Upper Body Musculoskeletal Pain Associated with Remote Working of Academics at the Durban University of Technology During the COVID-19 Pandemic

By

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I, Nevinia Narainsamy, 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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DEDICATION

To my greatest gifts from God, my parents, Sharon and Mervin Narainsamy, thank you for allowing me this opportunity to follow my dreams, I dedicate this dissertation and all my future success to you. I hope I have made you proud. I love you always.

To my most beautiful angel in Heaven, my aunty, Zerina Ambrose, you will always have a piece of my heart. Thank you for your never-ending support, guidance, and love. The memories of you always motivating and inspiring me will forever be etched on my heart. I hope you have the biggest smile up in heaven and I hope you are proud of me. Thank you for being my guiding light. I love you forever.

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ABSTRACT

BACKGROUND

The world-wide pandemic COVID-19, which initiated international lockdowns and varied degrees of work considerations, enforced remote working to reduce the spread of infection. Ergonomic support for effective remote working during this rapid transition received little consideration. Musculoskeletal disorders (MSDs) associated with musculoskeletal pain (MSP) are frequently linked to poor ergonomic support at the workplace and compromises the quality of life of those affected. MSP may be aggravated by prolonged, repetitive, and awkward movements, poor posture and ergonomics, or a fast-paced workload. Additionally, the onset of upper body MSP contributes to work-related MSDs, resulting in decreased work productivity. It is believed that the current shift to remote working may result in an increase in MSP. This study, therefore, aims to determine the prevalence and effects of upper body musculoskeletal pain (head, neck, shoulder and back) associated with the ergonomic changes of remote working during the current COVID-19 pandemic.

OBJECTIVES

1. To determine the prevalence of musculoskeletal pain among those working remotely during the COVID-19 pandemic.
2. To determine the selected risk factors predisposing to upper body musculoskeletal pain as an ergonomic effect of remote working.
3. To identify the extent to which remote working has impacted the occurrence of musculoskeletal pain with particular reference to ergonomic aspects.
4. To determine the effects of musculoskeletal pain and its impact on work performance/productivity.
5. To provide guidelines/recommendations and future considerations to support the prevention of MSP during remote working.

METHOD

A quantitative, descriptive cross-sectional study was conducted on all Durban University of Technology (DUT) academic staff members, to obtain relevant data regarding the onset of musculoskeletal pain and ergonomical factors, whilst working remotely during the COVID-19 pandemic. Data were collected through the use of an online questionnaire, administered through DUT's electronic platform. The Dutch Musculoskeletal Questionnaire was adapted to focus more on ergonomics and working remotely. Descriptive statistics were used to provide summarised questionnaire data. All data were analyzed using the IBM SPSS version 25 software package. Bivariate analyses, such as the Pearson's chi-squared test, ANOVA, and T-tests, where appropriate, were done. A $p<0.05$ was considered statistically significant. Findings of similar studies, both locally and internationally, provided generalised and more contextualised recommendations related to the ergonomic effects of working remotely.

RESULTS

In summary, 87.2% of participants reported to having musculoskeletal pain (MSP) prior to COVID-19. However, there was a massive increase in MSP while remote working, with 81.8% of participants reporting MSP during COVID-19. A great number of academic staff members (52.7%) reported to have worked remotely and having suitable equipment (59.1%) to facilitate remote work. With a reported increase in workload (89.1%), there was also an increase in productivity (53.6%). The most severe location of pain while remote working was the back (25.5%). Ergonomic factors that were noteworthy were that 64.5% participants sat without their back supported; shoulders were not relaxed in neutral (68.2%); wrists were not in a neutral position (51.8%) and the neck was not in a neutral position while remote working (63.6%). These factors remained consistent before and during COVID-19, indicating a minute change in the statistical significance of ergonomic factors. The *p*-value was less than 0.001. Regarding the emotional states of the respondents, it has been revealed that there was an association between the emotional status before and during COVID-19. All corresponding *p*-values were less than 0.001, indicating a statistically significant relationship.

CONCLUSION

The COVID-19 pandemic has placed unprecedented pressures on governments, economies, and families, posing what many observers consider the largest global peace-time challenge since the Great Depression a century ago. In South Africa, the government moved swiftly after the first confirmed case of COVID-19 on 5 March 2020, which subsequently led to a national lockdown by 27 March 2020. This placed huge challenges on the population, especially for the poor and those working from home. The exponential rise in COVID-19 infections rapidly transformed how and if people would return to the traditional way of working. Working from home during the nationwide lockdown led to poor quality of work and a lack of efficiency, which ultimately led to poor work productivity. Many employers worldwide chose to protect both the health and job security of their employees by implementing remote working. The average household lack the components of a functional office setup such as a simple desk and good quality chair. This consequently predisposed many to work hunched over coffee tables or on kitchen stools without proper neck and back support. It is possible that many working individuals will emerge with increased incidence of MSP after the coronavirus crisis. Ergonomic support for effective remote working may have been ignored amidst the more disastrous effects of the pandemic, but the crisis becoming a major contributor to an increased onset of MSP. This is likely to remain as the norm, even after the shifting of lockdowns, for millions of workers. The adverse effects of the pandemic thus appear to extend beyond its direct consequences into an increased onset of ergonomical concerns that warrants some investigation. This study therefore aimed to determine the prevalence and effects of upper body (head, neck, shoulder and back) musculoskeletal pain associated with ergonomic changes experienced with remote working during the COVID-19 pandemic. It is hoped that the results of this study will inform interventions to redress such effects in remote working climates.

Key words: COVID-19 pandemic, ergonomics, musculoskeletal pain, remote working.

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DEFINITIONS

Musculoskeletal disorder(s): An ache, pain or discomfort in the neck, shoulder, elbows, or hands/wrists (Buckle and Devereux 2002); or impairments of bodily structures of the limbs and back, including muscles, tendons, vessels, and cartilage (Ha *et al.* 2009).

University academic staff: Professionals who are involved in an academic activity (teaching/learning, research, and community service) in a university set up. In universities, the education status of academic stuff is from graduate assistant lecturer to professor (Sirajudeen *et al*. 2018)

Prevalence: The previous 12 months prevalence of musculoskeletal pains (Temesgen *et al*. 2019)

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).

Cross-sectional design: A research design where all data are 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)

Focus group: A meeting to allow for discussions to generate data which the researcher might not obtain otherwise, develop, and identify possible problems with the data collection tool (Connelly 2015).

Risk factor: A "condition present in the workplace" which may act as a trigger, may be solely responsible for creating a health problem, or which may create conditions contributing to the problem (Simoneau *et al.* 1996).

Exercise: Exertion of the body or the mind with the purpose of training or improvement, performing tasks as a means of practice (Tudor-Locke *et al*. 2003)

ABBREVIATIONS

The following abbreviations appear in this study:

MSP	Musculoskeletal pain
MSD	Musculoskeletal disorder
DUT	Durban University of Technology
PC	Pre-COVID
WFH	Working from home
IREC	Institutional Research and Ethics Committee
LBP	Low back pain
n	Sample number (of participants/respondents)
***p*-value**	Measurement of probability, showing statistical significance
WRMSD	Work-related musculoskeletal disorders
PPE	Personal protective equipment

CHAPTER 1

1.1 INTRODUCTION

The world-wide pandemic COVID-19 initiated international lockdowns and varied degrees of work considerations and enforced remote working as a means to reduce the spread of infection. Ergonomic support for effective remote working during this rapid transition received little consideration.

Musculoskeletal disorders (MSDs) associated with musculoskeletal pain (MSP) are frequently linked to poor ergonomic support at the workplace and compromise the quality of life of those affected. MSP maybe aggravated by prolonged, repetitive, and awkward movements, poor posture and ergonomics, or a fast-paced workload. Additionally, the onset of headaches contributes to approximately a fifth of the total incidence of work-related MSDs, resulting in decreased work productivity.

It is believed that the current shift to remote working may result in an increase in the prevalence in MSP, as well as headaches. This study therefore sought to determine the prevalence and effects of upper body musculoskeletal pain (head, neck, shoulder and back) associated with ergonomic changes of remote working during the COVID-19 pandemic.

1.2 RESEARCH PROBLEM

The COVID-19 pandemic has placed unprecedented pressures on governments, economies, and families. Related measures, such as limits on social gatherings, business closures or lockdowns, have reduced the individual opportunities to move outside the home and interpersonal contact. Moreover, most employees were asked to work remotely during the COVID-19 pandemic. At the Durban University of Technology (DUT) staff members were encouraged to work remotely during the COVID-19 pandemic. With inadequate working equipment and workplace support, a preceding increase in musculoskeletal pain was to be expected. This supports the view that the adverse effects of the pandemic extend beyond the direct consequences of COVID-19 and an area requiring research to inform interventions to redress such effects, in a work climate that is expected to significantly adapt further towards remote working over the next years.

1.3 RATIONALE

Since the outbreak of the fatal coronavirus (COVID-19) in December 2019 and the classification of its spread as a global pandemic in March 2020, daily living has changed drastically. Due to governmental regulations restricting public life (e.g., bans of public gatherings, business closures or city lockdowns) (Wang *et al.* 2020), the ability to move freely has been reduced for the general population.

As of April 2020, various countries took related actions to prevent the spread of the virus (Wang *et al.* 2020). The resulting limit in attending the office and most employees required to work remotely and led to changes in ergonomics, resulting in an increase of MSP. One such example is the DUT academic staff who were encouraged to work from home during the COVID-19 pandemic. This created huge challenges for the academic staff members, with most of them having to work hunched over a coffee table and ultimately leading to the exponential rise in MSP.

MSP effects the musculoskeletal system, such as the muscles, joints, tendons, and other tissues (Simu *et al.* 2014). The current combination of infectious and life-style diseases may contribute significantly to an increase in the incidences of MSP. The spectrum of MSP in developing countries mirrors that of industrialized countries, but the burden of disease is reportedly higher in developing countries due to diagnostic delays or insufficient health-care access (Mody and Brooks, 2012). MSP is caused or aggravated by prolonged, repetitive and awkward movements, poor posture and ergonomics, or a fast-paced workload (Farlex, 2012). Untreated MSP can result in fatigue, pain, and deformity of joints, which subsequently limits physical activity and causes loss of function and long-term disability amongst those affected (Rabiei *et al.* 2015). The discomfort experienced is an outcome of poor ergonomic design, prolonged computer usage, sustained awkward postures, psychosocial environments and high work demands (Akodu *et al.* 2015). Whilst technology has advanced, the workplace remains unchanged, resulting in uncomfortable working circumstances which may have a significant impact on the burden of MSP (Akodu *et al.* 2015). This, consequently, predisposes many to work in uncomfortable situations, such as hunched over coffee tables or on kitchen stools, without proper neck and back support (Kar and Hedge 2021).

This study, therefore, aimed to determine the prevalence and effects of upper body (head, neck, shoulder and back) musculoskeletal pain associated with ergonomic changes experienced with remote working during the COVID-19 pandemic. This research aimed to provide information on all the necessary precautions regarding posture to take while working from home and any preventative measures to prevent musculoskeletal pain while working remotely.

1.4 AIM AND OBJECTIVES:

1.4.1 Aim

To determine the prevalence and effects of upper body (head, neck, shoulder and back) musculoskeletal pain associated with ergonomic changes experienced in DUT academic staff members with remote working during the COVID-19 pandemic.

1.4.2 Objectives

1. To determine the prevalence of musculoskeletal pain among those working remotely during the COVID-19 pandemic.
2. To determine the selected risk factors predisposing to upper body musculoskeletal pain as an ergonomic effect of remote working.
3. To identify the extent to which remote working has impacted the occurrence of MSP, with particular reference to ergonomic aspects.
4. To determine the effects of musculoskeletal pain and its impact on work performance/productivity.
5. To provide guidelines/recommendations and future considerations to support the prevention of MSP during remote working.

1.5 OUTLINE OF CHAPTERS

Chapter One: The topic of the study is introduced, research problem stated, rationale and the aims and objectives.

Chapter Two: Provides a review of the literature pertinent to this topic to facilitate further understanding of the research and the need for the study.

Chapter Three: Details the methods and materials that were employed in this study, as well as how the data were statistically analyzed.

Chapter Four: Provides the results and interpretation of the data collected.

Chapter Five: Delivers an interpretation and discussion of the results.

Chapter Six: Draws conclusions from the study and provides recommendations for future studies in this field.

The references provide a list of all the academic sources used for this dissertation. The appendices include all appropriate, additional material used in this study.

CHAPTER 2 LITERATURE REVIEW

2.1 BACKGROUND OF THE COVID-19 PANDEMIC

In December 2019, an outbreak of pneumonia of unknown origin was reported in Wuhan, Hubei Province, China. Most of these cases were epidemiologically linked to the Huanan Seafood Wholesale Market. (Zhu *et al.* 2019). Inoculation of bronchoalveolar lavage fluid obtained from patients with pneumonia of an unknown origin into human airway epithelial cells led to the isolation of a novel coronavirus, officially named both COVID-19 or SARS-CoV-2, previously named 2019-nCov (Zhu *et al.* 2019). Clinical symptoms in patients infected with COVID-19, can present a wide range of symptoms, ranging from mild to severe. Fever, cough, and shortness of breath are the most common symptoms (Wang *et al.* 2019). In those patients who develop pneumonia, multiple mottling and ground-glass opacity are described on chest x-rays (Wang *et al.* 2019). Patients who develop acute respiratory distress syndrome may worsen rapidly and die of multiple organ failure (Wang *et al.* 2019). Patients with COVID-19 had gastrointestinal symptoms such as vomiting, diarrhea, and abdominal pain (Wang *et al.* 2019). Diarrhea and nausea preceded the development of fever and respiratory symptoms (Wang *et al.* 2019). Unfortunately, COVID-19 did not remain in China, but it also made its way around the globe and eventually found its way to South Africa in March 2020.

At the beginning of March 2020, South Africa (a country of 59 million inhabitants) was hit by the pandemic of COVID-19 and soon became the most affected country in Africa. South Africa entered the fight against COVID-19 in March 2020, with the first declared positive case on March 5th in KwaZulu-Natal (Bouchard and Stiegler 2020). From one single case on March 5th, the number of cases increased rapidly, forcing the South African government to swiftly react and place the country under strict ‘lockdown’ for six weeks (Bouchard and Stiegler 2020). Due to governmental regulations restricting public life (e. g., bans of public gatherings, business closures or city lockdowns) (Wang *et al.* 2020), the ability to move freely was reduced for the general population. Related measures, such as social distancing, considerably reduced the individual’s opportunities to move outside the home and reduced interpersonal contact (Bouchard and Stiegler 2020) (Wang *et al.* 2020). Moreover, most employees were asked to work remotely during the COVID-19 pandemic.

Working from home suddenly became the new normal as many organizations and workers try to keep operating under the social distancing restrictions needed to stamp out the spread of the COVID-19 virus. Working from home not only eliminated the potential spread of the virus at the workplace - between employees and between employees and customers - but also reduced the social contact associated with commuting to and from the workplace (Dockery and Bawa 2015).

COVID-19 has resulted in many businesses closing down and workers losing their jobs, but thanks to the capacity to work from home, many jobs have been saved and some core businesses have been able to continue operating and providing essential services (Dockery and Bawa 2015). Some employees may have been well accustomed to, and set up for, working from home. Others were grappling with trying to work from home for the first time (Dockery and Bawa 2015), and suddenly had their spare rooms or living spaces converted into a makeshift office.

With inadequate working equipment and workplace support, a preceding increase in musculoskeletal pain was to be expected (Dockery and Bawa 2015). This supports the view that the adverse effects of the pandemic extend beyond the direct consequences of COVID-19 and an area requiring research to inform interventions to redress such effects, in a work climate that is expected to significantly adapt further towards remote work in the future.

2.2 LOCKDOWN AND REMOTE WORKING

Abrupt changes due to the swift effects of the COVID-19 pandemic hit all sectors in society worldwide, ranging from daily life activities to work formats. Before the “the new normal” became a popular catchphrase, workers spent most of their time at homes or at their workplaces (Nakrosiene, Buciuniene and Gostautaite 2019). Ongoing developments in information technology have made communication more convenient and work more flexible (Lyu and Wehby 2020). Furthermore, companies, communities, and organizations of all kinds have reconciled how to merge both places together by adjusting to working from home and using a work agreement with a single employer. Work may be classified into two types: full-time meaning every weekday at home and part-time meaning working partly at home and partly at the office (Nakrosiene, Buciuniene and Gostautaite 2019). Working from home is beneficial for employees, employers, and society in terms of the economy and the environment (Bailey and Kurland 2002).

In the first three months of 2020, the COVID-19 pandemic began. The worldwide public health policy implementation to prevent the spread of this disease in the community was social distancing or physical distancing (Cirrincione *et al.* 2020). Working from home is one measure of this prevention method, while continuing to operate in a normal way for the benefit of businesses (Lyu and Wehby 2020). Work systems functioned continuously in terms of operation but changed from a traditional workspace in the office to one in the home. Some workplaces, such as universities, international companies, and so on, allowed employees to work from home on a full-time basis, whereas some workplaces allowed partial working from home, such as government organizations. Some jobs were not suitable for working from home, or for new and rapid changes to working from home, which were not adaptable (Kramer and Kramer 2020). Remote working could cause changes in health, result in lifestyle changes, and affect workers' wellbeing (Tavares 2017). The appearance of the unprecedented COVID-19 situation was an opportunity to investigate the health effects brought about by changing normal work life from typical workplaces to working from home (Ekpanyaskul and Padungtod 2021).

2.3 ACADEMIC STAFF MEMBERS

The COVID-19 pandemic shattered daily routine and triggered chaos, fear, anxiety, and stress among people (Montemurro 2020). Academic staff are specialist who are employed for critical assistance in the achievement of the goals and objectives of the intuition where they are employed (Ojoawo, Awotidebe, and Akinola 2016). The pandemic significantly affected the physical and mental state of people in all sectors, including the academic fraternity all over the globe. Due to the complete isolation measures and closure of the universities and colleges, the academic fraternity was under immense amount of mental pressure, raising the prevalence and rate of stress, anxiety and depression among them (Charnsil and Chailangkarn 2020).

