Prevalence and Associated Risk Factors of Musculoskeletal Disorders Among Undergraduate Radiography Students During Work Integrated Learning at the University of Technology, in Kwazulu-Natal.

Submitted in fulfilment of the requirements of the
Master of Health Sciences in Radiography
Durban University of Technology.

Masondo Siyanda Siphesihle

MAY 2022

Supervisor: Dr T.E Khoza PhD (Health Sciences)

ABSTRACT

Background

The term musculoskeletal disorders (MSDs) refer to injuries or disorders of the nerves, ligaments, muscles, joints, tendons and supporting structures of the upper and lower limbs, neck and spine which are caused by sudden or accumulative exposures to physical exertion. Musculoskeletal disorders (MSDs) are common among healthcare students including radiography students. Undergraduate radiography students during their study program are being placed in different hospitals for Work-integrated learning (WIL). During this period, they are prone to several risk factors that can trigger the occurrence of MSDs. There is a scarcity in the literature on the prevalence of MSDs in undergraduate radiography students attending WIL in the public and private sectors of South Africa. To date, no study has been performed which determines the risk factors for developing MSDs among Undergraduate radiography students within the eThekwini Municipality.

Aim

The aim of the study is to determine the prevalence of MSDs and to identify the risk factors associated with MSDs among undergraduate radiography students attending WIL within hospitals in the eThekwini Municipality.

Research Methodology

The research conducted was a quantitative study with a descriptive design that targeted undergraduate radiography students attending WIL within the hospital of the eThekwini Municipality, KwaZulu Natal. The research questionnaires were administered to undergraduate radiography students at the Durban University of Technology in order to determine the prevalence of MSDs and its associated risk factors. The questionnaire included demographic information, work routine during WIL, symptoms and impacts of MSDs on participants. Data was captured by the researcher and sent to a statistician for statistical analysis.

Results

In total, 144 questionnaires were utilised for statistical analysis, giving a response rate of 84.2%. The results showed a significantly high prevalence of the musculoskeletal

disorder among the students (92.4%). The most common areas of pain reported by the participants were the lower back (79.7%), neck (72.2%) and upper back (54.1%).

The statistically significant risk factors for musculoskeletal disorder among radiography students were bending, stress and depression. The Chi-square test showed that participants who are more often involved in bending experience significantly higher lower back pain. Multiple regression analysis shown found depression and stress during work-integrated learning (WIL) as independent risks factor for musculoskeletal disorders among radiography students

Conclusion and Recommendations

The study showed that the prevalence of musculoskeletal disorder is high (92.4%) among undergraduate radiography students during WIL. Further research is needed in this population and South Africa in order to address the high incidence of MSDs and their impacts on healthcare students. In addition, to prevent the recurrence of MSDs among students, it is recommended that the faculty of health sciences and the radiography department design and implement suitable interventions, such as an education program/training on ergonomics practice. Also, it would be beneficial for the students to become more aware of MSDs and take corrective measures to better equip themselves to mitigate MSDs and seek treatment when necessary.

Keywords

Musculoskeletal Disorders, Radiography students, Prevalence, Work-integrated Learning.

DECLARATION

By submitting this research dissertation, I Masondo Siyanda Siphesihle, declare that the entirety of the work contained herein is my own, original work, that I am the owner of the copyright thereof (unless to the extent explicitly otherwise stated), and that I have not previously, in its entirety or part, submitted it for obtaining any qualification.

The research was approved by:
The Institutional Research Ethics Committee (IREC), Durban University of Technology, reference number: 203/21.

15 May 2022

Signature
Masondo SS
Student

Date

I, the undersigned approve the submission of this dissertation.

Signature
Dr. Khoza T.E
Supervisor

Date

DEDICATION

I dedicate this work

To my grandmother Majoyina Mbhele, whose unwavering love, support, and encouragement have taught and motivated me to exceed my expectations, achieve, and be capable of things beyond my wildest imagination. Thank you for your many years of spiritual, intellectual, emotional, and financial support in helping me to become the person I am today and achieve my goals.

And

To my brothers and sisters and all my relatives for their endless love, support and encouragement during this study

ACKNOWLEDGEMENTS

I would like to place on record my gratitude to the following people for their guidance in completing this research dissertation:

- Dr. Khoza, for his tireless and copious work as my supervisor.
- To Dr. Khoza again I would like to express my heartfelt gratitude for his statistical support and guidance with regard to the presentation and discussion of the results.
- Dr. Hendry for your quick and efficient proofreading.
- The DUT Institutional Research Ethics Committee for granting approval to conduct the research.
- Dr. Linganiso for granting me permission to do the research in the institution.
- Dr. Nkosi for granting the permission to conduct my research among radiography students
- Thank you to all the radiography students who took part in my study, your help is greatly appreciated.
- DUT for the research budget that was made available
- My parents and siblings, for being there for me, as well as their encouragement, support and prayers throughout this study.

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

SYMBOLS AND ABBREVIATIONS

%	: Percentage
<	: Refers to a value less than the value shown
=	: Sign implies equals to
>	: Refers to a value greater than the value shown
MSD	: Musculoskeletal disorders
WMSD	: Work Musculoskeletal disorder
WIL	: Work Integrated Learning
BMI	: Body mass index
DoH	: Department of Health
DUT	: Durban University of Technology
HPCSA	: Health Professions Council of South Africa
IREC	: Institutional Research and Ethics Committee
DR	: Diagnostic Radiography
US	: Ultrasound
RT	: Radiotherapy
CI	: Confidence intervals
Kg	: Kilogram
kg/m2	: Kilogram divided by meter squared
km	: Kilometer
KZN	: KwaZulu-Natal
LBP	: Low back pain
M	: Meter
n	: Population size
p	: Indicates the statistical significance of the data.
SA	: South Africa
WHO	: World Health Organization
Sig	: Significance
UK	: United Kingdom

GLOSSARY OF TERMS

Prevalence : The existence of a disease or condition usually measured in a specific population and over a number of different time frames (Testa, & Simonson, 1996).

Risk Factor : The World Health Organisation defines risk factors as any attribute, characteristic or exposure that leads to an increased likelihood of an individual to develop a disease or injury (WHO, 2019).

Musculoskeletal : Relating to or denoting the musculature and skeleton together (Watson, Wilkinson, Gould, Graham-Brown, Major & Smith, 2020).

Musculoskeletal Disorders : An injury or disorder that affects the human body's movement or musculoskeletal system (i.e., muscles, tendons, ligaments, nerves, discs, blood vessels, etc.) (Watson, Wilkinson, Gould, Graham-Brown, Major & Smith, 2020).

Radiography : Radiography is the art and science of using radiation to provide images of the tissues, organs, bones, and vessels that comprise the human body

Undergraduate Students : is a student at a university or college who is studying for his or her first degree.

Work Integrated learning : it is the term given to educational activities that integrate academic learning of a discipline with its practical application in the workplace. The aim is to ensure that students develop the ability to integrate their learning through a combination of academic and work-related activities.

Demographic : Inherent characteristics of an individual (specifically age, gender, and ethnicity in this study).

Socio-demographic : Extrinsic characteristics regarding the social environment of an individual which may be determined/influenced by one's demographics (with specific focus on socioeconomic status and general health and lifestyle for this study).

Psychosocial : Extrinsic and interrelated psychological and social characteristics (with a specific focus on depression, anxiety, stress, and coping for this study (McCarthy, Trace, O'Donovan, Brady-Nevin, Murphy, O'Shea & O'Regan, 2018).

CHAPTER ONE: INTRODUCTION

1.1 INTRODUCTION

This is an introductory chapter which contextualises the study by providing background to the study, its significance, and its limitations. Here the aims and objectives are also presented, along with a chronological synopsis of the chapters which follow.

1.2 THE RESEARCH'S BACKGROUND

Musculoskeletal disorders (MSDs) were first discovered during the late 19th century among industrial workers in Great Britain (Akweetelela 2019:1). Over decades, high rates of workplace injuries related to MSDs have been reported in both developed and developing countries. Currently, MSDs are a serious global concern for many organisations, including industry, insurance, and health care (Khan, Ahmad, and Merchant 2017:1).

The term "musculoskeletal disorders" refers to injuries or disorders of the nerves, ligaments, muscles, joints, tendons, and supporting structures of the upper and lower limbs, neck, and spine that are caused by sudden or accumulative exposures to physical exertion (Kumalo 2015: 9). Musculoskeletal disorders (MSDs) are painful disorders that are degenerative and inflammatory conditions that affect the peripheral nerves, neurovascular, and musculoskeletal systems (Darvishi *et al.* 2017:23). These disorders are widespread and cause increasing occupational health problems in the workplace worldwide. They usually occur when a muscle, tendon, nerve, or joint is stressed and traumatised on a repeated basis for days, months, or years, and those body tissues eventually become damaged (Akweetelela 2019:1). According to the World Health Organization (2003:47), musculoskeletal disorders include all forms of ill-health, ranging from light, transitory disorders to irreversible, disabling injuries.

Studies have shown that musculoskeletal problems are common in healthcare workers who are in direct contact with patients (Tinubu *et al.* 2010: 30). It has been reported that healthcare workers are affected by work-related musculoskeletal disorders (WMSDs) in most cases. Work-related musculoskeletal disorder (WRMSD) refers to MSDs that are caused by work conditions (Korhan and Memon 2019:1). Mukhtad *et*

al. (2018: 319) highlighted the simple explanation of the development of WMSDs. According to Mukhtad *et al.* (2018: 319), when workers are exposed to MSD risk factors, they begin to fatigue. If fatigue outruns their body's recovery system, they develop a musculoskeletal imbalance. Over time, as fatigue continues to outrun recovery and the musculoskeletal imbalance persists, a musculoskeletal disorder develops. Work-related musculoskeletal disorders (WMSDs) are sometimes called repetitive strain injuries (RSIs), cumulative trauma disorders, and overuse injuries (Akweetelela 2019:1).

According to Yasobant and Rajkumar (2014:1), work-related musculoskeletal disorders (WMSDs) are responsible for morbidity in many working populations and are known as a significant occupational issue with increasing compensation and health costs, reduced productivity, and a lower quality of life. Akodu and Ashalejo (2019: 253) further state that these disorders can lead to permanent disability, loss of work hours, and the need for long-term medical care for healthcare workers. Moreover, it leads to absenteeism and early retirement (Hafner, Milek, and Fikfak 2018: 113). According to the Health and Safety Executive (HSE) report (2019: 10) outlined, in 2018/19 MSDs accounted for 37% of the total work-related illnesses in Great Britain. Back-related injuries are estimated to be the cause of 60% of absenteeism, followed by neck and upper extremity injuries (Lamprecht 2019:8).

Manual handling of patients, reparative movement, overexertion, and standing for long periods of time are the leading causes of musculoskeletal disorders among healthcare workers (Eggers 2016: 7). According to Ngan *et al.* (2010: 389), these tasks put physical stress on the body tissues and result in musculoskeletal pain. Manual handling is reported as the root cause of more than a third of all workplace injuries. Poor manual handling can result in injuries, joint problems, and other long-term musculoskeletal disorders (Putter, Miller, and Lee, 2021: 10).

Just like healthcare workers, undergraduate health students are also exposed to physical and psychological factors that may trigger the occurrence of MSDs. Previous research has found a high prevalence of MSDs among healthcare professional students (Morais 2019: 5; Elsayed 2019: 592; Bensusan 2019:21; and Hendi *et al.* 2019: 19). According to Kriel's (2020:80) study, 80% prevalence of MSD was found

among surveyed health sciences students at the University of Johannesburg (UJ), with nursing students having the highest prevalence of 84%, followed by optometry and sports and movement sciences students with 77% and 76%, respectively.

Work-related musculoskeletal disorders (WRMSDs) pose a significant challenge to the radiography profession (Ibrahim and Mohanadas 2012:2452). Radiographers are trained health professionals responsible for performing diagnostic imaging procedures. Radiography is a challenging and rapidly advancing profession with a high global demand for staff (Thambura 2016:1). Undergraduate radiography students during their study programme are being placed in hospitals for work-integrated learning (WIL). Work-integrated learning provides students with real-world experiences, and it plays a significant role for radiography students in gaining new knowledge, understanding, and capabilities (Bezuidenhout 2015:30). During WIL, students are rotated to different hospitals, and they perform almost all the tasks that are done at hospitals by qualified radiographers. These tasks include preparing the patient for radiographic examination, positioning and mobilising patients on the examination table (Kim and Roh 2014: 1423), moving heavy x-machines, handling x-ray image receptors, wearing a heavy lead apron during fluoroscopic or interventional procedures, and long-standing. All these tasks put the radiography students at risk of developing MSDs.

Given the above, there is a scarcity of research indicating the prevalence of MSDs among radiography students. To date, no study has been conducted in the eThekwini Municipality to determine the risk factors for developing MSDs among radiography students. The paucity of South African data with regard to the prevalence of MSDs among undergraduate radiography students has thus prompted the undertaking of this study.

1.3 PROBLEM STATEMENT

There are a few studies that have attempted to identify the prevalence and risk factors for MSDs among the radiography student population specifically. International studies found during extensive literature review have highlighted the need to further investigate MSDs among radiography students since WRMDs are documented less frequently among this population (Almhdawi *et al.* 2017:1291; Lorusso, Vimercati, and

L'abbate 2010: 1). In South Africa, Bensusan (2019: 21) is the only study found that has highlighted the prevalence of MSDs among radiography students. Bensusan (2019: 21) recommended that further research is necessary to compare the results to other faculty of health science departments. The recommendations from this previous study, as well as the scarcity of South African information on the prevalence of MSDs among undergraduate radiography students, generated the interest in conducting the current study. This study will attempt to determine the experience of MSDs among radiography students while practicing on WIL and will investigate the possible risk factors.

To the researcher's knowledge, there is no study in KZN that has been conducted to determine the prevalence and risk factors of MSDs among radiography students. Therefore, there is a need to conduct this study in order to determine the prevalence rate of MSDs among radiography students. The benefits of understanding what factors influence MSDs will assist the faculty of health sciences and radiography department boards to develop and provide appropriate interventions such as education programmes or training to reduce the incidence of MSDs among students. Moreover, information from this study will help to encourage students to take the steps to prevent the risks of MSDs.

1.4 AIM AND OBJECTIVES OF THE STUDY

1.4.1 Aim

The aim of the study is to determine the prevalence and risk factors associated with MSDs among undergraduate radiography students. In so doing, the study will contribute to and expand the literature on MSDs and make recommendations to the department of radiography to develop interventions such as education programmes or training on ergonomics practice to reduce the incidence of MSDs among students**.**

1.4.2 Objectives

The objectives of the study are:

1. To determine the prevalence of MSDs among undergraduate radiography students.
2. To identify the parts of the body that are most affected by MSD

3. To determine any association between the prevalence and selected risk factors for musculoskeletal disorder among radiography students

1.5 SIGNIFICANCE

This study investigated the prevalence, body parts affected, and risk factors for MSDs specific to radiography students. Currently, nothing is known about the prevalence of this disorder among undergraduate radiography students in KwaZulu-Natal, hence prevention strategies are not implemented, and nothing is known about the extent of the problem. Therefore, the findings of this study will add to the body of knowledge on the prevalence of MSDs. In addition, understanding what factors influence MSDs among radiography students will assist the faculties of health sciences and radiography departments in different institutions to develop and provide appropriate interventions such as education programmes or training on ergonomics practice to reduce the incidence of MSDs among students. Moreover, the information from this study will help to encourage students to take the steps to prevent the risks of MSDs.

1.6 ASSUMPTIONS, LIMITATIONS, AND DELIMITATIONS

An important part of any research project is identifying the delimitations, limitations, and assumptions of the study. In this way, the scope of the study is defined and potential weaknesses in the study are addressed. Delimitations are controllable limits set by the researcher in order to define the direction of the study and are usually based on practical factors such as budget and time constraints; by contrast, the limitations of the study are areas of weakness over which the researcher has no control. Assumptions, on the other hand, are factors that are difficult to prove but that are believed to be true by both the researcher and those reading the dissertation (Cunningham, Weathington, and Pittenger 2013:1; Simon and Goes 2013:10; Creswell 2017:10).

The study was conducted by the researcher in the form of a partial dissertation and as a requirement for obtaining an academic degree. As a result, factors such as time and budget constraints are noted in their influence on the direction and depth of the study.

1.6.1 Delimitations

The following factors were considered delimitations of the study:

- Participants were limited to second to fourth-year undergraduate radiography students enrolled at the DUT Ritson campus. This limit was set by the researcher in order to remain within the budget and time constraints imposed upon the study.

- The study was limited to risk factors for musculoskeletal disorders that affect students during WIL, according to the researchers.

