from the stress level rating scores by the participants.

Table 4.6: Cronbach's Alpha score

Cronbach' Alpha	N of Items
0.792	11

The reliability score for this question exceeded the recommended Cronbach's alpha score of 0.7. This indicates acceptable, consistent scoring for this question.

4.4.2 Part 2: Exercise related questions

Table 4.7 reveals the results of the frequency of exercise the participants reported.

Table 4.7: Frequency of exercise reported by participants

How often exercise	Frequency n =	Percent
No exercise	16	27.1%
Once a week	7	11.9%
Twice a week	10	16.9%
More than twice a week	26	44.1%
Total	59	100.0%

Just under three quarters of the participants (72.9%, n = 43) reported doing some exercise, with the majority (44.1%, n = 26) of those who exercised reporting that they exercise more than twice a week. Just over a quarter (27.1%, n = 16) of those sampled reported that they did not exercise.

The questions that follow are based on the type of exercise the participants reported. These exercise descriptions were placed into four broad categories based on the exercise participation reported by the participants. These were walking, football, gym and yoga and are illustrated in Figure 4.3. Almost a third of participants (32.8%, n = 19) reported that they were members of a gym, which was their chosen form of exercise, followed by walking (27.6%, n = 16), then football (6.9%, n = 4) and lastly, yoga (5.2%, n = 3).

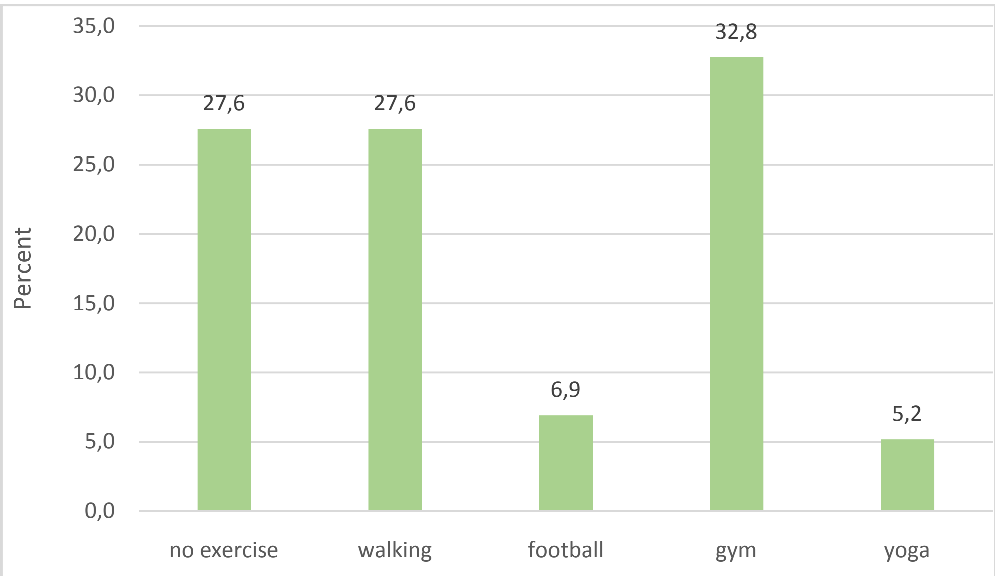

Figure 4.3: The frequency of exercise type reported by participants

4.4.3 Part 3: Treatment sought for reported MSDs

This section is based on whether the participants had received or were receiving any form of treatment for an MSD. Only 10.2% (n = 6) of participants reported “yes” to this question (Table 4.8).

Table 4.8: Report of any treatment sort by participants for any MSDs

Treatment sort for any MSD	Frequency n =	Percent
Reported “Yes”	6	10.2%
Reported “No”	53	89.8%
Total	59	100.0%

The percentage (10.2%) of participants having received or who were receiving treatment for a MSD during the time of the study appeared to be low.

The participants were also asked to comment, as a follow-up question, on the type of treatment sought for their specific MSDs. This question was listed as a follow-up question in the case participants did not want to reveal this information in the questionnaire. Participants only reported seeking treatment for more severe conditions. One participant reported requiring neck surgery as a result of a fall at their place of work. The participant reported that they continued to suffer from neck pain many years after the incident occurred. Another participant had anterior cruciate ligament reconstruction surgery for a knee injury, one participant had to seek medical treatment for an ankle fracture, one participant took medication (Voltaren) for cervical spondylosis and a few of the participants reported having received treatments for tennis elbow and general back, neck and shoulder pain.

4.4.4 Part 4: Self-reporting of MSDs

The self-reporting of MSDs was the most pertinent aspect of the study as it revealed the frequency and location of musculoskeletal pain experienced by the participants. The location of pain and frequency of pain for each participant is illustrated in Figure 4.4. The frequencies were categorised as follows: “seldom” or “never” was stipulated as once a month or never; “occasional” was stipulated at two to four times a month; and the “often” group was stipulated as more than four times a month. In reporting the results of the self-reported MSDs the researcher grouped the responses “occasional” and “often” together to indicate “Yes”, pain was experienced.

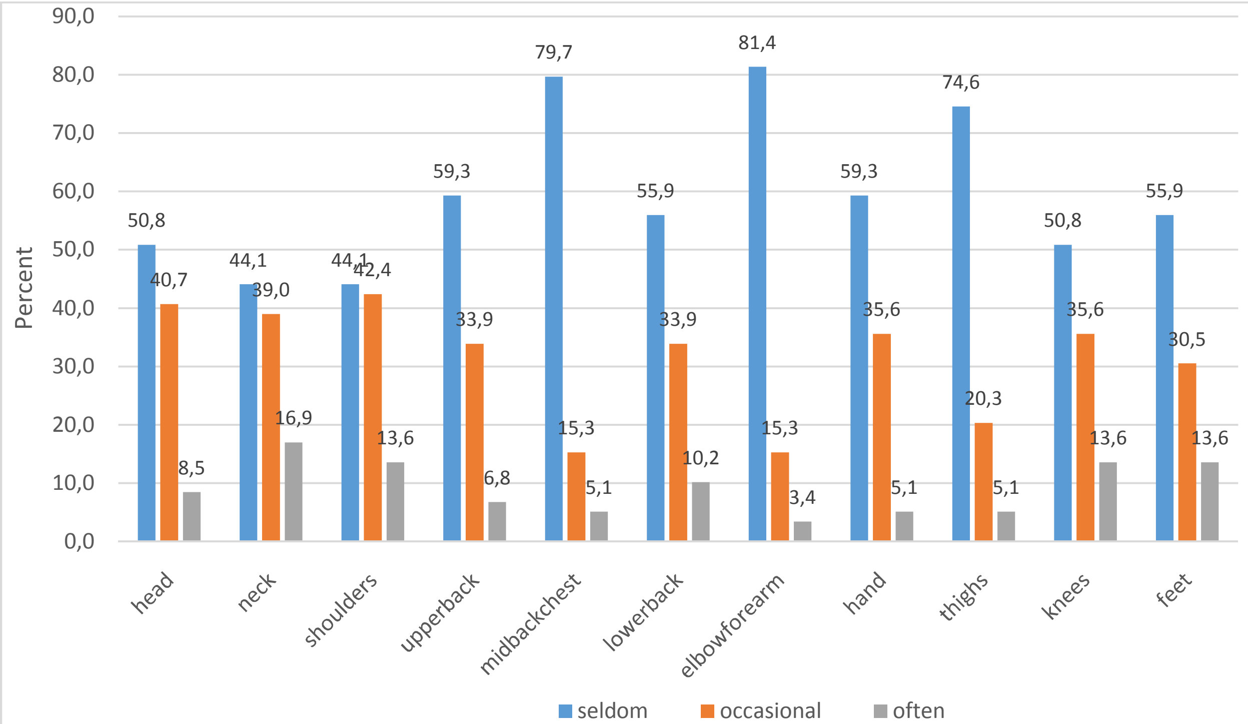

Figure 4.4: The frequency of musculoskeletal pain in the various body locations

Figure 4.4 illustrates the frequency of musculoskeletal pain reported by the participants in the various body locations. The numbers indicate the percentages for each category for each location. The elbows and forearms with 81.4% were selected as most “seldom”; the shoulders with 42.4% were selected as most “occasional”; and, the neck with 16.9% was selected as most “often”.

To determine whether the scoring patterns per statement were significantly different per option, a chi-square test was utilised. The null hypothesis states that similar numbers of respondents would score across each option for each statement (one statement at a time). The alternate hypothesis states that there would be a significant difference between the levels of agreement and disagreement. The results are shown below in Table 4.9.

Table 4.9: Frequency and prevalence of pain or MSDs in the various body regions depicted

Pain in the following body regions	Seldom	Occasional	Often	Chi-Square p-value
Head	50.8	40.7	8.5	0.000
Neck	44.1	39.0	16.9	0.025
Shoulders/Upper arm	44.1	42.4	13.6	0.005
Upper back	59.3	33.9	6.8	0.000
Mid back/chest	79.7	15.3	5.1	0.000
Lower back	55.9	33.9	10.2	0.000
Elbow/forearm	81.4	15.3	3.4	0.000
Wrist/Hand	59.3	35.6	5.1	0.000
Hips/Buttocks/Thighs	74.6	20.3	5.1	0.000
Knees and legs	50.8	35.6	13.6	0.002
Feet/Ankles	55.9	30.5	13.6	0.000

All the chi-square p-values were less than 0.05 (the level of significance), which implies that the distributions were not similar. The differences between the way respondents reported experiencing MSD`s in the various body parts (seldom, occasional, often) was significant.

4.4.5 Part 5: Mental state questions and pain interference with work

This section is based on the degree to which MSDs interfere with work or cause the individuals to be absent from work. It also includes reported feelings of being mentally exhausted from work, the period of time participants spend at their desks and how often they move from their desks in a day.

Figure 4.5illustrates the responses of the participants regarding pain interference with work, absence from work and mental exhaustion from work in the form of “Yes” and “No” questions.

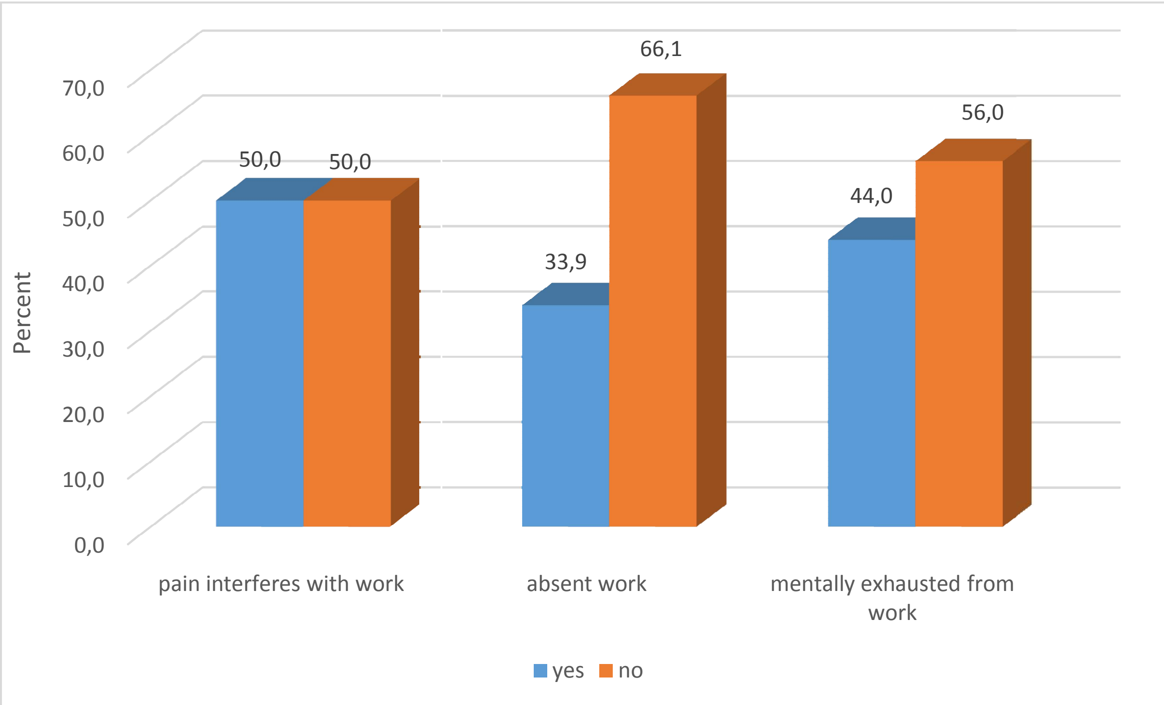

Figure 4.5: Summary of MSDs causing interference with work, absence from work and feeling mentally exhausted from work

Fifty percent of all participants reported that pain interfered with work and therefore the reporting of pain in the various body regions may be under-reported. Just over a third (33.9%) of participants reported being absent from work due to pain or discomfort. The self-reporting of feeling mentally exhausted from work was found to be 55.9% in the “seldom” or “never” category reported here as “No” and the “weekly” and “daily” categories combined are illustrated as “Yes”, with 44.1%reporting feeling mentally exhausted from work and can be viewed in Table 4.10.