The COVID-19 pandemic brought the work from home scenario into discussion. Due to the dilemma of lockdown and to maintain social distancing, authorities such as university deans, heads of departments and parents instructed the teaching fraternity to take their classes online (Choudhury *et al.* 2020). All professionals took this safer option to stay at home and work during the global pandemic. Though it was the immediate need, studies are showing it can be deleterious to physical and mental health (Bane, Aurangabadkar and Karajgi 2021).

Currently, the working pattern of academics has changed to a great extent with respect to preparing for classes/lectures on PowerPoint presentations, conducting online seminars/lectures and assignments leading to increased computer use. Awkward sitting postures and repetitive tasks make teachers susceptible to MSP (Bane, Aurangabadkar and Karajgi 2021). MSP occurs over time and is associated with strenuous and repetitive work (Bane, Aurangabadkar and Karajgi 2021). The frequent use of laptops and cell phones, both to support academic activity and in free time, tends to adopt inappropriate posture that causes pain and musculoskeletal alterations in upper limb and spine (Bane, Aurangabadkar and Karajgi 2021). Academic staff members also must deal with lot of cognitive demands, such as planning and preparing for online lectures, and using technology for their online academic, scientific research and for their administrative duties during this lockdown period. In some households with hardly any domestic help at home and balancing the domestic chores, taking care of family needs, and completing online teaching assignments can be stressful to the teaching faculty. The workload of teachers may be considered quite high and, consequently, the teaching profession may be characterized by high level of stress and physical complaints (Wang and Zhao 2020)

2.4 IMPACT OF REMOTE WORKING

Nowadays, working from home is a modern work-life practice and an increasing trend that may become a major working condition in some jobs and during critical events, such as the COVID-19 outbreak (Bouziri *et al.* 2020). Working from home may not only revolutionize the traditional concept of the workplace but may also result in occupational health risks (Bouziri H *et al.* 2020). The COVID-19 crisis and disruption provided a real-life opportunity to test workers who had never worked from home and had to deal with this sudden shift in the workplace and subsequent challenges to the modern economy (Ekpanyaskul and Padungtod 2021).

The rapid shift in working conditions of millions of office workers raised some significant ergonomic considerations. The shift towards a ‘‘home-office’’ model was deemed advantageous as it minimized the transmission of the infection and mitigated unemployment risks (Davis *et al*. 2020). Due to the pandemic, many companies had to abruptly adjust operations and many employees had to suddenly adapt to working from home (Alon *et al.* 2020).

Employees today exhibit higher dependence on ergonomic designs than before, considering the emergence of new jobs and transforming old ones and the paradigm shift in desk work conditions experienced in recent decades (Karir *et al.* 2018). Moreover, a new generation of workers, shaped by a communication society, appears to be more inclined and motivated in terms of working from home (Fadinger and Schymik 2020). Remote work style may also cause psychosocial health problems and musculoskeletal pain. Ultimately, musculoskeletal disorders are because of unsatisfactory ergonomic environments (Kar and Hedge 2021).

Ergonomics promotes a holistic, human-centered approach to work systems design in which cognitive, environmental, organizational, physical, social and other factors are considered (Karwowski 2012).

There are three goals 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 (Chandra *et al.* 2009).

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). In a typical home environment, furniture is selected based on emotional response, comfort perception, and build quality — not the features required to do work healthily and efficiently (Ponder 2013). The dimensions, angles, and curvature of the furniture, support characteristics, the ability to enable tissue perfusion, and breathability are not always a concern. Additionally, the placement of the furniture and relationships between worktops and seating surfaces are rarely optimized for work (Ponder 2013).

Workstation position, which includes the height, distance and tilt angles of a desk, computer monitor, and/or chair, may affect postural alignment. Both individual factors and environmental factors contribute to negative ergonomical effects while working remotely. 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). Environmental risk factors include work procedures, equipment and organizational factors such as business location, culture, tasks and technology (Akodu *et al.* 2015). Sedentary tasks are 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, and the combination of bad postures and movements, repetitive motions, force and vibrations (Fisher, Konkel and Harvey 2004).

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 and pain, which may lead to chronic discomfort, pain, and possible functional impairment. Worldwide, office workers commonly report musculoskeletal disorders (Mahmud *et al.* 2011).

The design and maintenance of a suitable work environment are some of the objectives of ergonomics to improve workers' performance, reduce stress and fatigue at work. The application of ergonomics is significant in the area where manual activities directly affect the physical and mental health of employees (Lindhom *et al.* 2010).

Along with the negative postural considerations during remote working, COVID-19 has had a profound effect on people's thoughts, emotions, and behavior. Understandably, it has generated much fear and panic globally. Psychological health issues relating to vulnerability and premorbid functioning, with social and economic factors contributing heavily, are correlated to the pandemic and have been widespread and varied in presentation (Pillay and Barnes 2020). Therefore, two of the main impacts of COVID-19 are the psychological impacts and the physical impacts of COVID-19.

2.4.1 Psychological Impact of COVID-19

It is well documented that the COVID-19 pandemic has resulted in large increases in unemployment in many countries (Blustein *et al.* 2020). South Africa is no exception. Studies estimate that between 2. 2 and 2. 8 million adults in the country lost their jobs from March to April 2020, following the lockdown and the wide-scale suspension of economic activity (Jain *et al.* 2020). This loss of employment had significant implications for people's access to economic resources (Casale and Posel 2020) and it may also be an important reason that elevated depressive symptoms were reported among adults during the first months of the pandemic (Oyenubi and Kollamparambil 2020; Posel, Oyenubi and Kollamparambil 2021).

The COVID-19 pandemic is one of the most serious disease outbreaks over the past century. It has induced significant distress and anxiety for patients and medical providers. Stress is the acute response to something fearful, unpredictable, and uncontrollable; it can also potentiate anxiety, an adaptive response that promotes harm avoidance (Li and Wang 2020; Cao *et al.* 2020). However, circumstances producing sustained distress, such as the COVID-19 pandemic, can result in overwhelming and excessive anxiety (Li and Wang 2020; Cao *et al.* 2020).

Studies of pandemics faced over time, such as SARS, Ebola, H1N1, Equine Flu, and the current COVID-19, show that the psychological effects of contagion and quarantine are not limited on the fear of contracting the virus (Barbisch *et al.* 2015). There are some elements related to the pandemic that affect more the population, such as separation from loved ones, loss of freedom, uncertainty about the advancement of the disease, and feelings of helplessness (Li and Wang 2020; Cao *et al.* 2020).

As a result of the emergence of COVID-19 outbreak in the Chinese city of Wuhan, a situation of socio-economic crisis and psychological distress rapidly occurred worldwide (Xiang *et al*. 2020). Many psychological problems and important consequences in terms of mental health including stress, anxiety, depression, frustration and uncertainty during the COVID-19 outbreak emerged progressively (Duan and Zhu 2020). The modern world in which all individuals can travel and communicate rapidly has been rarely forced into social isolation and restrictions and this is linked to feelings of frustration and uncertainty (Duan and Zhu 2020). This unprecedented situation related to COVID-19 outbreak is clearly demonstrating that individuals are largely and emotionally unprepared to the detrimental effects of biological disasters that are directly showing how everyone may be frail and helpless due to social isolation (Khan *et al.* 2020)

Social isolation related to restrictions and lockdown measures are linked to feelings of uncertainty for the future and fear of new and unknown infective agents, resulting in abnormally increased anxiety. Importantly, feelings of frustration and uncertainty have tended to occur even about inadequate basic supplies (e.g., food, water, clothes, etc.) during the quarantine period, as a major source of worries, anxiety and anger, even after four to six months in quarantine (Khan *et al.* 2020). Another effect of social isolation is loneliness and boredom, which have potential dramatic effects on both physical and mental individual well-being (Khan *et al.* 2020). Both frustration and loneliness seem to stem from the inhibition from daily activities, interruption of social necessities, and inability to take part in social networking activities, enhancing the risk of hopelessness and suicidal behavior in this specific context (Khan *et al.* 2020). Overall, it is well known that long periods of social isolation or quarantine for specific illnesses may have detrimental effects on mental wellbeing (Khan *et al*. 2020).

Implementing community-based strategies to support resilience and psychologically vulnerable individuals during the COVID-19 crisis has been fundamental for communities (Amerio *et al.* 2020). The psychological impact of fear and anxiety induced by the rapid spread of the pandemic needs to be clearly recognized as a public health priority and should clear behavioral strategies to reduce the burden of disease and the dramatic mental health consequences of this outbreak should be rapidly adopted (Amerio *et al.* 2020). Despite the phycological impacts of COVID-19, the physical impacts of COVID-19 due to remote working is also of high concern.

2.4.2 Physical Impact of COVID-19

Today, the increasing prevalence of musculoskeletal pain especially in the neck and upper limbs among office workers and academic staff members is one of the concerns of managers of organizations and occupational health and ergonomics engineers (Hoe *et al.* 2018). Musculoskeletal pain linked to working conditions can be identified by multiple clinical manifestations in the bones, muscles, and joints, and is correlated with some habits or activities related to the patient's working environment (Ezzatvar *et al.* 2020). In the United States, work-related neck and upper limb disorders have been reported to account for 56%–65% of all occupational injuries with over two billion dollars direct and indirect costs annually (Punnett and Wegman 2004)

According to previous studies, the main causes of MSP in office work can be classified into three main groups: (a) physical load factors (such as muscle load, posture and movement, work force and visual needs of work); (b) organizational factors of work, psychological and social factors and mental stress (such as work pattern and duration of work, management and communication style, support and job motivation); and (c) individual factors (such as age, gender, attitude and knowledge) (Sohrabi and Babamiri 2021). In ergonomics, the posture and movement of a worker are important information for determining the risk of MSP in the workplace (Vink *et al.* 1995).

2.5 MUSCULOSKELETAL PAIN SYNDROME

Musculoskeletal disorder (MSD) is defined as "a disorder of the muscles, tendons, peripheral nerves or vascular system not directly resulting from an acute or instantaneous event (e. g., slides or falls) (WHO 2017). Musculoskeletal disorder is one of the health problems which can be caused by the workforce. Work-related to musculoskeletal disorders signed by general chronic pain (Occhionero, Korpinen and Gobba 2014). These disorders are considered to be work-linked when the work environment and the performance of work contribute significantly but are just one of a number of genes leading to the movement of a multi factorial disease (WHO 2017). The reasons for MSDs are direct injuries, insufficient or inappropriate equipment, inappropriate work area design, or sitting for extended times with a flexed and twisted back and repetitive movements are contributing factors to neck and back ailments (Kierklo *et al.* 2011). Musculoskeletal disorders are among the most common disorders that contribute to days off from work, disabilities and general practitioner visits (Dagenais, Caro and Haldeman 2008). Research reviews have confirmed the dose-response association between the number of hours working at a computer workstation and the risk of MSDs, which include pain and other symptoms in the shoulder-neck, back and upper limbs particularly, which are common in academic staff members (Gerr, Marcus and Monteilh 2004, 2006; Vieira and Kumar 2004).

2.5.1 Pathophysiology of Musculoskeletal Disorders

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). The pain is dependent on the relative oxygen deficiency, irritating metabolites, lactic acid accumulation, and reduced intracellular potassium (Grieco and Molteni 2003). 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). 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 (Grieco and Molteni 2003).

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 (Grieco and Molteni 2003). Another aspect to consider is the nutritional supply of the intervertebral discs, which is by avascular means (Grieco and Molteni 2003). Nutritional supply takes place through diffusion of substances from adjacent tissues, through osmotic pressures and hydrostatic pressures. Prolonged fixed postures can therefore obstruct nutritional exchange (Grieco and Molteni 2003). This may result in a long-term effect that can induce degeneration processes of the intervertebral discs (Grieco and Molteni 2003). For these reasons, taking regular breaks to change position and move from the workstation are essential (Chim 2014). Research also suggests that muscle tension can be induced by mental stress thereby increasing the prevalence of musculoskeletal symptoms (Janwantanakul *et al.* 2010). 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, increase the likelihood of developing MSP (Chim 2014).

2.6 HEADACHES

According to the IHS (2004), a headache is “a pain located above an imaginary line drawn from the outer or lateral part of the orbit of the eye to the center of the external auditory meatus of the ear”. Worldwide, headache disorders are a painful and disabling condition. According to the World Health Organization, headache disorders are the third leading cause of years lost due to disability worldwide (Institute for Health Metrics and Evaluation 2013). Personal and work life may be equally affected in individuals who suffer from primary headaches (Bussone *et al.* 2004). Headaches affect almost half of the general population and about two thirds of the adolescent population, leading to a decreased quality of life (Larsson and Fichtel 2014). Decreased productivity due to headaches has a negative impact on the economy due to absenteeism, loss of productivity and the resultant loss to the economy (Jensen and Stovner 2008). Headaches result in functional disability, thereby impacting on the quality of life of the sufferers (Bussone *et al*. 2004). Days lost at work increased with headache severity (Wöber-Bingöl *et al.* 2014). Headaches are common, painful, often repetitive, disorders that can cause personal and professional hardship. Headaches are classified as primary and secondary (International Headache Society 2013).

2.6.1 The Two Categories of Headaches

The IHS (2004) classifies headaches as follows:

- Primary headache syndrome, which refers to a headache that exists entirely independent of any other disease process.
- Secondary headache that is caused by, or is secondary to, an underlying disease process or medical condition.

Primary headaches occur due to over-activity of pain sensitive structures in the head area. Blood vessels, nerves and muscles of the head and neck area contribute to the development of primary headaches (Mayo Clinic 2015). Secondary headaches are due to another disorder. The location of the headache is close to the temporal region and there is evidence of a causal relationship with another disorder. The headache will either resolve within three months or less depending on the causative disorder, treatment or remission of the disorder. Some examples include neck and/or head trauma, cranial or cervical disorders, infections and non-vascular intracranial disorders (International Headache Society 2013).

2.6.2 The Different Types of Headaches

2.6.2.1 Tension Type Headache (TTH)

A tension-type headache (TTH) is the most common primary headache and TTH commonly presents in the second and third decade of life (Stovner *et al.* 2007). Tension-type headaches are recurrent and may last anywhere between a few minutes to weeks (Chowdhury 2012). It is described as a band-like sensation around the head and is associated with tension, anxiety, and chronic contractions of the scalp muscles (Blumenfeld, Schim and Brower 2010). Frequent tension-type headaches occur with at least 10 episodes during a period of one to 14 days per month. This recurs for more than three months. Tension-type headaches are regarded as infrequent if there is an average of 12 headache episodes per annum (International Headache Society 2013).

2.6.2.2 Migraine Headaches

Migraine headaches affect many people throughout the world, having a global prevalence rate of 11% (Stovner *et al.* 2007). They present as unilateral, severe, pulsatile, throbbing pain in the temporal region, accompanied by symptoms such as photophobia, phonophobia, nausea and/or vomiting (Blumenfeld, Schim and Brower 2010).

There are three phases of a migraine. The first is the “warning phase” of a migraine and can occur several hours before the onset of the headache. About 33% of migraine sufferers experience this, and common symptoms include fatigue, gastrointestinal distress, and/or mood changes (Kelman 2004).

The second phase is the “aura phase” that is experienced by about a third of people with migraines. During this period people experience visual, auditory, or motor symptoms (McCance *et al*. 2010). The aura may last up to an hour or longer, and roughly 90% of those who experience aura develop the proceeding headache on the same side of the head.

The last phase in migraine headaches is the “headache phase” during which actual headache symptoms occur and is characterized by unilateral, throbbing pain that worsens with movement. They are often accompanied by nausea/vomiting, and the sufferer usually has sensory sensitivity to light, smell, and/or noise. Migraines can be defined as either episodic (less than 15 attacks per month) or chronic (15 attacks or more per month for at least three months) (Headache Classification Committee of the International Headache Society 2013).

There are various triggers common in patients with migraine: stress, weather changes, certain foods, skipping meals, too much or too little sleep or caffeine, bright sunlight, alcohol, strong odors, and menstruation (Wöber and Wöber-Bingöl 2010).

2.6.2.3 Cluster Headaches

A cluster headache presents as a unilateral headache located within the orbital, supraorbital or temporal region. It may also occur in more than one of these regions (International Headache Society 2013). They are characterized by severe unilateral pain, restlessness, and a recurrent pattern of attacks that may occur several times per day and last for 6–12 weeks on average, followed by a period of remission (International Headache Society 2013). There is also a tendency for abnormal bodily sensations to occur on the same side as the headache, such as a drooping eyelid and sweating (May 2005). It may also be accompanied by symptoms such as ipsilateral sweating, flushing of the facial or forehead area, rhinorrhea, lacrimation, nasal congestion or eyelid oedema. Restlessness or agitation usually accompanies the headache (International Headache Society 2013). A disturbance of this cycle causes molecular, biochemical, physiological, and behavioral changes which can then result in the headache (Germain and Kupfer 2008).

2.4.6.4 Headaches Associated with Personal Protective Equipment (PPE)

During the escalation of the COVID-19 pandemic outbreak throughout the world, frontline healthcare workers in all major hospitals were mandated to wear personal protective equipment (PPE) while caring for suspected or confirmed COVID-19 patients, which involved the donning of close-fitting N95 face masks, protective eyewear (mainly goggles), gowns, surgical gloves, and the use of powered air-purifying respirators (PAPR) (Wong, Leo and Tan 2020). In real world practice, donning of the PPE by frontline healthcare workers is often felt cumbersome and uncomfortable (Wong, Leo and Tan 2020), especially if a long period of exposure to such equipment is necessary during the outbreaks of emerging infectious diseases (Rebmann *et al*. 2009). A previous study among nurses working in a medical intensive care unit reported headaches as one of the main factors accounting for sub-optimal N95 face mask compliance (Rebmann, Carrico and Wang 2013). Previous reports highlighted that pain or discomfort (headache, facial pain, and/or ear lobe discomfort) arising from tight-fitting face masks and elastic head straps resulted in limited tolerability when the N95 face mask was used for a prolonged period (Shenal *et al.* 2012). The severity of headaches associated with PPE is clinically significant and might worsen if the outbreak spreads widely and stays for a longer time, affecting the work performance of healthcare workers and therefore better treatment strategies should be approached (Wong, Leo and Tan 2020).