- The researcher chose to utilise a quantitative, descriptive cross-sectional survey design for the study as opposed to other designs because it was believed to be best suited to achieving the aims and objectives of the study. Furthermore, the researcher chose a convenient sample strategy. This sampling technique is suitable for this study since the targeted population are student radiographers and can be easily accessible by the researcher. Also, this strategy is cost-effective for the study budget.

1.6.2 Limitations

The following factors were considered limitations of the study:

- The nature of using a quantitative, descriptive, cross-sectional approach is that the statistical models utilised in the study were only able to determine a correlation of selected risk factors with MSDs. Therefore, risk factors identified in the study are considered to be associated with MSDs but cannot be interpreted as having caused musculoskeletal pain.

- The data collection process for this study occurred during the COVID-19 pandemic. This poses significant challenges for this study. The study recruitment plan and response rate were affected. During this period, students were not attending campus-based lectures. The hours they spent attending WIL were also affected. Due to time constraints, the researcher had to get the study done, so it was conducted even during these unfavourable circumstances.

- In order to avoid fatigue bias, the questionnaire structure was closed-ended and kept as short as possible. This approach limits the participants' answers.

1.6.3 Assumptions

It has been assumed that the responses of the participants were honest, as it is impossible to prove or control this when conducting a study of this nature. Considering this assumption, every effort was made by the researcher during data collection to assure the participants that their responses would be kept anonymous and confidential in the hope that this would create an environment in which they felt comfortable responding truthfully to the questionnaire content. Moreover, participation was voluntary, and the participants were informed that they could withdraw from the study at any point without any negative ramifications as a result of their withdrawal.

1.7 OUTLINE OF THE CHAPTERS

1.7.1 Chapter One

This chapter introduced and contextualised the topic by providing a brief background on the research surrounding the topic. This chapter also outlines the aims, objectives, significance, delimitations, limitations, and assumptions of the study.

1.7.2 Chapter Two

This chapter reviews the current international and national literature on MSD and its associated risk factors. In order to keep the review current, research that has mostly been published in the past five to ten years was the focus of the review. Reviewing the literature allowed the research gap to be defined and, in so doing, highlighted the projected value of the study.

1.7.3 Chapter Three

The methodology of the study is documented in this chapter. It states the research paradigm and design as well as the inclusion and exclusion criteria of the study. The sampling strategy, sample size, and the data analysis method are explained. This chapter also outlines the instruments used in the development the questionnaire, the development of the questionnaire, the process of content and face validation of the questionnaire, the study procedure, and the ethical considerations of the study.

1.7.4 Chapter Four

The study's findings are presented in this chapter. The data is represented in a range of ways (text, tables, charts, graphs, etc.) for optimal visualisation, and the results are presented in the order of each objective. The significant associations and correlations between the measured variables are also displayed here.

1.7.5 Chapter Five

The results of the study (chapter four) are explored and interpreted in this chapter through a detailed discussion. The discussion progresses in accordance with the objectives, highlighting notable and statistically significant associations. The study's findings are discussed in relation to the relevant literature, which was reviewed in Chapter 2.

1.7.6 Chapter Six

This chapter wraps up the research and summarizes the key findings. It assesses the study by going over each objective and demonstrating the contribution to the body of knowledge as well as the gap in the literature. This chapter also discussed the study's limitations and limitations, outlining their implications in light of the findings. A review of the research process was provided, as well as recommendations for future research, the radiography department, and the radiography students.

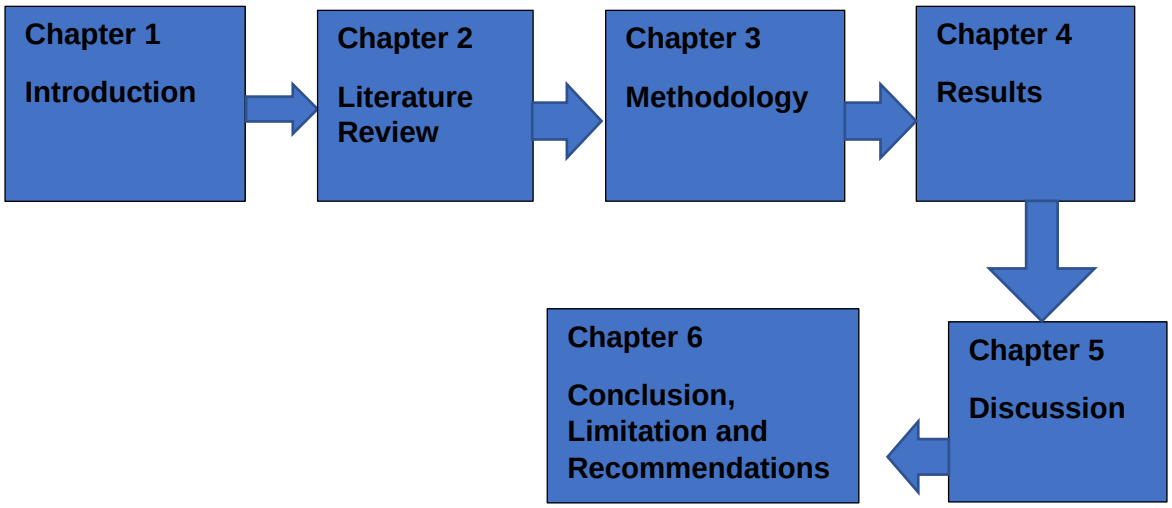


Figure 1.1 shows the outline of the chapters for the current study

1.8 SUMMARY

In summary, musculoskeletal disorders (MSDs) are common among radiography students. During clinical placements, undergraduate radiography students are exposed to physical and psychological factors that may trigger the occurrence of MSDs. However, both developed and developing countries, including South Africa, have limited studies that report the prevalence rate of MSDs among radiography students. Therefore, this generated the interest in conducting the current study. The findings of this study will add to the body of knowledge on the prevalence of MSDs. In addition, understanding what factors influence MSDs among radiography students will assist the faculties of health sciences and radiography departments in different institutions to develop and provide appropriate interventions to reduce the incidence of MSDs among students. The above chapter has outlined the background, problem statement, aim, objectives, and significance of the study.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Although there are numerous studies on MSDs (Yasobant and Rajkumar 2014: 75; Luan *et al.* 2018:1; Elsayed 2019: 952; Malany Moodley, and Kriel 2020: 25; Desai and Jain 2020:20; and Hafeez Saeed and Ghauris 2022:2), there are few articles that focus on MSDs in the diagnostic radiography profession. The following section will critically review different studies that have been conducted nationally and internationally. The literature reviewed was sourced from Medline, PubMed, Summons, Science Direct, CinaHL, SabiNet, EBSCO host, and Google Scholar databases. The search was limited to studies published in the period from 2010 to 2021. A secondary search was conducted by searching for articles and studies that had been referenced by the authors of the primary search.

The following keywords were used in the primary search strategy:

risk factors. musculoskeletal disorders, work-related musculoskeletal disorders, radiography, undergraduate radiography students, X-ray technologists, risk factors.

The following subheadings were used in compiling the literature review:

- Definition of musculoskeletal disorders
- Different Types of musculoskeletal disorders
- The prevalence of musculoskeletal disorders among radiography students.
- the prevalence of musculoskeletal disorders among other healthcare students
- The risk factors of musculoskeletal disorders
- The impact of musculoskeletal disorders on undergraduate students
- The theoretical framework used in this study
- Conclusion

2.2 Musculoskeletal Disorders Definition

The term "musculoskeletal disorders" refers to an injury or disorder of the nerves, ligaments, muscles, joints, tendons, and supporting structures of the upper and lower limbs, neck, and spine which are caused by sudden or accumulative exposures to physical exertion (Kumalo 2015: 9). Work-related musculoskeletal disorder (WMSD) is a collective and descriptive term for the symptoms caused or aggravated by work (Ellapen and Narsigan 2014:1). Different terms have been used to refer to MSDs as a result of diverse occupations, work groups, the different tissue involved, and the body locations affected. These disorders are also called cumulative trauma disorders, repetitive strain injuries, repetitive trauma disorders, or overuse syndrome (Adetiba 2017:8).

Work-Related Musculoskeletal Disorders (WMSD) are responsible for morbidity in many working populations and are known as a significant occupational issue with increasing compensation and health costs, reduced productivity, and a lower quality of life (Yasobant and Rajkumar 2014:1). According to Tinubu *et al.* (2010), these disorders are common in healthcare workers who are in direct contact with patients. Akodu and Ashalejo (2019: 253) further state that these disorders can lead to permanent disability, loss of work hours, and the need for long-term medical care for healthcare workers. Moreover, it leads to absenteeism and early retirement. According to the Health and Safety Executive (HSE) report (2019: 10) outlined, in 2018/19 MSDs accounted for 37% of the total work-related illnesses in Great Britain. Also, Shiri *et al*. (2018:1) study results showed that 30% of the participants had a higher risk of disability retirement due to MSDs. Back-related injuries are estimated to be the cause of 60% of absenteeism, followed by neck and upper extremity injuries (Lamprecht 2019:8).

An ache, pain, or discomfort in the neck, shoulder, elbows, or hands/wrists has previously been described as musculoskeletal symptoms (Eggers 2016: 7). Recent studies suggest that musculoskeletal symptoms are caused by excessive use of bones, ligaments, and muscles (Abdulmonem *et al*. 2014: 1991). Pain is often the most frequently mentioned MSD symptom (Darwish and Al-Zuhair, 2013:1). MSDs are classified as tendonitis, tenosynovitis, peripheral nerve entrapment, bursitis, low back pain, sciatica, and neuro-vascular syndromes based on the location of the pain

(Eggers 2016: 7). Musculoskeletal pain is described as either acute or chronic and is often work-related (Abdulmonem *et al.* 2014:10).

2.3 Different Types of Musculoskeletal Disorders

Work-related musculoskeletal disorders (WMSDs) may affect the different parts of the body associated with movement. Awkward posture during work, repetitive movements, prolonged standing, and long working periods to carry out work activities cause mechanical load on the joints, and this results in WMSDs in different anatomical parts (Mishra and Sarkar 2021: 1).

In their study, Collins, Janse van Rensburg, and Patricious (2011: 240–243) classified some common work-related musculoskeletal injuries as low back pain, neck/shoulder pain, and upper extremity conditions. Until now, little attention has been given to the epidemiology of work-related lower limb MSDs. However, lower limb MSDs are a problem in many workplaces. Lower limb disorders affect the hips, knees, and legs and usually happen because of overuse.

2.3.1 Back Pain

Low back pain (LBP) is defined as pain, muscle tension, or stiffness located between the posterior costal margin and the inferior gluteal folds (Chou 2011: 437). According to Casser, Seddigh, and Rauschmann (2016:223), acute LBP is defined as LBP lasting less than six weeks; sub-acute LBP is defined as LBP lasting more than six weeks but less than twelve weeks. On the other hand, back pain lasting more than twelve weeks is referred to as chronic LBP (Chou 2011:437).

Low back pain (LBP) is one of the most prevalent complaints among all age groups (Nordin, Singh, and Kanglun 2014:423) and has a negative impact on work ability and the general health of an individual (Manchikanti *et al.* 2014:10). At least 90% of the population has had low back pain at some point in their lives (Hafeez *et al*. 2013: 819; Al-Shayhan and Saadeddin 2018: 165). Eggers (2016: 8) pointed out that lower back pain (LBP) can be due to specific or non-specific causes. Non-specific low back pain (LBP) is one of the most common and costly disorders affecting people in industrialised countries (Collins, Janse van Rensburg, and Patricious 2011: 240).

Work-related LBP may occur as a result of different factors, such as traumatic injury, repetitive use, or other factors (Collins, Janse van Rensburg, and Patricious 2011: 240). Adetiba (2017: 9) pointed out that LBPs are caused by the deviation from an upright posture, resulting in increased pressure on the lumbar spine and heavy loading of the fibre layers. Other documented factors contributing to the development of LBP include a combination of individual factors such as high body mass index (BMI), fragile back strength and irregular exercise, biomechanical factors (frequent bending and twisting, whole body vibration, non-neutral static posture), and psychosocial factors (low job satisfaction, low social support in the workplace); (Collins, Janse van Rensburg and Patricious 2011: 241).

Low back pain (LBP) is one of the most common complaints among healthcare students, according to several studies (Aggarwal *et al*. 2013:103; Hafeez *et al.* 2013:819; AlShayhan and Saadeddin 2018: 165). The overall prevalence of LBP in health science students has been reported to range from 40.1 to 57.9% (AlShayhan and Saadeddin 2018: 165). Health science students are vulnerable to stress and prolonged periods of studying and training, which will make them predisposed to having LBP (AlShayhan and Saadeddin 2018: 165). According to Hafeez *et al. (*2013:10), back pain in the nursing population is well studied and is more prevalent in nursing students during their clinical duties. Gender, age, weight, general health status, socioeconomic status, smoking, year of study, psychosocial factors, history of back pain, history of back trauma, family history of treated back pain, use of a heavy backpack, physical fitness, prolonged sitting time, bad postural habits, short sleep hours, and discomfort in bed were identified as risk factors for LBP among health care students (Nordin, Singh, and Kanglun 2014:423); and (AlShayhan and Saadeddin 2018: 165).

2.3.2 Neck and Shoulder Pain

Neck and shoulder pain is a relatively mild musculoskeletal condition but has become a major health problem in recent years and represents a major burden on the individual and the community (Gheysvandi *et al.* 2019:1). The World Health Organization (WHO) has ranked neck pain and other musculoskeletal diseases as the fourth and tenth health problems, respectively, for years lived with disability (Gheysvandi *et al.* 2019:

1). Several studies have found that 6–76% of the working population suffers from neck and shoulder pain each year (Collins, Janse van Rensburg, and Patricious 2011: 243). Moreover, according to Kanchanomai *et al.* (2011: 1), the high prevalence of musculoskeletal symptoms in the neck and upper extremities among undergraduate students ranged from 48 to 78%.

Previous studies have reported the high prevalence of neck and shoulder pain among healthcare students (Hasan *et al.* 2018:131; Weleslassie *et al.* 2020:1); Fenemban *et al.* 2021:39; and Ogunlana, Govender and Oyewole 2021:35). Neck pains reduce educational attainment and lead to truancy from university lessons, which will affect students' future careers (Weleslassie *et al.* 2020: 1). Medical students seemed to have a higher risk of developing neck and shoulder pain compared to other healthcare students. A study conducted at a Malaysian medical college found that 41.8% of students had neck pain and reported an association with clinical years, computer use, and a prior history of trauma (Alshagga *et al.* 2013: 244).

There were a few studies that reported neck and shoulder pain among radiography students. However, the results from Elshami *et al.* (2018:12) study pointed out that neck pains are the most developed stress injury symptoms after working in the diagnostic radiology department. Moreover, this study reported that most of the radiographers who perform portable X-rays were reported to develop neck pain. Similar results were found in a study by Gevers (2018:116), which reported that of the eight health sciences programmes that were randomly selected and sampled, the highest prevalence of neck pain was observed among the Diagnostic Radiology students. The current study will be not only diagnostic radiography as seen in Gevers' study but will be specific to the prevalence of neck pain and other MSD disorders among radiography students.

Neck and shoulder pain occurs when workers are predisposed to performing repetitive or forceful precision tasks, which lead to sustaining static, awkward and constrained postures, such as flexing the thoracic and cervical spine, as well as shoulder elevation and abduction (Adetiba, 2017: 9). The conditions that are associated with neck and shoulder pain include cervical syndrome, cervicobrachial fibromyalgia, tension neck

syndrome, and rotator cuff muscle syndromes (Collins, Janse van Rensburg, and Patricious 2011: 243).

2.3.3. Upper Extremity Conditions

According to Kennedy *et al.* (2010:127), upper limb disorders (ULDs) were defined as musculoskeletal symptoms or signs or clinical diagnoses affecting the neck, shoulder, upper arm, elbow, forearm, wrist, hand, fingers, and thumbs and included injuries to or disorders of the muscles, ligaments, tendons, joints, nerves, and blood vessels. Some have well-defined signs and symptoms in the neck, shoulders, and upper limbs, while others are less well-defined, involving only pain, discomfort, numbness, and tingling. Upper extremity musculoskeletal disorders constitute a major portion of occupation-related illness, with annual costs related to treatment and absenteeism from work ranging between $45 and 54 billion in the United States (Mohan *et al.* 2019: 171).

Acute episodes of pain and/or impairment may arise from a single excessive overload. For example, direct impacts from heavy mechanical loads can cause ruptures of soft tissues or broken bones. Work-Related Upper Limb Disorders are, however, more likely to occur from the effects of many repeated moderate loads during an extended period. Smaller loads may not appear to cause immediate injury, but if they are imposed regularly over many months or years, they can cause muscle fatigue and lead to microscopic injuries in the tissues. If sufficient time to rest is allowed, the body will grow stronger (this is the goal in training or rehabilitation). If, however, there is not enough time to recover from the tiredness, or if the load is sustained for too long, this can result in WRULDs (European Agency for Safety and Health at Work Manual 2022:2).