Table 4.10: Summary of pain interference with work, absence from work and mental state questions and questions pertaining to rest breaks and average time working in front of a computer

	Frequency n =	Percent %
Aches, pains or discomfort that interferes with work.		
Reported "Yes"	29	49.2%
Reported "No"	29	49.2%
Aches, pains or discomforts causing absence from work.		
Reported "Yes"	20	33.9%
Reported "No"	39	66.1%
How often participants feel mentally exhausted from work.		
Seldom / Never	33	55.9%
Weekly	20	33.9%
Daily	6	10.2%
Average hours at desk		
2 to 4 hours	5	8.5%
4 to 6 hours	23	39.0%
>6 hours	31	52.5%
Number of times move from desk in a day.		
<8 times a day	32	54.2%
9 to 16 times a day	19	32.2%
>16 times a day	8	13.6%

The next question relates to the number of hours at the desk with the majority of the participants 52.5% (n = 31) spending more than six hours on average per working day at their desk, as illustrated in Table 4.10.

The data from two participants was excluded from the study due to the fact those participants were shelving staff and spent less than two hours at their desk as per inclusion / exclusion criteria.

4.4.6 Part 6: Participants' perceptions of their workstation ergonomics

This section reports on the participants' perceptions of their desk setup in terms of certain criteria. The data was gathered by means of a self-reported questionnaire which was distributed to each participant straight after the observational checklist data collection was completed. The questionnaire aimed to get participants to think about their workstation set up and their work environment and to answer questions regarding most appropriate desk set up for them. The questions asked required a "Yes" or "No" response. The summary data collected is illustrated in Figure 4.6.

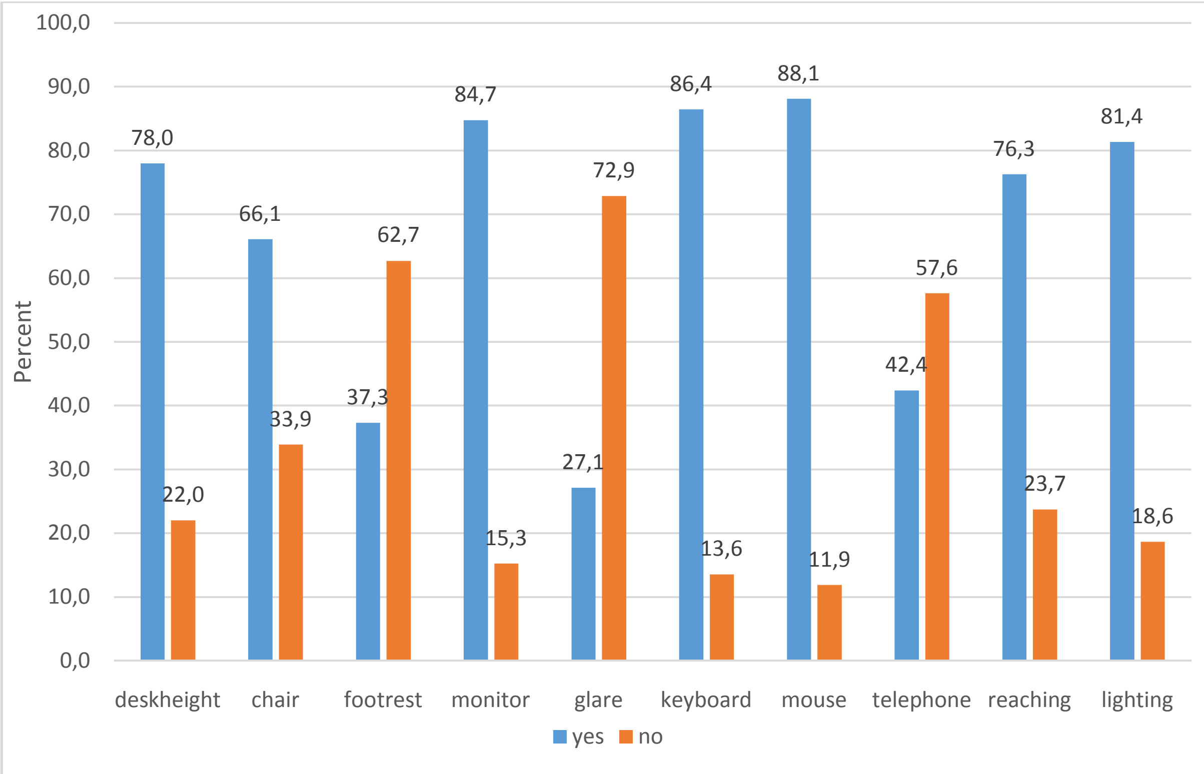

Figure 4.6: Participants self-perception of their office environment

As can be seen from Figure 4.6, the majority of participants reported that they perceived adequate positioning of office equipment and ergonomic layout with two exceptions. Almost two thirds (62.7%) reported to not having their feet supported and 76.3% reported that they have to reach for items in their work area. Table 4.11 below indicates the significant findings following the computation of the chi-square goodness of fittest.

Table 4.11: Participant perception of workstation set up

Perception of the placement of equipment	Yes	No	Chi-Square p-value
Is your desk height appropriate for you?	78.0	22.0	0.000
Is your chair comfortable for you?	66.1	33.9	0.013
Are our feet supported?	37.3	62.7	0.051
Is your monitor correctly positioned?	84.7	15.3	0.000
Is there glare on your monitor?	27.1	72.9	0.000
Is your keyboard correctly positioned?	86.4	13.6	0.000
Is your mouse correctly positioned?	88.1	11.9	0.000
Does your telephone require awkward postures?	42.4	57.6	0.241
Do you often have to reach for items in your work area?	76.3	23.7	0.000
Is lighting in your work area adequate for the work you do?	81.4	18.6	0.000

p = 0.05

4.4.7 Part 7: Observation checklist general component

The observational checklist of the workstation layout was captured through a series of "Yes" and "No" answers recorded by the researcher in an assessment of the workstations of each participant. Some were recorded as "not applicable", for example, following the question if a footrest is available, there is the question, "Is the foot rest used?" No foot rest was available, therefore it was not applicable because there was no foot rest for the participant to use. The worker postures as observed by the researcher, were captured in a separate table as those results reveal the participants in their actual working positions while they were working (Table 4.12).

Table 4.12: Summary of the results of the observational assessments of the participants at their workstations with significant p-values highlighted in grey where applicable

#	Observation assessment	Yes	No	Not applicable	Chi-Square p-value
1	Top of screen slightly below eye level?	50,8	49,2		0.896
2	Monitor directly in front worker?	59.3	40.7		0.152
3	Distance to monitor approximately 45cm?	91.5	8.5		0.000
4	Keyboard at correct height?	16.9	83.1		0.000
5	Keyboard aligned with body?	59.3	40.7		0.152
6	Keyboard aligned with monitor?	76.3	23.7		0.000
7	Keyboard tray is available?	0.0	100		0.000
8	Keyboard tray is used?	0.0	100		0.000
9	Lumbar curve is support by backrest?	54.2	45.8		0.515
10	Chair is adjustable?	74.6	25.4		0.000
11	Edge of seat is 2 fingers behind bend of knee?	49.2	50.8		0.896
12	Seat height allows thighs to be parallel to floor?	78.0	22.0		0.000
13	Footrest is available to support feet?	11.9	88.1		0.000
14	Footrest is used?	5.1	6.8	88.1	0.000
15	Operation of mouse requires reaching?	18.6	81.4		0.000
16	Mouse tray is available?	42.4	57.6		0.241
17	Mouse tray is used?	42.4	1.7	55.9	0.000
18	Location of copy rotation requires rotation to see?	5.1	3.4	91.5	0.000
19	Screen brightness is appropriate?	94.9	5.1		0.000
20	Tilt of monitor is appropriate?	69.5	30.5		0.003
21	Glare on monitor apparent?	30.5	69.5		0.003
22	Telephone within easy reach?	54.2	45.8		0.091
23	General lighting of work area is appropriate?	83.1	16.9		0.000
24	Noise or distractions in work area are present?	62.7	37.3		0.051
25	Temperature of work area is appropriate?	83.1	16.9		0.000

p = 0.05

4.4.8 Part 8: Worker posture component

The data analysis of worker postures illustrated in Table 4.13 below summarises the participants' positions while the participants were in their working postures. The researcher observed each participant individually and marked off on the checklist "Yes" or "No" to best represent the participants' sitting postures. Table 13 therefore represents a summary of these results with the percentages of "Yes" and "No" answers. The p-values represented in the far right column indicate the values from the chi-square goodness of fit test with all the significant values shaded grey.

Table 4.13: Summary of worker postures of the participants with significant p-values highlighted in grey where applicable

#	Worker postures	Yes (%)	No (%)	Not applicable	Chi-Square p-value
1	Thighs parallel to floor?	81.4	18.6		0.000
2	Feet supported on the floor or footrest?	67.8	32.2		0.006
3	Lower back supported by backrest?	50.8	49.2		0.896
4	Arms relaxed at sides and perpendicular to floor?	32.2	67.8		0.006
5	Elbows bent at ninety degrees and parallel to floor?	18.6	81.4		0.000
6	Wrists in neutral for flexion and extension?	62.7	37.3		0.051
7	Wrists are deviated (radially or ulnarly)?	25.4	74.6		0.000
8	Shoulders relaxed, not elevated?	20.3	79.7		0.000
9	Neck in neutral (i.e. chin is level)?	59.3	40.7		0.152
10	Neck flexed to hold phone?	35.6	55.9	8.5	0.000
11	Head rotated?	42.4	57.6		0.241
12	Trunk rotated?	44.1	55.9		0.362

p = 0.05

4.5 Section B

In this section, the correlation statistics and any associations between variables are presented and discussed.

4.5.1 Hypothesis testing for statistics

The traditional approach to reporting a result requires a statement of statistical significance. A p-value is generated from a test statistic. A significant result is indicated with $p < 0.05$. A second chi-square test was performed to determine whether there was a statistically significant relationship between the variables (rows versus columns). The null hypothesis states that there is no association between the two. The alternate hypothesis indicates that there is an association.

Table 4.14: Cross-tabulation between foot or ankle pain and the age of participants (p = 0.035)

Cross-tabulation between foot or ankle pain and age of participants						
Age of participants			**Foot or ankle pain**			**Total**
			Seldom	**Occasional**	**Often**	
Age of participants	25-35 years	n =	6	5	1	12
		% within feet	18.2%	27.8%	12.5%	20.3%
		% of Total	10.2%	8.5%	1.7%	20.3%
	36-45 years	n =	12	8	0	20
		% within feet	36.4%	44.4%	0.0%	33.9%
		% of Total	20.3%	13.6%	0.0%	33.9%
	46-55 years	n =	9	4	7	20
		% within feet	27.3%	22.2%	87.5%	33.9%
		% of Total	15.3%	6.8%	11.9%	33.9%
	Older than 56 years of age	n =	6	1	0	7
		% within feet	18.2%	5.6%	0.0%	11.9%
		% of Total	10.2%	1.7%	0.0%	11.9%
Total		n =	33	18	8	59
		% within feet	100%	100%	100%	100%
		% of Total	55.9%	30.5%	13.6%	100%

Since the p-value ($p = 0.035$) is less than the level of significance of $p = 0.05$, this implies that there is a significant relationship between age and foot / ankle pain (Table 4.14 above). It was evident that there was significantly increased foot or ankle pain with the older age groups, particularly in the 46 to 55 age category.