2.7 NECK PAIN

Neck pain is one of the major musculoskeletal disorders in the adult population (Vingard 2006). Neck pain has been defined as stiffness and/or pain felt dorsally in the cervical region between the occipital condyles and the C7 vertebra, accompanied by pain in the occiput (presenting as a headache), upper thoracic region and jaws, and may be associated with pain referred along myotomal patterns (Ferrari and Russell 2003).

Neck pain is defined by Nachemson and Jonsson (2000) (cited by Jensen and Harms-Ringdahl 2007) by the duration of the pain: acute (0-3 weeks of pain and/or disability), subacute (4-12 weeks of disability), chronic (more than 12 weeks of disability) or recurrent (patients seeks help after one month of not seeking care or being on sick leave after at least one month of working) (Jensen and Harms-Ringdahl 2007).

Across the world, it was observed that individuals who reported neck pain were the ones who performed manual activities above shoulder level, utilized vibrating tools, and remained in the sitting or standing position with bent necks (Yue, Liu and Li 2012). Neck pain is a major cause of morbidity and disability in everyday life and at work in many countries. It can have an impact on the individual's physical, social, and psychological well-being, contributing to increasing costs to society and businesses. In addition, with the increasing aging population of medium and low-income countries, the prevalence of neck pain will grow significantly in the coming decades (Hoy D *et al.* 2010)

2.7.1 Summary of the Anatomy of the Cervical Spine

The spine serves to provide an axis for movement, supports the weight of the body and protects the spinal cord and other nervous structures (Moore, Dalley and Agur 2010). The cervical spine consists of seven vertebrae, that extend from the base of the skull to the thorax (Drake, Vogl and Mitchell 2005; Moore, Dalley and Agur 2010).

2.7.2 Diagnosis

Neck pain is diagnosed when the source of the pain/stiffness is found in the cervical region between the occiput and the seventh cervical vertebrae. The symptom distribution includes the head, jaw, and upper limb, including the nerve myotomal and dermatomal patterns (Ferrari and Russell 2003). The diagnosis of neck pain is also determined by the patients' complaint and the doctor's physical examination as either acute, subacute or chronic (Larsson *et al.* 2007). An acute diagnosis is made from the onset of pain until three-month duration. It is typically caused by muscle, tendon or ligament strain due to high impact trauma. A subacute diagnosis is made within seven to 12 weeks of experiencing pain. It has a lengthy and ongoing commencement and can disappear and reappear with no intermittent symptoms (Chanda *et al.* 2011). A chronic diagnosis is made when the pain presents for more than three months (Chanda *et al.* 2011).

2.7.3 Causes of Neck Pain

The causes of neck pain can be classified as mechanical, non-mechanical, inflammatory, myofascial or radicular (Le Roux 2016).

2.7.3.1 Mechanical

Mechanical pain is of spinal origin, primarily due to dysfunction of the articular facet with no definitive pathology (Endean, Palmer and Coggon 2011). Mechanical pain is aggravated by physical and psychological stress and is typically relieved by rest (Endean, Palmer and Coggon 2011). Symptoms include a history of repetitive neck movement, irregular range of motion, trauma and dysfunctional postures (Boon and Davidson 2006).

2.7.3.2 Non-Mechanical Pain

Non-mechanical pain is of a non-spinal origin but rather a pathological, traumatic or degenerative origin (Sherman *et al*. 2009). The origin of non-mechanical neck pain is not often easy to pinpoint because of the non-specific referral pain patterns to the occiput, temple, face, scapula, shoulder, arm or chest (Boon and Davidson 2006).

2.7.3.3 Inflammatory Pain

Inflammatory pain is due to inflammation. Inflammation is a normal healing process, but chronic inflammation within the joint leads to tissue damage, for example arthritis. The released chemicals lead to increased blood flow resulting in swelling which can cause nerve stimulation and pain (Zelman 2016). Inflammatory pain is commonly found within the elderly with cervical spondylitis and rheumatoid arthritis. Symptoms include 12 gradual onsets of pain in multiple segments of the spine and extremities, accompanied by morning stiffness (Boon and Davidson 2006).

2.7.3.4 Radicular Pain

Radicular pain is a result of nerve root compression either by an osteophyte (excess bone formation) or herniation of an intervertebral disc (mostly C6 disc leading to C7 radiculopathy) (Boon and Davidson 2006). Disc degeneration, herniation and trauma may lead to symptoms that include sharp shooting pain down the shoulder, arm and hand, with associated numbness and tingling (Moore and Dalley 2006)

2.7.3.5 Myofascial Pain

Myofascial pain is caused by muscle and fascial dysfunction from trauma and muscular overuse (Phillips and Froese 2016). Myofascial pain is poorly localized, ranging from mild discomfort to severe discomfort and can be associated with paraesthia (Saxena *et al.* 2015). Treatment depends on the severity of the signs and symptoms and can be treated conservatively or surgically (Saxena *et al.* 2015). A more complicated version of myofascial neck pain has a longer duration of symptoms and results from a combination of different contributing factors, leading to a more complex assessment and treatment protocol.

2.8 TREATMENT

There is usually a multidisciplinary approach to the treatment of neck pain (Ferrari and Russell 2003).

The *International Neck Pain Task Force* (Hurwitz *et al.* 2008) and other systematic reviews have reported that exercises and manual therapy provide some degree of short-term relief of non-traumatic neck pain (Boocock *et al.* 2007; D'Sylva *et al.* 2010; Miller *et al.* 2010). Other studies have reported significant effects of resistance exercises in strengthening neck–shoulder musculature and reducing neck pain among office workers (Andersen *et al*. 2014; van Eerd *et al*. 2016). Additional modalities such as transcutaneous electric powered nerve stimulation (TENS) or low-level laser therapy (LLLT) are helpful for short term symptom reduction. Rehabilitation in the form of cervical exercises, several times per week, is effective as a non- invasive treatment (Jensen and Harms-Ringdahl 2007).

2.9 SHOULDER PAIN

2.9.1 Summary of the Anatomy of the Shoulder Joint

The shoulder joint is comprised of both bony (humerus, glenoid, scapula, acromion, and clavicle) and soft tissue components (e.g., rotator cuff muscles, glenohumeral ligaments, subacromial bursa) (Woodward and Best 2000). The shoulder complex is comprised of three articulations that is. the glenohumeral, acromioclavicular and scapulothoracic. The glenohumeral joint is primarily secured by the muscles which attach to it due to the relatively small size of the socket in relation to the size of the humeral head (Di Giacomo *et al.* 2008).

The main muscle group involved in the dynamic stability of the glenohumeral joint is the rotator cuff. This is comprised of four muscles: subscapularis, supraspinatus, infraspinatus and teres minor, which all have different origins but a common attachment to the joint capsule (Di Giacomo *et al.* 2008).

The arterial supply to the glenohumeral joint is from the anterior and posterior circumflex humeral arteries and branches of the suprascapular artery (Moore and Dalley 2006).

There are many bursae located in the shoulder girdle which are important in the functioning of the shoulder as they allow for gliding between adjacent structures. The two main bursae are the subacromial bursa, below the acromion and coracoacromial ligament and above the supraspinatus muscle, and the subscapular bursa between the subscapular tendon and the neck of the scapula (Moore and Dalley 2006)

The shoulder joint has several degrees of freedom which permit a large range of movement, such as flexion, extension, abduction and adduction, internal and external rotation. These movements allow the shoulder joint to facilitate the many activities of daily living (ADL) (Bickley and Szilagyi 2009). Aberration in the functions of the shoulder can affect ADL, such as grooming, bathing, and dressing (Roy 2012).

2.9.2 Diagnosis of Shoulder Pain

The shoulder is prone to several pathologies which present a diagnostic challenge to clinical evaluation (Silva *et al.* 2008) and obtaining a specific diagnosis of shoulder pain is difficult and can vary between professionals. The correct diagnosis is required for effective treatment of shoulder pain (Burbank *et al.* 2008) but due to the anatomical structure and wide ROM of this joint, it can be challenging (Woodward and Best 2000). Moreover, assessment of the same shoulder movement can vary considerably amongst professionals (Burbank *et al.* 2008). There are difficulties associated with diagnosing shoulder pain due to the highly mobile nature of the shoulder joint, and the possibility that there is more than one lesion which may influence the outcome of specific tests (Burbank *et al.* 2008). A thorough case history is vital to the outcome of the clinical diagnosis. The history is the first step in the evaluation of any patient's chief complaint as a good clinical history supplemented by the examination findings will often lead the physician to the correct diagnosis (Wyatt 2005).

2.9.3 Clinical Diagnosis of Shoulder Pain

Fractures and dislocations are often associated with a fall onto an outstretched hand or a direct trauma to the area, such as of the result of a motor vehicle accident or sporting activities (Vassallo, 2008). The patients tend to avoid movement of the limb which may show deformity (i.e., the attitude of the limb) and swelling (Vassallo 2008).

Impingement syndrome can occur at any age and is characterized by a painful arc of motion when the arm is raised above shoulder height (De Berardino 2012).

Patients with instability usually have history of injury or repetitive microtrauma and tend to avoid certain movements due to fear of pain 12 (apprehension) or dislocation (Vassallo 2008).

Muscular pathologies include rotator cuff injury characterized by pain, weakness and decreased ROM and are found in young athletes and more commonly in patients older than 40 years of age (Quintana 2012).

Bicipital tendonitis is characterized by local tenderness and pain on movement which is exacerbated by lifting objects and can be tested with simple orthopedic tests, such as the Speed’s test (Durham 2012).

Patients with supraspinatus tendonitis often have an athletic history or an occupation involving repetitive overhead work and it can be associated with impingement syndrome.

Adhesive capsulitis has a slow onset and is indicated by a gradual decrease in ROM and an increase in pain with the inability to sleep on the affected side (Vassallo 2008).

Suprascapular neuropathy can mimic the symptoms of rotator cuff tendinopathy. However, these patients often have a history of loading the shoulder in an abducted and externally rotated position and painless atrophy of the infraspinatus muscle (Reeser 2011).

Bursitis can occur at any age but more frequently occurs in older patients due to inflammatory joint disease, repetitive injury or infection. It is characterized by decreased ROM, swelling and nocturnal pain (Harold 2009)

2.9.4 Treatment of Shoulder Pain

The treatment of shoulder pathology depends on the clinical and/or the radiographic diagnosis and usually involves conservative, medical or surgical care (Vassallo 2008). There are two main types of treatment approaches namely, conservative and surgical. Conservative treatment does not involve surgical intervention and is aimed at preventing the progress of a disease process, controlling symptoms, pain management and activity modification (Pandya 2011). Surgical treatment is a more invasive form of treatment for diseases or injuries that involve operative procedures (e.g., soft tissue release, tenosynovectomy, synovectomy, osteotomy, etc.) to provide pain relief and restore function (Colledge *et al.* 2010).

2.9.4.1 Conservative Treatment

There are two types of conservative treatments: invasive conservative treatment and non-invasive conservative treatments. They depend on the degree of penetration of the skin. Non-invasive conservative care refers to the use of modalities and techniques which do not penetrate the skin such as manipulation and mobilization, US, transcutaneous electrical nerve stimulation (TENS), ischemic compression, stretching, etc. (Vassallo 2008).

Invasive care refers to dry needling, acupuncture and injection which penetrate the skin (Kalichman and Vulfsons 2010). Invasive techniques are riskier than non-invasive methods due to the possibility of introducing infection into the body. The use of sterile needles that have not been utilized before and the practice of aseptic techniques (e. g., wiping relevant area with alcohol swab) minimizes this risk (Dommerholt and De las Penas 2013).

Conservative treatment may involve rest, inflammation and pain control, soft tissue therapy (massage and ischemic compression), ROM and proprioception exercises, as well as stretching and strengthening exercises to increase functioning of the shoulder (Gonzalez 2011). Cryotherapy (e.g., ice), heat, mobilization, physiotherapy, manipulation and home care can also be used in the treatment (Hains 2002).

2.9.4.2 Surgical Treatment

Patients are often referred to an orthopedic specialist when there has been a poor response to non-operative treatments, disabling pain or have an unknown diagnosis (Burbank *et al*. 2008). Surgery may also be indicated by radiographs (in the case of fractures and dislocations) (Burbank *et al*. 2008). Post-surgical and onset of the rehabilitation, opioids are used as a part of the management process. Unfortunately, opioids have side-effects such as nausea, vomiting and respiratory depression, and their therapeutic window is short (Kavanagh *et al.* 1995). Rehabilitation can be complex and both physical and emotional factors need to be considered in chronic and post-surgical treatment. General goals of treatment include increasing function and quality of life and decreasing pain, symptoms and dependence on caregivers (Burbank *et al*. 2008).

2.10 BACK PAIN

2.10.1 Introduction to Low Back Pain

Low back pain causes personal suffering, disability, and impaired quality of life and work in general, which can pose a great socioeconomic burden for both patients and society (Manchikanti *et al.* 2014). Office workers are usually required to sit for long hours working on a computer, spending most of their time in a sitting position. Occupational groups exposed to poor postures while sitting for longer than half a day have a considerably increased risk of experiencing LBP (Lis *et al.* 2007). The prolonged postural loading of the spine while sitting can reduce joint lubrication, fluid content of intervertebral discs, and increase stiffness, which can be detrimental to back health (Chan *et al.* 2011).

2.10.2 Summary of the Anatomy of the Low Back

The lumbar spine (low back) is the segment of the spine in which there is an inward curvature (lordosis) toward the abdominal region. The lumbar spine joins with the thoracic spine (mid-back) at the top and extends into the sacral spine where it forms the lumbosacral joint (L5-S1) (Fine and Stokes 2018). The lumbar spine is made up of five vertebral bones which are interconnected above and below by the intervertebral 9 disc, ligaments and muscles. This (lumbar spine) provides a flexible support structure and protects the spinal cord (Fine and Stokes 2018; Wilke and Volkheimer 2018). Each vertebra articulates with the next through two zygapophyseal joints, commonly known as the facet joints, one on each side of the vertebrae and through the intervertebral disc (IVD) (Kishner 2014). The facet joints are required to withstand large amounts of stress from the body and are often subjected to acute and repetitive injuries which may lead to degenerative arthritis (Laub 2008). Pain may originate from these structures due to degenerative or inflammatory processes within the joint itself or from any outgrowth from the joint which may impinge on nearby structures; referred to as facet syndrome (Malanga 2011). At the base of the lumbar spine there is a large, triangular and wedged-shaped structure called the sacrum. It is composed of five fused sacral vertebrae and at its distal end is the coccyx. The sacrum provides strength and stability to the pelvis and transmits the weight of the body to the pelvic girdle (Moore and Dalley 2005). The sacrum articulates with the ilium of the pelvic bone, forming the sacro-iliac joints (SIJ) (Laub 2008). Mechanical dysfunction, inflammation, infection, trauma and degeneration may cause pain within these joints, which is known as sacroilliac joint dysfunction (Sherman 2014).

2.10.3 Duration of Low Back Pain

LBP is classified according to the duration and severity of the pain: 1) acute pain is sudden and can last for a few days, weeks or even a month; 2) sub-acute LBP lasts between six weeks and three months, it is usually due to muscle strain or joint pain and the pain can affect daily living activities; and 3) chronic back pain lasts for more than three months and is usually described as severe in nature and does not respond to initial treatment (Maher, Underwood and Buchbinder 2017).

A patient with mechanical low back pain usually presents with pain in the lumbosacral region progressing into the lower limbs, accompanied by muscle spasm and a decrease in range of motion (Levin 2000). Numbness, tingling or weakness throughout the lower limb may also be present (Dagenais and Haldeman 2012). It is often characterized by an increase in pain with motion, and a decrease in pain with rest (Karnath 2003). Diagnosis of acute mechanical low back pain is based on a patient’s history (onset, location and duration of signs and symptoms) as well as clinical findings during the physical and orthopedic examination (Karnath 2003). If a patient is not responding to a course of conservative therapy or has any red flags or risk factors present, further investigations such as plain radiographs, computed tomography (CT) and magnetic resonance imaging (MRI) may be indicated to confirm a diagnosis (Atlas and Deyo 2001).

2.10.4 Causes of Low Back Pain

Many cases LBP, is non-specific although in approximately, 10% of cases a specific cause is identifiable. The causes of LBP can be classified into specific and non-specific causes as will be discussed below (Balagué *et al.* 2011).

Specific LBP is the type of pain that arises as a result of disc herniation, nerve irritation, osteoporosis, tumours, infection, degenerative joint disease, rheumatoid arthritis, fracture, or tumor (Hamilton 2013).

Non-specific LBP is defined as those LBP cases in which a clear, specific cause of the pain is not overtly identifiable (Hamilton 2013).

Mechanical LBP is often associated with trauma, including muscular LBP, a sprained back, fractures (e.g., vertebral body fractures due to motor vehicle accident or osteoporosis), ankylosing spondylitis, intervertebral disc herniation, disc bulge, discitis, disc degeneration, lumbar spinal canal stenosis, facet syndrome, or sacroiliac degeneration (Hartvigsen, Natvig and Ferreira 2013).

Organic LBP refers to a pain that is of non-muscular skeletal origin, and is due to abdominal diseases of the liver, gallbladder, pancreas, aorta or kidneys, tuberculosis, spinal metastasis (from prostate cancer, breast cancer, or lung cancer) or diffuse tumours such as multiple myeloma (Hoy *et al*. 2010).

2.10.5 Treatment and Management of Low Back Pain

Treating acute mechanical low back pain primarily focus on the reduction of pain, muscle spasm and joint restriction, with the aim of improving functionality and prevent reoccurrence through education (Dagenais and Haldeman 2012).

Non-steroidal anti-inflammatory drugs (NSAIDs) and paracetamol have been known to be more effective for relieving acute pain, but they have notable side effects (Bier *et al*. 2017). Patients with acute LBP, continuing ordinary and daily activities within the limits of pain, have more rapid recovery effect than bed rest or back-mobilizing exercises (Maher, Underwood and Buchbinder 2017). For chronic LBP, non-pharmacologic therapies include acupuncture, back-exercise, massage therapy, yoga, cognitive-behavioral therapy or progressive relaxation, muscles relaxants or opioids and intensive interdisciplinary rehabilitation are all effective (Maher, Underwood and Buchbinder 2017).