Studies have shown that upper body musculoskeletal disorders represent an increasingly important issue for healthcare students. However, few studies have targeted radiography students. According to Pallotta and Roberts (2017:5), ultrasound sonographers are at an increased risk of developing musculoskeletal disorders affecting the wrists (e.g., carpal tunnel syndrome, carpal instability, tendonitis), upper extremities, back, neck, and shoulders. The literature shows that when a poor

scanning position is used, it causes significant stress on the upper body, particularly the shoulders, neck, and back, which can lead to injury (Pallotta and Roberts 2017: 5).

There are various upper extremity conditions. Table 2.1 presents some common WRULDs and a description of the disorder, as well as the symptoms and causes (Collins, Janse Van Rensburg, and Patricios 2011: 243). One example of WRMSD that sonographers often develop is carpal tunnel syndrome (CTS), which is a condition resulting from extrinsic compression on the median nerve within the carpal tunnel. Johnson (2012:1) conducted a study that aimed to discover if first-year ultrasound students would develop signs of swelling or injury of the median, indicating carpal tunnel syndrome. It was hypothesised that first-year sonography students would show signs of CTS since sonographers have a high rate of developing musculoskeletal injuries like CTS. However, this study was unable to prove that first-year sonography students can manifest CTS due to the length of time over which the study took place and the fact that the sample size was very small (only 18 first-year sonography students were included). Schoenfeld *et al.* (1999: 41), as cited in Evans *et al.* (2010:127), discovered that 4.5% of obstetrical sonographers had carpal tunnel syndrome and 2.3% had carpal instability.

Table 2.1: Common work-related musculoskeletal disorders that affect the upper limbs (Collins, Janse Van Rensburg and Patricios 2011: 243).

Disorders	Symptoms	Causes
Carpal tunnel syndrome	Numbness of the middle finger especially at night	Repetitive wrist flexion
Myofascial pain of the neck	Heaviness and aching in the shoulders, upper back and neck	Overhead work and work with extended arms, computer posture, stress reaction
Shoulder bursitis	Shoulder pain and stiffness	Repetitive shoulder movements
Rotator cuff tendinosis	Shoulder pain and stiffness	Repetitive shoulder movements with twisting and overhead activities
Lateral epicondylitis	Lateral elbow pain	Extended wrist
Trigger finger	Locking of fingers in flexion	Repetitive hand grip

2.4 Prevalence of Musculoskeletal Disorders Among Radiography Students

The vast majority of identified prevalence or incidence studies evaluated qualified radiographers (Kim and Roh 2014: 1423; SH 2018: 198; Daniel *et al.* 2018: 57; Udoh *et al.* 2019: 1 and Adesi, Kwadw and Kab 2015: 2379). Also, most of the published literature reports that there is a higher prevalence of work-related musculoskeletal disorders among radiographers (Alhasan *et al.* 2014: 291; Kim and Roh 2014:1423; Hulls 2018:354 and Oke and Adeyekun 2013:63). However, few studies have targeted radiography students regarding the incidents of MSDs (see table 1.2). Just as seen in qualified healthcare workers, the prevalence of work-related musculoskeletal disorders amongst undergraduate healthcare workers is high worldwide (Morais *et al.* 2019:10).

The few studies found globally (Bowles and Quinton 2019:1); Bolton and Cox 2015:145; African (Ofori-Manteaw, Antwi, and Arthur 2015:93) and in South Africa (Gevers 2018:166; Bensusan 2019:1) have reported a high prevalence (above 40%) of MSDs among radiography students. During clinical placements in radiography, students are frequently involved in transferring patients onto and off the examination table. This can increase their risks of developing MSDs (Ngo, Schneider-Kolsky and Baird 2013: 125). Diagnostic radiography is a physically demanding job (Gam 2015:16) and commonly involves the handling of larger numbers of patients and procedures per day than the other radiography disciplines.

In Italy, Lorusso, Vimercati, and L'abbate (2010:1) published the first study that was aimed at investigating the musculoskeletal complaints among Italian X-ray technology students. This study reported that the prevalence rates of musculoskeletal complaints among radiography students were somewhat high. Of the 109 radiography students surveyed, 29/109 (27%) reported back pain, 18/109 (16%) were experiencing neck pain, and 12/109 (11%) reported shoulder pain. The results showed that 9/34 (26%) first-year students reported an MSK complaint, compared to 18/39 (46%) of second-year students and 13/36 (36%) of third-year students.

Moreover, in Saudi Arabia, Almhdaw *et al.* (2017: 1291) conducted a study aimed to investigate the prevalence of MPS and their associated factors among different allied health professions (AHP) majors' students, including radiography students. This study

reported that MPS in the neck, lower back, and shoulders at 12 months were the most prevalent (67.1%, 61.4%, and 58.8%, respectively). Significantly increased clinical training load, mental stress symptoms, and smartphone average use time were significantly associated with MPS. According to Almhdaw *et al.'s* (2017: 1291) study, radiography students experience mostly neck pain (64.0%), followed by shoulder pain (55.3%). These results are different from those reported by Senarath, Thalwaththe, and Tennakoon (2021:1), which showed that radiography students experienced mostly back pain (44.2%), followed by neck pain (36.5%). Senarath, Thalwaththe, and Tennakoon (2021:1) conducted a recent study at the University of Peradeniya in Sri Lanka, which had the similar aim of evaluating the prevalence of musculoskeletal disorders among the undergraduate students of the Faculty of Allied Health Sciences. Both studies, Almhdaw *et al.* (2017: 1291) and Senarath, Thalwaththe, and Tennakoon (2021:1) included radiography students in their target population. In addition, Senarath, Thalwaththe, and Tennakoon (2021:1) compared the level of study and prevalence of MSDs and found that third-year students complained mostly about low back discomfort since they had more laboratory work and practicals. On the other hand, second and fourth-year students experienced more neck discomfort since they have more lectures and clinical placements and therefore have to flex their neck while engaging in their work.

In Australia, Bowles and Quinton (2019:1) published a study that highlighted the prevalence of musculoskeletal disorders, specifically in sonography students. Sonographers develop WRMSD due to arm abduction, transducer grip force, downward transducer pressure, and spine twisting that occurs while scanning (Baker 2011:3). The study by Bowles and Quinton (2019:1) was conducted at an Australian university. It was aimed to determine whether final-year sonography students undergoing clinical placement experienced pain while scanning or developed a musculoskeletal injury while on placement. This study reported that 97% (n = 34) of respondents experienced musculoskeletal pain while scanning on university practical placements. These findings are more than reported by Bolton and Cox (2015:145) in the United Kingdom. According to Bolton and Cox (2015:145), more than 80% of sonographers in the United Kingdom have reported experiencing pain from repeatedly performing sonographic (US) examinations. Most of the studies highlighted that shoulder, wrist, and back pain are more prevalent among the sonography profession

(Roll, Selhorst and Evans 2014:253); Feng *et al.* 2016: 1; Murphey 2017:10; Roussel *et al.* 2013:157). According to Harrison and Harris (2015:224), shoulder pains are due to arm abduction and can lead to reduced blood flow to the shoulder. Also, wrist flexion and extension during the scan increase wrist injuries, and the twisting of the body can lead to back pain and injury (Baker 2011:4).

In Ghana, Ofori-Manteaw, Antwi, and Arthur (2015: 93) highlighted that neck and lower back injuries were the most prevalent MSDs reported by student radiographers. This is similar to what was reported by Udoh *et al.* (2019:1) in Nigeria, where most radiographers' respondents complained of low back pain (52.6%), followed by neck pain, shoulder pain, and hand/wrist pain. According to Udoh *et al.* (2019: 1), the major risk factors were prolonged standing or sitting during the prolonged duration of duty, lifting of patients and heavy equipment, and overstretching of the neck following heavy work schedules.

Furthermore, in South Africa, Bensusan (2019:1) reported that 81.2% of undergraduate radiography students experienced MSDs. This study was aimed at determining the prevalence of musculoskeletal disorders among undergraduate students in biomedical technology, environmental health, medical imaging, and radiation sciences (radiography) at the Faculty of Health Sciences at the University of Johannesburg. This is the only study that was found in South Africa in the Gauteng region that provided some information on MSD experienced by the radiography students. However, this study was not extensive on how to measure the prevalence of MSD during clinical placements of radiography students. According to Bensusan (2019:1), further research is necessary to compare the results found in their study to other Faculty of Health Science Departments. The current study has a similar aim to Bensusan's (2019:21) study in that it seeks to determine the prevalence of musculoskeletal disorders; however, this study will focus specifically on radiography students in KwaZulu Natal, eThekwini region. Furthermore, the current study will fulfil Bensusan's (2019:21) recommendation, which is to compare the results of their study to the results of other studies.

In addition, previous literature in South Africa reported that there was a high prevalence of neck pain in undergraduate radiography students (Gevers 2018:166).

According to Gevers (2018:166), reported that of the eight health sciences programmes that were randomly selected, the highest prevalence of neck pain was observed among the diagnostic radiography students (23.1%). SH (2018:198) reported almost similar results in their study to investigate the prevalence of musculoskeletal disorders among X-ray radiographers and nurses. The mouse work required for MRI has been shown to place significant strain on the neck (Kim and Roh 2014: 1423), leading to the development of neck pains in diagnostic radiographers.

Table 2.2: Summary of research on Prevalence of MSDs in undergraduate radiography students.

Research study	Prevalence of MSD in the different anatomic regions								
	Neck	Shoulder	Elbow	Wrist/ hand	Upper back	Lower back	Hip/thigh	Knee	Ankle/Foot
Lorusso, Vimercati, and L'abbate (2010: 1)	16%	11%	-	5%	-	27%	-	-	-
Almhdaw *et al.* (2017: 1291)	64.0%	55.3%	17.5%	33.3%	53.5%	59.6%	26.3 %	43.0 %	37.7 %
Senarath, Thalwaththe, Tennakoon (2021:57)	36.5%	23.5%	21.6%	4.1%	18.4%	44.2%	8.0%	28.3 %	33.3 %
Ofori-Manteaw, Antwi, and Arthur (2015)	-	-	-	-	-	-	-	-	-
(Bensusan 2019:1)	55.3%	40.2%	8.3%	31.1%	42.8%	73.4%	31.4 %	40.4 %	41.0 %

Bowles and Quinton (2019:1)	44%	82.3%	8.8%	Wrist 52.9% Hand 17.6%	41.2%	38.2%	-	-	Ankle 2.9% Feet 8.8%
Gevers (2018:166)	23.1%	-	-	-	-	-	-	-	-

2.5 Prevalence of Musculoskeletal Disorders Among other Healthcare Students

Several undergraduate healthcare students are also exposed to different risk factors, both in the academic scenario and in their insertion into the work environment, which can trigger the occurrence of MSD. Different healthcare students perform professional activities, which often lead to the adoption of inappropriate postures, repetitive movements, and long sitting and standing (Yasobant and Rajkumar 2014: 200). Also, most healthcare students are involved in manual handling of patients and pushing and pulling heavy materials which results into high prevalence of MSDs (Backberg *et al.* 2014:358).

Nursing is reported as a leading healthcare profession that is mostly affected by musculoskeletal disorders (Yasobant and Rajkumar 2014: 200). Several studies show a high prevalence (50–90%) of long-lasting musculoskeletal disorders among nursing students (Elsayed 2019:10; Antochevis-de-Oliveira *et al.* 2017:160; Moodley and Kriel 2020:1). Being a nursing student demands clinical placement periods that include moving and handling patients, which are shown to be risk factors for MSD (Backberg *et al.* 2014:358).

In Western Australia, Pugh *et al.* (2019: 2110) reported that nursing students experience the highest prevalence of musculoskeletal trouble in the low back (45.6%), followed by the neck (32.0%) and shoulder (18.5%) regions. The majority of previous research found that lower back pain is more common among nursing students (Abledu and Offei 2015:444; Backberg *et al.* 2014:358). Ribeiro *et al.* (2017:10) and Tinubu *et al.* (2010:30) pointed out that this is caused by heavy load handling whilst working with patients, such as shifting patients and picking them up.

A study in South Africa reported an 83% prevalence of MSDs in the total sample of undergraduate nursing students (Moodley and Kriel 2020: 1). Of this, 82.7% (n = 86) were represented by female students, whilst 17.3% (n = 18) were represented by male students. These findings are higher than those reported by Abledu and Offei (2015:444) in Ghana, which highlighted that of 200 first-year nursing students, 110 (70.1%) reported having MSDs in the previous 12 months. In both of these studies, lower back disorders were found to have the highest prevalence rate. The second most prevalent musculoskeletal disorder amongst nurses is foot and ankle injuries. Nurses spend almost half of their time on their feet and walking between wards (Reed *et al.* 2014:5).

Furthermore, medicine, physiotherapy, occupational therapy, podiatry, dental, chiropractic, and emergency medical care students are also reported by most of the literature to have the highest prevalence of musculoskeletal disorders. A study in Malaysia reported that the prevalence of musculoskeletal pain among medicine students was 45.7% in the past week and 65.1% in the previous year (Alshagga *et al.* 2013:1). According to Smith and Leggat's (2007: 39) study in tropical northern Australia, the prevalence of MSP among medicine students at anybody site varied from 75.8% in the second-year students to 89.3% in the third-year students. This study showed that most musculoskeletal disorders frequently occur in the neck (52.8%), lower back (51.6%), and shoulders (46.5%). Hasan *et al.* (2018:131) report that when compared with males, female medicine students report a higher prevalence of musculoskeletal disorders (Hasan *et al.* 2018:131). According to Shamsi *et al*. (2020:72), a justification for increased MSD in females is that women express their pain more than men. Also, due to hormonal and physiological differences, women are more vulnerable to musculoskeletal problems than men. On the other hand, in South Africa, Dachs *et al.* (2014:57) found that 91% of medical students were not competent in managing MSDs, and this study highlighted that undergraduate musculoskeletal education in South Africa is inadequate and that programmes throughout the country should be reassessed.

According to Desai and Jain (2020:20), 70.1% of the physiotherapy students had musculoskeletal pain after joining the physical therapy profession. This prevalence was higher when compared to the study conducted by Bharadva, Verma, and

Kantharia (2014:157) in Surat, which reported that 52% of physiotherapy students had MSDs. Lower back pain also appeared as a significant MSD that affects physiotherapy students. Imdad *et al.* (2016) pointed out that physiotherapy students attain potentially deleterious postures during training-related activities, prolonged sitting during lectures, and twisting and bending activities, thus increasing the risk of lower back pain (LBP). The research by Nazari *et al.* (2017:31) in Iran compared the prevalence of musculoskeletal disorders among psychotherapists and occupational therapist students. This study found that out of 17 occupational and 24 physical therapists who were included in the study, 13 (76.4%) and 14 (58.3%) of them experienced symptoms of MSD. The result showed that the occupational therapists experienced more serious problems than the physical therapists.

On the other hand, there are limited studies found that report MSDs among podiatrist students. Podiatrists have a high risk of MSD due to the ergonomic challenges associated with working posture, use of specialised equipment, and repetitiveness of the manual processes they engage in their work (Williams *et al.* 2017:10). In South Africa, Cartwright (2020:56) reported that 85.2% of podiatry students experienced musculoskeletal disorders. This figure is significantly higher than the 76% reported by Williams *et al.* (2017:1) in their study of podiatrists in Australia, New Zealand, and the United Kingdom.

Moreover, dental students are reported to be among the highest-paid professions that are affected by MSDs. A study in India (Kumar *et al.* 2014:1) revealed that 91% of dental students reported muscular pain due to clinical practice. These results are almost similar to the 91.2% reported by Felemban *et al*. (2021: 39) in Saudi Arabia and are higher than the 84.6% reported by Ng, Hayes, and Polster (2016: 10) in Australia. Kumar *et al.* (2014:1), highlighted that dental student experienced more pain while performing periodontics and restorative procedures. The neck, shoulder, and lower back are the areas that are most frequently affected by dental students.

Moreover, the majority of the previous studies reported the high prevalence of MSDs among qualified chiropractors (Lamprecht and Padayachy 2019:10; Howarth *et al*. 2020:1). There is one identified study in South Africa that reported the prevalence of MSDs among chiropractic students at the University of Johannesburg (Cartwright

2020:56). According to this study, it was found that 99.2% of chiropractic students had the highest prevalence of MSD. This is a very high figure compared to the 69% that was reported by Lamprecht and Padayachy (2019:10) among qualified chiropractors practicing in the eThekwini Local Municipality in Durban. Cartwright (2020:56) mentioned that one potential reason for the high MSD prevalence in chiropractic departments is that students specialise in the musculoskeletal system, and they are more conscious of their bodies.