Table 4.15:Cross-tabulation between the ages of the children of participants and shoulder pain (p = 0.034)

Cross-tabulation of ages of the children of the participants and shoulder pain						
			Shoulder pain			Total
			Seldom	Occasional	Often	
Ages of children	0-3 years	n =	6	1	0	7
		% within shoulders	23.1%	4.0%	0.0%	11.9%
		% of Total	10.2%	1.7%	0.0%	11.9%
	4-6 years	n =	6	3	0	9
		% within shoulders	23.1%	12.0%	0.0%	15.3%
		% of Total	10.2%	5.1%	0.0%	15.3%
	Older than 6 years of age	n =	9	14	8	31
		% within shoulders	34.6%	56.0%	100%	52.5%
		% of Total	15.3%	23.7%	13.6%	52.5%
	N/A	n =	5	7	0	12
		% within shoulders	19.2%	28.0%	0.0%	20.3%
		% of Total	8.5%	11.9%	0.0%	20.3%
Total		n =	26	25	8	59
		% within shoulders	100%	100%	100%	100%
		% of Total	44.1%	42.4%	13.6%	100%

The second chi-square test (Fisher's Exact test) statistic was computed at a significance level of p = 0.05. It was found that the ages of the participants' children and shoulder pain was significant at p = 0.034. It was evident that participants who reported "often" experiencing shoulder pain had children over the age of six years. Table 4.15 above indicates the frequencies of shoulder pain of the participants who have children with the age categories of the children and those participants who did not have children were represented by "N/A" ("Not applicable"). These results were to be expected as it would be expected that older employees would have older children. In reporting the results of the self-reported MSDs the researcher grouped the responses "occasional" and "often" together to indicate "Yes", pain was experienced.

Table 4.16: Cross-tabulation between exercise and low back pain (p = 0.001)

Cross-tabulation between exercise and low back pain						
			Low back pain			Total
			Seldom	Occasional	Often	
Exercise	Yes	n =	26	16	0	42
		% within low back	78.8%	80.0%	0.0%	71.2%
		% of Total	44.1%	27.1%	0.0%	71.2%
	No	n =	7	4	6	17
		% within low back	21.2%	20.0%	100%	28.8%
		% of Total	11.9%	6.8%	10.2%	28.8%
Total		n =	33	20	6	59
		% within low back	100%	100%	100%	100%
		% of Total	55.9%	33.9%	10.2%	100%

It is evident from Table 4.16 above and Table 4.17 below that the participants who reported doing exercise had significantly less low back pain (p = 0.001), and buttocks/hips/thigh pain (p = 0.019) than those who did not exercise.

Table 4.17: Cross-tabulation between exercise and pain reported in the hips/buttocks/thighs region (p = 0.019)

Cross-tabulation between pain in the hips/buttocks/thighs region and exercise						
			Pain in hips/buttocks/thighs			Total
			Seldom	Occasional	Often	
Exercise	Yes	n =	34	8	0	42
		% within hips/buttocks/thighs	77.3%	66.7%	0.0%	71.2%
		% of Total	57.6%	13.6%	0.0%	71.2%
	No	n =	10	4	3	17
		% within hips/buttocks/thighs	22.7%	33.3%	100%	28.8%
		% of Total	16.9%	6.8%	5.1%	28.8%
Total		n =	44	12	3	59
		% within hips/buttocks/thighs	100%	100%	100%	100%
		% of Total	74.6%	20.3%	5.1%	100%

Table 4.18 shows that there is a significant relationship between the frequency of exercise and low back pain (p = 0.004). The participants who exercised more than twice a week had reported low back pain more frequently than those who exercised once or twice a week.

Table 4.18: Cross-tabulation between low back pain and frequency of exercise reported by the participants (p = 0.004)

Cross-tabulation between frequency of exercise and low back pain						
			Low back pain			Total
			Seldom	Occasional	Often	
How often exercise	Once a week	n =	5	2	0	7
		% within low back	15.2%	10.0%	0.0%	11.9%
		% of Total	8.5%	3.4%	0.0%	11.9%
	Twice a week	n =	8	2	0	10
		% within low back	24.2%	10.0%	0.0%	16.9%
		% of Total	13,6%	3.4%	0.0%	16.9%
	More than twice a week	n =	14	12	0	26
		% within low back	42.4%	60.0%	0.0%	44.1%
		% of Total	23.7%	20.3%	0.0%	44.1%
	Total	n =	33	20	6	59
		% within low back	100%	100%	100%	100.0 %
		% of Total	55.9%	33.9%	10.2%	100.0 %

Table 4.19 shows that there is a significant relationship between type of exercise and reported low back pain (p = 010). It is noteworthy from the cross-tabulation that the participants who did yoga and or football had less frequent low back pain.

Table 4.19: Cross-tabulation between type of exercise done by participants and reported low back pain (p = 0.010)

Cross-tabulation between low back pain and the type of exercise participants do						
			Low back pain			**Total**
			Seldom	**Occasional**	**Often**	
Type of exercise the participants do	**No exercise**	n =	6	4	6	16
		% within low back	18.2%	21.1%	100,0 %	27.6%
		% of Total	10.3%	6.9%	10.3%	27.6%
	Walking	n =	10	6	0	16
		% within low back	30.3%	31.6%	0.0%	27.6%
		% of Total	17.2%	10.3%	0.0%	27.6%
	Football	n =	4	0	0	4
		% within low back	12.1%	0.0%	0.0%	6.9%
		% of Total	6.9%	0.0%	0.0%	6.9%
	Gym	n =	10	9	0	19
		% within low back	30.3%	47.4%	0.0%	32.8%
		% of Total	17.2%	15.5%	0.0%	32.8%
	Yoga	n =	3	0	0	3
		% within low back	9.1%	0.0%	0.0%	5.2%
		% of Total	5.2%	0.0%	0.0%	5.2%
Total		n =	33	19	6	58
		% within low back	100%	100%	100%	100%
		% of Total	56,9%	32,8%	10.3%	100%

Table 4.20 shows that there is a significant relationship between type of exercise and mid back/chest pain (p = 0.028). Participants whom reported doing walking or football reported very little mid back/chest pain.

Table 4.20: Cross-tabulation between type of exercise and self-reported mid back/chest pain (p = 0.028)

Cross-tabulation between type of exercise done by participants and mid back/chest pain						
			Mid back/chest pain			Total
			Seldom	Occasional	Often	
Type of exercise done by participants	No exercise	Count	11	3	2	16
		% within Midback/chest	23,9%	33,3%	66,7%	27,6%
		% of Total	19,0%	5,2%	3,4%	27,6%
	Walking	Count	16	0	0	16
		% within midback/chest	34,8%	0,0%	0,0%	27,6%
		% of Total	27,6%	0,0%	0,0%	27,6%
	Football	Count	4	0	0	4
		% within midback/chest	8,7%	0,0%	0,0%	6,9%
		% of Total	6,9%	0,0%	0,0%	6,9%
	Gym	Count	14	5	0	19
		% within midback/chest	30,4%	55,6%	0,0%	32,8%
		% of Total	24,1%	8,6%	0,0%	32,8%
	Yoga	Count	1	1	1	3
		% within midback/chest	2,2%	11,1%	33,3%	5,2%
		% of Total	1,7%	1,7%	1,7%	5,2%
Total		Count	46	9	3	58
		% within midback/chest	100,0%	100,0%	100,0 %	100,0 %
		% of Total	79,3%	15,5%	5,2%	100,0 %

Table 4.21 shows that there is a greater frequency of headaches when noise or distractions were present in the work area, and that this was a significant relationship (p = 0.048).

Table 4.21: Cross-tabulation between head pain and noise or distractions in the participants work area (p = 0.048)

Cross-tabulation between head pain and the presence of noise or distractions in the work area						
			Head pain			**Total**
			Seldom	**Occasional**	**Often**	
Noise or distractions present in the worker area	**Yes**	n =	15	17	5	37
		% within head	50.0%	70.8%	100%	62.7%
		% of Total	25.4%	28.8%	8.5%	62.7%
	No	n =	15	7	0	22
		% within head	50.0%	29.2%	0.0%	37.3%
		% of Total	25.4%	11.9%	00%	37.3%

Table 4.22 shows that there is a significant relationship between the presence of noise and self-reported neck pain (p = 0.014).

Table 4.22: Cross-tabulation between neck pain and the presence of noise or distractions in the work area (p = 0.014)

Cross-tabulation between neck pain and the presence of noise or distractions in the work area						
			Neck			**Total**
			Seldom	**Occasional**	**Often**	
Noise or distractions present in the worker area	**Yes**	n =	11	19	7	37
		% within neck	42.3%	82.6%	70.0 %	62.7%
		% of Total	18.6%	32.2%	11.9 %	62.7%
	No	n =	15	4	3	22
		% within neck	57.7%	17.4%	30.0 %	37.3%
		% of Total	25.4%	6.8%	5.1%	37.3%
Total		n =	26	23	10	59
		% within neck	100%	100%	100%	100%
		% of Total	44.1%	39.0%	16.9 %	100%

The prevalence of head and neck pain was therefore associated with the presence of noise as depicted in tables 4.21 and 4.22.

Table 4.23 shows that there is a significant relationship between arms at the sides and hand and wrist pain (p = 0.011).

Table 4.23: Cross-tabulation between arm position in working position and hand/wrist pain (p = 0.011)

Cross-tabulation between arm position in working position and hand/wrist pain						
			Hand			Total
			Seldom	Occasional	Often	
Arms relaxed at side and perpendicular to the floor	**Yes**	n =	15	2	2	19
		% within hand/wrist pain	42.9%	9.5%	66.7%	32.2%
		% of Total	25.4%	3.4%	3.4%	32.2%
	No	n =	20	19	1	40
		% within hand/wrist pain	57.1%	90.5%	33.3%	67.8%
		% of Total	33,9%	32.2%	1.7%	67.8%
Total		n =	35	21	3	59
		% within hand/wrist pain	100%	100%	100%	100%
		% of Total	59.3%	35.6%	5.1%	100%

4.6 Conclusion

The socio-demographic features of library staff were reported together with the self-reported MSDs by the participants and perception of good workstation layout. The perceptions of the library staff are mostly that they have a good layout of office equipment with the exception of inappropriate footrest and having to reach for items in their workspace. Generally, there was a high self-reported prevalence of MSD`s by participants particularly of the knees, neck, shoulders and head. Noteworthy relationships existed between age of participants and foot pain, age of children and shoulder pain, exercise and low back pain, hips/buttocks/thigh pain and mid back/chest pain. In terms of the relationship between the observational checklist and MSDs, associations between noise and head and neck pain were significant, as well as hand/wrist pain with the arms not being relaxed at the sides and perpendicular to the floor when the participants were in their working postures.

Chapter 5 : Analysis of the Results

5.1 Introduction

This chapter will provide an analysis of the results presented in Chapter 4 and the findings of the study conducted. In Chapter 4, the demographics of the participants, their perceptions of the appropriateness or comfort of their workstation and perceived physical well-being were presented. Participants explained their experience of MSDs, whether these were work-related or not. Chapter 4 also outlined the workstation setup of all participants, and whether the setup was ergonomically appropriate as per the observational checklist (Bohr, 2000). In this chapter, an analysis of the results will be presented in a response to the objectives of this study, namely: a) to examine the occurrence of self-reported musculoskeletal disorders (MSDs) among library staff at the DUT; and b) to describe any possible association between the workstation and MSDs.

5.2 Analysis of demographics

The scope in age of the participants ranged between 25 and 61 years, with the average age of participants being 44 years. The duration of employment in their current position ranged from one year to 32 years with the average duration of employment being 12 years and 9 months. This information concurred with other studies such as Bohr (2000). In this study, approximately two thirds were female and one third male. This gender distribution supports other studies of administrative or non-secretarial office occupations (Peek, 2005; Raad, 2012; Gavgani et al, 2013).

Population groups are divided into four broad race categories in South Africa, which were used in the questionnaire, namely; black African, coloured, Indian/Asian and white. It has been established that Kwa-Zulu Natal (KNZ) is the most densely populated province in South Africa (Statistics South Africa, 2001). In almost all provinces of South Africa, black Africans are the majority of the population at over 80%; the coloured and white population at over eight percent each; and the Indian/Asian population group forming the smallest proportion of the population at 2.47%. These statistics were obtained from the 2016 census (Statistics South Africa, 2016). In the eThekwini Municipality (previously known as Durban), KwaZulu-Natal, the

2001 census revealed that 68.3% of the population were black Africans with higher compositions of Indians and whites. Black Africans accounted for 49.2% of the population, Indians at 37.3% of the population and coloureds and whites at 6.8% for each of the population groups in this study. These figures do not fall within the statistical norms of the eThekwini Municipality, however, they do reflect the broader Durban community. There is likely to be a higher percentage of Indians within the Durban City Centre where the study took place.

Another factor noted in the demoraphical findings was the high proportion of participants who reported doing regular exercise (73%). One in every two South Africans live sedentary lifestyles (Thompson et al., 2013). According to Hallal et al. (2012), the global average of physically inactive lifestyles is 31.1%. Sedentary work has been linked to MSDs, more specifically to the upper back, lower back, hand, wrist and neck (Ekman, 2000; Korhenen et al, 2003; Wahlstrom, 2005).