A decompression surgical treatment can only be done when there is a structure compressing on a nerve root from the spinal column, which may include a herniated disc, bone osteophytes or any spinal tumors (Hamilton 2013). Microdiscectomy is a minimally invasive procedure for patients with a lumbar herniated disc causing a sciatica (Hamilton 2013).

Chiropractic deals with and treats LBP and other conditions such as muscle pains, wrist, elbow, knee, shoulder, hip, ankle and foot pain, headaches, sport injuries and other musculoskeletal disorders through manual therapy (spinal manipulation and manual manipulation) and other modalities (Fine and Stokes 2018).

2.11 CONCLUSION

Since the outbreak of the fatal coronavirus (COVID-19) in December 2019 and the classification of its spread as a global pandemic in March 2020, the opportunities to engage in daily living have changed drastically. Due to governmental regulations restricting public life (e.g., bans of public gatherings, business closures or city lockdowns) (Wang *et al.* 2020), the ability to move freely has been reduced for the general population. As of April 2020, various countries have taken related actions to prevent the spread of the virus (Wang *et al.* 2020). The resulting limits in access to attending the office and most employees are required to work remotely and this has led to change in ergonomics resulting in an increase of MSP. One such example is the DUT academic staff who were encouraged to work from home during the COVID-19 pandemic. This placed huge challenges for the academic staff members with most of them having to work hunched over on a coffee table and ultimately leading to the exponential rise in MSP. MSP effects the musculoskeletal system, such as the muscles, joints, tendons, and other tissues (Simu *et al.* 2014).

The current combination of infectious and life-style diseases may contribute significantly to an increase in the incidence of MSP. The spectrum of MSP in developing countries mirrors that of industrialized countries, however, the burden of disease is reportedly higher in the developing countries due to diagnostic delays or insufficient health-care access (Mody and Brooks 2012). MSP is caused or aggravated by prolonged, repetitive, and awkward movements, poor posture and ergonomics, or a fast-paced workload (Farlex 2012). Untreated MSP can result in fatigue, pain, and deformity of joints, which subsequently limits physical activity and causes loss of function and long-term disability amongst those affected (Rabiei *et al.* 2015). The discomfort experienced is an outcome of poor ergonomic design, prolonged computer usage, sustained awkward postures, psychosocial environments and high work demands (Akodu *et al.* 2015). Whilst technology has advanced, the workplace remains unchanged resulting in uncomfortable working setups which may have a significant impact on the burden of MSP (Akodu *et al.* 2015). This consequently predisposes many to work hunched over coffee tables or on kitchen stools without proper neck and back support (Kar and Hedge 2021). it is safe to assume that the typical home conditions are unable to support the worker for extended periods of time, and in the long run, it can be expected that work productivity will suffer. Research has been investigating the relationship between employee wellbeing and productivity and other variables for decades (Isham, Mair and Jackson 2020). Some research specifically focusing on ergonomic problems in desk jobs, however, ergonomic problems, musculoskeletal pain, and working efficiency of employees who switched to the home working model during the pandemic have been investigated only by a very limited number of studies (Garrett *et al*. 2016).

This study therefore aimed to determine the prevalence and effects of upper body (head, neck, shoulder and back) musculoskeletal pain associated with ergonomic changes experienced with remote working during the COVID-19 pandemic. This research will provide information on all the necessary precautions regarding posture to take while working from home and preventative measures to prevent musculoskeletal pain while working remotely.

CHAPTER 3 METHODOLOGY

3.1 BACKGROUND

This chapter describes the methodology that have been utilized in terms of my study design, setting, population, permissions granted, inclusion and exclusion criteria, participant recruitment, measuring tools, the study procedure, along with the data collection and its analysis. This provides in-depth detail as to how my research aim and objectives of the study were achieved via the research methods, instruments, and study design. My research was in a quantitative paradigm, using a descriptive, cross-sectional survey to obtain data from the academic population at DUT, that have been working remotely during the COVID-19 pandemic.

3.2 STUDY DESIGN

This was a descriptive, cross-sectional study, using a survey data collection tool. Survey research is defined as “the collection of information from a sample of individuals through their responses to questions” (Check and Schutt 2012). The data collection tool was a questionnaire (Appendix A), that was electronically distributed to all academic staff members at the Durban University of Technology (DUT). The questionnaire comprised of basic demographic details and data regarding the onset of musculoskeletal pain and postural effects, whilst working remotely during the COVID-19 pandemic.

3.3 STUDY SETTING

The study was electronically done at the Durban University of Technology through email. Following informed consent, participants were directed to the questionnaires via a question pro link.

3.4 STUDY POPULATION

The study population included 105 full-time, non-contract academic staff members employed at the Ritson, ML Sultan and Steve Biko, Riverside, Indumiso, Brickfield and City campuses of DUT. Only academics currently working remotely and those who worked remotely during the nationwide lockdown in response to the COVID-19 pandemic were included. A letter of information (Appendix B) and informed consent (Appendix C) was provided for completion as a mandatory field to click on prior to linking to the questionnaire.

3.5 PARTICIPANT RECRUITMENT

A total of 700 academic staff members are currently employed but based on a 10% response rate for online questionnaire studies, the minimum sample size required was 105 (*n*=105), as per consultation with a statistician (Singh 2020). Once ethical approval and permission was received and the pilot study completed, the questionnaire was amended as per recommendations of the pilot study. Recruitment was initiated via an advertisement on the DUT pin board (Appendix H).

Interested participants were requested to contact the researcher via email and thereafter an electronic link the letter of information, the informed consent and the questionnaire was provided. Data were collected via the online questionnaire, administered through **Question Pro**. The Anti-Ballot Box Stuffing (ABBS) feature on **Question Pro** prevents completion of the study multiple times. The voluntary nature of participation will be present in the start of the survey, in order to provide the potential participant with an option of whether they wish to participate or not. Once informed consent was obtained, participants were automatically linked to the questionnaire (Appendix A) for completion.

3.5.1 Inclusion and Exclusion Criteria

INCLUSION CRITERIA

- Participants 21 years and older.
- Full-time permanent/contract academic at DUT.
- Involved in teaching and learning of undergraduate or postgraduate programmes.
- Informed consent was gained when participants clicked on the link prior to taking part in the survey.

EXCLUSION CRITERIA

- Part-time/temporary/ad-hoc employees.
- Employees who are not involved in teaching and learning of undergraduate or postgraduate programmes.
- Participants of the pilot study and focus group.

3.6 MEASUREMENT TOOLS

The research measurement tool was a descriptive, cross-sectional survey to obtain data from the academic staff members at DUT. After questionnaire development, and upon approval of the study by the Institutional Research Ethics Committee, a pilot study was conducted to determine the face validity of the questionnaire.

The data collection tool was developed by adapting and amending three online questionnaires: the Dutch Musculoskeletal Questionnaire, the Standardized Nordic Questionnaire (SNQ) for musculoskeletal symptoms and the McCaffrey Initial Pain Assessment Tool. All questionnaires were available online and thus no permission request was necessary.

The questionnaire used in the study was made up of seven sections: section A (demographics), section B (history of stress), section C (medical history), section D (working history before COVID-19), section E (MSP and ergonomics before COVID-19), section F (work environment during COVID-19) and section G (MSP during COVID-19).

3.6.1 Dutch Musculoskeletal Questionnaire

The Dutch Musculoskeletal Questionnaire is a questionnaire that has been validated using available reviews of the epidemiological literature, which identified various potentially harmful postures, force-exertions, movements, and hazardous working conditions (Hildebrandt *et al.* 2001)

3.6.2 Standardized Nordic Questionnaire (SNQ)

The validated SNQ was developed by a team of Nordic Council of Ministers who were tasked with creating a simple, standardized questionnaire that could be used for screening MSDs in ergonomic settings, and is an open access, reliable and valid tool. The SNQ has been repeatedly used to investigate MSDs both in South Africa and internationally (Rabiei *et al.* 2015).

3.6.3 McCaffrey Initial Pain Assessment Tool

This tool includes diagrams of the human body to help patients locate the pain they experience and questions to prompt the patient to describe the intensity, quality, causes, effects, and contributing factors of the pain (McCaffery and Pasero 1999).

3.7 PILOT GROUP

The objective of the pilot group would be to determine how the questions would be perceived and understood by members of the population, who were similar to the study population (Brancato *et al*. 2006).

A pilot study was done via the Microsoft teams' online platform to assist in planning and modifying the main study. The participants for this group included two permanent/contract full-time DUT staff member's working remotely during the COVID-19 pandemic, one chiropractic lecturer/clinician, one academic staff member each from the applied sciences department, the engineering department, and the arts department, one current chiropractic student currently conducting a questionnaire-based study, the study supervisors and the research student (facilitator of the pilot group).

All pilot study participants were forwarded a letter of information (Appendix E) and informed consent (Appendix F) prior to participation. All who participated in this group were excluded from the main study. The focus of this group was to interrogate the structure of the questionnaire and improving the quality and efficiency of the main study. All comments arising from this study was appropriately reviewed, and where necessary used to amend the original questionnaire.

Inclusion criteria for the pilot group:

- Participants 21 years and older.
- Full-time permanent/contract academic at DUT.
- Involved in teaching and learning of undergraduate or postgraduate programmes.
- Participants who click on the link to partake in survey imply informed consent.

Exclusion criteria for the pilot group:

- Part-time/temporary/ad-hoc employees.
- Employees who are not involved in teaching and learning of undergraduate or postgraduate programmes group were excluded from the main study.

3.8 MAIN STUDY PROCEDURE

Following partial ethical approval, permission to conduct research within DUT was obtained from DUT Gatekeepers (Appendix D).

Once ethical approval and permission was received and the pilot study completed, the questionnaire was amended as per recommendations of the pilot study. Questionnaires were distributed through the online platforms. All DUT staff members were invited to participate in this study via an advertisement on DUT pinboard. Once staff members were identified, a letter of information (Appendix B) and informed consent (Appendix C) was given. Recruitment occurred via the DUT pinboard. Additional recruitment later occurred by providing a link to the letter of information, the informed consent, and the questionnaire. Data were collected via online questionnaires, administered through **Question Pro**. The Anti-Ballot Box Stuffing (ABBS) feature on **Question Pro** prevented completion of the study multiple times. The voluntary nature of participation and use of data were included on the first page of the questionnaires, to provide the potential participant with an option of whether they wish to participate or not. Once informed consent was provided, participants were provided with the questionnaire (Appendix A) to complete.

3.9 ETHICAL CONSIDERATIONS

This study was approved by the Institutional Research and Ethics Committee (IREC) at the Durban University of Technology (Ethics number: IREC 136/20). To ensure the ethical principle of autonomy, each participant was required to read a letter of information (Appendix B) and complete a letter of informed consent (Appendix C). Since this was an online recruitment, a signed consent was given in the form of an initial. Confidentiality was maintained by not requesting the names participants on the questionnaires. Nonmaleficence was ensured as participants did not suffer any harm from the research. Justice was ensured throughout as the study was fair and impartial. There was no direct benefit for participation and each participant was treated the same. Participation was voluntary and participants were allowed to withdraw at any time. All research data were evaluated only by the researcher, the supervisory team and the statistician, always maintaining confidentiality. All data collected have been safely stored and will be kept for five years in the DUT Chiropractic department, thereafter, will be destroyed by shredding.

3.10 SUMMARY

A quantitative, descriptive, cross-sectional study involving the full-time academic staff members at DUT, using an online questionnaire to gather information was utilised. The study design, sampling, pilot study and main research study procedures, and the ethical considerations; data collection measurement tool and statistical analysis have been presented and discussed.

CHAPTER 4 RESULTS

4.1 INTRODUCTION

This chapter presents the results obtained from the questionnaires completed by the participants in this study. The questionnaire comprised the demographic profile, general perception of health, psychological well-being before and during COVID-19, working environment, aspects of musculoskeletal pain pre- and during COVID-19, Ergonomics and working posture pre- and during COVID-19 and benefits and challenges experienced during COVID-19. The findings are summarized in tables and cross-tabulations of variables. The data were analyzed using IBM SPSS version 27.0. Inferential techniques include the use of the Chi-square test for association between variables and a *p*-value is less than 0.05 was considered statistically significant.

4.2 PARTICIPATION RATE

The sample population included 110 full time registered DUT staff members, and a 100% completion rate was achieved.

4.3 DEMOGRAPHICS

The demographic profile of the study population is shown in Table 4.1, Of the total sample (*n*=110), 59.1% were male and 39.9% were female. With regard to the age distribution, 28.22% of the participants were between 35-44 and 45-54 years old respectively. The majority (76.4%) reported to not having had surgery or being subjected to accidents or trauma. Notably, 93.6% of the participants reported no smoking, of which of the remaining number, three participants smoked 10 cigarettes per day and one smoked 12 cigarettes per day. Of the total population, 56.4% reported no alcohol consumption. Regarding physical exercise, only 39.1% reported that they did exercise. Based on exercise intensity, 40.9% reported doing light exercise, 27.3% reported no exercise, whilst 25.5% and 6.4% reported doing moderate intensity exercise and intense exercises respectively. Of note, 18.2% reported that they exercised five out of the seven days a week.

Table 4.1: Demographic characteristics of the study population (*n* = 110)

Demographics	*N* (%)
Gender	
	44 (39.9%)
Females	65 (59.1%)
Males	1 (0.6%)
Other	
Age(years)	
	22 (19.63%)
25-34	31 (28.22%)
35-44	31 (28.22%)
45-54	22 (20.25%)
55-64	4 (3.68%)
Above 64	
Surgery, Accident and Trauma	26 (23.6%)
Yes	84 (76.4%)
No	
Smoking status	7 (6.4%)
Yes	103 (93.6%)
No	
Number of Cigarettes smoked per day	
2	1
4	1
5	1
10	3
12	1
Exercise status	
Yes	43 (39.1%)
No	67 (60.9%)
Intensity of exercise	
None	30 (27.3%)
Light	45 (40.9%)
Moderate	28 (25.5%)
Intense	7 (6.4%)
Number of days exercised per week	
0	31 (28.2%)
1	11 (10.0%)
2	14 (12.7%)
3	15 (13.6%)
4	13 (11.8%)
5	20 (18.2%)
6	3 (2.7%)
7	3 (2.7%)

4.4 PSYCHOLOGICAL HEALTH, PRE-COVID-19

The general health status, an indicator of the health status of all participants, is shown in Table 4.2. Of those who participated, 51.8% rated their health as good, whilst 25.5% and 18.2 % rated it as fair and excellent respectively. Moreover, 54.5 % reported that they experienced no psychological stress prior to COVID-19, in contrast to 45.5% reporting being stressed. Majority reported not receiving medication before COVID-19 (76.4%). With regards to feelings of depression, 78.2% reported having no feelings of depression before COVID-19, which is consistent with the 84% reporting not receiving any medication before COVID-19.

Table 4.2: Psychological health, pre-COVID-19 (*n* = 110)

Psychological health pre-COVID-19	*N* (%)
General Health Status	
Poor	5 (4.5%)
Fair	28 (25.5%)
Good	57 (51.8%)
Excellent	20 (18.2%)
Stress/anxiety PC	
Yes	50 (45.5%)
No	60 (54.5%)
Medication-stress/anxiety	
Yes	26 (23.6%)
No	84 (76.4%)
Depression PC	
Yes	24 (21.8%)
No	86 (78.2%)
Medication	
Yes	17 (15.5%)
No	93 (84.5%)

4.5 MUSCULOSKELETAL PAIN, PRE-COVID-19 AND DURING COVID-19

The musculoskeletal pain profile prior to and during COVID-19 is shown in Table 4.3. Of the total participants recruited, 87.20% reported experiencing some type of MSP in the past. Notably, 5.5% reported having first experiencing MSP between 20 – 29 years old. However, only 8.2% experienced their first bout of MSP between 50 - 59 years old. Moreover, 61.8% reported receiving treatment for MSP, whereas 81.8% reported an increase in MSP and 27.3% reported a reduction. Furthermore, 25.5% indicated that a higher severity of pain was localised in their back, whereas only 11.8% and 10% indicated their neck and a combination of the neck, shoulders, and back as major pain locations, respectively. In addition, 50.9% reported that their MSP responded affected their sleep, whilst 49.1% indicated that their MSP affect their physical ability.

Table 4.3: Musculoskeletal pain (*n*=110)

Musculoskeletal Pain	*N* (%)
Have you experienced MSP in the last 12 months?	
Yes	96 (87.20%)
No	14 (12.80%)
Onset Age at which MSP occurred	
0	8 (7.3%)
< 20	6 (5.5%)
20 - 29	31 (28.2%)
30 - 39	28 (25.5%)
40 - 49	28 (25.5%)
50 - 59	9 (8.2%)
Treatment of MSP	
Yes	68 (61.8%)
No	38 (34.5%)
None	4(3.6%)
Increase or decrease in MSP during COVID-19	
Increase	90 (81.8%)
Decrease	19 (27.3%)
None	1 (0.9%)
Location of worst Pain during Remote working	
No pain	5 (4.5%)
Headache	6 (5.5%)
Headache, neck pain	1 (0.9%)
Headache, neck pain, shoulder pain	3 (2. 7%)
Headache, neck pain, shoulder pain, back pain	8 (7. 3%)
Headache, neck pain, back pain	6 (5. 5%)
Headache, shoulder pain	1 (0. 9%)
Headache, back pain	4 (3. 6%)
Neck pain	13 (11.8%)
Neck pain, shoulder pain	9 (8.2%)
Neck pain, shoulder pain, back pain	11 (10.0%)
Neck pain, back pain	9 (8.2%)
Shoulder pain	7 (6.4%)
Back pain	27 (25.5%)
Does MSP affect your sleep?	
Yes	56 (50.9%)
No	54 (49.1%)
Does MSP affect your physical activity levels?	
Yes	54 (49.1%)
No	56 (50.9%)

4.6 WORKING ENVIRONMENT DURING COVID-19

The details of remote working conditions are outlined in Table 4.4. A total of 52.7% reported working remotely during the COVID-19 pandemic, in contrast to 29.1% who reported working both at the office and remotely. Of those who responded, 59.1% reported having suitable equipment to support their remote working during COVID-19. Interestingly, 53.6% reported being more productive while working remotely during COVID-19. Moreover, 89.1% reported an increase in their workload during COVID-19.