In addition, emergency medical care (EMS) personnel are at risk for musculoskeletal injuries because they participate in patient transfers that require physical effort (Fisher and Wintermeyer 2012:30). Moodley and Ismail (2019:1) found that emergency medical care students had a 97.9% prevalence of MSDs at the University of Johannesburg in South Africa. This prevalence is higher than the 60% that was reported by Fisher and Wintermeyer (2012:33). According to Fisher and Wintermeyer (2012:30), WRMSDs could be a result of the cumulative nature of assuming awkward postures when repetitively bending, reaching, or using twisting motions during job tasks. Furthermore, Almhdawia *et al.* (2017:10) found that 67.4% of student EMCs in Jordan suffered from neck pain, 54.3% from shoulder pain, and 69.6% of students suffered from lower back pain.

2.6 Risk Factors for Musculoskeletal Disorders

The risk factors for MSDs are up to date and still being researched by different authors. However, most of the literature (Sakzewski and Naser-ud-Din 2014: 39; Adetiba 2017: 24; Levy 2018: 17; Coetzee 2018: 6 and Lamprecht 2019: 6) grouped the factors that may contribute to musculoskeletal disorders into the following categories: personal or demographic, work-related factors; and psychosocial factors.

2.6.1 Demographic Risk Factors

Individual factors, such as demographics (gender, body mass index, level of study) and lifestyle (smoking, alcohol, exercise) have been reported to have an effect on the risk factors for MSDs (Adetiba 2017: 24). Few studies have reported the association of individual factors and MSDs among health students, including radiographers. This

section will seek to analyse the studies that have reported any association between individual and lifestyle factors and MSDs.

2.6.1.1 Gender

In most of the studies, females recorded a higher incidence of MSD compared to males. According to Almhdaw *et al.* (2017: 1291) study, which was among allied health students, including radiography students, reported that females had significantly higher MSD as compared with males in the neck, shoulder, wrist/hands, and upper and lower back. Similar findings are reported by Moodley and Ismail (2019:1), where it was highlighted that there was an association between gender and musculoskeletal disorders under the Chi-square test, as more female participants (79.7%) had musculoskeletal disorders in one or more body region/s and specifically in the low back region when compared to male participants. Senarath, Thalwaththe, and Tennakoon (2021:4) compared different anatomic regions affected by MSDs and found a higher prevalence of neck, wrist, hand, upper and lower back problems in males and a higher prevalence of shoulder, elbow, hip/thigh, knee, and ankle/foot problems in females. One possible explanation for gender effects on MSD is that females might have a higher sensitivity to pain and therefore usually report more pain complaints, while males tend to under-report MSD and seek less medical care compared to females (Almhdaw *et al.* 2017: 1291). Shamsi et al. (2020:72) further mentioned that due to hormonal and physiological differences, women are more vulnerable to musculoskeletal problems than men.

In contrast, a study done among Italian student radiographers found that males experienced a higher prevalence of LBP (52.5%) than females (47.5%). Due to the structural, physiological, and anatomical differences that exist between males and females, there have been conflicting results with regard to the effect of gender on MSD. In addition, despite previous studies reporting increased WRMSD in females, Bowles and Quinton's (2019:1) study reported that gender was not found to be associated with the development of WRMSD among final-year sonography students. According to Bowles and Quinton (2019:1), the reason for this may be due to the small sample size and a small number of male respondents.

2.6.1.2 Year of Study

A student's year of study is reported to be a risk factor and a predisposing factor associated with the student's MSD (Moodley and Ismail 2019:1). There is evidence that as the years of study increase, the prevalence rate of MSD disorder also increases.

A study by Lorusso, Vimercati, and L'abbate (2010:1) reported that the prevalence of MSD is lower in first-year radiography students compared to second and third-year students. Similarly, Moodley and Ismail (2019:1) revealed that there was an increase in low back MSD throughout the year of study, from 52.3% in the first year to 76.2% in the fourth year during the last 12 months. Furthermore, Moodley and Ismail (2019:1) study reported that musculoskeletal disorders were found to be associated with the year of study under the Chi-square test.

2.6.1.3 Body Mass Index (BMI)

BMI is calculated by dividing weight in kilogrammes by height squared (BMI = weight/Height2). This is mostly used to classify underweight, overweight, and obese adults at population levels (Kumalo 2015:16). Normal BMI is defined as being between 18 and 25, overweight as having a BMI greater than or equal to 25, and obese as having a BMI greater than or equal to 30 (World Health Organization 2015).

Lower body mass index (BMI) is reported as a risk factor for the development of hand injuries (Gyer *et al.* 2018: 8). According to Snodgrass *et al.* (2010:1), a low BMI among physiotherapists was associated with an increased prevalence of thumb injuries. However, evidence to support this claim is still limited, as no other study has so far reported BMI as a potential risk factor for hand/wrist injuries among other healthcare workers, including radiography. On the other hand, being overweight or obese has been found to result in an increased risk of dysfunction and deformities related to bones and joints (Govender 2017: 8).

Few studies sought to determine BMI as a contributing factor to MSDs among students. A study conducted among allied health students, including radiography students, reported that according to the BMI category, under-weighted students complained more about lower back and hip discomfort, while normal-weighted and

pre-obese students complained more about neck pain (Senarath, Thalwaththe, and Tennakoon 2021:4). In contrast, a South African study by Moodley and Ismail (2019:1) found that there was no correlation found between the healthcare students' musculoskeletal disorders and their weight or height.

2.6.1.4 Smoking and Alcohol Consumption

Cigarette smoking and alcohol consumption are reported by many studies (Hohls 2010: 26, Kumalo 2014: 19, Abete, Vanni, Pantalone and Salini 2013: 63-69; Adetiba 2017: 22) as personal risk factors that contribute to MSD. Smoking increases the risk of hypoxia through reduction of blood flow, thus resulting in chemical changes that cause muscle, joint, and disc degeneration (Abete, Vanni, Pantalone, and Salini 2013: 63-69; Kumalo 2014: 19). Kumalo (2014: 19) pointed out that alcohol consumption increases the risk of musculoskeletal injuries and fractures. According to this study (Kumalo 2014: 19), women are reported to be more at risk than men.

There are very few studies that report the association between smoking, alcohol consumption, and the development of musculoskeletal disorders among healthcare students. A study conducted by Lestari and Palupi (2020: 944) among dental students reported that smoking habits were correlated with the complaints of MSDs. This is in line with the findings of Ekechukwu *et al.* (2020: 15) that reported that physiotherapy students who smoked more MSD-related complaints. Lestari and Palupi (2020: 944) pointed out that smoking can cause or worsen the development of rheumatoid arthritis and back pain. Furthermore, Ekechukwu *et al.* (2020: 15) found that there was a significant association between alcohol consumption and each of neck MSDs among physiotherapy students.

2.6.1.5 Physical Activity

Physical exercise improves musculoskeletal fitness, overall health, and quality of life and decreases morbidity, mortality, and risk of developing MSDs (Hendi *et al.* 2019: 10). Low levels of physical exercise have been shown to be more associated with musculoskeletal pain than higher levels. However, there is limited literature that reports an association between physical exercise and musculoskeletal disorder occurrence.

A quantitative descriptive study conducted by McDonald and Salisbury (2019: 305) mentioned that stretching exercises have been reported as beneficial for sonographers; therefore, regular stretching could help lower the pain associated with a WRMSD. Furthermore, Ekechukwu *et al.* (2020: 15) conducted a study among physiotherapy students and noticed an inversely significant relationship existed between days of exercise and wrist MSD. This implies that students who engaged in exercise for longer days in a week reported fewer MSDs, especially that of the wrist, than those that exercised for fewer days in a week.

Physical fitness and exercise have been recommended for lowering WRMSD risk and improving muscular capabilities and efficiency. It improves muscle strength, physical performance and balance, posture, and aids in injury prevention (McDonald and Salisbury 2019: 305). Furthermore, routine physical activity was said to improve musculoskeletal fitness, which in turn had a positive impact on the individual's overall health status (Kumalo 2014: 19).

2.6.2 Work-Related Risk Factors

Work procedures, equipment, and the environment all contribute to MSD by causing biomechanical stress to muscles, tendons, intervertebral discs, and nerves (Lamprecht 2018: 6). These factors are also related to occupational or environmental factors (Govender 2017:11). According to Lamprecht (2018:6), major physical work-related risk factors for musculoskeletal disorders include force, repetition, awkward position or position, long-term static posture, vibration, and low-temperature operation. Work-related musculoskeletal injuries and physical risk factors also include common everyday movements such as bending, straightening, grabbing, lifting, turning, clasping, and reaching (Sakzewski and Naser-ud-Din 2014: 39). Sakzewski and Naser-ud-Din (2014: 39) said that these movements are generally not harmful, but continuous repetitions have the potential for musculoskeletal injuries.

An extensive review of the literature shows that there are limited studies that have investigated the correlation between the physical or biomechanical work-related factors and MSD experienced by radiography students. Radiographers are vulnerable to sustaining MSDs as their job tasks often involve lifting patients, bending, twisting, stooping, carrying, pushing, pulling, prolonged standing (for intervention

examinations), and the application of manipulative force (Society of Radiography, 1992). According to Hulls *et al.* (2018), poor equipment design and poor posture are reported as causes of MSD among sonographers (Work-related ill-health in radiographers). In addition, Baker (2011:3) pointed out that sonographers develop MSD due to arm abduction, transducer grip force, downward transducer pressure, and spine twisting that occur while scanning patients.

2.6.3 Psychosocial Risk Factors

Adetiba (2017) defines psychosocial factors as factors related to the job and work environment. Psychosocial risk factors such as stressful jobs, social pressure at work, and job dissatisfaction contribute to the formation of MSDs. When an injury occurs, psychosocial factors, such as incongruous pain and depression, are the main reasons for the development of a disability and the transition from acute to chronic pain. In addition, work pace, autonomy, monotony, work/rest cycle, task demands, social support from colleagues, management uncertainty, and job uncertainty are considered important psychosocial risk factors that contribute to the development of WMSDs (Coetzee 2018:10). Baek *et al.* (2018) pointed out that these factors are believed to interact with each other to affect the health and job performance of an individual.

Healthcare students are exposed to multiple factors during their academic and clinical studies that have been shown to contribute to high levels of depression, anxiety, and stress. Staff shortages, increased workload, and pressure are significant stressors associated with MSDs (Alhasan *et al.* 2014: 291). Many studies have addressed the causes of stress in different health professions, but little is reported about radiography (Alhasan *et al.* 2014: 291). Among student radiographers, stress can be generated as they rotate to different hospitals. Different hospitals have different working protocols, which can confuse the students and therefore lead to stress. Also, the practical examinations that are conducted while the students are at WIL can add stress. When practical examinations are conducted, students tend to be stressed if they will pass their examinations, and all this can lead to stress, which in turn results in MSDs.

2.7 Impacts of Musculoskeletal Disorders on Undergraduate Students.

The presence of WRMSD is reported to have different impacts among healthcare students. Work-related musculoskeletal disorders have been reported to affect the quality of life of nurses. Munabi *et al.* (2014:1) pointed out that MSD is a major occupational problem and a significant cause of morbidity. The development of work-related musculoskeletal disorders in healthcare students may have a substantial impact on absences from work.

The majority of studies found that musculoskeletal conditions cause some nurses to leave the profession (Elsayed 2019:952; Backberg *et al.* 2014:358). Moreover, it was reported that the presence of WRMSD can lead to pain, sickness absence, surgical procedures, and, in some cases, long-term disability or career-ending injury (Harrison and Harris 2015:224).

A study by Barros-Gomes *et al.* (2019:1138) found that the presence of WRMSD in sonographers was significantly associated with interference in the performance of daily activities, sleeping, recreational activities, and work-related activities. More sonographers missed workdays, had work restrictions, changed their work-related responsibilities and considered changing jobs. In addition, headaches were more common in cardiac sonographers.

2.8 Conceptual Framework

A conceptual framework illustrates what you expect to find through your research. It defines the relevant variables for your study and maps out how they might relate to each other (Swaen 2021:1). Theories enable researchers to organise observations and facts (Polit and Beck 2012: 126–148). According to Kumalo (2015:22), one has to find the one theory or model that best fits the study.

To better support the literature review, a conceptual model of factors that can contribute to musculoskeletal disorders in radiography students was adopted in this study. Several conceptual models have been proposed to address the etiological mechanisms linking exposure to the risk factors for work-related MSDs and the development of health outcomes. However, one such model included in the NORA

Research Agenda for MSDs (National Institute for Occupational Safety and Health, 2001:2) was adopted to underpin the current study (this model is shown in Fig. 1). This model was adopted based on its relevance to the study objectives and aims. The primary aim of this model is to account for the factors and processes that result in musculoskeletal disorders, and this is in line with one of the aims and objectives of the current study.

According to this model, physical loads are placed on individual musculoskeletal systems (loads) either by external forces or by internal forces resulting from dynamic and gravitational effects on the mass of the body segments. These applied loads create internal tissue responses in the muscles, ligaments, and joint surfaces (tissue response). Depending upon the magnitude of the load and other factors, one or more outcomes may result (outcome). These may include adaptation effects (such as increases in strength, fitness, or conditioning) or potentially harmful outcomes (such as pain or other symptoms, and structural damage to tendons, nerves, muscles, joints, or supporting tissues) that may result in symptoms, impairment, or disability (Marras *et al.,* 2009:16). The core concept being illustrated is that the amount of load dictates whether tissues are handling a load that is within or not within their capacity. If tissue capacity is not exceeded, then a healthy, adaptive state is maintained. If tissue capacity is exceeded, then a temporary or permanent unhealthy state occurs.

The model recognises that there can be a range of risk factors that may affect the physiological response to the load. This model includes the following risk factors which may contribute to the causation of musculoskeletal disorders: (1) work-related factors (e.g., work procedure(s), work environment(s), equipment, tool(s)/method(s)), and (3) psychosocial factors (e.g., stress, anxiety, depression) (Kumar and Kumar 2008:10). above literature review, these risk factors are discussed in terms of how they are related to radiography students and how they contribute to musculoskeletal disorders.

In addition, this model clearly states that interventions designed to reduce the risk of MSDs can be implemented anywhere along this pathway. The interventions identified to reduce MSDs and provide preventative measures are ergonomic care, altering workstations, medical and alternative management methods for MSDs, exercise programs, and a supportive working environment.

When linking this model to the current study is as follows, since the risks factors of MSDs are unknown among radiography students at KwaZulu-Natal, applying this model to the current study will assist to meet the third objective of this study which is to determine what are the risks factors of MSDs among these student radiographers. Furthermore, since this model has mentioned that (1) work-related factors (2) Individual factors and (3) psychosocial factors contribute to MSDs in different ways, the data will be collected and analysed in this current study to measure any relationship between these risk factors and MSDs.