Numerous studies posit that exercise has a positive impact on the body, reducing the prevalence of MSDs (Bohr, 2000; Handschin and Spielgman, 2008; Owen et al., 2010; Beinart et al., 2013; O'Conner et al., 2015). In this study, three quarters of the library staff participating in the study reported to doing some exercise at least once a week, with over 44% reporting that they exercised more than twice a week. Statistically significant relationships existed regarding MSDs and exercise. Low back pain and hip/buttock/thigh pain were reported less frequently by participants who exercised regularly than by those who did not do any exercise. Participants who exercised more than twice a week as opposed to once or twice a week reported higher frequencies of low back pain. Thus, those participants who exercised often or very little, reported a higher prevalence of low back pain than those participants that exercised a moderate amount. The type of exercise also revealed significant variations pertaining to the frequency and location of pain reported. For instance, participants who did yoga or played soccer reported less low back pain; and those who played soccer or ensured a fair amount of walking within the week reported no midback pain or chest pain. While the above relationships were statistically significant in this study, it must be noted that the sample size was very small and with a larger sample size, more associations and more concise cause and effect relationships may have been drawn. Evidence has indicated that exercise participation can increase function and reduce pain in patients with chronic low back pain (Beinart et al, 2013). A systematic review and meta-analysis revealed that walking may be effective for improving chronic MSDs in participants, however should be supplemented with strategies aimed at maintaining participation in walking (O’Conner et al., 2014). The overall finding by O’Conner et al. (2014) was that aerobic exercise decreased pain associated with MSDs and helped maintain function in the short term.

The majority of participants in the current study reported that they spent more than six hours a day at their workstation which concurs with other studies (Gavgani et al, 2013; Labeodan, 2013). It was also reported than 54% of participants moved away from their workstations less than eight times per day. Galinsky et al. (2007) reported that the traditional two fifteen minutes rest breaks and thirty minute lunch break is insufficient to minimize discomfort in a work day. Policies should be implemented requiring participants to move away from the workstation every twenty to thirty minutes (Galinsky et al., 2007). Regular rest periods are effective in reducing the prevalence of MSDs in computer users especially for the neck and shoulder regions (Goodman et al, 2012). A study by Davis and Kotowski (2014) revealed that computerized reminders to take breaks at thirty minute intervals decreased discomfort in the shoulders, upper back and lower back. Even though many of these breaks were less than sixty seconds, they proved effective in reducing the discomforts of MSDs (Davis and Kotowski, 2014).

It was noteworthy that only 10% of participants sought treatment for MSDs and it appeared that participants would only seek treatment when problems were perceived as a major health risk affecting everyday activities. The low reporting of participants seeking medical assistance for their MSDs or pain could be a matter of concern, as these results were extremely low in comparison to other studies (Bruls et al., 2016; Johnston, 2016; Peek, 2005). For instance, in an Australian study of female office workers all of whom had neck pain, participants reported a low severity of neck pain. For these workers, while the severity was low, the 100% prevalence indicated the significance of risk factors, which were considered of high concern (Johnston, 2016). In that study, 57.5% of participants had consulted a health professional, 42% had reduced leisure activities and 22.4% had decreased work capacity as a consequence of the neck pain. Over-the-counter medications were the most commonly used strategy to cope with the neck pain (Johnston, 2016). In a South African study by Peek (2005), 52.8% of the participants had consulted a health care practitioner for neck pain, and 46.6% of the participants for shoulder pain. A study by Bruls et al. (2016) in the Netherlands investigated the “help seeking behaviour” of students and office workers with complaints of the arm, neck and or shoulder. The findings revealed that 44.5% of the student participants sought help, and 50.6% of the office workers also required external assistance or help (Bruls et al., 2016).

5.3 Participant perceptions of ergonomics in the workplace

The majority of participants reported that they were, in general, content with the work environment. The data was collected through a series of “Yes” and “No” questions. The following ergonomic factors were reported as adequate by the participants; mouse positioning, keyboard positioning, monitor positioning, lighting, desk height, not having glare on the monitor that causes visual interference, chair comfort and telephone position. The areas in which the participants reported inadequacy were foot support and having to reach for items in the work place. The majority of participants, 63%, reported not having the feet supported and 76% reported having to reach for items in the workplace, such as files, office supplies and books. The data collected confirmed that ergonomic factors that a participant could influence, such as the position of the mouse, keyboard and monitor, were of least concern to the participants. However, as per the researcher’s observations collected during the observational checklist, these workstation items were not in an optimal position. Thus, if participants were informed on possible changes to the ergonomic setup, perhaps these perceptions of comfort might change.

Ergonomic guidelines regarding office workstation setup and postures are an increasingly popular topic and a number of studies have been conducted in order to identify optimal workstation design (Korhonen et al, 2003; Sillanpaa et al., 2003; Goodman et al., 2012; Akodu et al., 2015). The various studies highlight the particular risk factors associated with the office environment such as keyboard height, mouse position, chair design and noise (Korhonen et al, 2003; Sillanpaa et al, 2003, Joon et al., 2007; Sharan and Ajeesh, 2012; Akodu et al., 2015; Habib, Yesmin and Moniruzzaman, 2015). Many studies provide evidence that there are direct associations between inappropriate working postures and MSDs (Sillanpaa et al., 2003; Joon et al., 2007; Sharan and Ajeesh, 2012; Akodu et al., 2015). While a number of participants in the current study reported various levels of pain and discomfort, as well as a notable prevalence of MSDs, the overall consensus was that they occupied a suitable working environment, which they perceived as satisfactory in ergonomic design.

5.4 Observations made by researcher of ergonomics in the workplace

The observational checklist by Bohr (2000) was utilised to evaluate the workstation configuration and worker posture of participants. The observed finding of most significance was keyboard height, with 83% of participants having the keyboard at the incorrect height. The key observations made by the researcher concerning worker postures were as follows: only 18% of participants had their elbows bent at the recommended position with the wrists in line or directly below the elbows allowing the forearms to be parallel to the floor and appropriate forearm support (Queensland Government, 2012); and for 80% of the participants, the shoulders were not relaxed, as the shoulders were elevated and tense. It was also observed that for most participants, the arms were not relaxed at the sides, and therefore, not perpendicular to the floor. This arm position was correlated with hand pain indicating a statistically significant relationship. This finding is congruent with the literature in terms of arm position and upper limb MSDs (Korhonen et al., 2003; Sillanpaa et al., 2003; Joon et al., 2007).

Reported perceptions of the participants were vastly different from the observations recorded by the researcher. For instance, 78% of participants reported that their desk height was appropriate. However, the observational checklist performed by the researcher with the participant in their workstation indicated that the keyboard height was incorrect for 83% of participants. None of the participants had keyboard trays and therefore keyboard height was directly related to the desk height (Tayyari and Smith, 1997: 371).

Biomechanically, if the keyboard height is too low, the user will flex the back to compensate for the inadequate position of the keyboard. This results in a shift in weight of the head forward, and therefore, the muscles supporting the head are stressed and strained (Tayyari and Smith, 1997:371). The elbow angle is further increased causing the forearms to be unsupported and leading to stress and strain of the musculature of the upper extremity. (Tayyari and Smith, 1997: 371). Alternatively, if the keyboard height is too high, the compensation patterns to be expected is the tensing or shrugging of the shoulders, which results in shortening of the musculature (Peek, 2005). Poor placement of the keyboard is a predictor for neck pain (Korhonen et al., 2003). The keyboard height would ultimately affect the forearm support and consequently the wrist and hand positioning depending on how the worker compensates for the unnatural position. By having the forearms adequately supported by the work surface, the load would be decreased on the trapezius musculature bilaterally. It is probable that if the keyboard is too high, the shoulders would shrug, the upper arms would be abducted, and the ninety degree angle of the elbows would decrease.

A study on working posture by Joon et al. (2007) confirmed a decrease in MSDs in workers who were able to manipulate their working position with the use of adjustable keyboard trays. Grip strength was enhanced and upper extremity function was improved among computer users due to the adequate height and tilt of the keyboard (Joon et al., 2007). Mouse and keyboard height, as well as duration of computer usage were also significantly associated in a study of IT professional in India (Sharan and Ajeesh, 2012).

Although this study does not present many statistically significant correlations in the comparisons between workstation setup and MSDs of the different body locations, the prevalence of pain and MSDs reported is high overall. It was evident to the researcher as a result of the observational assessments that certain risk factors were present due to inappropriate workstation setup. Thus, the postures of participants may have been affected as a consequence of these risk factors. Furthermore, the discomfort or pain experienced by participants may indeed be associated to the ergonomics of the workstation. The risk factors for neck and upper extremity MSDs are evident from the observations completed in the current study and reflect similar results to that of the literature discussed (Korhonenet al., 2003; Joon et al., 2007; Noack-Cooper, Sommerich and Mirka et al., 2005; Sharan and Ajeesh, 2012).

There were a number of discrepancies between the subjective perceptions of the participants regarding their workstation and the researcher’s objective observations. These may be due to ambiguities in the tools used to question participants, as participants were not provided any indications as to what ergonomic factors were being used to observe their work position until the questionnaire and observations had been completed. For instance, in the subjective questionnaire, participants were asked if their feet were supported. Thirty-seven percent of the participants reported that their feet were supported. Participants could have therefore anticipated that because they did not have a footrest, their feet were not supported which could have influenced their answers. Only seven participants had footrests available. These footrests recorded were mostly old paper boxes or parts of broken chairs that participants had recycled to use as footrests. Another question in the observational checklist asked participants if the feet were supported in working position, for which 81% of participants had scored “Yes”, indicating that the feet were supported. The researcher scored “Yes” if the participants' feet were firmly on the floor. In most instances when the feet were supported, the lower back was not supported or vice versa because the participant would compensate for the unsupported body location.

Sitting posture is dependent on design of the chair, the tasks to be performed, as well as the sitting habits of the individual (Pope, Goh and Magnusson, 2002). Prolonged sitting is a risk factor for low back pain due to the prolonged and monotonous mechanical load which may result in increased intradiscal pressure, static loading of joint and muscle tissue leading to pain and discomfort (Pope, Goh and Magnusson, 2002). The chair should therefore allow for movement and adjustability through adjustability of the seat pan and back rest. The hips should be level or slightly higher than the knees with an open angle of 100 to 120 degrees at the hips (Queensland Government, 2012).

It was noted during the study procedure by the researcher that many of the participants did not have adequate leg room and no foot rests were provided. Many participants had their feet supported on the floor however; many did not have any foot support as was revealed in observational checklist findings. However, there was not adequate leg room for many of the participants which left them having their legs and feet positioned at awkward angles or causing them to compensate their body by rotating the trunk and other such consequences. Observations such as these were not included in the questionnaire or observational checklist, but became apparent to the researcher during the data collection process. This could possibly be a contributor to the high frequencies of knee/leg and foot/ankle pain reported by the participants, as noted in the data collection. These findings were to those listed in a review of the literature by Rook (2015). It was evident from the review of literature that occupational activities can have an impact on osteoarthritis of the hips, knees or ankles. Working in cramped spaces and awkward postures are risk factors for osteoarthritis in these regions (Rook, 2015).

Another discrepancy between participant responses and researcher's observations involved the office chairs. Sixty six percent of the participants indicated that their office chair was comfortable, and 75% of participants had an adjustable chair, which was captured in the observational checklist. However, during the observational assessment, the researcher, through consultations with the participants, noted that the participants did not regularly adjust their chair height. Participants explained that either they did not know how to operate the adjustment settings, or the chairs were broken and did not function properly. Thus, the chair settings were not necessarily suited to individual requirements of participants, but their responses were recorded as “Yes”, that the chair was adjustable.

5.5 Participant reporting of MSDs

As evidenced in this study, participants experienced varying frequencies of MSDs in various body locations. Comparing the prevalence of pain in the different body locations to other studies becomes more complex as different methodologies may have been used to collect the data. However, similarities are apparent as the studies do indicate consistent problem areas of those who occupy a similar working environment.

The frequencies of pain reported by the participants were collected in the following categories:“seldom” or “never” (once a month or less), “occasionally” (two to four times a month) and “often” (more than four times a month). When viewed from the perspective of three separate categories, it appeared that MSDs were not that commonly presented. However, when the occasional and often categories are combined indicating the frequencies of pain, it becomes evident that the prevalence of pain amounts to a higher percentage and is comparable to the results indicated in other studies (Gavgani et al., 2013; Labeodan, 2013; Habib, Yesmin and Moniruzzaman, 2015). These results were evident when pain is perceived as a “Yes” or “No”, and “Yes” indicates an overall finding of an MSD.