Table 4.4: Working environment during COVID-19 (*n* = 110)

Working environment during COVID-19	*N* (%)
Where have you been working since COVID-19?	
Remotely	58 (52.7%)
Office	18 (16.4%)
Both	32 (29.1%)
No currently employed	2 (1.8%)
***Suitable equipment while remote working*?**	
Yes	65 (59.1%)
No	45 (40.9%)
***Does remote working allow you to be more productive or less productive*?**	
Yes	59 (53.6%)
No	51 (46.4%)
Did your workload increase of decrease?	
Yes	98 (89.1%)
No	11 (10.0%)
No Change	1 (0.9%)
Rest breaks	
Yes	87 (79%)
No	23 (21%)
***How often do you take rest breaks*?**	
Every hour for at least 5 minutes	23
Every 2 hours for at least 5 minutes	36
Every 3 hours for at least 5 minutes	15
>3 hours	36
How many hours spent at desk?	
<4 hours	7 (6.36%)
4-6 hours	29 (26.36%)
>6 hours	74 (67.27%)
Do you work with a computer?	
Yes	110 (100%)
No	0 (0%)

4.7 CHALLENGES AND BENEFITS EXPERIENCED DURING REMOTE WORKING

The challenges and benefits experienced by the study population is shown in Table 4.5. Major challenges included taking little or no break from the working world (8.2%), followed by data/technology issues (7.3%), and issues with time management (4.5%), followed by high workload (4.5%). Notable benefits experienced included financial savings linked to petrol costs (22.7%) and little or no experience of stress while remote working (14.5%).

Table 4.5: Challenges and benefits experienced with remote working (*n* = 110)

Challenges	N (%)	Benefits	N (%)
No challenges	8 (7.3%)	No benefits	17(15%)
No Proper equipment	3 (2.7%)	Comfortable space	1 (0.9%)
No proper equipment, domestic responsibilities, No breaks, time management	1 (0.9%)	Comfortable space, saving petrol, less stress	2 (1.8%)
No proper equipment, time management	1 (0.9%)	Meals on time	2 (1.8%)
No proper equipment, time management, high workload	1 (0.9%)	Safe during COVID	3 (2.7%)
		More productive	4 (3.6%)
No proper equipment, high workload	2 (1.8%)	More productive, Pursue other activities	1(0.9%)
No proper equipment, over working, No breaks, Time management	1 (0.9%)		
		Family responsibilities	1(0.9%)
No Proper equipment, No breaks	1 (0.9%)	Not Applicable	4(3.6%)
Domestic responsibilities	2(1.8%)	Saving money on petrol	25(22.7%)
Domestic responsibilities, High workload	2(1.8%)	Saving money on petrol, Safe during covid	1 (0.9%)
Domestic responsibilities, Student compliance	1 (0.9%)		
Time management	3 (2.7%)	Saving money on petrol, More productive	5 (4.5%)
Time management, high workload	7 (6.4%)	Saving money on petrol, More family time.	1 (0.9%)
Time management, no breaks	1 (0. 9%)		
High workload	5 (4.5%)	Saving money on petrol, Less stress	3 (2.7%)
High workload, student compliance	1 (0.9%)	Saving money on petrol, Less stress, Less distraction	1 (0.9%)
Increased utility bill	1(0.9%)		
Technology	5(4.5%)	Saving money on petrol, Less stress, Working at own pace	3(2. 7%)
Technology, No breaks, data/internet	1 (0.9%)	Saving money on petrol, Less stress, Not having to dress up	1(0.9%)
Increased pain	4 (3. 6%)		
Increased work time	1 (0.9%)	Saving money on petrol, Not having to dress up	1(0.9%)
Student compliance	3(2.7%)	Flexible hours	3(2.7%)
Student compliance, Time management	1(0.9%)	Less stress	16(14.5%)
Student compliance, Loneliness	1(0.9%)	Less stress, safe during COVID, more productive	1(0.9%)
Student compliance,No breaks, time	1(0. 9%)		

management		Less stress, more productive	2(1.8%)
Student compliance, Data	2(1. 8%)	Less stress, Saving money on petrol	2(1.8%)
Student compliance, Data, no equipment	1(0.9%)	Less stress, Working at own pace	1(0. 9%)
Student compliance, Data, time management	1(0.9%)	Less stress, Working at own pace, Safe during COVID	1(0.9%)
Loneliness	4(3.6%)	Less stress, Working at own pace, more productive	1(0.9%)
Loneliness, data	1(0.9%)	Less distraction	1(0.9%)
Over working	1(0.9%)	Working at own pace	1(0.9%)
No breaks	9 (8.2%)	Working at own pace, More productive	2(1.8%)
No breaks, domestic responsibilities, time management	1 (0.9%)	Working at own pace, Less stress	1(0.9%)
No breaks, time management	5 (4.5%)	Working at own pace, Less stress, more productive	1(0.9%)
No breaks, time management, high workload	5 (4.5%)	Pursue other activities	1(0.9%)
No breaks, time management, high workload, loneliness	1(0.9%)		
No breaks, high workload	1(0.9%)		
No breaks, data, domestic responsibilities	1(0.9%)		
No breaks, data, Time management, high workload	4(3.6%)		
Data	8(7.3%)		
Data, time management	1(0.9%)		
Data, time management, high workload	4(3.6%)		
Data, high workload	1(0. 9%)		
Data, increased pain	1(0. 9%)		

4.8 ERGONOMIC PRACTICES WHILE WORKING REMOTELY DURING COVID-19

The postural positions pre- and during COVID-19 are shown in Table 4.6. Of the total participants, 65.5% reported sitting with their thighs parallel to floor. It should be noted that 64.5% do not sit with the back supported by a back rest and 68.2% do not sit with shoulders relaxed and in a neutral position.

Table 4.6: Ergonomics practiced while remote working (*n* = 110)

Ergonomics	N (%)
Sit with thighs parallel to floor	
Yes	72 (65.5%)
No	38 (34.5%)
Sit with feet supported on floor/footrest	
Yes	69 (62.7%)
No	41 (37.3%)
Back supported by back rest	
Yes	39(35.5%)
No	71(64.5%)
Elbows bent so forearm parallel to the floor	
Yes	51 (46.4%)
No	59 (53.6%)
Wrists in neutral position	
Yes	53(48.2%)
No	57(51.8%)
Shoulders relaxed in neutral position	
Yes	35(31.8%)
No	75(68.2%)
Neck in neutral	
Yes	40(36.4%)
No	70(63.6%)
Significant amount of time with neck flexed	
Yes	23(20.9%)
No	87(79.1%)
Significant amount of time with head rotated	
Yes	37(33.6%)
No	73(66.4%)
Significant amount of time with trunk rotated	
Yes	16(14.5%)
No	94(85.5%)

4.9 POSTURAL POSITIONS PRE- AND DURING COVID-19

The chi-square test was used to determine if any associations existed between respondents' postural positions pre-COVID-19 and during the COVID-19 pandemic. The responses obtained for pre-covid and during the covid pandemic were cross-tabulated and statistically significant data, reported.

Positive results were seen in the table below, with regards to, "back not supported by a back rest", 60 participants revealed that while remote working their back was not supported. Majority of participants, 52, stated that their "elbows were not bent so forearm parallel to floor" during the work from home period. Another positive finding was that 42 participants stated that their "wrist was not in neutral" while remote working. Finally, a large number of participants (64) revealed that their "shoulders were not relaxed in neutral", while remote working. These crosstabulations indicate statistically significant relationships between altered ergonomics and remote working during the COVID-19 pandemic.

Table 4.7: Crosstabulations of postural positions before and during COVID-19

Pre-COVID	During COVID		*P*-value
Thighs Parallel when seated	*Yes*	No	
Yes	*67*	11	<0.001
No	*5*	27	
Total	**72**	**38**	
Feet supported on floor or footrest			
Yes	58	11	<0.001
No	11	30	
Total	**69**	**41**	
Back supported by backrest			
Yes	34	11	
No	5	60	<0.001
Total	**39**	**71**	
Elbows bent so forearm parallel to floor			
Yes	37	7	
No	14	52	<0.001
Total	**51**	**59**	
Wrist in neutral position			
Yes	49	15	<0.001
No	4	42	
Total	**53**	**57**	
Shoulders relaxed in neutral position			
Yes	25	11	
No	10	64	<0.001
Total	**35**	**75**	
Significant amount of time with neck flexed			
Yes	17	12	
No	5	75	<0.001
Total	**22**	**87**	
Significant amount of time with head rotated			
Yes	31	11	
No	6	62	<0.001
Total	**37**	**73**	
Significant amount of time with trunk rotated			
Yes	12	3	
No	4	91	<0.001
Total	**16**	**94**	

Total	**110**	**110**	

4.10 FEELINGS PRE- AND DURING COVID-19

Participants were asked questions about their feelings pre- and during COVID-19 to determine whether the COVID-19 period had impacted on participants' emotional state. The responses for the replies pre- and during COVID-19 were cross-tabulated and the Chi-squared test for association was applied to the tables. All corresponding p-values were less than 0. 001, indicating that there was an association between the response to the question on feelings pre- and during COVID. The association noted is that frequencies on the principal diagonal of the tables (highlighted in green) are where the responses remained the same pre- and during COVID. Frequencies in yellow changed from "most of the time" to "a little more than half of the time" and "a little less than half of the time". The frequency highlighted in pink is where the feeling changed from "a little more than half of the time” to “a little less than half of the time”. These results show that there was a significant change in the emotional state of participants.

Table 4.8: Change in feelings before and post COVID-19

Feelings Post COVID

Feelings during COVID	All the time	Most of the time	A little more than half of the time	A little less than half of the time	At no time	Total	P value
Feeling cheerful and in good spirits (pre-COVID)							(p<0.001)
All the time	5^a	2	5	4	0	16	
Most of the time	0	22^a	23^b	16^b	1	62	
A little more than half of the time	0	1	7^a	9^c	1	18	
A little less than half of the time	0	1	0	10^a	2	13	
At no time	0	0	1	0	0^a	1	
Total	**5**	**26**	**36**	**39**	**4**	**110**	
Feeling Calm and Relaxed							(p<0.001)
All the time	4^a	4	3	3	1	15	
Most of the time	1	15^a	17^b	16^b	0	49	
A little more than half of the time	0	3	6^a	10^c	2	21	
A little less than half of the time	0	2	5	12^a	1	20	
At no time	0	0	0	0	5^a	5	
Total	**5**	**24**	**31**	**41**	**9**	**110**	
Feeling active and vigorous							(p<0.001)
All the time	5^a	3	3	2	0	13	
Most of the time	0	15^a	19^b	18^b	1	53	
A little more than half of the time	0	1	7^a	8^c	2	18	
A little less than half of the time	0	3	2	15^a	4	24	
At no time	0	0	0	0	2^a	2	
Total	5	22	31	43	9	110	
Woke up feel refreshed and restful							(p<0.001)
All the time	4^a	1	0	3	0	8	
Most of the time	0	19^a	18^b	9^b	1	47	
A little more than half of the time	0	2	11^a	10^c	1	24	
A little less than half of the time	1	4	3	14^a	4	26	
At no time	0	0	0	2	3^a	5	
Total	5	26	32	38	9	110	
My day is filled with things that interest me							(p<0.001)
All the time	4^a	1	1	2	0	8	
Most of the time	1	24^a	17^b	14^b	3	59	
A little more than half of the time	0	1	15^a	10^c	3	29	
A little less than half of the time	1	0	0	9^a	2	12	
At no time	0	0	0	0	2^a	2	
Total	**6**	**26**	**33**	**35**	**10**	**110**	
Total						110	

a- Represents the principal diagonal of the table, which indicates that these responses remained the same pre- and during COVID-19.

b- Represents those frequencies changed from “most of the time” to “a little more than half of the time” and “a little less than half of the time”.

c-Represents the frequency where the feeling changed from “a little more than half of the time” to “a little less than half of the time”.

4.11 CONCLUSION

In summary, 87.2% of participants reported to having musculoskeletal pain (MSP) in the past and prior to COVID-19. However, there was a large increase (81.8%) in MSP while remote working. The percentage of academic staff members who reported to have worked remotely was 52.7%, and 59.1% had suitable equipment to facilitate remote working. With a reported increase in workload (89.1%), 53.6% reported an increase in productivity. The worst location of pain while remote working was back pain (25.5%). Ergonomic factors that are noteworthy are that 64.5% of participants sat without their back supported and 68.2% had shoulders that were not relaxed in neutral, while 51.8% had a wrist was not in a neutral position and 63.6% reported not having the neck in neutral while remote working.

Regarding the emotional states of the respondents, it was revealed that there was an association between the feelings pre- and during COVID-19. The shift was in state “a little more than half the time” and “most of the time” to “a little less than half the time”. All the corresponding *p*-values were less than 0.001, indicating a statistically significant relationship.

CHAPTER 5 DISCUSSION

5.1 INTRODUCTION

The chapter focuses on evaluating and discussing the results of the prevalence of upper body musculoskeletal pain associated with remote working during the COVID-19 pandemic. The structure follows the evaluation of the aims and objectives that were set out at the beginning of the study amidst the backdrop of existing research.

5.2 THE PREVALENCE OF UPPER BODY MUSCULOSKELETAL PAIN

The findings demonstrate that 87.20% of the study population experienced some type of MSP prior to the COVID-19 pandemic. Those findings concur with findings from a previous Malaysian population, in which 70% of the annual MSP prevalence was due to of ULPs (Ojoawo, Awotidebe and Akinola 2016). Likewise, in a study population of 73 participants, inclusive of academic staff members, 61.6% had musculoskeletal complaints prior to the COVID-19 pandemic (Bane, Aurangabadkar and Karajgi 2021), in contrast to the 85.7% prevalence rate reported amongst Brazilian academics from Petrolina (de Lima and da Silva 2014). It is possible that the cause of these musculoskeletal symptoms experienced during remote working maybe attributed to the increase in working hours, unsuitable desks, lack of physical activity, and poor postures.

The prevalence data corroborate the findings reported by an Irish study, in which the prevalence was 85% (Collins and O'Sullivan 2015). Similarly, a prevalence rate of 85% was reported in the University of Pernambuco, Brazil (de Lima and da Silva 2014); 78.9% in Mara University, Malaysia (Mohan *et al*. 2015), and 71.7% in Obafemi University, Nigeria (Ojoawo, Awotidebe and Akinola 2016). Similarities in the prevalence rate across the various study populations maybe due to the use of similar data collection methods, sample size and sampling techniques. For instance, the Irish study utilized an online self-reported survey to collect data, suggestive of the possibility of increased remembrance of the participant's previous pain/discomfort, although the prevalence of MSP was 65.2% in a study population conducted at Mekelle University (Meaza *et al*. 2020). This drop in prevalence may be attributed to the larger sample number (n=414), the use of face-to-face interviews, and possible interviewer bias in comparison to this study. Additionally, the Nigerian study population included both teaching and non-teaching staff employed in the service in contrast to this study, in which only teaching staff were recruited. Methodological and participant's characteristics were also similar between the Brazilian, Nigerian and this study. The high prevalence rates in this study may be associated with the various job descriptions of this study population since the prevalence of MSP amongst academics in higher education teaching institutes may be associated with the work environment and ergonomic arrangements.

5.2.1 Age at First Onset of Musculoskeletal Pain

Most participants in this study experienced their first onset of MSP between the age groups of 30 (n=15, 13.6%) to 40 (n=12,10.9%) years. This suggests that this age group (i.e. between 30-40 years) may be most vulnerable to MSP exposure and the most affected age group. Our findings corroborate Hazarika and Pegu (2016), who also reported the age group of 31-40 years to be most affected for the onset of MSP (29.4%). It is possible that this age group may be most vulnerable because exposure to MSP risk factors during this age range can cause fatigue and consequent injury to muscles, bones, and tendons. Furthermore, this age group includes many who are in their prime of the careers and who are able to work longer and tedious hours, which consequently predisposes them to an increased onset of MSP.

5.2.2 Location of Most Severe Pain While Remote Working During the COVID-19 Pandemic

In this study, most participants reported that they experienced their worst pain in their back (*n*=27, 25.5%), followed by the neck (*n*=13,11. 8%), and a combination of pain in multiple regions like the neck, shoulders and back (*n*=11, 10.0%). It is possible that poor posture, working at desks without a back rest and no back support may be key factors that contribute to the high prevalence of back pain/worst pain experienced in this study. Notably, prevalence rates of 48% and 64.4% of back pain were experienced during remote working, as reported by Guler *et al.* (2021) and Aldhafian *et al.* (2021), respectively. Similarly, a Turkish study reported a prevalence rate of 43.8% for low back pain, followed by 42.5% for neck pain and 28.7% for shoulder pain (Korkmaz *et al.* 2011). Similar findings were noted in this study. These findings may be attributed to the management of multiple tasks including household chores and childcare, that many academics had to endure during the lockdown. Managing household responsibilities, undefined working hours, increased stress due to job insecurities, and fear of the spread of the infection, may have culminated in in the onset of MSP.

In contrast, Aldhafian *et al.* (2021) reported neck pain as the worst type of pain experienced. An earlier report also suggests that during remote working, neck pain contributes to the highest level of discomfort (67.85%), followed by upper back pain (66.33%) (Ardahan and Simsek 2016). Meaza *et al.* (2020) also identified neck pain as a more severe type of pain experienced by most participants (41.5%), followed by low back pain (40.3%) and shoulder pain (20.5%) (Meaza *et al.* 2020). Collins *et al.* (2015) reported a higher prevalence of neck pain (58%) in their population, followed by shoulder pain (57%), and low back pain (51%) respectively. Similarly, a Chinese study confirms prevalence rates of 48.7% for neck and shoulder pain, followed by 45.6% for low back pain (Yue *et al.* 2012). Higher rates of neck pain may be attributed to the risk factors such as: confinement, the prolonged working hours, increased screen use, higher BMIs, increased teaching hours and the presence of comorbidities. In this study, the lack of physical activity and poor posture due to the use of non-ergonomic equipment may be responsible for the onset of MSP disorders and neck pain reported. The use of make-shift offices combined with prolonged hours of neck flexion and non-neutral positioning of their necks, are potential risk factors for increased onset of MSP.