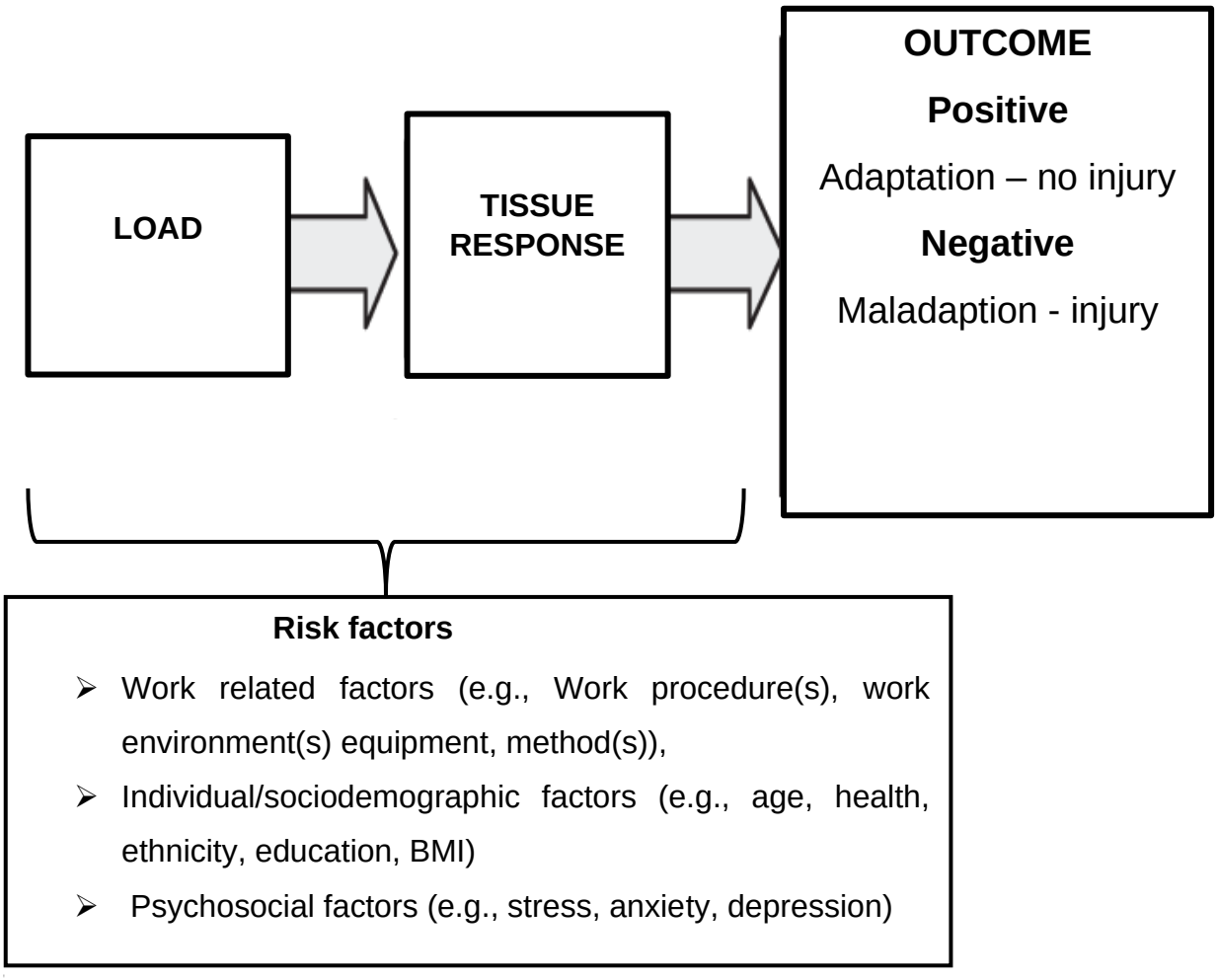


Figure 1: Conceptual model of potential factors for musculoskeletal disorders. developed from reviewing Marras *et al.* (2009:16) and Kumar and Kumar (2008:10)

2.9 Summary

In light of this review, musculoskeletal disorders have been highlighted as a common and most prevalent condition both nationally and internationally. It has been shown that it affects most healthcare students in different ways. Lower back pain has been reported as the most prevalent musculoskeletal disorder among health students including radiography students. Work-related lower back pain occurs as a result of different factors such as traumatic injury, repetitive use, or other factors. Also, Lower back pains are caused by the deviation from the upright posture, resulting in increased pressure on the lumbar spine and heavy loading of the fiber layers.

While many demographics, work related and psychological factors have been identified as having an association with the prevalence of musculoskeletal disorders, the extent of this relationship among radiography students is not yet fully understood. Furthermore, these factors have not been as extensively researched in both developing and developed countries. A review of the previous literature shows that in the South African context studies of this nature are seemingly sparse.

Therefore, the paucity of the literature in an educational context in both developed and developing countries like South Africa generated the aim of the current study which is to investigate the prevalence of the musculoskeletal disorder among undergraduate radiography students and to better understand the individual, work related and psychosocial factors of these students in relation to their musculoskeletal disorder.

CHAPTER THREE: METHODOLOGY

3.1 INTRODUCTION

This chapter provides a detailed account of the methodology of the study. It describes the framework of the study by stating the paradigm and design and outlining the development and validation of the questionnaire, the procedures followed for the collection of the data, and the statistical analysis of the data.

3.2 RESEARCH PARADIGM

A paradigm is a set of common beliefs and agreements shared between scientists about how problems should be understood and addressed. It is the philosophical way of thinking (Kuhn 1962:3). The research paradigm explains the type of research that is being conducted. It influences what should be studied, how it should be studied, and how the results of the study should be interpreted. It has significant implications for every decision made in the research process (Kivunja and Kuyini 2017:26).

As follows, Kivunja and Kuyini (2017: 26–27) outline the essential elements of a research paradigm as follows:

- Ontology is the philosophical study of the nature of existence, or reality. The reality of the study is that undergraduate radiography students experience MSD during WIL, and through data collection, questionnaires, and data analysis, the researchers of this study will discover or establish that

- Epistemology is concerned with the very basis of knowledge, its nature, and forms, how it can be acquired, and how it can be communicated to other human beings. The knowledge that the researcher of this study will get will be based on students' experiences with musculoskeletal disorders. The closed-ended questionnaires will be used to get knowledge about this reality.

- "Methodology" is the broad term used to refer to the research design, methods, approaches, and procedures used in an investigation. The quantitative research design will be used for this study to determine the prevalence and risk factors of MSD. The closed-ended questionnaires will be used for the data collection for this study.

This study used the positivistic paradigm of quantitative research. The Positivist paradigm maintains the belief that reality is out there to be studied, captured, and understood.

3.3 RESEARCH DESIGN

The study design that was used for this study will be a quantitative, descriptive cross-sectional survey. Quantitative research is a type of research in which the researcher decides what to study, then asks specific and narrow (close-ended) questions, collects numerical data and analyses the data using statistics in an unbiased and objective manner (Polit and Beck 2012: 10). A cross-sectional survey is used to study a phenomenon at a given time or to gather data from multiple groups at the same time (Parahoo 2014: 14). This study design is reported as an effective way of gaining insight into the prevalence and risk factors of MSD (Kumalo 2015: 9), (Adetiba 2017: 24). Therefore, it will be effective for this study since the primary aim is to determine the prevalence rate and associated risk factors of MSD. Moreover, this study design will be cost-effective for the budget of the study.

3.4 STUDY SETTING

The study was conducted at the Durban University of Technology (DUT) in South Africa. The Durban University of Technology is located in Kwa-Zulu Natal province in the eThekwini region. The DUT is a result of the merger, in April 2002, of two technikons, ML Sultan and Technikon Natal. It was named the Durban Institute of Technology and later became the Durban University of Technology in 2007. This institution has six faculties, and this study will be directed to the faculty of health sciences specifically to radiography department at the Ritson campus.

This institution has more than 30 000 students, and the reason it will be suitable for that study is that it offers radiography in all four disciplines, namely diagnostic, ultrasound, nuclear medicine, and radiotherapy. Radiography students, during their study programme, are rotated to different private and public hospitals, which makes them vulnerable to the risks of musculoskeletal disorders.

3.5 POPULATION

A population is a group of experimental data, people, animals, businesses, etc., that is made up of elementary units that cannot be further decomposed (Gevers 2018: 75). The target population for this study comprises undergraduate radiography from the second to fourth-year level of study at the DUT. The expected population size is 171 (see table 3.1).

3.5.1 Inclusion criteria

- full-time registered undergraduate radiography students.
- Diagnostic, ultrasound, nuclear medicine, and radiotherapy students will be included as participants in this study.
- Students at the second to fourth-year level of study.
- Students ranging in age from 18 to 40. This is because there is a report of higher MSDs in those older than 40 years compared to those younger than 40 years.
- The student should be attending WIL practical at public or private hospitals.
- all races and genders.
- The participant should be willing and able to give informed consent for participation in the study.

3.5.2 Exclusion criteria

- Students participated in a pilot study.
- Part-time students
- Post graduate radiography students
- First-year students because they do not attend WIL during year of study
- Any person not willing to participate
- Any person who did not voluntarily read the Letter of Information
- Any person who failed to or refused to sign informed consent.

Table 3.1: Undergraduate radiography students' enrolment statistics from second to fourth year (provided by the radiography department administration office) at the DUT

Study level	Radiography disciplines				Total
	DR	RT	US	NM	
Second year	44	8	2	6	60
Third year	48	7	2	0	57
Fourth year	46	1	7	0	54
Total	138	16	11	6	**171**

3.6 SAMPLING

Sampling is the act, process, or technique of selecting a representative part of a population, called a sample, for the purpose of determining parameters or characteristics of the whole population (Polit and Beck 2012: 10). The goal of sampling is to determine a population's characteristics by directly observing only a portion of the population. This step of the study involved selecting participants from the population, where the researcher's intention was to use established methods of selection for the purpose of obtaining a group of participants who were characteristic of the population. This was important in order to translate the results of the study into general observations or assumptions about the population (Mouton 1996:123). There were several important components considered when selecting the sample for this study, such as sample strategy as well as the size of the sample. These components were selected in order to ensure a characteristic sample and are outlined and elaborated upon below.

3.6.1 Strategy

Convenient sampling was used in this study. Convenience sampling involves selecting participants because they are often readily and easily available. This sampling technique is suitable for this study since the targeted population are student radiographers and can be easily accessible by the researcher. Also, time and financial allocation were limited for this study, so this type of sampling was more favourable in

that case. Convenience sampling is known to be a low-cost and simple alternative to other sampling techniques (Taherdoost 2016: 20).

3.6.2 Sample Size

Size is an important factor depending on what the researcher is investigating, and the population involved (Gevers 2018: 75). The number of participants invited to participate in the study was expected to be approximately half of the population size, and it was anticipated that about 50% to 70% of the invited individuals would consent to participate in the study. Since the population size of undergraduate radiography students registered for the second to fourth year is 171, the minimum sample size expected for this study was between 86 and 119. This was calculated using a 95% confidence interval and a 5% margin of error.

3.7 TOOL FOR DATA COLLECTION

The following instruments were chosen for data collection based on their established validity and reliability, as well as their suitability for achieving each of the study objectives.

3.7.1 Study Questionnaire

A questionnaire is a method of gathering self-reported responses to a written set of questions from participants through written, verbal, or electronic means (Grove, Gray, Burns 2014:304). It is a predetermined, standardized, and structured tool that has been solely designed for the purpose of collecting data from a large number of people over a geographical area as part of a research study (Parahoo 2014:10), and so it is an appropriate data collection tool in this study.

To collect data, the validated Standardized Nordic Questionnaire (SNQ) for musculoskeletal symptoms was used to collect data. This tool was developed by a team of Nordic Council of Ministers who were tasked with creating a simple, standardised questionnaire that could be used for screening MSDs in ergonomic settings and epidemiological studies of MSDs in occupational health services (Kuorinka *et al.* 1987:233). The SNQ is an open-access, reliable and valid tool that has been repeatedly used among health professionals to investigate MSDs both in

South Africa (Kumalo 2014:30; Adetiba 2017:32) and internationally. The tool is in English and was not translated into any other local languages.

The questionnaire was created in order to assess the prevalence and risk factors of MSDs among radiography students. The conceptual model of potential factors for musculoskeletal disorders found in chapter 2 of this study was used during the development of these research questions. The researcher ensured that the work-related factors, individual factors, and psychosocial factors that contribute to MSDs were asked in this questionnaire. The study questionnaire consisted of four sections:

3.7.1.1 Section A

Section A covered demographics and some questions that the researcher considered appropriate and necessary. There were 13 questions in total in Section A, which covered basic demographics, hand dominance, smoking and alcohol consumption.

3.7.1.2 Section B

Section B collected data on the work environment and work routine during WIL. There were 12 questions in total in Section B. This section gathered information on how many hours students work during WIL, duration of lunch time, physical work activities and stress and depression during WIL.

3.7.1.3 Section C

Section C of the questionnaire covered the symptoms of musculoskeletal disorders experienced by the respondent. The Standardized Nordic Questionnaire (SNQ) that is discussed above was employed in this section to gather information on which body regions that are affected by MSDs.

3.7.1.4 Section D

Section D asked about the impact of musculoskeletal disorders. This was a short section that consisted of four questions that gathered information on what are the impacts that MSDs has on radiography students.

3.8 Pilot Study

Validity and reliability are the most essential elements in quantitative research design. Parahoo (2014:10) referred to validity as the extent to which a questionnaire or other method of data collection measures the phenomenon under investigation. Golafshani (2015: 597) defines reliability as the extent to which results are consistent over time and an accurate representation of the total population under study. If the results of a study can be reproduced using a similar methodology, the research instrument is considered reliable.

Thabane *et al.* (2010:25) identified pilot studies as an important part of the process of determining the viability of a study that is intended to be conducted on a larger scale (Thabane *et al.* 2010:25). As part of this study, a pilot study was conducted to determine the face validity of the study questionnaire, as well as its usability and any problematic or ambiguous areas or questions that needed to be addressed. Piloting the questionnaire also gave an indication of the average time taken to complete the questionnaire. For measuring face validity, it was important to invite participants who shared similar characteristics to the intended sample (i.e., were undergraduate radiography students). The pilot study was conducted in a lecture venue, which mirrored the proposed setting of the final data collection. These considerations were important as they gave the researcher an indication of how the study questionnaire would be perceived by the sample (in the appropriate setting) and as mentioned above, a trial run for final data collection.

The researcher sent a letter to the faculty of health sciences (appendix B1) and radiography Heads of Department (appendix B2) and lecturers to seek permission to access their undergraduate radiography students, as well as to inquire about their whereabouts and the best times to approach them to invite them to participate in the pilot study. Three radiography students were approached and asked to take part in the pilot study. During this phase, the researcher selected the students from various study years and radiography disciplines (second year from radiotherapy, diagnostic third year and fourth year ultrasound). The context and value of the research and the inclusion and exclusion criteria were explained to each prospective participant in the pilot study. Three undergraduate radiography students who met the inclusion criteria

were invited to participate in the pilot study, and all three consented to participate. The researcher assured the students that their participation and results would be kept strictly confidential and anonymous. The participants of the pilot study were excluded from participating in the main study.

Each participant was given the following documentation:

- A copy of the Pilot Study Questionnaire (Appendix C1).
- Information Letter and Informed Consent (Appendices C2 and C3)
- Code of Conduct (Appendix C4)
- Confidentiality Clause (Appendix C5).
- A Pilot Group Questionnaire Evaluation Form (Appendix C6)

The researcher welcomed the pilot study participants and explained the context and importance of the research, as well as how their participation would contribute to the research process. The participants were reminded that their participation was voluntary, anonymous, and confidential, and they were encouraged to complete the questionnaire critically and to ask clarifying questions along the way. Thereafter, each participant was given a letter of information and informed consent (Appendix C2 and C3) and was asked to read and sign these documents to indicate their willingness to participate. Once the documentation was signed, the code of conduct (Appendix C4) and confidentiality clause (Appendix C5) were explained and passed around to be signed. After that, the pilot study questionnaire (Appendix C1) and the pilot study evaluation form (Appendix C6) were then distributed to each participant. The participants were given the opportunity to go through the evaluation form first to get a sense of what was expected of them, after which they were asked to fill out the pilot research questionnaire. The researcher kept a time record of how long it took each participant to complete the questionnaire, and an average time was calculated based on the individual times. The average time taken to complete the questionnaire was 25 minutes. Each participant placed their consent forms in a sealed box labelled "Informed Consent Forms", their questionnaire in a sealed box labelled "Questionnaires" and their evaluation forms in a sealed box labelled "Pilot Study Evaluation Forms". As they did so, they were thanked for their participation and invaluable contribution and reminded about their confidentiality agreement and that,

should their programmes be selected, they were not required to participate in the main study.

3.9 STUDY PROCEDURE

The study's data collection procedure is outlined in Figure 3.1, from the time the study's provisional ethical clearance was granted to the time the results were interpreted. Each step of the procedure is discussed under its respective heading.