In this study, “Yes” indicated that pain was experienced by participants twice a month or more, and “No” indicated that participants did not experience pain (pain reported was as experienced once a month or less). In this case, the prevalence of pain does compare with other studies. The three studies used for comparison were selected due to the similarities of the population regarding the work roles of the participants, and the grouping of MSDs in selected body locations. The comparative studies were completed in three locations, namely: Iran, Nigeria and Bangladesh. Library staff were the population participating in the study in Iran (Gavgani et al., 2013). In this study, the worker roles were similar, but there was a notable difference in the age of participants, with the Iran study consisting of a younger demographic. The Nigerian University study (Labeodan, 2013) shared similar socio-demographics to the current study and the sample population were also administrative staff in a university setting. The Bangladesh study was a pilot study for MSDs reported in a single office setting (Habib, Yesmin and Moniruzzaman, 2015). Table 5.1 below summarises the results of these studies, alongside the results of this study, for comparative purposes. The table indicates the prevalence of MSDs in the various body locations.

Table 5.1: Prevalence or frequencies of self-reported pain or MSDs in the various body locations for the current study and other studies in the literature for comparison

Pain within various body locations	Current study (%)	Iran Library study (%)	Nigerian University (%)	Bangladesh study (%)
Head	49.2		21.3	
Neck	55.9	50.1	32.5	40.5
Shoulders/upper arm	55.9	44.6	25.8	45
Upperback	40.7	33.0	21.7	32
Midback/chest	20.3			
Lowerback	44.1		31.7	53
Elbow/forearm	18.6		10	33.5
Hand/wrist	40.7	37.5	18.3	34
Hips/buttocks/highs	25.4	24.1	14.6	28.5
Knees/legs	49.2	20.5	9.6	32.5
Feet/ankles	44.1	7.1	10.8	33
Authors		**Govganiet al., 2013**	**Labeodan, 2013**	**Habib, Yesmin and Moniruzzaman, 2015**

The findings of the current study regarding reported MSDs in the workplace was congruent with the three comparative studies listed in Table 5.1 (Gavgani et al., 2013; Labeodan, 2013; Habib, Yesmin and Moniruzzaman, 2015). The current study did, however, reveal a higher prevalence of MSDs in the knees/legs and the feet/ankles.

It is evident that the prevalence of MSDs are of concern and do have an impact on quality of life and work capacity. The responses to the questionnaire in this study revealed that 50% of participants reported that pain or discomforts caused interference with their work; and 34% of participants reported that pain or discomforts caused them to be absent from work. These results indicate the extent to which MSDs can affect the quality of life and standard of work of employees. These results were higher than those of the other studies discussed. The office workers in the Bangladesh study (Habib, Yesmin and Moniruzzaman, 2015) reported that 40.5% of the total participants had an interruption of their daily activities due to MSDs. An Australian study (Johnston, 2016) of female office workers posited that 42% of the participants with neck pain, even if rated as mild, had reduced leisure activities and that 22.4% of those participants had a reduced work capacity. In addition, 20.7% of the participants had been absent from work as a result of the neck pain.

As evidenced by the results of this study, as well as the comparative studies, there is a need for attention to, or implementation of, proactive treatment of early MSD complaints and indicators. While the reported experience of pain may be relatively mild in nature, proactive treatment and ergonomic awareness can still prove affective, as these actions may decrease the intensity of pain, allow for improvement in work activities, and result in the reduction of chronic problems (Anderson, Green and Payne, 2009; Bruls et al., 2016). Proactive measures to reduce ergonomic stressors and MSDs may include participatory ergonomics, redesign, and ergonomic improvement and redesign education or exercise based programmes (Mirmohammadi et al., 2012). Participants need to become aware of the risk factors for MSDs, and take cognizance of the environment in which they work and their activities of daily living to mitigate any potential causes or aggravators of MSDs.

5.6 Associations between the ergonomic design of the workstation and the prevalence of MSDs

This study set out to measure various components of the ergonomic environments in which a broad demographic group work. The findings of this study concur with other studies that were conducted within a similar ergonomic setting. The results of this study show a prevalence of neck, shoulder pain and low back pain for most participants, which was a finding indicated in the comparative studies discussed. A significant finding in this study was the high occurrence of knee and ankle/foot pain, which was higher than the other studies discussed (Govgani et al., 2013; Labeodan, 2013; Habib, Yesmin and Moniruzzaman, 2015). The increased prevalence of reported pain in these locations of the body could be due the participants in this study being of an older age group than those participants in the comparative studies, or because of the inadequate foot support or inadequate leg room noted as per the observational checklist. A statistically significant relationship was evident between older participants and foot or ankle pain in this study.

A significant finding of the observational assessment was that 83% of participants had the incorrect keyboard height. The observation of participant worker postures revealed that 81% had their elbows at inappropriate angles, 80% of participants had their shoulders elevated or tensed, and 68% did not have their arms positioned perpendicular to the floor. These postures and positions are likely to be compensation patterns for incorrect keyboard height. An inappropriate ergonomic setting, and unnatural postures and positions, are typical risk factors for workers in an office environment (Korhonenet al., 2003; Sillanpaa et al., 2003; Mirmohammadi et al., 2012).

It was evident in the study that a correlation existed between aging and foot/ankle pain. Chronic foot pain is a common occurrence in the older population commonly affecting women over the age of 45 (Dufour et al., 2016; Menz, 2016). People may perceive foot pain as an inevitable consequence with age rather than a treatable condition (Menz, 2016). The highest prevalence of foot pain in the current study occurred in the 46 to 55 age category and concurs with the literature (Dufour et al., 2016; Menz, 2016). Risk factors for foot pain include the female sex, obesity, advancing age, depression and other co-morbidities such as diabetes mellitus and osteoarthritis (Menz, 2016).

The Global Burden of Disease study revealed a relationship between age and low back pain (Hoy et al., 2014). Low back pain causes more global disability than any other condition, especially in the aging population and is the leading cause of activity limitations and absence from work globally (Hoy et al., 2014).

Noise/distractions in the work area were present and were strongly associated with head and neck pain which is supported by various reports and reviews (Evans and Johnson, 2000; Magnavita et al., 2011; Basner et al., 2014). Basner et al. (2014) state that noise and disturbances can to lead to interference with daily activities and lead to negative responses such as stress and stress-related responses. Evans and Johnson (2000) state that the effect of noise or occupational stressors may provide a link between stress exposure and MSDs. Noise and light complaints had associations in a study by Magnavita et al. (2011) in which strong associations existed between MSDs and psychosocial factors. The mechanism for which psychosocial stress and environmental factors at work relating to MSDs is not well understood. However, it has been hypothesized that mental and psychosocial stress may increase muscle tension leading to muscle fatigue and mental fatigue (Magnavita et al., 2011). The central nervous system responses to the stress may amplify the painful sensations leading to higher levels of MSDs. The neck and shoulder were reported to be the most vulnerable to increased muscle tension which could indirectly lead to headaches (Magnavita et al., 2011). It may be unclear from this study, the direct link between cause and effect of the various MSDs reported, and the ergonomic factors observed. However, the results of the study do indicate clear risk factors, and a high prevalence of MSDs for the population group participating in the study. As no statistical link was correlated, it may be argued that the work environment is not a direct cause of the MSDs reported.

As discussed, there were a number of risk factors evident in this study, namely; incorrect keyboard height, poor ergonomic awareness, awkward postures, inadequate leg room and the incorrect adjustments of the chairs of the participants. While there were few direct correlations, there were major indicators for the risk or exacerbation of MSDs from the work environment. It was evident that MSDs were extensive in this population group. Greater awareness of participants of MSDs, of their bodies, and of the work environment would be beneficial for the library staff. Such awareness would provide information to participants in how to better their working environment and seek treatment for their MSDs before they worsen or get exacerbated.

5.7 Limitations of the study

The research conducted was a point prevalence study and therefore the participants were observed at one time only and may have been influenced by physical and psychosocial factors of that particular point in time. As such, the data may have presented alternative results had the researcher done the data collection on a different day or at a different time of year. For instance, the data collection process took place in January 2017, the beginning of the academic year. Participants may have reported certain variables differently had it been the end of the year when the library was busier and when their job roles entailed more work, or different working dynamics. Perhaps following the December holidays, participants would have reported more pain, as many of them would have been in their second week back at work, and their bodies may still have been adapting to being back in the work environment.

Another factor involved aspects such as air conditioning. The air conditioning is centrally controlled for most of the workstations with little to no control for many of the participants. The question pertaining to temperature was based on the researcher's perspective on the day that the researcher did the observations. The temperature seemed appropriate at that time to the researcher, and as the air conditioning was centrally located, the same temperature was recorded for many of the participants in that environment and on that day. It was only noteworthy to the researcher when the participants were seated directly below or next to a fan or air conditioner or in one of the offices, where the sound of the air conditioner was too loud.

No questions pertaining to the participant perception of air quality and temperature were included in the study and therefore, this was a biased opinion of the researcher based on the particular time that the researcher was there. Had it been a typical hot summer day in Durban, with many students occupying the working environment, the researcher may have noted a different report on the temperature.

Although the study did provide evidence of the prevalence of MSDs in the given population, the results are largely based on the subjective interpretations by the researcher.

The library was a large demographic group with a relatively small sample size and differing work roles of the participants. Had the sample size been larger and more focused on a group with more specific and related work roles, the questionnaire could have been more specifically designed and focused for that particular work group. More comprehensive questioning could have provided more definite conclusions.

5.8 Recommendations

This study did not want to limit the group to particular MSDs, or limit the population to specific demographics. For a closer look at specific MSDs and certain correlations, the sample could be specified to certain demographics and criteria. For instance, low back pain and exercise could be correlated. A sample of participants within a particular age category could have a more in-depth questionnaire relating to exercise in a larger sample size.

It is recommended that future studies have larger sample sizes and draw more on the individual tasks of the workers with more specific job tasks.

Ergonomic intervention studies would be beneficial for the study population to create more awareness of the given population of MSDs and factors that could help mitigate the risk factors for developing or exacerbating MSDs, both personally and at work. If participants have a better knowledge base, participants would have better reporting of their MSDs and better quality research may be obtained and drawn from for future studies.

Recommendations for ergonomic improvement in the library would be to promote education of the library staff in terms of ergonomic guidelines, health and wellbeing. Movement within the work environment should be encouraged among staff. The staff should be encouraged to move away from their desk at regular intervals and incorporate movement into the work procedures to maintain and improve productivity.

5.9 Conclusions

The results of the study revealed that the library population had a high prevalence of MSDs and the extent of the MSDs was of concern. Half of the participants in the population reported work interference as a result of MSDs. It may be unclear from this study what the causes and effects of the various MSDs are. However, it is evident in the findings of this study that risk factors exist and the prevalence of MSDs is high in this population group.

Musculoskeletal disorders are a major cause of sickness or absence from work and often result in a decrease in activities of daily living, productivity and quality of life. The implementation of preventative strategies early on before the disease process progresses is essential. Many intervention strategies are available and include participatory ergonomics, office exercise based programmes, postural advice, workstation design and education. The findings of this study suggest that it would be beneficial for the library staff to become more aware of MSDs and their ergonomic environments both at work and privately. This would empower and equip staff to mitigate MSDs. The awareness of the prevalence of MSDs might also encourage staff to seek treatment when needed. As Punnet and Wegman (2004: 13-27) state: "Whether occupational factors account for few or many MSDs in the general population, is not the same question as to what extent people can be protected from preventable risks at work."

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APPENDICES

APPENDIX A: LETTER OF INFORMATION (FOCUS GROUP)

LETTER OF INFORMATION

Dear Participant

I would like to welcome you into the focus group of my study and thank you for taking the time to participate.

Title of the Research Study: The relationship between ergonomics of the office workstation and related musculoskeletal disorders in the library administrative staff at the Durban University of Technology.

Principal Investigator: Cherise Danielle Levy (BTech: Chiropractic)

Supervisor: Dr P. Orton (PhD Nursing)

Brief Introduction and Purpose of the Study: Work-related musculoskeletal disorders appear to be more prevalent with the increase of computer usage. The prolonged and sedentary behaviour and chronic, repetitive nature of the work has led to rapidly increasing musculoskeletal disorders.