A previous study also reported a high prevalence rate (80%) of at least one episode of MSP, in a group of Kuwait office workers using the Nordic musculoskeletal questionnaire (NMQ) Akrouf *et al.* (2010). The body regions where most pain was experienced included the neck (53.5%), followed by the shoulders (49.2%), and upper back (38.4%). Similar findings were reported amongst computer users in Isfahan using the NMQ, in which a high prevalence rate was noted for neck pain (54.9%), followed by back pain (53.1%) and shoulders (62.1%) (Ghanbary and Habibi, 2015). Likewise, the NMQ highlights that 55.5% of Chinese office workers experienced neck pain, followed by shoulder pain (50.7%), and the upper back pain (26.2%) respectively (Wu *et al.* 2012). In Thailand, the prevalence rate for shoulder pain amongst schoolteachers were 41. 6%, followed by 36.1% for upper back pain and 34.5% for neck pain (Chaiklieng and Suggaravetsiri 2012). An increase in shoulder pain may be due to the tense and highly elevated shoulders while having online lectures and preparing syllabus work, as reported in this study.

5.2.3 Exercise and Its Effects on Musculoskeletal Pain

Exercise positively influences the body, thereby reducing the onset of MSPs (Owen *et al.* 2010; Beinart *et al.* 2013; O'Conner *et al.* 2015). Only 39.1% of participants reported regular exercise patterns prior to the implementation of lockdown restrictions, in contrast to the 96% reported by Argus and Paasuke (2021). Poor exercise patterns and sedentary lifestyles may be instrumental to the increase in MSP onset as observed in this study group. Participants who exercised very little, reported a higher prevalence of MSP than those participants who regularly exercised. Moderate to vigorous physical activity can mitigate the deleterious health effects of sedentary behaviour (Biddle *et al.* 2019). The current study depicted that of the 39.1% that exercised, 25.5% of participants indicated that they do performs moderate to vigorous exercise. In another study of academics, 84.30% participants reported to being physically inactive prior to the lockdown (Meaza *et al.* 2020). Bane, Aurangabadkar and Karajgi (2021) reported that 46.6% of teachers engaged in some form of physical activity, such as brisk walking, yoga, or stretching exercise, prior to the lockdown (Bane, Aurangabadkar and Karajgi 2021). However, a drastic reduction was noted during the lockdown because of increased workload linked to both domestic chores and workplace responsibilities, influencing both the physical and mental health in teachers (Bane, Aurangabadkar and Karajgi 2021).

5.2.4 Past Treatment of Musculoskeletal Pain

It is noteworthy that 61.8% of participants in this study sought treatment for MSP, which concurs with an earlier report (Bruls *et al.* 2016). In an earlier South African study, 52.8% of the participants consulted a health care practitioner for neck pain whilst 46.6% consulted for shoulder pain (Peek 2005). Johnston (2016) reports that 57.5% of female office workers in their investigation sought professional healthcare support for MSP (Johnston, 2016); whilst 10% of library workers sought treatment for MSPs (Levy 2018), whereas only 23.3% of teachers required medical support for MSP onset during the COVID-19 pandemic (Bane, Aurangabadkar and Karajgi 2021). It is possible that many only seek treatment when the pain is perceived as a major health risk affecting everyday activities.

5.3 RISK FACTORS OF UPPER BODY MUSCULOSKELETAL PAIN AS AN ERGONOMIC EFFECT OF REMOTE WORKING

Various risk factors are needed to be considered when exploring the relationship between ergonomics and MSPs, while working remotely. 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 (Oxford University Press, 2010). Individual factors include poor prolonged awkward postures, poor workstation design, and psychosocial environments, which can lead to symptoms of musculoskeletal discomfort and pain (Akodu *et al.* 2015).

5.3.1 Commencement of Remote Working During the COVID-19 Pandemic

Remote working appears to be the “new normal” with the shift towards remote working increasing daily. Working from home is most common amongst educational professionals (66%) (Dockery and Bawa 2015). In this study, approximately 52.7% of participants confirm working remotely during the pandemic, although 16.4% reported working at the office, and 29.1% reported working at both at the office and remotely at home. It is evident that academics may be predisposed to a higher risk of MSP due to the nature of their work, which requires long hours of sitting or standing without changing positions. These types of postural issues become more pronounced while working remotely in unsuitable ergonomic environments. Our findings however indicate lower rates in comparison to that reported by Chung *et al.* (2020), who observed that 86% of employees confirmed working flexibly during lockdown during the pandemic (Chung *et al.* 2020). Based on this increase in remote working, these investigators further noticed a high rise in the onset of MSP, which is consistent with our findings.

Another study reported that 26.8% of their study population worked at the office, in contrast to 37.7% who worked from home (Zhang *et al.* 2020). The findings suggest a major shift towards remote/home working during the COVID-19 lockdown. Coinciding with the higher numbers of participants working from home, Brynjolfsson *et al.* (2020) indicated that the fraction of workers who switched to working from home was about 35.2%, whereas 15.0% reported already working from home pre-COVID-19, indicative that almost 50% have been working from home since the onset of the pandemic (Brynjolfsson *et al.* 2020). In contrast, only 37% of people appear to be working at home, indicating that certain occupations could not be carried out at home efficiently and effectively while working remotely (Dingel and Neiman 2020).

In another study it was indicated that the number of remote workers increased by 69%)\ in Italy (Eurofound and the International Labour Office 2017). According to the UK Household Panel Data Understanding Society, about half of all employees surveyed, worked from home at least some of the time during the COVID-19 lockdown in April, with 36% saying they were exclusively working from home (Chung *et al*. 2021).

5.3.2 Appropriate Workstation Equipment to Facilitate Optimal Remote Working

A total of 59.1% of participants in this study revealed that they did have suitable workstation equipment while working remotely during COVID-19. In contrast, another study indicated that 82% of workstations used during remote working were not ergonomically suitable to support remote working, (Mohammadipour *et al.* 2018). This poor working environment consequently resulted in an increase in the onset of MSP and a deterioration in one's physical health.

The significant ergonomic positions while remote working that contributed to the exacerbation and onset of musculoskeletal pain included:

5.3.3 Optimal Feet Positioning During Remote Working

This study's results indicate that 62.7% of the participants sit with their feet supported which is contrary to previous reports. Moretti *et al.* (2020) indicated that no-one utilised a footstool while remote working (0%) (Moretti *et al.* 2020), whereas Davis (2020) revealed that only 7% of participants sat with their feet unsupported during remote working (Davis 2020). This study's findings are higher than previous reports and may be indicative of a possible increase in the severity in MSP onset.

5.3.4 Backrest Support During Remote Working

Over the past decade, excessive sitting has emerged as a risk factor for an individual's health (Hadgraft *et al.* 2016; Mameli *et al.* 2014), but there is much controversy regarding the relationship between sitting and LBP. It has been argued that the risk of LBP seems to increase when office workers stay seated for more than seven hours per day (Mameli *et al.* 2014). However, no significant association has been reported between sitting and the risk of LBP (Bontrup *et al.* 2019). Duties of academic staff involves prolong sitting especially during reading and preparation of lecture material, marking of assessments, collation of results and attending various academic meetings and seminars. Prolonged sitting may precipitate stiffness of the lumbar region in which flexion may alter the passive stiffness of the lumbar spine and if passive flexion precedes such a sitting, it may increase the risk of low back injury (Beach *et al.* 2005).

In this study, 35.5% of the participants reported using suitable chairs that provide adequate back support by a backrest while remote working, corroborating the findings of Meaza *et al.* (2020), who confirmed that only 32.90% of their study population have their back supported while remote working (Meaza *et al.* 2020). Davis (2020) suggests that the support provided by the back of the chair was reported to be poorly used by most of their study population (69%) during remote working, suggestive that the onset of LBP in their group occurred as a result of poor back support.

5.3.5 Positioning of the Wrist During Remote Working

The hard surface of the workstation/desk may be a cause for the wrist to deviate from neutral position, resulting in contact stress and consequent increase in MSP (Davis 2020). In this study, 51.8% of the participants reported that their wrists were not in neutral positions, indicating cause for concern for the onset of MSP.

5.3.6 Shoulder Position During Remote Working

This study's findings indicate that 68.2% of the participants reported that their shoulders were unrelaxed in neutral position, which corroborates a previous study that higher prevalence (80%) of the participants reported little or no relaxation of their shoulders, as the shoulders were elevated and tense, (Levy 2018).

5.3.7 Neck Position During Remote Working

In this study, 63.6% of the participants reported that their necks were not maintained in neutral positions which may be associated with an increase in neck pain. This concurs with an earlier study that confirm neck pain as a common MSP finding amongst academics (Meaza *et al*. 2020). Furthermore, the most common body site affected was the neck due to poor positioning of the neck (i.e., not being in neutral position). This may be attributed to the forward head, shoulder and neck posture associated with daily use of computers or document reading, which often aggravates neck pain (Ojoawo, Awotidebe, and Akinola 2016).

5.3.8 Neck Flexion During Remote Working

A total of 79.1% of participants reported poor flexing of their neck, which is contrary to that reported by Davis (2020), who reported that 31.0% of their participants positioned their laptops too low, resulting in twisting of the neck and/or back to view the screen (Davis 2020). This consequently resulted in prolonged neck flexion and increases muscular stress and the onset of MSP.

5.3.9 Trunk Rotation During Remote Working

Approximately 85.5% of participants reported inadequate time spent with their trunk being rotated. Likewise, 40.3% of participants reported spending a significant amount of time with their trunk rotated, albeit much lower than this study's data (van den Berge *et al.* 2020). An earlier report indicated that a sustained sedentary job in a forced non-neutral trunk posture may be a risk factor for LBP and ultimately MSP (Naidoo *et al*. 2010).

5.3.10 Computer Usage During Remote Working

Desk posture and the setup of a computer workstation also contribute to the ergonomic wellbeing of an individual. The monitor positioning should be approximately 45 cm or arm's length from the eyes, and have a ten-degree tilt whilst the top of the screen should be level with the eyes to prevent one from flexing or extending the neck in awkward postures (Dimberg *et al.* 2015). All the participants (100%) in this study used a computer while working remotely in contrast to the 58.8% reported by Moretti *et al.* (2020). Sitting at a computer increases sedentary activity (Cole, Tully and Cupples 2015; Hadgraft *et al.* 2016; Mackenzie *et al*. 2019), whereas standing while working creates discomfort and negatively influences work performance (Cole, Tully and Cupples 2015; Nooijen *et al.* 2018). Many offices and workspaces have been revolutionised with technological advances, most notably through computer usage, which has become an integral part of life. However, a strong relationship exists between the time spent on the computer and the risk of developing muscular pain (Szeto *et al.* 2002).

Computer usage, both professionally and recreationally, has become an integral part of life and has been linked to increased risk for MSP because of frequent sustained and repetitive movement (Bohr 2000; Goodman *et al.* 2012). Computers or laptops are placed in a position which the individual assumes to be the most comfortable. Academic staff therefore may unknowingly expose themselves to risk factors through these harmful positions (Tayyari and Smith 1997). An earlier report on a computer-based program suggests that the use of a computer mouse can aggravate neck-shoulder pain (Andersen *et al.* 2008). The use of a computer also appears to precipitate discomfort on the cervico-pectoral region of the spine and head (Palm *et al.* 2007). It is possible that the use of laptops/computers/computer mouse by participants in this study may predispose them to an increased onset of MSP while working remotely.

5.3.11 Use of Rest Breaks While Remote Working

Regular rest periods are effective in reducing the onset and prevalence of MSP especially for the neck and shoulder regions (Goodman *et al.* 2012). Setting up computerized reminders to take breaks at thirty-minute intervals appears to decrease discomfort in the neck, shoulders and upper back associated with computer use, and decreases the onset of MSP (Davis and Kotowski, 2014). Working for a long period of time without changing position may also predispose individuals to microtrauma and soft tissue injury and consequently increase the risk of MSP (Meaza *et al.* 2020).

A total 79% of participants reported taking regular rest breaks while positioned at their workstation. This study’s findings concur with Meaza *et al.* (2020), in that 85.3% of their participants reported taking rest breaks while working from home (Meaza *et al.* 2020). In contrast, Tzaneti (2021) indicates that most participants in their population reported not taking rest breaks while working remotely, which may be attributed to the higher workloads and academic dissatisfaction, limited teaching experience, and job stress and its associated psychological demands (Tzaneti 2021).

5.3.12 Time Spent at a Desk While Remote Working

Almost 74% of participants reported a daily average of approximately 6 hours or more at their workstations/desks. Likewise, 74.2% participants reported spending 6-10 hours at their desk while working remotely (Meaza *et al.* 2020). In another study done on DUT library administrative staff, it was reported that they spent more than six hours a day at their workstation (Levy 2018), which corresponds with other studies (Gavgani *et al*. 2013;

Labeodan 2013). Similarities in the findings may be due to a similar population and characteristics, and workload and academic experience. In an earlier report, office workers who spent 75% and more on their computers appeared to be more at risk of experiencing upper body MSP (Juul-Kristensen *et al.* 2004), whereas those who worked four to six hours per day were twice as much more likely to be predisposed to upper body MSP than those working four hours per day (Ijmker *et al.* (2010). Blatter *et al*. (2002) confirms an association between working on the computer for more than four hours per day with upper body MSP.

Notably, those with more than four years or more work experience and who worked more than eight hours per day appears to have a higher risk for MSP compared to their counterparts, Ali and Sathiyasekaran *(*2006). The length of employment appears to increase the risk of injury to the neck/shoulder region Kamwendo *et al*. (1991), whereas Jensen (2003) reported the length of employment increased risk of injury in the hand/wrist but not in the neck/shoulder region. Working from home implies longer working hours because of additional home responsibilities which creates distractions and forces longer work hours in order to complete the daily work-related tasks, thus increasing the risk of MSP (Crosbie and Moore 2004).

5.4 IMPACT OF REMOTE WORKING ON MUSCULOSKELETAL PAIN, WITH REFERENCE TO ERGONOMIC ASPECTS

The increase in prevalence of musculoskeletal disorders (MSDs), especially in the neck and upper limbs, amongst office workers and academics is a major occupational health and ergonomic concern (Ho *et al.* 2018). Musculoskeletal pain is a common occupational health issue experienced by office workers and may be aggravated by poor ergonomic features especially whilst working remotely (Sohrabi and Babamiri 2021).

5.4.1 Musculoskeletal Pain (MSP) During Remote Working

Approximately 81.8% of participants in this study reported an increase in MSP whilst working remotely, whilst 17.3% reported a decrease in MSP. The data of this study contradict reports by Colloca *et al.* (2021), whose results indicated that the majority of patients suffering from pain reported a reduction of pain severity and with 73% self-reporting improved pain severity during the lockdown (Colloca *et al.* 2021). It is possible that the variations observed may be due to the discrepancies in working hours and the smaller sample sizes investigated. This study’s results of pain improvements are in contrast with pain experts’ concerns for a potential for pain worsening during the COVID-

19 pandemic (Clauw *et al.* 2020). A recent UK survey reports a significant increase in the onset musculoskeletal complaints since the start of the pandemic (Bevan *et al.* 2020). More than half of survey respondents reported the onset of new aches and pains, mainly in the neck (58%), followed by the shoulder (56%) and back (55%), which is similar to this study's findings (Bevan *et al.* 2020).

This study set out to measure various components of the remote ergonomic environments of academic staff members, as in current times, the working pattern of academics has changed to a greater extent with respect to preparing for classes/lectures on power point presentations, conducting online seminars/lectures and assignments leading to increased computer use (Meaza *et al.* 2020). Awkward sitting postures and repetitive tasks make academics susceptible to MSP (Bane, Aurangabadkar and Karajgi 2021).

The results of this study are comparable with other studies that were conducted within a similar ergonomic setting. The results of this study show a prevalence of back pain, neck pain and shoulder pain for majority of the participants, which was a finding indicated in the corresponding studies discussed. A significant finding in the current study was the high occurrence of participants who reported back pain as being the worst location of pain (25.5%). This could be due to the high number of respondents sitting without a back rest during remote working (64.65%). The *p*-value is less than 0.001, indicating a statistically significant relationship between sitting without a back rest and the increase in back pain.

Another aspect was the second highest location of reported pain being the neck pain (13.11%). This could be due to the great number of participants reported to having their neck flexed for prolonged working hours (23.09%), and not having their neck in neutral position while positioned at the workstation (63.6%) while remote working.

Lastly, there were instances of combined pain in the neck, shoulders and back (10.0%). This was possibly could be due to a great number of respondents reported to not having their shoulders relaxed in neutral position while remote working at their workstations especially while working on a laptop/computer (68.2%) and their elbows were not bent, ensuring that their forearm was not parallel to the floor (53.6%), indicating excess stress and muscular load to the shoulders and subsequently the neck. The *p*-value is less than 0.001, indicating a statistically significant relationship between these ergonomic positions and the subsequent increase in MSP while remote working, proving that the negative effects of the COVID-19 pandemic extend beyond just getting infected by the virus.

Psychological risk factors previously reported included an increased workload, poor job control, repetitive work activities, and poor management support (Buckle and Devereux 2002). With the sudden shift remote work and the possibility of it becoming the 'new normal', it is noteworthy that almost 59.1% of the participants reported having suitable workstation equipment to support a conducive and optimal working environment. The increase in MSP onset while working remotely may be due to the increase in workload (89.1%) that most participants reported, suggestive of a possible link between psychological risk factors and an increase in MSP onset.

5.5 THE IMPACT OF MUSCULOSKELETAL PAIN ON WORK PERFORMANCE/PRODUCTIVITY

In an attempt to reduce the spread of SARS-CoV-2 infections, higher education institutions worldwide switched to online classes and re-constructed all existing curriculums to meet the requirements of online teaching. Academics across the globe were expected to work from home in make-shift offices, which appears to be deleterious to both physical and mental health, resulting in either positive or negative outcomes on work productivity.