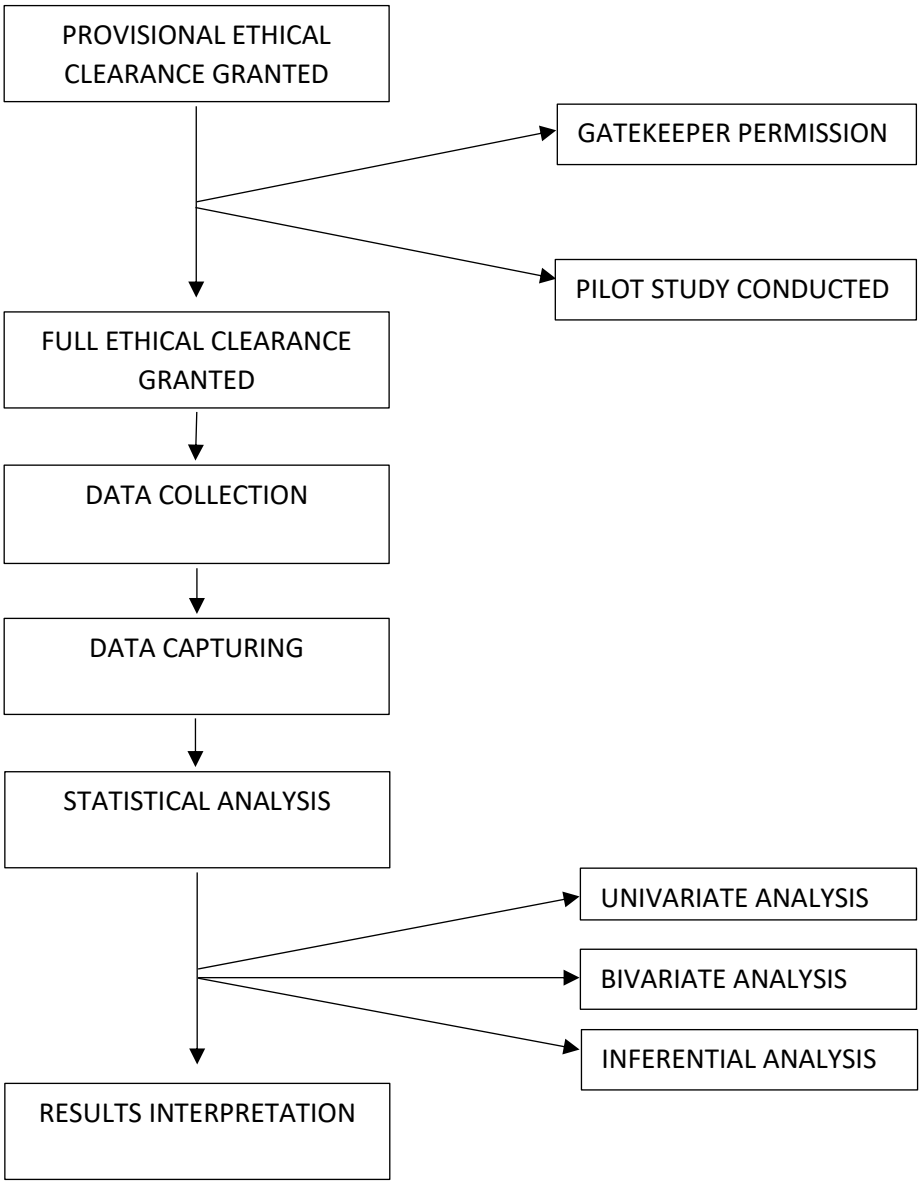


Figure 3.1: Flow diagram of study procedure

3.9.1 The Ethical Clearance Procedure

Firstly, the study was approved by the radiography department research committee, and then it was approved by the Faculty Research Committee (FRC). Thereafter, the study was granted provisional ethical clearance by the Institutional Research Ethics Committee (IREC) at DUT (Appendix A), which stated that full ethical clearance would be granted upon the completion of the pilot study and once gatekeeper permission was obtained by the researcher. Following the completion of the pilot study and the obtainment of gatekeeper permission (Appendix H), the study was granted full ethical clearance by IREC (Appendix E) and was assigned the following ethical clearance number: 203/21.

3.9.2 Data Collection Procedure

The plan was to approach the second- to fourth-year undergraduate radiography students from different disciplines (namely Diagnostic, Ultrasound, Radiotherapy, and Nuclear Medicine) during first lecture times while on Work Integrated Learning placements. The first lecture times from WIL placements were chosen as they were believed to be crucial so that students could reflect on their experience of MSDs while still fresh from WIL. However, due to the suspension of classes because of the Covid pandemic, the students had online classes, so it was difficult to get them while from WIL. The plan was then changed, and students were approached during their tests because that was the only time they came to campus. The researcher communicated with the lecturers in order for them to be aware of the dates on which students would be on campus. And after the students were done writing, they were asked to pay attention. Then the researcher was given the opportunity to explain the aims and objectives of the study to the undergraduate radiography students, as well as the motivation for the study and how the desired outcome was hoped to have a number of benefits. The researcher explained that participation was on a volunteer basis and that participation would remain anonymous and confidential. The prospective participants were each given a Letter of Information (Appendix F1) and an Informed Consent (Appendix F2). Those who chose to participate in the study were asked to sign the consent form, and once signed, they were given the study questionnaire (Appendix G) to complete. The participants were instructed that, upon completion of the questionnaire, they were to place their consent forms in a sealed ballot box labelled

"Informed Consent Forms" and their study questionnaire in a sealed ballot box labelled "Questions" to ensure anonymity. As they did so, they were thanked for their participation in, and contribution to, the study. Throughout the data collection process, the researcher was present to answer and clarify any questions that arose but did not assist in answering the study questionnaire.

3.9.2.1 The Data Collection Environment and Response Rate

As it is mentioned above, the researcher prearranged the appropriate time to approach the students with lecturers, and this strategy was believed to be the most reliable way of ensuring all 171 students were given the opportunity to participate in the research.

Since the study was conducted in an era of the Covid-19 pandemic, the researcher ensured that all Covid-19 regulations were followed during data collection. All health-related information was taken into account. The participants were instructed to wear masks, and their hands were sanitised with an alcohol-based hand sanitizer prior to the data collection process. Also, the researcher ensured that participants practiced social distance. The Covid-19 pandemic poses a lot of challenges for this study. Students were attending online classes during this period, so the study did achieve a 100% response rate. The Covid-19 pandemic affected the initial strategy of approaching students during lecture times.

3.9.3 Procedure for Data Capturing and Analysis

Data capture is the process of extracting information from a document and converting it into data readable by a computer (Haissam 2021:1). On the other hand, data analysis is the organization and processing of the data that has been collected, which is further structured and made meaningful for appropriate interpretation (Polit and Beck 2012: 10).

The current study's data collection and analysis procedure was as follows: once data collection from the participants was completed, the researcher assigned each completed study questionnaire a number that represented the participant number on the data sheet. The content of the study questionnaire was captured in an Excel spreadsheet and coded as guided by the coding template (Appendix H), where the answers to each question in the study questionnaire were assigned a numerical value.

Once the data was captured on a spread sheet, the data set was quality checked by randomly selecting questionnaires from the sample and comparing the answers to the data set on an Excel spread sheet. After that, the spread sheet was given to a statistician (Appendix I) for statistical analysis.

3.9.4 Statistical Analysis Procedure

Marshall and Rossman (1999:150) describe data analysis as the process of bringing order, structure, and meaning to the mass of collected data. Data analysis is the most crucial part of any research project. Data analysis summarises collected data. It involves the interpretation of data gathered through the use of analytical and logical reasoning to determine patterns, relationships, or trends (Steynberg 2022:1).

In order to conduct the statistical analysis of the questionnaire results for the current study, the data set was imported into the IBM Statistical Package for Social Science (SPSS) (version 23.0.0) and analysed accordingly by the statistician. Marston (2010:3) highlighted the importance of specifying the type of data for the variables of each question in the data sheet (i.e., nominal or ordinal) in order for accurate statistical analysis of the data to be conducted in SPSS (i.e., if an ordinal variable was incorrectly labelled as nominal, SPSS would recognise it as a categorical instead of a quantitative variable with an inherent order which would affect the results of the analysis).

3.9.4.1 Univariate Analysis

Univariate analysis has the purpose of describing a single variable distribution in one sample (Canova, Cortinovis, and Ambrogi 2017: 1741). Here, the data contains just one variable and does not have to deal with the relationship between cause and effect. It is considered the first important step in every study. It enabled the researcher to see the results of the data in relation to the bigger picture and functioned as a quality check of the data set (Mouton 1996:163).

This descriptive analysis of the data made use of the following statistical techniques:

- Frequency distribution tables were used to establish the distribution of two or more variables and to determine the descriptive nature of the sample.

- The bar chart is represented in the form of rectangular bars. The graphs were used to compare various categories.
- Pie charts are used to understand how a group is broken down into small pieces. The pie chart displays the data in a circular format. The graph is divided into pieces where each piece is proportional to the fraction of the complete category. So, each slice of the pie in the pie chart is relative to the category size. The entire pie is 100 percent, and when you add up each of the pie slices, it should also add up to 100.

3.9.4.2 Bivariate Analysis

Sandilands (2014):1 conducted bivariate analyses to determine whether a statistical association exists between two variables, the degree of association if one does exist, and whether one variable may be predicted from another (Sandilands 2014:1). For this study, cross-tabulations were used for questions where an association was measured between two or more variables.

3.9.4.3 Inferential Statistics

Inferential statistics are the statistical procedures that are used to reach conclusions about associations between variables (Bhattacherjee, 2012:129). Bivariate statistics are used in research in order to analyse two variables simultaneously (Bertani *et al.* 2018: 1133).

For this study, inferential statistics, including a chi-square test of independence, were used to analyse the demographic and lifestyle characteristics that formed part of the possible risk factors.

3.10 RESULTS INTERPRETATION

Interpretation involves attaching meaning and significance to the analysis, explaining descriptive patterns, and looking for relationships and linkages among descriptive dimensions (Egger and Carpi 2008:12). The interpretation of the results of the statistical analysis of the data is based on probability, and the statistical significance is determined by the *p* value (Gevers 2018:65). In health sciences research, the following guidelines are given regarding the *p* value: *p 0.01 indicates that there is*

*strong evidence of a difference or association; p = 0.01-0.05 indicates that a difference or association exists; p 0.05 indicates that the association is statistically significant; and p > 0.1 indicates that there is minimal evidence of a difference or association (Marston 2010:58).*Therefore, for this study, a *p* value of 0.05 was considered to indicate the presence of a statistically significant association. Furthermore, the prevalence of musculoskeletal disorders among radiography students was reported with a 95% confidence interval. Confidence intervals give the reader an indication of the range of a variable and the likelihood of the population mean falling within the upper and lower parameters for an observed association and are thus important in the interpretation of the results (Gevers 2018:65).

3.11 ETHICAL CONSIDERATIONS

Participation was entirely on a voluntary basis, and prospective participants were informed of this. A letter of informed consent was obtained from each participant prior to them filling out the questionnaire, and this was collected in a ballot box labelled "Informed Consent Form". The questionnaires were coded, so there was no form of identification (name, surname, ID number, student numbers, or signatures) on the questionnaire. The questionnaires were collected in a ballot box labelled "Questionnaire". The ballot box method ensured that participation was both confidential and anonymous, and participants were assured of this. Gatekeeper permission was granted by the director of research and all data collected was secured in a locked cupboard for the duration of the study and thereafter for a period of five years, following which it will be destroyed by the researcher using a shredder. Only the researcher, the research supervisor, co-supervisor, and the research statistician had access to the documentation and data collected.

With regards to non-maleficence, no harm was caused to the participants of this study via the questionnaire. The questions did not expose any sensitive information, or any information that could lead to incrimination. Regarding beneficence, the questionnaires were anonymous and confidential, so that any open response wouldn’t be held against them. The questionnaires were filled out in a non-threatening environment allowing for the participants to respond as freely and openly as possible. Autonomy was respected in this study. Each participant took part on a voluntary basis

and had the freedom to withdraw from the study at any given time. With regards to justice, this study was fair and equitable, everyone was treated the same and there was no direct benefit from participating in the study.

3.12 SUMMARY

This chapter delivered all aspects involving the methodology of the study. A quantitative, descriptive study was conducted, involving the sampling of undergraduate radiography students from a selected university of technology in KwaZulu-Natal. Ethics approval in order to perform the research study was obtained from the DUT's IREC. Data was analyzed using Statistical Package for Social Science (SPSS) and the resulting information will be presented in the next chapter.

CHAPTER FOUR: RESULTS

4.1 INTRODUCTION

This chapter presents the outcome of the data gathering process and reports the results obtained on the prevalence of musculoskeletal disorders (MSDs) among undergraduate radiography students. The questionnaire was the primary tool that was used to collect data and was administered to radiography students attending Work Integrated Learning (WIL). The data obtained from the questionnaires was analysed using SPSS version 27 (IBM 2018).

This section includes both descriptive and interferential statistics, which have been discussed simultaneously based on the study objectives. The results were presented as mean percentages per variable. Where applicable, the significant relationships between the variables were emphasized. Descriptive statistics are presented in the form of graphs, cross-tabulations, and other figures for the quantitative data that was collected. Inferential techniques include the use of One-Way Analysis of Variance and multiple regression analysis, which are interpreted using p-values**.**

4.2 SAMPLE REALISATION

A list obtained from the radiography department administration office showed a total of 171 registered undergraduate radiography students (from 2nd year to 4th year) during the year of study within the eThekwini municipality. Therefore, in total, 171 radiography students were targeted, but 147 students consented to participate and return the completed questionnaire.

Of these 147 respondents, 3 were excluded from the statistical analysis due to the fact that they participated in the pilot study. The final sample number for this study was thus 144 (n = 144). This was above the minimum requirement of 86 questionnaires, as determined by the statistician. A final response rate of 84.2% was achieved. The process of determining the final sample size is depicted in Figure 4.1.

4.2.1 Non-responses

The non-responses in this study were due to various reasons. The possible reasons identified for the recorded non-responses are as follow:

- The major reason was the suspension of lectures due to the COVID-19 pandemic, so most of the students were not always on campus during data collection.
- Other participants were approached during tests and exams; they didn't return the questionnaire, and they mentioned that they were exhausted from writing the tests and exams.
- On the other hand, other radiography disciplines (radiotherapy and nuclear medicine) were not writing campus-based tests/exams during the time of data collection.
- In addition, other participants voluntarily chose to not participate in this study

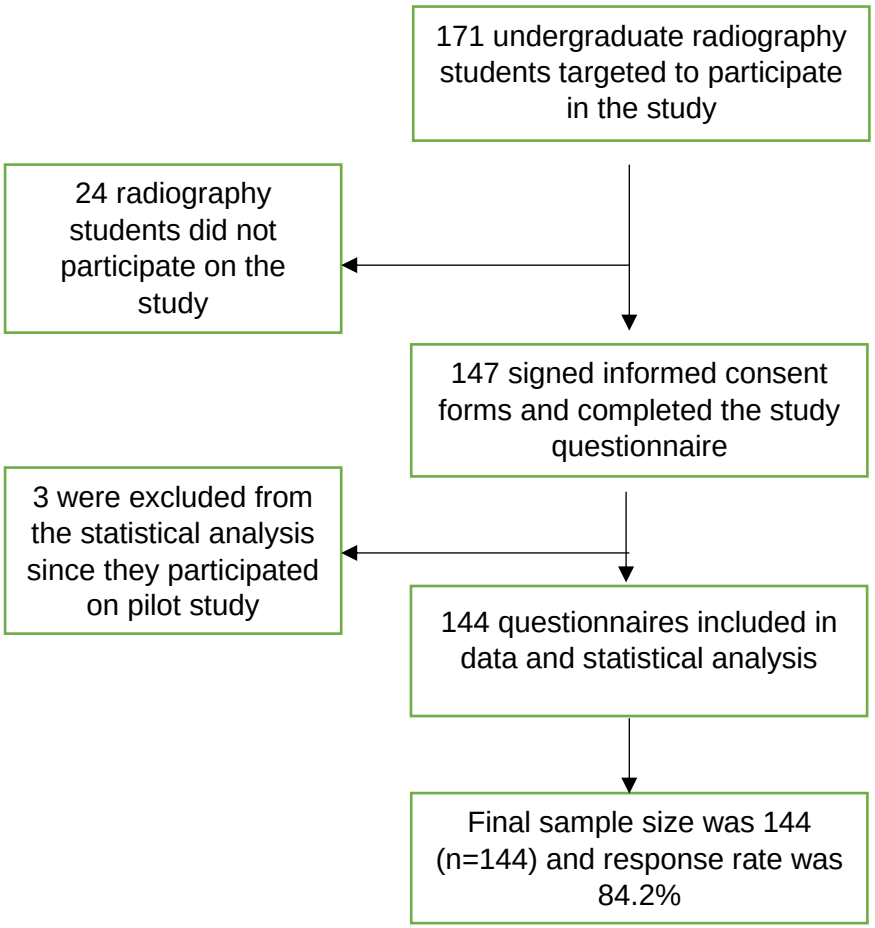


Figure 4.1: Flow diagram depicting the process of determining the final sample size and response rate

4.3 DATA COLLECTION TOOLS

The research instrument consisted of 34 items, with a level of measurement at a nominal or an ordinal level. The questionnaire was divided into four sections which measured various themes as illustrated below:

1	Socio-demographic characteristics
2	Work history (during WIL)
3	Musculoskeletal disorder (Prevalence and body parts affected)
4	Impact of musculoskeletal disorders

Table 4.1 themes of the study

4.4 SECTION A: SOCIO-DEMOGRAPHIC CHARACTERISTICS

4.4.1 Radiography Discipline And Year Of Study Among Respondents

Most of the students who comprised this sample (Table 4.2 and figure 4.2) were in their 3rd year (42.7%, n = 53), whilst 29.8% (n = 37) were in their 2nd year and 25.8% (n = 32) were in their 4th year of study. According to table 4.1 the majority were from diagnostic radiography 84% (n=121), followed by ultrasound 14.6% (n=21) and radiotherapy 1.4% (n=2).