The aim of this study is to examine the occurrence of self-reported musculoskeletal disorders among library administrative staff at the Durban University of Technology and to describe association between the workstation and musculoskeletal disorders. The research is a two part study, the observational checklist and the questionnaire. The observational checklist will be completed by the researcher at the participant workstation with the participant in working posture and will be measured with a measuring tape and be recorded by the researcher. The questionnaire was designed to determine the prevalence of perceived musculoskeletal pain and associated risk factors. The questions involve demographic data, pain related questions and questions pertaining to the work environment of the participants and perceived level of work and pain.
Objectives of the study:

1. To describe the workstation of the library administrative staff at DUT.
2. To determine self-reported prevalence of any musculoskeletal pain.
3. To describe any associations between the workstation and prevalence of musculoskeletal disorders.

Purpose of the focus group: This focus group will help in creating face validity to the newly constructed questionnaire and highlight any possible flaws or ambiguities that may have occurred in the questionnaire through a discussion of the questions. The focus group may also provide ways or recommendations in which to improve the quality and accuracy of the questionnaire to better suit the research study and the study population.

Outline of the Procedures: The focus group discussion will be scheduled to take place at the Durban University of Technology and will take approximately one and a half hours. The focus group will be conducted once ethical clearance (as per DUT Research Committee) has been obtained. The focus group will be conducted by myself and my supervisor and will include two full-time administrative staff employed by DUT, one participant with research experience, one practicing Chiropractor, one participant with a specialization in ergonomics and two DUT students. The participation in the focus group will be voluntary and the participants are required to read the Letter of Information (Appendix F), and sign the letter of informed consent (Appendix G). The focus group discussion will be recorded and treated as confidential. Necessary changes to the questionnaire will be made following the focus group discussion.

Risks or Discomforts to the Participant: There are no risks/ discomforts expected with your participation in this study.

Benefits: Developing a more accurate questionnaire.

Reason/s why the Participant May Be Withdrawn from the Study: Your participation in this study is voluntary and you are free to withdraw from this study at any time without any adverse consequences.

Remuneration: There will be no remuneration (payment) for participating in this study.

Costs of the Study: You will not be expected to pay towards any costs of the study.

Confidentiality: All focus group information and suggestions will be recorded and will be treated as confidential. This focus group data will be safely stored for five years as per the DUT requirements and destroyed after.

Research-related Injury: Participation in this study will not cause any injury to you.

Persons to Contact in the Event of Any Problems or Queries:

The researcher:	Cherise Levy on (+27) 81 887 3491
The supervisor:	Dr Penny Orton on (+27) 31 373 2537
Research and Postgraduate Support:	Prof S. Moyo on 031 3732577or

moyos@dut.ac.za

APPENDIX B: INFORMED CONSENT (FOCUS GROUP)

DUT DURBAN UNIVERSITY OF TECHNOLOGY INSTITUTIONAL RESEARCH ETHICS COMMITTEE

CONSENT

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Cherise Danielle Levy, about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: IREC ___________,
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

_____________________ __________ ____ ______________________________

Full Name of Participant Date Time Signature/Right Thumbprint

I, ______________ (name of researcher) herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

__________________ __________ ____________________

Full Name of Researcher Date Signature

__________________ __________ ____________________

Full Name of Witness Date Signature

(if applicable)

__________________ ___________ ________

Full Name of Legal Guardian Date Signature

(if applicable)

APPENDIX C: CONFIDENTIALITY STATEMENT (FOCUS GROUP)

IMPORTANT: THIS FORM IS TO BE UNDERSTOOD AND COMPLETED BY EVERY PARTICIPANT IN THE EXPERT GROUP BEFORE THE EXPERT GROUP COMMENCES.

1. All information contained in the research documents and any information discussed during the expert group meeting will be kept private and confidential.
2. The returned questionnaires will be coded and kept anonymous in the research process.
3. None of the information shall be communicated to any other individual or organisation outside of this specific expert group as to the decisions of this expert group.
4. The information from this expert group will be made public in terms of a journal publication, which will in no way identify any participants of this research.

Once this form has been read and agreed to, please fill in the appropriate details below and sign to accept the agreement.

PLEASE PRINT IN BLOCK LETTERS

Participant ____________________ Signature ____________________ Date ____________________

Researcher ____________________ Signature ____________________ Date ____________________

Supervisor ____________________ Signature ____________________ Date ____________________

Witness ____________________ Signature ____________________ Date ____________________

APPENDIX D: PRE-FOCUS GROUP QUESTIONNAIRE

Please answer all questions by indicating with letter (X) on your answer or fill in where appropriate. All information that you give will be kept confidential. Do not write your name on any of the forms.

1. Age _______ years
2. Gender

Male	Female

3. Race

Black	Coloured	Indian	White	Other (specify)

4. How long have you been in your current position as an employee at DUT? ______years and _______ months.

5. Are you right handed or left handed?

Left handed	Right handed

6. Overall, how would you rate your health at the present time?

Excellent	Good	Fair	Poor

7. How would you rate your stress levels generally?

High	Moderate	Low

8. Are you currently pregnant?

Yes	No	N/A

9. Do you have children?

Yes	No	N/A

10. Do you exercise?

Yes	No

11. If yes to question 10, please specify how many times a week you exercise? ______________________
12. Please specify the type of exercise that you do. ____

13. Have you received or are you currently receiving any form of treatment for a musculoskeletal condition?

Yes	No

If yes, please specify the condition and the type of treatment sort for the condition.
____
____

14. Please place a (X) in the appropriate box regarding pain in the following areas.

	Seldom (<1/month) or Never	Occasionally (1-4/month)	Often (>4/month)
Head			
Neck			
Shoulders/Upper Arm			
Upper Back			
Lower Back			

Forearm			
Wrist/Hand			
Hips/Buttocks			
Knees			
Feet/Ankles			

15. Have you experienced aches, pain or discomfort causing you to be absent from work or interfere with your work?

Yes	No

16. How often are you mentally exhausted after work?

Daily	Weekly	< Once a month or never

17. Please indicate how many hours you spend at your desk in a day on average.

<4 hours	4 to 6 hours	>6 hours

18. How often do you get up and move away from your desk during the day?

<8 times a day	9 to 16 times a day	>16 times a day

19. Please answer the following and comment where necessary:

EQUIPMENT	YES	NO	COMMENTS
Is your desk height appropriate for your work?			
Is your chair comfortable for you?			
Are your feet supported?			
Is your monitor correctly positioned?			
Is there glare on your monitor?			
Is your keyboard correctly positioned?			
Is your mouse correctly positioned?			
Does using your telephone require awkward postures?			
Do you often have to reach for items in your work area?			
Is lighting in your work area adequate for the work you do?			

Appendix E: Pre-focus group Observational Checklist

Participant number: ________ ____

WORK AREA CONFIGURATION	YES	NO	COMMENTS
1. Top of screen slightly below eye level?			
2. Monitor directly in front of worker?			
3. Distance to monitor approximately 18?00			
4. Keyboard at correct height?			
5. Keyboard aligned with body?			
6. Keyboard aligned with monitor?			
7. Keyboard tray is available?			
Keyboard tray is used?			
8. Lumbar curve is supported by backrest?			
9. Chair is adjustable?			
10. Edge of seat about 2 fingers behind bend of knee?00			
11. Seat height allows thighs to be parallel with floor?			
12. Foot rest available to support feet?			
Footrest is used?			
13. Operation of mouse requires reaching?			
14. Mouse tray is available?			
Mouse tray is used?			
15. Location of copy requires rotating to see?			
16. Screen brightness appropriate for work area lighting?			
17. Tilt of monitor is appropriate for worker and area?			
18. Glare on monitor is apparent?			
19. Telephone within easy reach?			
20. General lighting of work area is appropriate?			
21. Noise/distractions in work area are present?			

22. Temperature of work area is appropriate?			
WORKER POSTURES	YES	NO	COMMENTS
1. Thighs parallel to the floor?			
2. Feet supported on floor or footrest?			
3. Low back supported by backrest?			
4. Arms relaxed at side & perpendicular to floor?			
5. Elbows bent at 90° so forearms are parallel to floor?			
6. Wrists in neutral for flexion & extension?			
7. Wrists are deviated (radially or ulnarly)?			
8. Shoulders are relaxed, not elevated?			
9. Neck in neutral (i.e. chin is level)?			
10. Neck flexed to hold phone?			
11. Head rotated?			
12. Trunk rotated?			

P Bohr, Washington University School of Medicine, 1998

APPENDIX F: LETTER OF INFORMATION (PILOT STUDY)

LETTER OF INFORMATION

Dear Participant

I would like to welcome you into the pilot study and thank you for taking the time to participate.

Title of the Research Study: The relationship between ergonomics of the office workstation and related musculoskeletal disorders in the library administrative staff at the Durban University of Technology.

Principal Investigator: Cherise Danielle Levy (BTech: Chiropractic)

Supervisor: Dr P. Orton (PhD Nursing)

Brief Introduction and Purpose of the Study: Work-related musculoskeletal disorders appear to be more prevalent with the increase of computer usage. The prolonged and sedentary behaviour and chronic, repetitive nature of the work has led to rapidly increasing musculoskeletal disorders.

The aim of this study is to examine the occurrence of self-reported musculoskeletal disorders among library administrative staff at the Durban University of Technology and to describe association between the workstation and musculoskeletal disorders. The research is a two part study, the observational checklist and the questionnaire. The observational checklist will be completed by the researcher at the participant workstation with the participant in working posture and will be measured with a measuring tape and be recorded by the researcher. The questionnaire was designed to determine the prevalence of perceived musculoskeletal pain and associated risk factors. The questions involve demographic data, pain related questions and questions pertaining to the work environment of the participants and perceived level of work and pain.
Objectives:

1. To describe the workstation of the library administrative staff at DUT.
2. To determine self-reported prevalence of any musculoskeletal pain.
3. To describe any associations between the workstation and prevalence of musculoskeletal disorders.

Outline of the Procedures: A minimum of sixty-three employees from the library administrative staff will be chosen through a convenience sampling procedure. The selected employees will be eligible to take part in the study. Each employee will be given a Letter of Information and should he / she agree to take part in the study, will sign the letter of informed consent. An observational checklist will be completed by the researcher at the employee workstation followed by the completion of the questionnaire by the participant. This will be done at a time convenient to the employee.

The researcher will be available for the entire duration of the study to assist with any queries that may arise. The research is a two-part study and therefore the total time to fill out the paperwork by the employees will take approximately five minutes and the observational checklist would take approximately ten minutes. All information will be strictly anonymous and confidential.

Please do not discuss any aspects of the research with your colleagues during the duration of the pilot study and data collection process. This is to avoid potential participants making changes in expectation of the study which could hinder the results and validity of the study.

Risks or Discomforts to the Participant: None

Benefits: Your full co-operation will assist in expanding of knowledge of office ergonomics and related musculoskeletal pain. The study should open doors to allow for further intervention studies to improve the office environment and job satisfaction at the Durban University of Technology.

Reason/s why the Participant May be Withdrawn from the Study: If you do not agree to sign the Letter of Information and consent form. No adverse consequences will occur should you, the participant, choose to withdraw from the study.

Remuneration: No remuneration will be given as this research is purely voluntary.

Costs of the Study: There will be no costs to you, the participant. No remuneration will be given.

Confidentiality: All information is confidential and the results will be used for research purposes only. All employees will remain anonymous and confidential. All participants will be allocated a number in which the researcher would have recorded on a piece of paper with the participant name to ensure the researcher has the correct questionnaire to match the observational checklist and to allow the researcher to approach the participants. The piece of paper with the names will only be available to the researcher during the data collection process only and will be shredded immediately on completion of the data collection. The researcher will document the information for statistical analysis. No names will be documented and no information will be identifiable to you. All information obtained will be kept in complete confidence and the overall results of the study will be made available in the Durban University of Technology library in the form of a dissertation. Please do not hesitate to ask any questions on any aspect of this study.