5.5.1 Work Productivity Whilst Working Remotely

Almost 53.6% of respondents in this study reported being more productive whilst working remotely. This study's findings are consistent with data reported by FlexJobs' seventh annual survey, in which 65% of workers reported higher work productivity at home than in a traditional office (Flexjobs 2020), which may be due to reduced commuting times. In contrast, 39.2% of participants reported to be less productive during remote working (Moretti 2020; Kazekami 2020), which may be explained by domestic distractions and limited interaction with colleagues. Previous studies also suggest that remote working positively influences the productivity of workers (Neufeld and Fang 2004, 2005; Baker *et al*. 2017; Coenen and Kok 2014; Campbell 2015).

5.5.2 Workload Whilst Remote Working

Almost 89.1% of participants in this study confirmed an increase in their workload during the pandemic. Albeit many workers also reported an increase in productivity when working from home (Moretti 2020, Kazekami 2020). Despite a lower percentage of participants (46%), an Australian study also revealed an increase in workload during the pandemic (Candido *et al.* 2020).

5.5.3 Benefits and Challenges Whilst Remote Working

Remote working comes with its fair share of challenges and benefits (Longhurst *et al.* 2020). Challenges of this current study included: little or no break from the working world

(8.2%), data/technology (7.3%) limitations, time management (4.5%), high workload (4.5%) and improper workstation equipment (2.7%). Benefits included reduced petrol costs (22.7%), less stress while remote working (14.5%) and being more productive (3.6%). Moretti *et al.* (2020) also reported that 82.4% participants acknowledged "saved travel time" as a huge benefit (Moretti *et al.* 2020). A major challenge experienced by this study's population, and corroborated by Ekpanyaskul and Padungtod (2021), is the limitations associated with data/technology issues, especially while majority of work was done via online platforms (Ekpanyaskul and Padungtod 2021).

An Australian study previously indicated that being able to do some of hours of work from home is a valuable job attribute since it does not negatively impact on family relationships (Dockery and Bawa 2015). Remote worktime may also allow workers to devote more time to work by more efficiently combining work time with family and other non-work responsibilities, as most workers tend to work longer hours when they work from home (Dockery and Bawa 2015). Other challenges experienced by an Australian population while remote working included workstation furniture/ equipment and internet issues (Candido *et al.* 2020).

5.5.4 Psychological Impact of Remote Working

Doing the same work repeatedly creates a burden to one's mindset, resulting in mental stress and consequent painful muscular issues, physical discomfort, increase in muscular contraction which affects one's pain threshold, reduced muscular endurance and an additional workload on the muscular system (Lundberg 2002). Repeatedly doing the same work activity can be interpreted as physical work involving upper extremity movements that corresponds to one's mind set (Lundberg 2002). It also correlates with poor job confidence and poor skill judgement, or freedom of action and may be inferred as a psychosocial load and a contributing factor to muscular pain (Huang, Feuerstein and Sauter 2002). Approximately 45.5% of our respondents reported being stressed whilst 21.8% reported being depressed before COVID-19. Similar findings were reported by Colloca *et al.* (2021), in which 40.30% participants reported being stressed/anxious and 10.3% reported being depressed before the pandemic (Colloca *et al.* 2021).

Other aspects that showed significant correlation in emotional change included: 'feeling cheerful and in good spirits (pre-COVID)' changed from 22% most of the time to 16% a little less than half of the time. 'Feeling calm and relaxed' changed from 15% to 26% little less than half of the time. 'Feeling active and vigorous' changed from 15% to 18% a little less than half of the time. 'Woke up feel refreshed and restful' changed from 19% most of the time to 9% a little less than half of the time. 'My day is filled with things that interest me' changed from 24% most of the time to 14% a little less than half of the time. This study's results are lower than another similar study on parents working from home during the pandemic depicted higher levels during COVID-19 than that of the current study. Only 31% of mothers responded that they had woken up feeling fresh and rested and only 32% responded that they have felt active or vigorous more than half the time, while 41% reported feeling calm or relaxed more than half of the time. In comparison, for fathers, although only 33% reported waking up feeling fresh and rested more than half the time, 42% felt active and vigorous, and a half felt calm and relaxed. However, most people reported feeling cheerful with women (both mothers and women without children) more likely to feel this way more than half the time (Chung *et al.* 2020).

Potential risk factors responsible for the onset of stress may include the limited control lecturers have over students due to the online teaching, difficulties experienced while developing and conducting assessments suitable for online evaluation. Managing time with respect to maintaining a balance between household chores, online teaching, preparing for online lectures, seminars and tests were also major challenges experienced. Limited knowledge of how to conduct online lectures, the use of technology, effective communication, the altered/reduced quality of lectures also created much anxiety amongst many and were instrumental as causative factors for stress among academics.

5.6 GUIDELINES AND RECOMMENDATIONS FOR REMOTE WORKING

An optimal working environment is essential to maintain the physical and mental health of those working remotely. Home offices must therefore be correctly set up to prevent physical discomfort or injury (Davis 2020). A list of guidelines is provided to create a conducive and optimal working environment.

5.6.1 The Office Chair

Office chairs must have an adjustable height, adjustable armrests, five casters, and lumbar support located in the back of the chair (Davis 2020). This study's findings suggest that many participants sat without supporting their backs, predisposing them to an increase risk of LBP. It is therefore essential that while sitting on an office chair, the following guidelines should be adhered, as suggested by Davis (2020):

- Placing a pillow on the seat to elevate the seat height.

- Placing a pillow and/or rolled up towel behind the back to provide lumbar support and back support to eliminate the need to lean away from the back of the chair.
- Wrapping the armrests if they are low and adjustable.
- Moving the chair closer to the desk or table to ensure one's back is against the chair back.

As a 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).

5.6.2 Working with a Personal Computer/Laptop

The use of a computer by all participants in this study may have resulted in poor back and neck postures, which increases the risk of experiencing MSP. Hence, adhering to the guidelines, as prescribed by Davis (2020), may reduce the onset of MSP while working with a personal computer or laptop:

- Place a lap desk or large pillow under the laptop to raise the monitor when using it on the lap.
- Use an external keyboard and mouse, along with raising the monitor by placing a stack of books or a box under the laptop when using a laptop on a desk.
- When possible, use an external monitor at the right height (e.g., top at eye height) and centred on the person.
- When using dual or multiple monitors, it is key to keep the primary monitor directly in front of you and to place the secondary monitors (e.g., laptop or second external monitor) to the side of the primary monitor.

5.6.3 The Workstation or Desk

The hard surface, and specifically the front edge of the workstation/desk that comes into contact with the wrists and forearms, may significantly influence the onset of MSP (Davis 2020). A large proportion of participants in this study did not sit with their wrists in neutral position. Additionally, most participants reported that their feet were supported but their back was unsupported. Despite many participants reporting varying levels of pain/discomfort, and an onset of MSP, the majority reported having a suitable working environment. Thus, a comfortable workstation/desk is essential in preventing MSK disorders (Sharan and Ajeesh 2012).

Hence the following guidelines as suggested by Davis (2020) and Sharan and Ajeesh (2012) may assist in mitigating the onset of any unnecessary MSP:

- Place a folded towel over the edge on the desk and in front of the keyboard.
- Use pipe insulation from a local hardware store, or a pool noodle, which can be split down the seam and placed along the edge
- The worktable and chair must be adjustable in height so that the feet are supported and well placed on the ground. In the absence of a height-adjustable chair, the use of a footrest is recommended (Sharan and Ajeesh 2012).

5.6.4 Postural Changes Throughout the Day

Postural changes throughout the day are essential in maintaining both mental and physical health. It is recommended that one should stand up and move around for two minutes within every 30 minutes (Davis and Kotowski 2014, 2015; Healy *et al.* 2013; Neuhaus *et al*. 2014). Prolonged sitting is associated with increased weight gain (Smith *et al.* 2014), and increased physical discomfort (Tissot *et al.* 2009). A recommendation to maintain fluid posture is being able to switch between a sitting and standing desk throughout the day so the shift can be balanced between sitting and standing.

Standing appears to improve calorie usage (Benden *et al.* 2011), reduce glucose levels (Thorp *et al.* 2014) and reduce physical discomfort (Davis and Kotowski 2014; Karakolis and Callaghan 2014). However, it is impossible to stand and use a computer throughout a working day, as prolonged standing can also have detrimental physical effects (Waters and Dick 2015). Current recommendations include postural changes, such as walking, changing between sitting and standing, regular comfort breaks such as using the restroom, and taking snack or water breaks (Davis 2020).

5.6.5 The Expectations of Remote Working

Home offices must incorporate comprehensive ergonomic models, such as proper work chair and desk space and position their computer/laptop to ensure long-term longevity. As the home offices become a permanent option for many workers, companies will need to provide proper ergonomic equipment. Without suitable working environment the widespread discomfort will progress into MSP, which will directly impact on the economy of companies through medical and compensation costs, absenteeism and presenteeism and employee satisfaction (Davis 2020).

5.7 SUMMARY

This study provides many statistically significant correlations in the comparisons between workstation environment and the onset of MSP. Overall, the prevalence of pain and MSPs reported is high and ergonomic risk factors, such as unsuitable workstation and office space, insufficient rest breaks and hours spent at a desk, may increase the risk of MSP while working remotely. Thus, participant postures and the discomfort or pain experienced may have been affected by these risk factors and may be associated with the workstation ergonomics. The risk factors for upper body MSPs are evident from the current study and reflect similar results to that of the literature discussed. In conclusion, the COVID-19 lockdown and the consequent remote working conditions may impact the physical and mental health of the academics. These factors should be considered when implementing remedial and wellness programmes for teaching staff as a means to improve their quality of life.

CHAPTER 6 CONCLUSION AND RECOMMENDATIONS

Introduction

There is an increasing trend to work from home as a means to limit the spread of the COVID-19. This trend may remain after COVID-19, since working from home not only revolutionizes the traditional concept of the workplace but also results in a new generation of occupational health risks. The COVID-19 crisis and disruption provided an opportunity to determine and assess some of the threats posed by this sudden shift in the workplace.

6.1 KEY FINDINGS OF THE CURRENT STUDY

- Over half of the participants (52.7%) reported working remotely during the COVID-19 pandemic.
- The majority (81.8%) reported an increase in the onset of MSP during remote working.
- Approximately 25.5% identified the “back region” to be the main location of their worst pain experienced.
- More than half of the participants (59.1%) reported having suitable work equipment while working remotely.
- Almost 74.0% reported that they spend more than six hours at the desk while working remotely.
- A total of 89.1% of the participants reported an increase in workload whilst working remotely during the pandemic.

6.2 STRENGTHS

- This study provides new insights with regards to effective strategies, such as the optimal chair and workstation environment, as well as the optimal computer set up whilst remote working, that may be implemented in the future. To the best of our knowledge, this is the first study to have evaluated the impact of remote working amongst academics and its association with the onset MSP.

- As the COVID-19 pandemic continues, employees are required/recommended to work from home, hence insights into effective remote working have become significant for developing future suitable interventions.

6.3 LIMITATIONS

- The small sample size may misrepresent the study population.
- 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 at that 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.
- Since the questions on ergonomic features were based on self-reported responses, this may have contributed to “recall bias” and “underestimation or overestimation”.
- Information pertaining to whether the employees contracted COVID-19 infection during the working from home period was not obtained.

6.4 RECOMMENDATIONS

- Future studies should explore larger sample sizes and investigate associations between MSP and specific job tasks, additionally evaluating the risks in different job profiles.
- Implementing staff awareness programmes/mechanisms in terms of ergonomic guidelines, health and wellbeing must be applied more actively towards reducing the ergonomic challenges of remote work.
- Developing simple strategies that encourage physical movement within the work environment must be applied and evaluated through future research.

6.5 CONCLUSIONS

The exponential rise in COVID-19 infections is rapidly transforming how and if people do return to the traditional way of working. Remote working is likely to remain as the norm, even after the shifting of lockdowns, for millions of workers. This study’s findings demonstrate that the wellbeing of an individual, which has a significant impact on productivity, may be compromised while working remotely during a pandemic. The onset and exacerbation of MSP has increased tremendously during the pandemic since the onset of remote working. It is possible that many working individuals will emerge with increased incidence of MSP post the coronavirus crisis. The findings suggest that it would be beneficial for academics to become more aware of the onset of MSP, its locations and their ergonomic environments, especially whilst remote working. It is possible that amidst the more disastrous effects of this pandemic, ergonomic support for effective remote working may have been side lined, with a consequent increase in the onset of MSP. The data have the potential to inform interventions to re-dress such effects such as an unsuitable work environment in a remote working climate that many are currently subjected to.

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APPENDICES

Appendix A: Final Questionnaire

This survey is being conducted to determine the prevalence and effects of upper body (head, neck, shoulder and back) pain during the COVID-19 pandemic as a result of the ergonomic changes through working remotely. It will take approximately 10 minutes to complete.

Your participation is voluntary; hence you may withdraw from the study at any time during the duration of this study without incurring any disadvantages.

All data collected will be kept confidential by encrypting and password-protecting during electronic storage. Participant identification codes will be used to ensure anonymity and no data will be passed on to third parties. All collected data will be used only for the purposes of this study, and the reporting thereof.

By participating in this survey (in clicking the 'Participate' button), I confirm that I am older than 18 years and have read and understood the informed consent.

Participate

SECTION A – DEMOGRAPHIC PROFILE

1. Gender

O Male

O Female

O Other

2. Age

___ (years)

3. Height

___ (metres)

4. Weight

___ (kilograms)

SECTION B-GENERAL HEALTH HISTORY (PRE-COVID-19 PANDEMIC) (PLEASE TICK THE MOST APPROPRIATE OPTION)

1. Please rate your perception of your general health status	Poor	Fair	Good	Excellent		
2. Please rate your perception of your general dietary habits	healthy	Fairly healthy	poor			
3. How would you rate your daily levels of exhaustion at the end of a working day?	Very low	Low	Moderate	High	Very high	
4. Rate the level of physical activity required of you at work	Very low	Low	Moderate	High	Very high	
5. Do you sleep adequately (i. e. 6-8 hours) at night?	Yes	No	State the average number of hours of daily sleep attained? ______hrs			
6. Do you have any pre-existing medical conditions?	Carpal tunnel syndrome	tendinitis	osteoporosis	arthritis	Ligament laxity	Other
6. 1 If yes to Q6, have any of these conditions resulted in being absent from work in the past year?	Yes	No	If Yes, state how long you were at home for?			
7. Are you on any chronic medication?	Yes	No	If yes, please specify			
8. Have you had any surgery/ accidents/ trauma	Surgery (appendix, spinal surgery, abdominal surgery, etc)	Accidents (Motor vehicle accident, whiplash), Falls / Trauma that has affected your movement (injury to limbs or spine)				
9. If yes, please specify the location and year in which you had the surgery ______ ______ ______						
10. Do you exercise regularly (at least 5 times per week)? Yes O No O	If YES, please specify the nature of activity in terms of intensity of activity: Light O Moderate O Vigorous O	How many days per week is spent exercising? ___days per week How many hours per day is spent exercising? ___Hours per day				
11. Do you smoke cigarettes?	Yes	No	If yes, how many cigarettes do you smoke per day? ___ How long (years) have you been smoking? ___Years			
12. Are you a former smoker?	Yes	No	How many cigarettes per day did you smoke? Cigarettes How long ago did you quit smoking? ___Years			
13. Do you drink alcohol?	Yes	No	If yes, how many drinks (ml) per week? ______ml per week			

<u>SECTION C- GENERAL PSYCHOLOGICAL WELL BEING (PRE-COVID-19 PANDEMIC)</u>

1. Do you consider yourself currently under a high level of stress/anxiety?

O yes

O no

2. Are you currently receiving any medication for stress/anxiety?

O yes

O no

3**. Do you consider yourself currently under any form of depressio**n?

O yes

O no

4. Are you currently receiving any medication for depression?

O yes

O no

5. For each of the five statements below, choose the statement which is closest to how you have been feeling <u>before</u> the outbreak of the novel coronavirus.

	All the time	Most of the time	A little more than half of the time	A little less than half of the time	At no time
I have felt cheerful and in good spirits					
I have felt calm and relaxed					
I have felt active and vigorous					
I woke up feeling refreshed and rested					
My daily life has been filled with things that interest me					

6. For each of the five statements below, choose the statement which is closest to how you have been feeling since the outbreak of the novel coronavirus.

	All the time	Most of the time	A little more than half of the time	A little less than half of the time	At no time
I have felt cheerful and in good spirits					
I have felt calm and relaxed					
I have felt active and vigorous					
I woke up feeling refreshed and rested					
My daily life has been filled with things that interest me					

SECTION D - WORKING ENVIRONMENT (PRE-COVID-19 PANDEMIC)

1. How long have you been in your current position at DUT?

1-5 years O	5-10 years O	>10 years O

2. How many hours per day do you work?

________ hours

3. Please state how many hours a day you spend at your desk.

< 4 hours O	4-6 hours O	>6 hours O

4. Do you work with a computer?

O YES

O NO

5. If yes to Q4, how many hours per day do you work with a computer?

________ hours

6. Do you take rest breaks in between working hours?

O YES

O NO

If YES, how often do you take rest breaks

O After every hour for at least 5 minutes

O After every 2 hours for at least 5 minutes

O After every 3 hours for at least 5 minutes

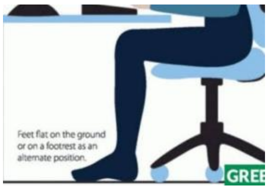
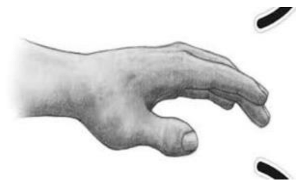
O More than 3 hours

SECTION E-MUSCULOSKELETAL PAIN AND ERGONOMICS (PRE-COVID-19 PANDEMIC)

1. **Musculoskeletal Pain (PRE-COVID-19 PANDEMIC):**

<table>
<tr><td>1. 1 Have you ever experienced musculoskeletal pain in the past?</td><td colspan="2">Yes</td><td colspan="2">No</td></tr>
<tr><td colspan="2">1. 2. If yes, what type of musculoskeletal pain did you experience? (E.g., low back pain, neck pain, etc.)</td><td colspan="3"></td></tr>
<tr><td colspan="2">1. 3 When (age) did you first start experiencing some form of musculoskeletal pain?</td><td colspan="3">__________ years old</td></tr>
<tr><td>1. 4 Have you ever been treated for musculoskeletal pain?</td><td colspan="2">Yes</td><td colspan="2">No</td></tr>
<tr><td colspan="2">1. 5 If yes to Q1.4, where was treatment sought from? (E.g., General practitioner, Chiropractor, Sangoma, Pharmacist, Physiotherapist, Inyanga, Occupational therapist, etc).</td><td colspan="3">1.
2.
3.</td></tr>
<tr><td colspan="2">1. 6 Based on your answer in Q1.5, have you been diagnosed with any type of musculoskeletal disorder?</td><td colspan="3">1.
2.
3.</td></tr>
<tr><td colspan="2">1. 7 What type/s of medication have you previously used for managing your musculoskeletal pain? (E.g., Panado, Grandpa, etc)</td><td colspan="3">1.
2.
3.</td></tr>
</table>

2. Ergonomics (PRE-COVID-19 PANDEMIC)

		YES	NO
2. 1 When you sit at your desk, are your thighs parallel to the floor?			
2. 2 Are your feet supported on the floor or footrest?			
2. 3 Is your back supported by a backrest			
2. 4 Are your elbows bent at 90◦ so that your forearms are parallel to floor?			
2. 5 Are your wrists in neutral position?			
2. 6 Are your shoulders relaxed, at all times and not elevated?			