Table 4.2 showing radiography discipline and year of study among respondents

			Radiography Discipline			
			DR*	**US***	**RT***	**Total**
Year of study	**2nd**	Count	40	4	0	44
		% within discipline	33.0	19,1	0	30,5
	3rd	Count	46	10	2	58
		% within discipline	38.0	47,6	100	40,3
	4th	Count	35	7	0	42
		% within discipline	28.9	33.3	0	29,2
Total		Count	121	21	2	144

DR*-Diagnostic Radiography, US*-Ultrasound, RT*- Radiotherapy

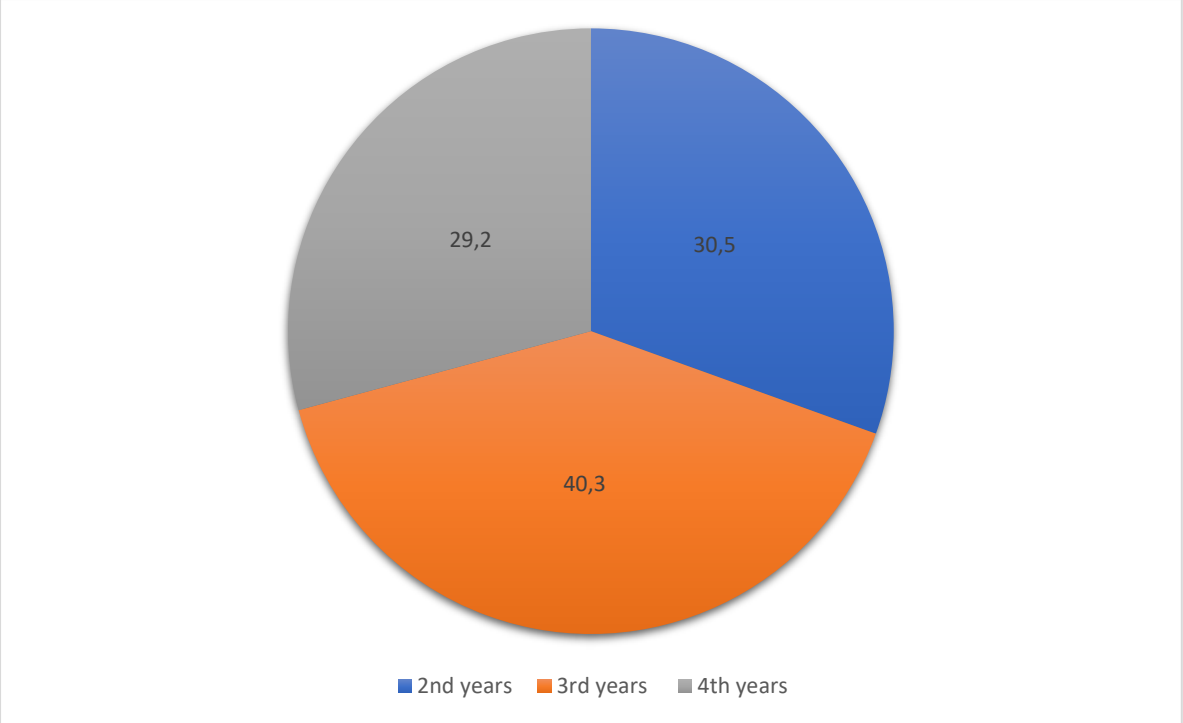


Figure 4.2 shows the year of study among respondents

4.4.2 Age, Gender, Marital Status, Race And Hand Dominance Of The Participants

The information in Table 4.3 and figure 4.3 shows that of the total sample size (n= 144), majority of the respondents were African (71.5%) female (76.4%), within 20-24 years of age (81.3%), single (99.3%) and they were right-handed (90.3%).

Table 4.3 shows age, gender, marital status and hand dominance of the participants

			Radiography year of study			Total
			2nd	3rd	4th	
Age	Under 20	Count	11	1	0	12
		% within year of study	25	1,7	0	8,3
	20-24	Count	32	46	39	117
		% within year of study	72,7	79,3	92,9	**81,3**

	25-29	Count	1	11	3	15
		% within year of study	2,3	19	7,1	10,4
Gender	Male	Count	15	11	8	34
		% within year of study	34,1	19	19	23,6
	Female	Count	29	47	34	110
		% within year of study	65,9	81	81	**76,4**
Marital status	Single	Count	43	58	42	143
		% within year of study	97.7	100	100	**99.3**
	Married	Count	1	0	0	1
		% within year of study	2,3	0	0	0,7
Race	African	Count	37	47	19	103
		% within year of study	84,1	81	45,2	**71.5**
	Caucasian	Count	1	1	2	4
		% within year of study	2,3	1,7	4,7	2,8
	Coloured	Count	2	1	2	5
		% within year of study	4,6	1,7	4,7	3,5
	Indians	Count	4	10	18	32
		% within year of study	9.1	17,2	42,9	22,2
Hand Dominance	Right	Count	39	53	38	130
		% within year of study	88,6	91.4	90.5	**90.3**
	Left	Count	5	5	4	14
		% within year of study	11.4	8.6	9.5	9.7

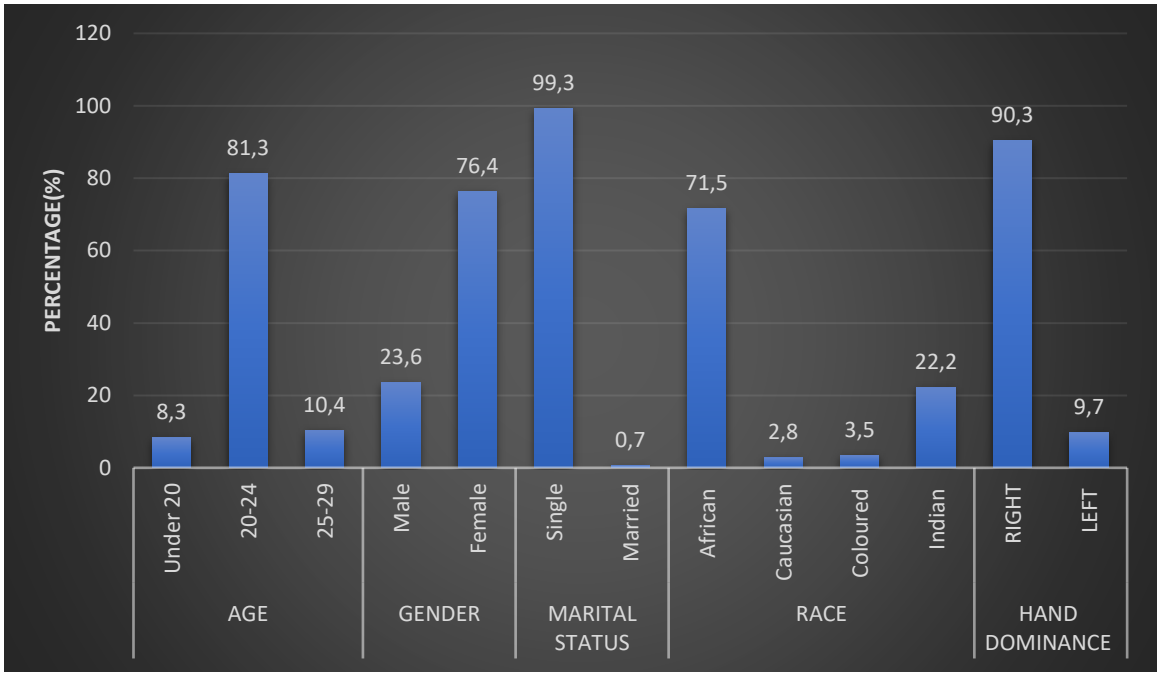


Figure 4.3 shows age, gender, marital and hand dominance status of the participants

4.4.3 Weight Height, And Body Mass Index Of The Respondents

Participants were asked to indicate their weight, height. Figure 4.4, indicate that in overall nearly half of the respondents (n=66; 45.8%) weighed 60-79kg; 55 (38.2%) weighed 40-59kg; 17 (11.8%) weighed 80-90kg; and 6 (4.2%) weighed 100-119kg. Also, half (n=73; 50.7%) of the respondents' height was in the range of 150-169 cm, 69 (47.9%) had a height of 170-189cm while 2 (1.4%) a height in the range of 190-199cm.

Moreover, the respondents were asked to indicate their BMI. According to Locke *et al.* (2015), the BMI of 18.50 -24.99 kg/m2 indicates normal weight; 25.00-29.99kg/m2 overweight, while 30.00kg/m2 and above indicates obese; and less than 18.50kg/m2 indicates underweight. The figure 4.3 indicate that the majority (n=133, 78.5%) were of normal weight, 17 (11.8%) were overweight, and 14 (9.7%) were underweight. It is worth stating here that the BMI is calculated by using an individual's height and weight. The equation is weight (kg) divided by height (cm) squared (BMI= kg/m2). Also, table 4.4 specifically show the distribution of BMI within different age group, majority of the participants aged between 20 to 24 had

normal BMI (n=91, %). Also, it should be noted that no one was underweight within on the participants aged between 30 to 34 (n=0).

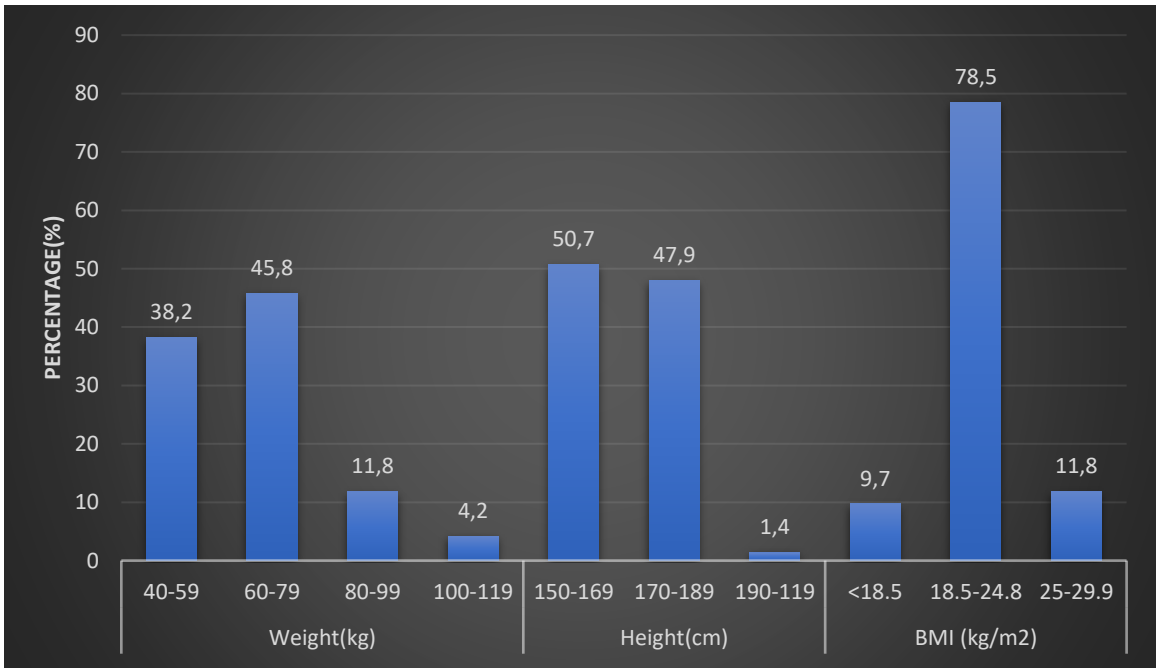


Figure 4.4 show Weight, Height and BMI of the respondents

Table 4.4: BMI of the respondents in relation to age categories

	AGE RANGE			
BMI	**Under 20 n(%)**	**20 to 29 n(%)**	**30 to 34 n(%)**	**Total n**
Underweight	3(25)	11(9,4)	0(0)	14
Normal	8(66,7)	91(77,8)	14(93,3)	113
Obese	1(8,3)	15(12,8)	1(6,7)	17
Total	**12**	**117**	**15**	**144**

4.4.4 Lifestyle Factors of the Participants

The lifestyle characteristics that were investigated included smoking, consumption of alcohol and involvement in physical exercise. When asked to indicate if the respondents smoked cigarettes, the figure 4.5 indicate that a significant 87.5% say do not smoke cigarettes (p<.001), while only 12.5% (n=18) indicated to smoke cigarettes

(Figure 4.5). All the respondents (n=18) who are smokers have been smoking for between 1-9 years.

When asked to indicate if they consume alcohol, more than half of respondents (59.7%, n=86) answered ‘no’, while 40.3% (n=58) answered ‘yes’. Figure 4.5 below show the prevalence of alcohol consumption within respondents. The respondents (n=58) who indicated that they consumed alcohol were further asked to indicate how many units of alcohol they drank per week. For clarity, a unit was defined as follows: 1 unit of alcohol = 1 glass of wine or 1 beer or 1 tot of whiskey. The majority (93.1%) drank 1-4 units per week, which suggests that they were ‘mild drinkers’, those who consumed 5-9 units per week (Moderate drinkers) and 10+ units per week (heavy drinkers) were 3.4% each.

Moreover, when asked if the respondents are currently involved in any structured physical exercises,44.4% (n=64) indicted that they are involved in physical exercise while more than half 55.6% (n= 80), indicated that they are not involved in physical exercise (figure 4.5). In terms of the number of times the respondents were involved in structured physical exercise, the data indicated that 27.1% (n=39) were involved 3-5 times/week, 16% (n=23) involved 1-2 times/week, and 1.4%(n=2) involved every day.

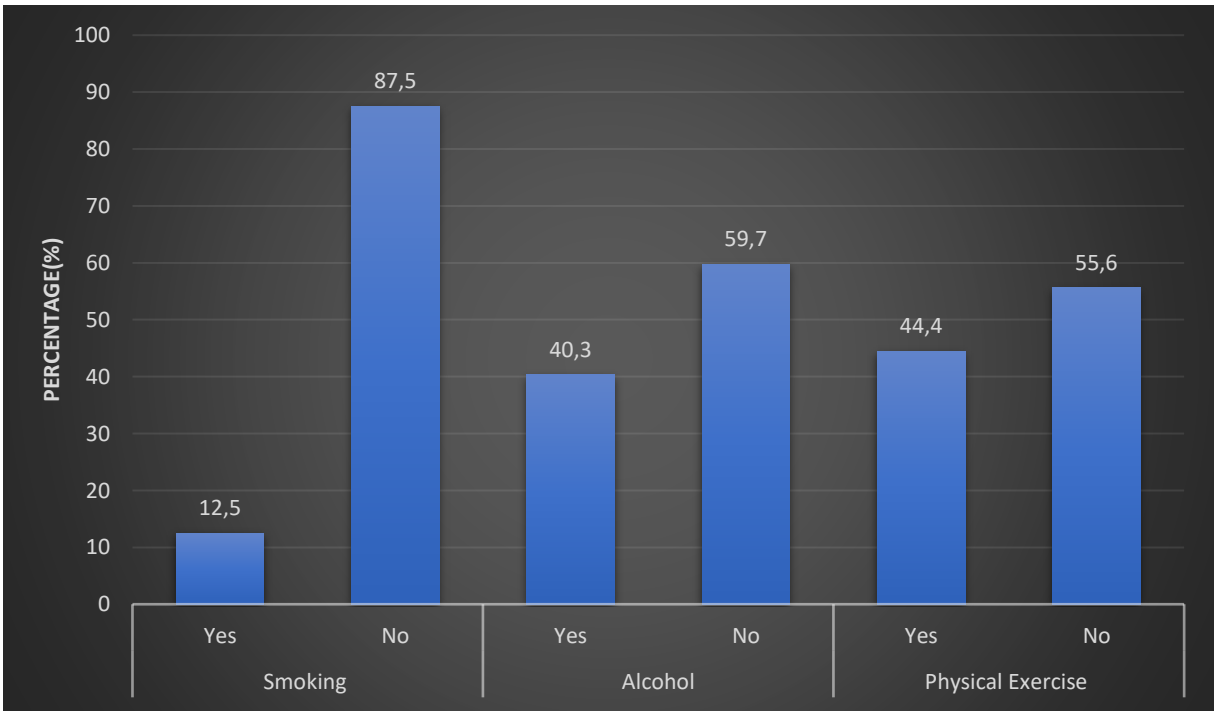


Figure 4.5: Lifestyle factors of the participants

4.5 SECTION B: WORK HISTORY

This section details the work-related activities of the respondents during WIL placements.