Research-related Injury: None

Persons to Contact in the Event of Any Problems or Queries:

The researcher:	Cherise Levy on (+27) 81 887 3491
The supervisor:	Dr Penny Orton on (+27) 31 373 2537
Research and Postgraduate Support:	ProfS. Moyo on 031 3732577or moyos@dut.ac.za

APPENDIX G: INFORMED CONSENT FORM (PILOT STUDY)

CONSENT

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Cherise Danielle Levy, about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: IREC ___________,
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

____________________ __________ ____ ____________________________

Full Name of Participant **Date** **Time** **Signature/Right Thumbprint**

I, ______________ (name of researcher) herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

_________________ __________ ___________________

Full Name of Researcher **Date** **Signature**

_________________ __________ ___________________

Full Name of Witness **Date** **Signature**

(if applicable)

_________________ ___________ ________

Full Name of Legal Guardian Date **Signature**

(if applicable)

Appendix H: Pre-test Evaluation

1 What is your opinion of the subject presented in this questionnaire? (Please mark the most appropriate box)
  1.1 Extremely interesting ☐
  1.2 Interesting ☐
  1.3 Average ☐
  1.4 Boring ☐
  1.5 Very boring ☐

2 Do you think the topics raised in this questionnaire were adequately covered?
  2.1 Yes ☐
  2.2 No ☐

3 What is your opinion about the Letter of Information (Please mark one box only)
  3.1 Very clear ☐
  3.2 Clear ☐
  3.3 Adequate ☐
  3.4 Unclear ☐
  3.5 Needs revising ☐

4 How would you describe the instructions accompanying each of the questions? (Please mark one x only)
  4.1 Very clear ☐
  4.2 Clear ☐
  4.3 Adequate ☐
  4.4 Unclear ☐
  4.5 Needs revising ☐

5 Do you think the questionnaire is too long?
  5.1 Yes ☐
  5.2 No ☐

6 What is your opinion of the wording of the questionnaire? (Please mark the appropriate box/es)
  6.1 The meaning of **all questions** is absolutely clear ☐
  6.2 The meaning of **most** questions is clear ☐
  6.3 There is too much chiropractic/medical jargon ☐
  6.4 The questions will not be understood by laypersons ☐
  6.5 The questionnaire needs to be revised because it is unclear ☐

If you had any difficulty answering any question/s, please write the number/s of the question/s in the space below with a suggestion on how the question/s can be improved?

____

____

____

____

Thank you for your most valuable time in helping me with my research project. Please be reminded that the topics discussed above are strictly confidential.

Appendix I: Notice of changes to research tools

Dear Chairperson

I received IREC approval on 22nd of November for my PG2a approval regarding my research titled, "*The relationship between ergonomics of the office workstation and related musculoskeletal disorders in the library administrative staff at the Durban University of Technology"*, subject to the focus group and pilot study being conducted. The focus group was conducted on the 29th of November 2016 and minor changes were noted as stipulated by the following.

Question 6: It was suggested in the meeting to change the structure of the sentence, "Overall, how would you rate your health?" to "How would you rate your overall health at the present time?" This change was made.

Question 7, it was suggested to provide a visual, Likert Scale, to rate stress instead of rating it as high, moderate or low. This change was implemented.

Following question 9, it was suggested that age groups were incorporated into the question in order to understand the age groups of children of administrative staff as this infants may contribute to musculoskeletal pain. This was introduced by including this as a new question.

Questions 11 and 12 related to exercise. It was suggested that the amount of time (in minutes) should be incorporated as a new question. However, after a discussion with my supervisor, this suggestion was declined.

From the table in question 14, some useful comments were made in the focus group discussion which was implemented including a wording change in the question, and more specifics in the list of conditions, i.e. incorporation of midback and chest as a category, and including more anatomical landmark to help identify more specifically, the location of pain.

Question 15 was originally asking two questions which was then split in two questions in order to make it easier for the reader to answer.

Question 17 included a question which discussed the number of hours a person spends at their desk on average in a day, a new box category was introduced, a less than 2 hours box. This was included as the literature suggests a change in behaviour with the new ergonomic knowledge and it was therefore altered in the inclusion criteria of the study to alter the hours to greater than two hours from greater than 4 hours spent at a desk on an average day.

Other questions were discussed with regards to musculoskeletal pain experienced before they worked at DUT or if musculoskeletal pain was aggravated or caused by their work at DUT. This was discussed in further detail between my supervisor and I and it was decided to exclude these questions as these were not necessary for this study.

The other remark that was made in the focus group was to change the numbering system in the observational checklist which was done. A suggestion was also made to remove the word point from the second objective of the study. This change was implemented.

The pilot study was conducted on 02 December 2016 and the only change that was made was a numbering error from question 10 due to the changes made from the focus group. This change was implemented.

Please contact me if you require any further information.

Kind Regards,

Cherise Levy

cherise.levy@gmail.com

0818873491

Appendix J: Letter of information to participant

LETTEROF INFORMATION

Dear Participant,

Welcome to my research study.

Title of the Research Study: The relationship between ergonomics of the office workstation and related musculoskeletal disorders in the library administrative staff at the Durban University of Technology.

Principal Investigator/s/researcher: Cherise Levy

Supervisor: Dr P. Orton (PhD Nursing)

Brief Introduction and Purpose of the Study: Work-related musculoskeletal disorders appear to be more prevalent with the increase of computer usage. The prolonged and sedentary behaviour and chronic, repetitive nature of the work has led to rapidly increasing musculoskeletal disorders.

The purpose of this study is to examine the occurrence of self-reported musculoskeletal disorders among library administrative staff at the Durban University of Technology and to describe association between the workstation and musculoskeletal disorders.

Outline of the Procedures: The researcher will aim to approach all library administrative staff at DUT to participate in the study and anybody who agrees to participate will be given the Letter of Information to read before signing the informed consent letter. The researcher will arrange to do an observation checklist (approximately ten minutes) at a time convenient to you with you at your workstation to determine the arrangement of your desk, your chair and your computer set up as well any of the peripherals in your work area. This is a basic checklist that will require some simple measurements. You will also be given a short questionnaire (estimated five minutes to complete) which entails placing an (X) or simple one word answers where relevant. This questionnaire will include demographic data, pain related questions and some perception based questions.

The researcher will be available for the entire duration of the study to assist with any queries that may arise. The research is a two-part study and therefore the total time to fill out the paperwork by the employees will take approximately five minutes and the observational checklist would take approximately ten minutes. All information will be strictly anonymous and confidential.

Please do not discuss any aspects of the research with your colleagues during the duration of the data collection process. This is to avoid potential participants making changes in expectation of the study which could hinder the results and validity of the study.

Risks or Discomforts to the Participant: None

Benefits: Your full co-operation will assist in expanding of knowledge of office ergonomics and related musculoskeletal pain. This study should open doors to allow for further intervention studies to improve the office environment and job satisfaction.

Reason/s why the Participant May be Withdrawn from the Study: If you do not agree to sign the Letter of Information and consent form.
No adverse consequences will occur should you, the participant, choose to withdraw from the study.

Remuneration: No remuneration will be given as this research is purely voluntary.

Costs of the Study: There will be no costs to you, the participant. No remuneration will be given.

Confidentiality: All information is confidential and the results will be used for research purposes only. All employees will remain anonymous and confidential. All participants will be allocated a number in which the researcher would have recorded on a piece of paper with the participant name to ensure the researcher has the correct questionnaire to match the observational checklist and to allow the researcher to approach the participants. The piece of paper with the names will only be available to the researcher during the data collection process only and will be shredded immediately on completion of the data collection. The researcher will document the information for statistical analysis. No names will be documented and no information will be identifiable to you. All information obtained will be kept in complete confidence and the overall results of the study will be made available in the Durban University of Technology library in the form of a dissertation. Please do not hesitate to ask any questions on any aspect of this study.

Research-related Injury: None

Persons to Contact in the Event of Any Problems or Queries:

The researcher:	Cherise Levy on (+27) 81 887 3491
The supervisor:	Dr Penny Orton on (+27) 31 373 2537
Research and Postgraduate Support:	ProfS. Moyo on 031 3732577or moyos@dut.ac.za

APPENDIX K: INFORMED CONSENT FORM (RESEARCH STUDY)

CONSENT

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Isabel. Cherise Danielle Levy, about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: IREC ___________,
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

____________________ __________ ____ ____________________________

Full Name of Participant **Date** **Time** **Signature/Right Thumbprint**

I, ______________ (name of researcher) herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

_________________ __________ ___________________

Full Name of Researcher **Date** **Signature**

_________________ __________ ___________________

Full Name of Witness **Date** **Signature**

(if applicable)

_________________ ___________ ________

Full Name of Legal Guardian Date **Signature**

(if applicable)

Appendix L: Observational Checklist

Participant number: ________ ____

WORK AREA CONFIGURATION	YES	NO	COMMENTS
1. Top of screen slightly below eye level?			
2. Monitor directly in front of worker?			
3. Distance to monitor approximately 18?00			
4. Keyboard at correct height?			
5. Keyboard aligned with body?			
6. Keyboard aligned with monitor?			
7. Keyboard tray is available?			
8. Keyboard tray is used?			
9. Lumbar curve is supported by backrest?			
10. Chair is adjustable?			
11. Edge of seat about 2 fingers behind bend of knee?00			
12. Seat height allows thighs to be parallel with floor?			
13. Foot rest available to support feet?			
14. Footrest is used?			
15. Operation of mouse requires reaching?			
16. Mouse tray is available?			
17. Mouse tray is used?			
18. Location of copy requires rotating to see?			
19. Screen brightness appropriate for work area lighting?			
20. Tilt of monitor is appropriate for worker and area?			
21. Glare on monitor is apparent?			
22. Telephone within easy reach?			
23. General lighting of work area is appropriate?			
24. Noise/distractions in work area are present?			
25. Temperature of work area is appropriate?			

WORKER POSTURES	YES	NO	COMMENTS
1. Thighs parallel to the floor?			
2. Feet supported on floor or footrest?			
3. Low back supported by backrest?			
4. Arms relaxed at side & perpendicular to floor?			
5. Elbows bent at 90° so forearms are parallel to floor?			
6. Wrists in neutral for flexion & extension?			
7. Wrists are deviated (radially or ulnarly)?			
8. Shoulders are relaxed, not elevated?			
9. Neck in neutral (i.e. chin is level)?			
10. Neck flexed to hold phone?			
11. Head rotated?			
12. Trunk rotated?			

P Bohr, Washington University School of Medicine, 1998

APPENDIX M: QUESTIONNAIRE FOR ACTUAL STUDY

Please answer all questions by indicating with letter (X) on your answer or fill in where appropriate. All information that you give will be kept confidential. Do not write your name on any of the forms.

1. Age ________ years
2. Gender

Male	Female

3. Race

Black	Coloured	Indian	White	Other (specify)

4. How long have you been in your current position as an employee at DUT?
   ______years and ________ months.

5. Are you right handed or left handed?

Left handed	Right handed

6. How would you rate your overall health at the present time?

Excellent	Good	Fair	Poor

7. How do you rate your stress levels on a scale of 0 to 10 with 0 being no stress and ten being the most stress by circling the appropriate number?
   0 1 2 3 4 5 6 7 8 9 10

8. Are you currently pregnant?

Yes	No	N/A

9. Do you have children?

Yes	No	N/A

10. If yes to question 9, please specify their ages.

0 – 3 years	4 – 6 years	>6 years

11. Do you exercise?

Yes	No

12. If yes to question 11, please specify how many times a week you exercise?
    ____
13. Please specify the type of exercise that you do.
    ____

14. Have you received or are you currently receiving any form of treatment for a musculoskeletal condition?

Yes	No

If yes, please specify the condition and the type of treatment sort for the condition.

____
____
____
____

15. Please place a (X) for each of the appropriate boxes regarding pain in the following areas.

	Seldom (<1/month) or Never	Occasionally (1-4/month)	Often (>4/month)
Head			
Neck			
Shoulders/upper arm			
Upper back			
Midback and chest			
Lower back			
Elbow and forearm			
Wrist/hand			
Hips/buttocks/thighs			
Knees and legs			
Feet/ankles			

16. Have you experienced aches, pain or discomfort causing interference with your work?

Yes	No

17. Have you experienced aches, pain or discomfort causing you to be absent from work?

Yes	No

18. How often are you mentally exhausted after work?

Daily	Weekly	< Once a month or never

19. Please indicate how many hours you spend at your desk in a day on average.

< 2 hours	2 – 4 hours	4 – 6 hours	>6 hours

20. How often do you get up and move away from your desk during the day?

<8 times a day	9 to 16 times a day	>16 times a day

21. Please answer the following and comment where necessary:

EQUIPMENT	NO	YES	COMMENTS
Is your desk height appropriate for your work?			
Is your chair comfortable for you?			
Are your feet supported?			
Is your monitor correctly positioned?			
Is there glare on your monitor?			
Is your keyboard correctly positioned?			
Is your mouse correctly positioned?			
Does using your telephone require awkward postures?			
Do you often have to reach for items in your work area?			
Is lighting in your work area adequate for the work you do?			

Appendix N: Letter of information - Library Directorate

To whom it may concern:

I am a chiropractic master's student who is doing my research on the relationship between ergonomics of the office workstation and related musculoskeletal disorders in the library administrative staff at the Durban University of Technology.

Supervisor:	Dr P. Orton	(031 373 2537)
Research student:	Cherise Levy	(081 8873491)

Title of the Research Study:
The relationship between ergonomics of the office workstation and related musculoskeletal disorders in the library administrative staff at the Durban University of Technology.