2. 7 Is your neck in neutral (i. e. chin is level)			
2. 8 Do you spend a significant amount of time with your neck flexed while holding the phone?			
2. 9 Do you spend a significant amount of time with your head rotated?			
2. 10 Do you spend a significant amount of time with your trunk rotated?			

<u>SECTION F-WORKING ENVIRONMENT (DURING THE COVID-19 PANDEMIC)</u>

1. Where have been working from since the outbreak of COVID-19?

O Remotely (Home office)

O Office/regular place of work

O Both

O I do not have a formal employment.

2. If you are working remotely (at home), do you have suitable working equipment (eg. desk, chair, etc)

O YES

O NO

3. Does working remotely allow you to be more productive or less productive?

____

4. Did your workload increase or decrease during the COVID-19 pandemic?

____

5. List some of the major challenges you experienced while working remotely?

____

____

____

____

____

6. List some of the benefits you experienced while working remotely?

____

____

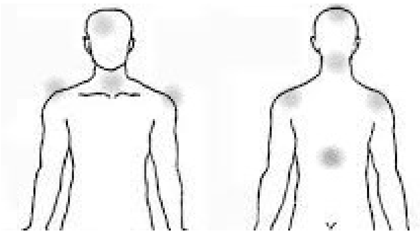
____

____

____

SECTION G-MUSCULOSKELETAL PAIN (DURING THE COVID-19 PANDEMIC)

1. Have you experienced an increase or decrease in musculoskeletal pain during the COVID-19 pandemic?	Increase	Decrease

2. Identify the location of pain in the image that you perceive as your worst experience. 	Head	Neck	Shoulders	Back

With regard to Q3 below, rate the intensity of the pain you have experienced based on the scale (0=least amount of pain and 5=most amount of pain)

3. Intensity	3. 1 The pain you are currently experiencing?	3. 2 The most excruciating pain gets?	3. 3 The most bearable amount of pain gets?	3. 4 An acceptable amount of pain gets?

4. Pain characteristics	Aching	dull	sharp	shooting	stabbing	throbbing	tight

5. Is your musculoskeletal pain aggravated by any of these factors? You can select more than one.

A. Alcohol consumption □

B. Bending/twisting movements □

C. Foods types (if so, please list):

1)

2)

3)

4)

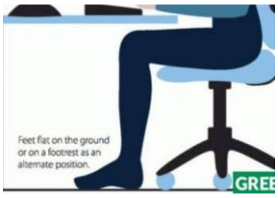
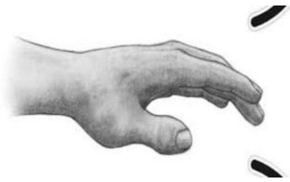
D. Time of day □

E. Weather/season □

F. Chewing/clenching teeth □

G. Medication □ H. Stress/tension □ I. Exercise □ J. Fatigue/exertion □ K. Walking □ L. Lack of sleep □ M. Laying down□ N. Over-sleeping □ O. Reaching overhead □ P. Sneezing/Coughing Q. Standing □ R. Sitting □		
6. Is your musculoskeletal pain relieved by any of these factors? You can select more than one. A. Applying ice/something cold □ B. Compression □ C. Exercise □ D. Heat □ E. Laying down □ F. Massage □ G. Medication H. Moving around/walking □ I. Sitting□ J. Standing □ K. Sleep □ L. Relaxing □		
7 A. Does the pain affect your sleep?	Yes	No
B. Does the pain affect your physical activities?	yes	No

SECTION H- ERGONOMICS DURING THE COVID-19 PANDEMIC

		YES	NO
2. 1 When you sit at your desk, are your thighs parallel to the floor?			
2. 2 Are your feet supported on the floor or footrest?			
2. 3 Is your back supported by a backrest			
2. 4 Are your elbows bent at 90◦ so that your forearms are parallel to floor?			
2. 5 Are your wrists in neutral position?			
2. 6 Are your shoulders relaxed, at all times and not elevated?			

2. 7 Is your neck in neutral (i. e. chin is level)			
2. 8 Do you spend a significant amount of time with your neck flexed while holding the phone?			
2. 9 Do you spend a significant amount of time with your head rotated?			
2. 10 Do you spend a significant amount of time with your trunk rotated?			

Below is the expert of the email that was sent to all academic staff members requiring their assistance in completion of my survey. The link was provided via question pro.

Good Afternoon

I trust this email finds you well.
My name is Nevinia Narainsamy.

Thank you to all that have already completed my survey.

As part of a research project towards a master's degree in Chiropractic, the following study is to be undertaken:

"Upper body musculoskeletal pain associated with remote working of academics at the Durban University of Technology during the COVID-19 pandemic"

Supervisor: Prof JD Pillay

Co-supervisor: Dr N Govender

We humbly request the completion of a short survey (approximately 10-15 minutes to complete) as per the link below:

https://dut.questionpro.com/t/ARi2jZmQGA

Thank you for your contribution and support.

Best regards

Nevinia Narainsamy

Appendix B:Partcipant Letter of information

Dear Participant:

Title of the Research Study:

Upper body musculoskeletal pain associated with remote working of academics at the Durban University of Technology during the COVID-19 pandemic

Principal Investigator/s/researcher: Nevinia Narainsamy

Co-Investigator/s/supervisor/s: Professor J. D. P(PhD-physiology) and DR. N. Govender (PhD-physiology)

Brief Introduction and Purpose of the study: The COVID-19 pandemic has placed unprecedented pressures on governments, economies, and families. Related measures, such as limits on social gatherings, business closures or lockdowns, are expected to considerably reduce the individual opportunities to move outside the home and reduce interpersonal contact. As a result, a number of employees were asked to work remotely during the COVID-19 pandemic. With inadequate working equipment and workplace support, a preceding increase in musculoskeletal pain is expected. This supports the view that the adverse effects of the pandemic extend beyond the direct consequences of COVID-19 and an area requiring research to inform interventions to redress such effects, in a work climate that is expected to significantly adapt further towards remote working over the next years.

Outline of the Procedures: You will be invited by email to participate. A letter of information and informed consent will be signed before participation in the study can commence. You will then be required to complete a once-off questionnaire which will take approximately ten (10) minutes.

Risks or Discomforts to the Participant: This research study is a questionnaire-based study and therefore poses no anticipated risks or discomfort to the participant of any kind. Questionnaires will be anonymous. No names will appear on the questionnaire.

Benefits: You will benefit by learning about the ergonomical effects of working from home and the measures that can be put into place.

Reason/s why the Participant May Be Withdrawn from the Study: You may withdraw from the research study at any given time without penalty/ consequence

Remuneration: You will not receive any form of remuneration for your participation in this research study.

Costs of the Study: You will not be liable for any financial contribution/s towards this research study.

Confidentiality: The information provided by you will be treated as highly confidential and will always remain anonymous. You will not be required to include your name or any identifiable details when completing the questionnaire. Data records may be inspected for data analysis by relevant Ethics Committees.

Research-related Injury: None to be expected

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

Researcher-Nevinia Narainsamy- narainsamynevinia@dut. ac. za

Supervisor - Prof J. D. Pillay - 0826039111 or pillayjd@dut. ac. za

Co-supervisor - Dr. N. Govender - nalinip@dut. ac. za

Institutional Research Ethics Administrator on 0313732577. Complaints can be reported to the Director:Research and Postgraduate Support Dr L Linganiso on 0313732577 or researchdirector@dut. ac. za

Appendix C:Partcipant Informed Consent

CONSENT

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, ___________________ (Name of researcher), about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: ______________,
- 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 (If applicable) Date **Signature**

_______________________ ___________ _____________________

Full Name of Legal Guardian (If applicable) Date **Signature**

Appendix D: Gatekeeper's Permission Letter

[24/07/20]

Request for Permission to Conduct Research

<u>Dear Dr Linda</u>

My name is Nevinia Narainsamy, a master's student at the Durban University of Technology. The research I wish to conduct for my master's dissertation involves:

Upper body musculoskeletal pain associated with remote working of academics at the Durban University of Technology during the COVID-19 pandemic

I am hereby seeking your consent to carry out this research at the Durban University of Technology staff members.

I have provided you with a copy of my proposal which includes copies of the data collection tools and consent and/ or assent forms to be used in the research process, and a copy of the approval letter which I received from the Institutional Research Ethics Committee (IREC).

If you require any further information, please do not hesitate to contact me [0747680533 or nevinianaransamy@dut. ac. za]. Thank you for your time and consideration in this matter.

Yours sincerely,

[Nevinia Narainsamy]

Durban University of Technology

Appendix E: Letter of information - Pilot Group

Dear Participant: Welcome and thank you for being part of my pilot group.

Title of the Research Study:

Upper body musculoskeletal pain associated with remote working of academics at the Durban University of Technology during the COVID-19 pandemic

Principal Investigator/s/researcher: Nevinia Narainsamy

Co-Investigator/s/supervisor/s: Professor J. D. P(PhD-physiology) and DR. N. Govender (PhD-physiology)

Brief Introduction and Purpose of the study: The COVID-19 pandemic has placed unprecedented pressures on governments, economies, and families. Related measures, such as limits on social gatherings, business closures or lockdowns, are expected to considerably reduce the individual opportunities to move outside the home and reduce interpersonal contact. As a result, a number of employees were asked to work remotely during the COVID-19 pandemic. With inadequate working equipment and workplace support, a preceding increase in musculoskeletal pain is expected. This supports the view that the adverse effects of the pandemic extend beyond the direct consequences of COVID-19 and an area requiring research to inform interventions to redress such effects, in a work climate that is expected to significantly adapt further towards remote working over the next years.

Outline of the Procedures: Pilot study participants will be invited via email to participate on either zoom or Microsoft teams. A letter of information and informed consent will be signed before participation in the study can commence. The participant will then be required to complete a once-off questionnaire which will take approximately fifteen (15) minutes. The participants will then provide information on the quality of the questionnaire, and to highlight any problem areas observed in the research tool that were utilized. This should take 1-2 hours of duration to be completed. The researcher will be available for the entire duration of the study to assist with any queries that may arise. 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: This research study is a questionnaire-based study and therefore poses no anticipated risks or discomfort to the participant of any kind. Questionnaires will be anonymous. No names will appear on the questionnaire.

Benefits: you will benefit by learning about the ergonomical effects of working from home and the measures that can be put into place.

Reason/s why the Participant May Be Withdrawn from the Study: You may withdraw from the research study at any given time without penalty/ consequence

Remuneration: You will not receive any form of remuneration for your participation in this research study.

Costs of the Study: You will not be liable for any financial contribution/s towards this research study.

Confidentiality: The information provided by you will be treated as highly confidential and will always remain anonymous. You will not be required to include your name or any identifiable details when completing the questionnaire. Data records may be inspected for data analysis by relevant Ethics Committees. All information is confidential and the results will be used for research purposes only. All employees will remain anonymous and confidential. The pilot study will take place via zoom or Microsoft teams, anonymity will be ensured by just tape recording the participants voices and without the mention of their names. The researcher will document the information for statistical analysis on a Microsoft excel spreadsheets under the different headings. 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 to be expected

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

Supervisor-Prof J. D. Pillay-0826039111

Co-Supervisior – Dr N. Govender - **nalinip@dut. ac. za**

Institutional Research Ethics Administrator on 0313732577. Complaints can be reported to the Director:Research and Postgraduate Support Dr L Linganiso on 0313732577 or researchdirector@dut. ac. za

Appendix F: Informed Consent - Pilot 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, ______________________ (name of researcher), about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: ___________,
- 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 (If applicable) **Date** **Signature**

_________________ __________ ___________________

Full Name of Legal Guardian (If applicable) **Date** **Signature**

Appendix G: Changes by Pilot Group

Pilot Group Suggestions:

Recommended Suggestions	Page number and changes
Question 6 and 8 should have a “no” option	Amended-page 2
It took 15 minutes to complete the questionnaire on my laptop	Amended-page 1
Change the gender section to blocks so it’s easy to just a tick or cross where necessary, does not look user friendly as it stands	Amended -page 1
The questionnaire assumes that the participant has musculoskeletal problems. There should be a “no” option as well for those that would not have any musculoskeletal complaints to make.	Amended-page 5
Remove the questions on type of chronic medication as this will be a stats and analysis nightmare given that one needs to figure out ever medication and with chronic diseases it can be a lot of medication	Amended-page 2
Section E – question 1. 2 is too open ended, consider adding options they can choose for the various areas example neck pain, shoulder pain, elbow pain, wrist pain and so on	Amended-page 5
Section B Question 9 It asks if ‘yes’ but there is no option to tick yes in question 8? If it is a follow up question, shouldn’t it be 8. 1?	Amended-page 2
Section B Question 10 How many hours per day is spent exercising? I might answer that question as 20 minutes. Perhaps ask how many minutes a day is spent exercising? Many don’t have the time to spend hours a day exercising or would result in answering in fractions.	Amended-page 2

Question 2 should have “therapy” as an alternative for medication so it should read as “…. medication/therapy”. In case some people are undergoing counselling sessions.	Amended-page 3
Question 1. 3 should be phrased as “At what age did you first start experiencing some form of musculoskeletal pain”?	Amended-page 2
Question 5. Please state only if the answer is no to state the number of hours they sleep. By saying yes, they are stating 6-8 hours already.	Amended-page 2
Question 9 – they could say yea to the accident, but you only have location of surgery. Please be more specific for location could be interpreted as location of the accident i. e N3 highway and not location on the body.	Amended-page 2
Question 13 – perhaps add occasional or binge drinking as most people drink alcohol but only in occasions or a night out…not everyone drinks every week.	Amended-page 3
Section C –states psychological wellbeing PRE-COVID however questions use words like currently…are you enquiring pre-covid or now?	Amended- throughout questionnaire
Maybe use COVID-19 as the term throughout the questionnaire to keep consistency instead of ‘novel coronavirus	Amended- throughout questionnaire
Include stretching or even Pilates or yoga?	Amended- page 9
There are no page numbers on the questionnaire	Amended- throughout questionnaire

Appendix H: Letter of permission to advertise on DUT pinboard

[24/07/20]

Request for Permission to advertise on DUT pinboard

Dear Mr Alan Khan

My name is Nevinia Narainsamy, a master's student at the Durban University of Technology. The research I wish to conduct for my master's dissertation is titled:

Upper body musculoskeletal pain associated with remote working of academics at the Durban University of Technology during the COVID-19 pandemic

I am hereby seeking your consent to advertise for this research on DUT pin board

I have provided you with a copy of my proposal which includes copies of the data collection tools and consent and/ or assent forms to be used in the research process, and a copy of the approval letter which I received from the Institutional Research Ethics Committee (IREC).

If you require any further information, please do not hesitate to contact me [0747680533 or nevinianarainsamy@dut. ac. za]. Thank you for your time and consideration in this matter.

Yours sincerely,

[Nevinia Narainsamy]

Durban University of Technology

Advert for DUT pinboard

The world-wide pandemic, COVID-19, initiating national lockdowns and varied degrees of work considerations, has enforced remote working as a means to reduce the spread of infection.

Were you working from home during the COVID-19 Pandemic?

Did you experience an increase in musculoskeletal pain during the COVID-19 Pandemic while working from home?

Are you a full time, registered DUT staff member?

If you answered Yes to all the above questions, then you are the perfect participant for a research

study titled**:**

Upper body musculoskeletal pain associated with remote working of academics at the Durban University of Technology during the COVID-19 pandemic

All you need to do is click on the following link to access the questionnaire via question pro. This questionnaire will only take 10 minutes of your time.

For more information you can contact the researcher, Nevinia Narainsamy via email nevinianarainsamy@dut.ac.za

Thank You.

Appendix I: IREC Approval

Institutional Research Ethics Committee
Research and Postgraduate Support Directorate
2nd Floor, Berwyn Court
Gate 1, Steve Biko Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2375
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

30 April 2021

Ms N Narainsamy
34 Liberty Road
Bayview
Chatsworth
4092

Dear Ms Narainsamy

Upper body musculoskeletal pain associated with remote working of academics at the Durban University of Technology during the COVID-19 pandemic.
Ethical Clearance number IREC 136/20

The Institutional Research Ethics Committee acknowledges receipt of your final data collection tool for review.

We are pleased to inform you that the data collection tool has been approved. Kindly ensure that participants used for the pilot study are not part of the main study.

In addition, the IREC acknowledges receipt of your gatekeeper permission letter.

Please note that FULL APPROVAL is granted to your research proposal. You may proceed with data collection.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC Standard Operating Procedures (SOP's).

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Yours Sincerely,

Prof J K Adam
Chairperson: IREC