Brief Introduction and purpose of the study:
Work-related musculoskeletal disorders appear to be more prevalent with the increase of computer usage. The prolonged and sedentary behaviour and chronic, repetitive nature of the work has led to rapidly increasing musculoskeletal disorders.

The aim of this study is to examine the occurrence of self-reported musculoskeletal disorders among library administrative staff at the Durban University of Technology and to describe any association between the workstation and musculoskeletal disorders.

How are you to assist with this research study?
The library department at both the Steve Biko Campus and the ML sultan Campus have been selected to take part in the above study. Participation for the study by the library department and the employees is at all times voluntary and refusal to participate will not result in adverse consequences of any kind to either participant or the library department of DUT. The results of this study will be made available in the form of a mini-dissertation in the DUT library.

Procedures:
A minimum of sixty-three employees from the library administrative staff will be chosen through a convenience sampling procedure. The selected employees will be eligible to take part in the study. Each employee will be given a Letter of Information and should he / she agree to take part in the study, will sign a letter of informed consent. An observational checklist will be completed by the researcher at the employee workstation. This will be

followed by the completion of the questionnaire by the participant. This will be done at a time convenient to the employee.

The researcher will be available for the entire duration to assist with any queries that may arise. The research is a two-part study and therefore the total time to fill out the paperwork by the employees will take approximately five minutes and the observational checklist would take approximately ten minutes. All information will be strictly anonymous and confidential.

Confidentiality:
All information is confidential and the results will be used for research purposes only. All employees will remain anonymous and confidential. Please do not hesitate to ask any questions on any aspect of this study.

Your department's approval for access to your employees would be of importance in allowing for this process to be completed and feedback sent to you.

Risks / Discomfort and Cost:
There are no risks / discomfort or cost to the library department or DUT or the employee as a result of your collective participation in the study.

Persons to contact with problems or queries:
Should you have any questions that you may want answered by an independent source, you can contact my supervisor on the above number. If you are not satisfied with any aspect of this study, feel free to forward any concerns to the Durban University of Technology Research and Ethics Committee.

In order to move forward with this study, would you be so kind as to respond to this letter in writing indicating whether you would approve of this study taking place on your premises or not, provided that the attached proposal is approved by the Durban University of Technology Research and Ethics Committee.

Thank you.
Cherise Levy

Signature: ________________Date: ___________

Penny Orton (PhD Nursing)
Signature: ________________Date: ___________

Appendix O: Letter of information - Library Managers

To whom it may concern:

I am a chiropractic master’s student who is doing my research on the relationship between ergonomics of the office workstation and related musculoskeletal disorders in the library administrative staff at the Durban University of Technology.

Supervisor:	Dr P. Orton	(031 373 2537)
Research student:	Cherise Levy	(081 8873491)

Title of the Research Study:
The relationship between ergonomics of the office workstation and related musculoskeletal disorders in the library administrative staff at the Durban University of Technology.

Brief Introduction and purpose of the study:
Work-related musculoskeletal disorders appear to be more prevalent with the increase of computer usage. The prolonged and sedentary behaviour and chronic, repetitive nature of the work has led to rapidly increasing musculoskeletal disorders.

The aim of this study is to examine the occurrence of self-reported musculoskeletal disorders among library administrative staff at the Durban University of Technology and to describe any association between the workstation and musculoskeletal disorders.

How are you to assist with this research study?
The library department at both the Steve Biko Campus and the ML sultan Campus have been selected to take part in the above study. Participation for the study by the library department and the employees is at all times voluntary and refusal to participate will not result in adverse consequences of any kind to either participant or the library department of DUT. The results of this study will be made available in the form of a mini-dissertation in the DUT library.

Procedures:
All full-time library employees will be selected to take part in the study. Each employee will be given a Letter of Information and should he / she agree to take part in the study, will sign a letter of informed consent. An observational checklist will be completed by the researcher at the employee workstation. This will be followed by the completion of the questionnaire by the participant. This will be done at a time convenient to the employee.

The researcher will be available for the entire duration to assist with any queries that may arise. The research is a two-part study and therefore the total time to fill out the paperwork by the employees will take approximately five minutes and the observational checklist would take approximately ten minutes. All information will be strictly anonymous and confidential.

Confidentiality:
All information is confidential and the results will be used for research purposes only. All employees will remain anonymous and confidential. Please do not hesitate to ask any questions on any aspect of this study.

Your department's approval for access to your employees would be of importance in allowing for this process to be completed and feedback sent to you.

Risks / Discomfort and Cost:
There are no risks / discomfort or cost to the library department or DUT or the employee as a result of your collective participation in the study.

Persons to contact with problems or queries:
Should you have any questions that you may want answered by an independent source, you can contact my supervisor on the above number. If you are not satisfied with any aspect of this study, feel free to forward any concerns to the Durban University of Technology Research and Ethics Committee.

In order to move forward with this study, would you be so kind as to respond to this letter in writing indicating whether you would approve of this study taking place on your premises or not, provided that the attached proposal is approved by the Durban University of Technology Research and Ethics Committee.

Thank you.
Cherise Levy
Signature: ________________Date: ___________

Penny Orton (PhD Nursing)
Signature: ________________Date: ___________

Appendix P: Request to use research tools

Dear Michael Feuerstein

I am a fifth year Chiropractic student at Durban University of Technology in South Africa currently doing my masters research programme. During my literature review, I came across an article in the field of ergonomics with specific reference to, "Efficacy of Office Ergonomics Education published in the Journal of Occupational Rehabilitation, Vol 10, No. 4, 2000, by Paula C. Bohr.

I kindly request your permission to use the baseline office ergonomic survey and observational checklist from that study as it would be of great benefit to my research. In response to my email request, Paula Bohr informed me that the editors hold the publishing rights to the surveys. In the event of permission being granted, all necessary references and acknowledgements will be implemented.

If you have any further queries pertaining to my research, my contact details are included. I look forward to hearing from you.

Kind Regards,

Cherise Levy

(+27) 818873491
cherise.levy@gmail.com

Appendix Q: Permission to use research tools

Dear Cherise,

Permission is granted. Please do include a credit line with reference to the original JOR publication.

Best wishes,

Janice

Janice Stern

Senior Editor, Health and Behavior

Springer Science + Business Media

233 Spring Street (3rd Floor)

New York, NY 10013

212-460-1551

janice.stern@springer.com

Appendix R: Request for permission from research directorate

Dear Professor Moyo

I am a sixth year Chiropractic student at Durban University of Technology currently doing my masters research programme in the field of ergonomics. My supervisor is Penny Orton from the Department of Nursing.

The provisional title for my research is, "*The relationship between ergonomics of the office workstation and related musculoskeletal disorders in the library administrative staff at the Durban University of Technology*".

I would like to request permission to conduct my study at DUT. I have received permission from IREC to complete the focus group and pilot study from which there were minimum changes. I have also received permission from the Library Directorate for DUT. I therefore need gatekeeper's permission for IREC to give me the full IREC approval for me to start the data collection process. As soon as full ethics approval has been given by the Institutional Research Ethics Committee, I will include a copy of my proposal for your convenience. I will keep all consent forms for ethical purposes and these will be available to your department on request from my supervisor or myself.

I hope this research will be of value to my department and to DUT. Thank you for the opportunity to conduct this research at DUT.

Kind Regards,

Cherise Levy

(+27) 81 8873491
cherise.levy@gmail.com

Appendix S: IREC approval

Directorate for Research and Postgraduate Support
Durban University of Technology
Tromso Annexe, Steve Biko Campus
P.O. Box 1334, Durban 4000
Tel.: 031-3732576/7
Fax: 031-3732946
E-mail: moyos@dut.ac.za

15th December 2016

Ms Cherise Danielle Levy
c/o Department of Chiropractic and Somatology
Faculty of Health Sciences
Durban University of Technology

Dear Ms Levy

PERMISSION TO CONDUCT RESEARCH AT THE DUT

Your email correspondence in respect of the above refers. I am pleased to inform you that the Institutional Research Committee (IRC) has granted full permission for you to conduct your research "The relationship between ergonomics of the office workstation and related musculoskeletal disorders in library administrative staff at the Durban University of Technology" at the Durban University of Technology.

We would be grateful if a summary of your key research findings can be submitted to the IRC on completion of your studies.

Kindest regards.
Yours sincerely

[redacted]

PROF. S. MOYO
DIRECTOR: RESEARCH AND POSTGRADUATE SUPPORT

Appendix T: List of variables with the p-values

#	Variables	Chi-Square	Df	Asymp. Sig.
1	Age of participants	8,322	3	0,040
2	Gender	3,814	1	0,051
3	Race	33	3	0,000
4	Duration of employment	9.729[c]	4	0,045
5	Hand dominance	40,695	1	0,000
6	Health rating	23.322[d]	2	0,000
7	Stress level rating scale	11.655[e]	9	0,233
8	Pregnant	3,814	1	0,051
9	Children	20,763	1	0,000
10	Ages	24,729	3	0,000
11	Exercise	12,356	1	0,000
12	How often exercise	14,288	3	0,003
13	Type of exercise	19.414[f]	4	0,001
14	Sort treatment for MSD	37,441	1	0,000
15	Head	17.322[d]	2	0,000
16	Neck	7.356[d]	2	0,025
17	Shoulders	10.407[d]	2	0,005
18	Upperback	24.441[d]	2	0,000
19	Midback chest	57.898[d]	2	0,000
20	Lower back	18.542[d]	2	0,000
21	Elbow/forearm	62.475[d]	2	0,000
22	Hand	26.169[d]	2	0,000
23	Thighs	47.220[d]	2	0,000
24	Knees	12.441[d]	2	0,002
25	Feet	16.102[d]	2	0,000
26	Pain interferes with work	.000[g]	1	1,000
27	Absent work	6,119	1	0,013
28	Mentally exhausted from work	18.542[d]	2	0,000
29	Average hours at desk	18.034[d]	2	0,000
30	How often move from desk	14.678[d]	2	0,001
31	Desk height	18,458	1	0,000
32	Chair	6,119	1	0,013
33	Footrest	3,814	1	0,051
34	Monitor	28,492	1	0,000
35	Glare	12,356	1	0,000
36	Keyboard	31,339	1	0,000
37	Mouse	34,322	1	0,000
38	Telephone	1,373	1	0,241
39	Reaching	16,288	1	0,000
40	Lighting	23,203	1	0,000
41	Screen eye level	0,017	1	0,896

#	Variables	Chi-Square	Df	Asymp. Sig.
42	Monitor in front worker	2,051	1	0,152
43	Monitor distance	40,695	1	0,000
44	Keyboard correct height	25,78	1	0,000
45	Keyboard aligned body	2,051	1	0,152
46	Keyboard aligned monitor	16,288	1	0,000
47	Keyboard tray available	106.305[d]	2	0,000
48	Keyboard tray used	106.305[d]	3	0,000
49	Lumbar curve support	0,424	1	0,515
50	Chair adjustable	14,254	1	0,000
51	Edge seat 2 fingers	0,017	1	0,896
52	Seat height legs parallel to floor	18,458	1	0,000
53	Foot rest available	34,322	1	0,000
54	Foot rest used	79.763[d]	2	0,000
55	Reaching for mouse	23,203	1	0,000
56	Mouse tray available	1,373	1	0,241
57	Mouse tray used	28.203[d]	2	0,000
58	Copy rotation to see	89.932[d]	2	0,000
59	Screen brightness appropriate	47,61	1	0,000
60	Monitor tilt appropriate	8,966	1	0,003
61	Glare on monitor apparent	8,966	1	0,003
62	Telephone easy reach	2,864	1	0,091
63	General lighting appropriate	25,78	1	0,000
64	Noise present	3,814	1	0,051
65	Temperature appropriate	25,78	1	0,000
66	Thighs parallel to floor	23,203	1	0,000
67	Feet supported	7,475	1	0,006
68	Lower back supported	0,017	1	0,896
69	Arms at sides	7,475	1	0,006
70	Perpendicular	23,203	1	0,000
71	Wrists in neutral	3,814	1	0,051
72	Wrists deviated	14,254	1	0,000
73	Shoulders relaxed or elevated	20,763	1	0,000
74	Neck in neutral	2,051	1	0,152
75	Neck flexed for phone	20.068[d]	2	0,000
76	Head rotated	1,373	1	0,241
77	Trunk rotated	0,831	1	0,362

Note: df refers to the degrees of freedom and the symp. Sig denotes the p-value from the chi-squared goodness of fit test. All the significant values ($p < 0.005$) are shaded in light grey and represent the significant values.