4.5.1 Health Sector, Working Hours and Break Time among the Respondents.

Figure 4.6 show that 60.4% (n=87) of the respondents attended WIL in the public sector, 34.7%(n=50) in the private sector, and only 4.9% (n=7) in both the private and public sectors. After indicating work sector during WIL, the participants were asked working hours per day during WIL, all the respondents 100% (n=144) spent between 7-8 hours per day working during the WIL. Furthermore, they were asked the break times during WIL, the data indicate that 54.6% (n=79) spent 30 minutes for teatime while 45.1% (n=65) spent 15 minutes. By contrast, 55.6% (n=80) spent 1 hr for lunchtime while 44.4% (n=64) spent 30 minutes.

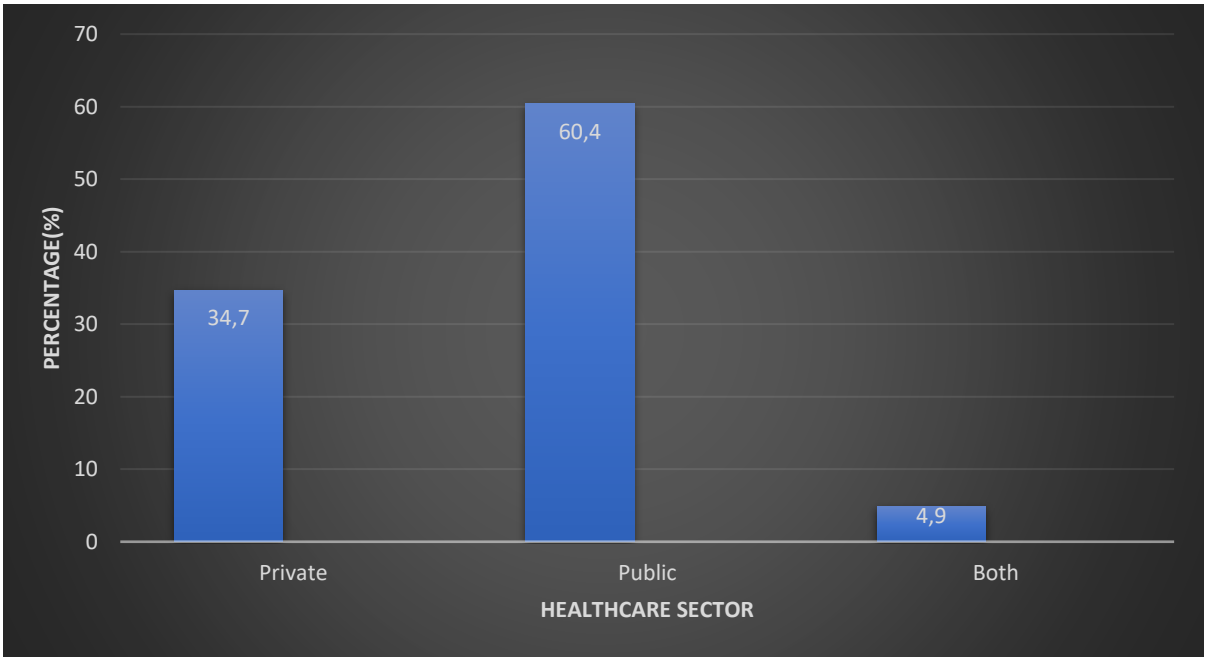


Figure 4.6: Showing sectors where respondents attended WIL

4.5.2 Physical Job Activities During Work Integrated Learning

Table 4.5 and figure 4.7 highlights the physical job activities the respondents engaged with during WIL. The data revealed that ‘always’ 49.3% job involved bending, 33.3% ‘always’ involved overstretching, 75.7% ‘always’ involved standing, 66.7% ‘always’ involved repetitive movement, 39.6% ‘sometimes involved wearing of a lead apron,

45.8% ‘often’ involved same postures for a long period, 44.4% ‘often’ involved lifting/transferring patients to chair/bed, 39.6% ‘often’ involved pulling/pushing mobile x-ray unit, 33.3% ‘sometimes’ involved handling heavy objectives, 35.4% ‘often’ involved grasping.

Analysis indicates that a significant proportion of the respondents' jobs during WIL ‘always’ involved standing ($p<.001$), and repetitive movement ($p<.001$) whilst a significant proportion of the respondent's job ‘often’ or ‘always’ involved bending ($p<.001$), overstretching ($p=.003$), same postures for a long period ($p<.001$), lifting/transferring patients to chair/bed ($p<.001$), pulling/pushing mobile x-ray unit ($p<.001$), handling heavy objectives ($p=.015$), and grasping ($p<.001$).

Table 4.5: Common physical job activities during WIL

Does your job during WIL involve any of the following?	Total (n)	Frequency (%)			
		Never	Sometimes	Often	Always
Bending	144	1.4%	16%	33.3%	49.3%
Overstretching	144	6.3%	31.3%	29.2%	33.3%
Standing	144	0.7%	2.8%	20.8%	75.7%
Repetitive movement	144	2.8%	6.9%	23.6%	66.7%
Wearing of lead apron	144	11.1%	39.6%	31.9%	17.4%
Same postures for a long period	144	0.7%	28.5%	45.8%	25%
Lifting /transferring patients to chair/beds	144	0.7%	18.8%	44.4%	36.1%
Pulling/pushing mobile x-ray units	144	2.8%	27.8%	39.6%	29.9%
Handling heavy objects	144	6.3%	33.3%	30.6%	29.9%
Grasping	144	2.1%	28.5%	35.4%	34%

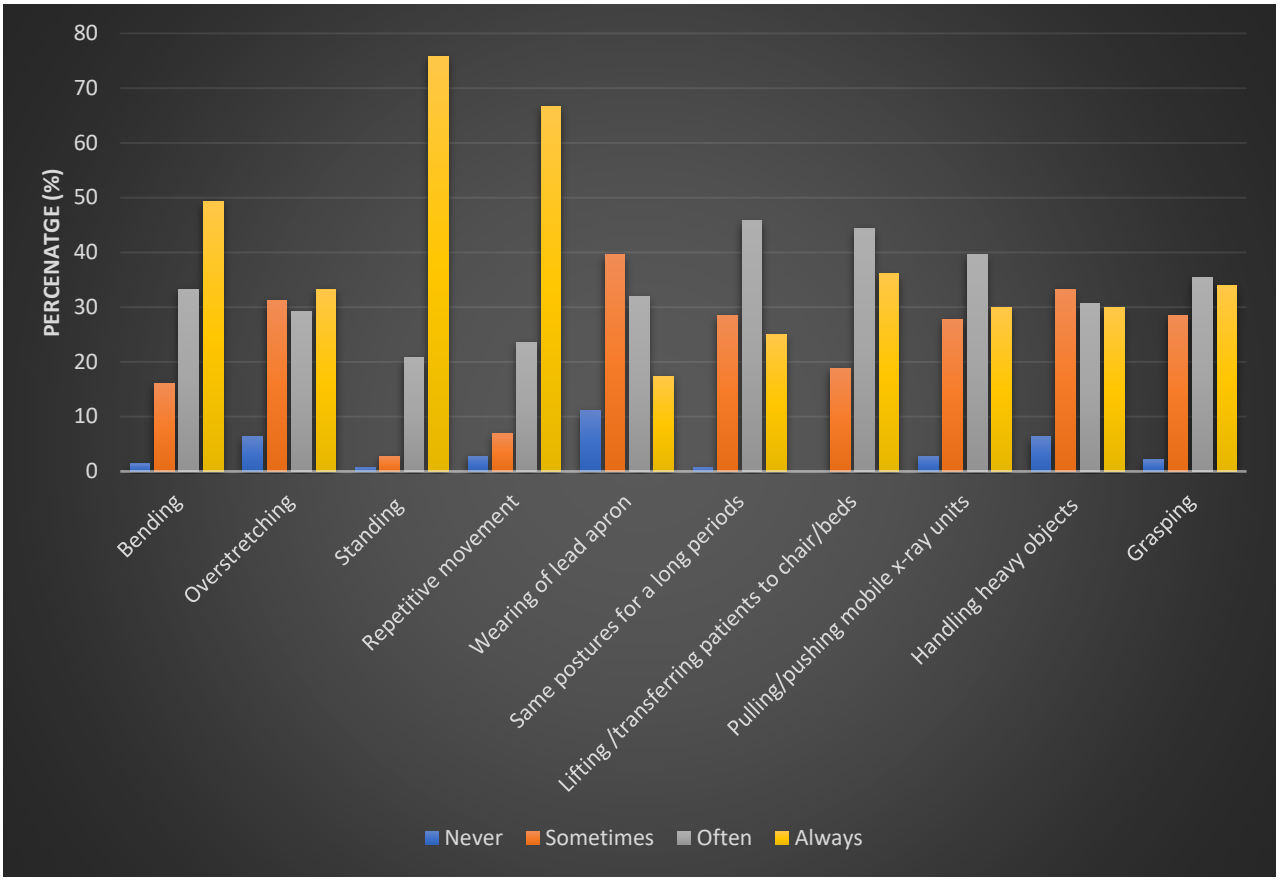


Figure 4.7 show frequency of common physical job activities during WIL

4.5.3 Stress, Depression and Level of Support During Work Integrated Learning

When asked if the respondents feel stress during WIL, a significant majority (n=131, 91.0%) answered ‘yes’, while 9% (n=13) answered ‘no’ (Figure 4.8) (p<.001), When asked if the respondents felt depressed stress during WIL, approximately half (n=73, 50.7%) answered ‘no’, while 49,3% (n=71) answered ‘yes’ (figure 4.8).

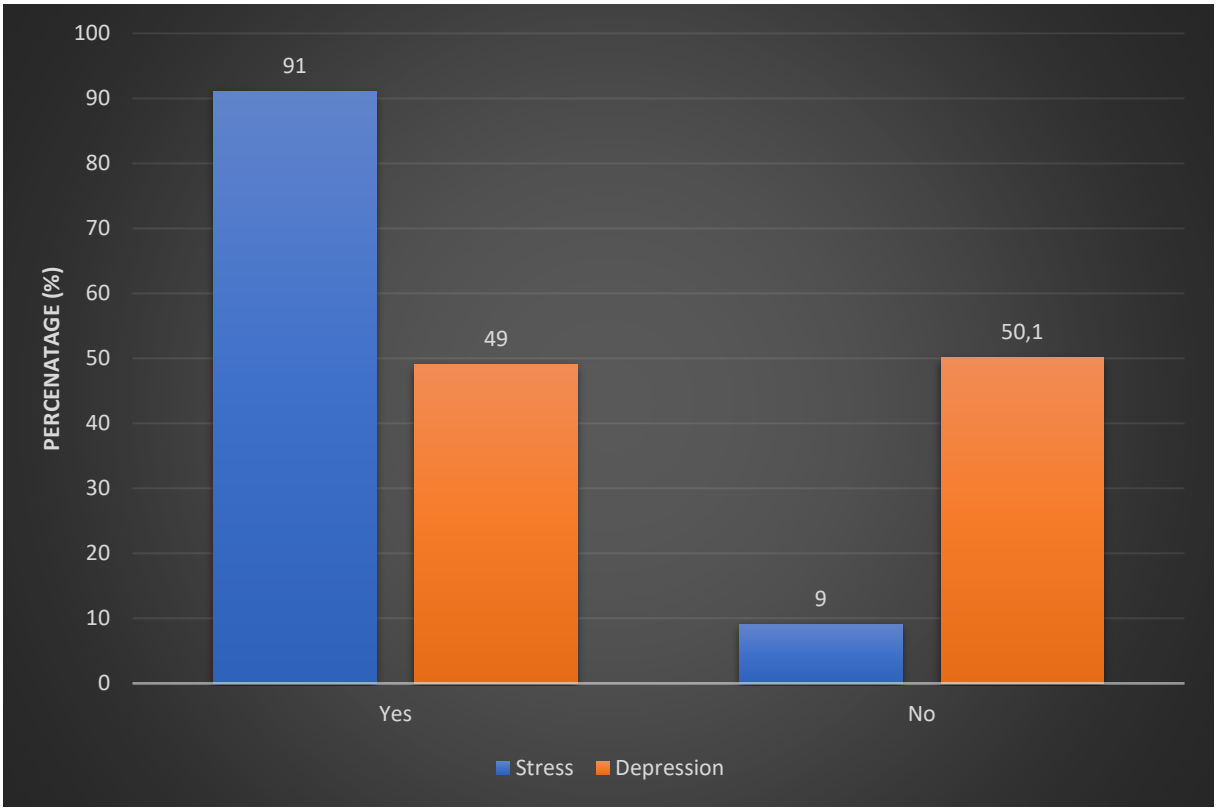


Figure 4.8 show self-reported stress and depression during WIL

4.5.3.1 Level of Perceived Stress And Depression During WIL

When asked to rate the perceived stress level during the WIL, 47,3% (n=62) rated it 'worse stress possible'; 41,2% (n=54) rated it 'moderate stress'; 9,9% (n=13) rated it 'mild stress'; and 1.5% (n=2) indicated no stress at all (Figure 4.9). The few (n=2) who indicated no stress at all may be connected to felt that their stress level was negligible. The numeric visual analogue scale (rated 0-10) was used to rate the respondents' levels of perceived stress with 0= 0 =no stress at all, and 10=highest level of stress rate.

Moreover, when asked to rate the perceived depression level during the WIL, 43,7% (n=31) rated it 'moderate'; 31% (n=22) rated it 'worse depression possible'; whilst 25,4% (n=18) rated it 'mild (figure 4.8). A significant majority (50.7%, n=73) indicated that they were not depressed, *p*<. 001.The numeric visual analogue scale (rated 0-10) was used to rate the respondents' levels of perceived depression with 0= 0 =no depression, and 10=highest level of depression.

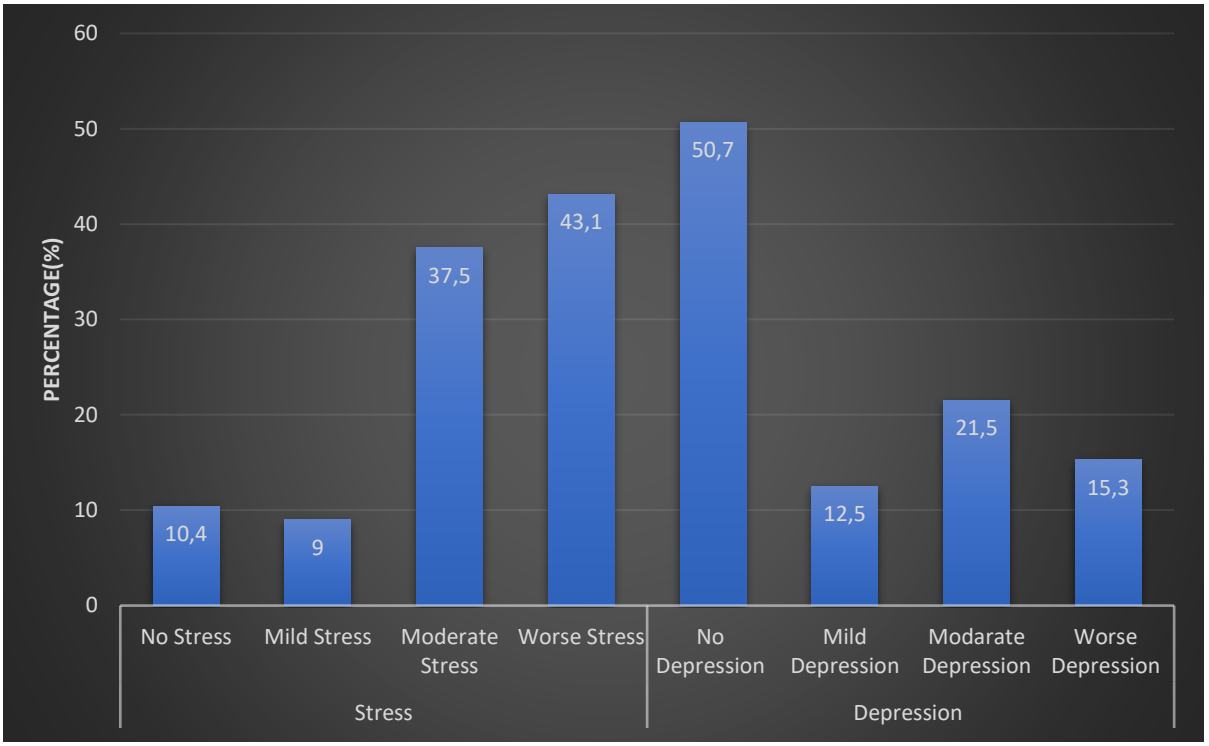


Figure 4.9 show level of perceived stress and depression during WIL

4.5.3.2 Stressors During Work Integrated Learning

The highest form of the stressor during WIL is given in Figure 4.10. The data indicate that 47,3% (n=62) had no stressors. On the contrary, 33,6% (n=44) noted assessments during WIL as a form of stressor while 19.1% (n=25) noted transportation during WIL as a form of a stressor. A chi-square goodness-of-fit analysis indicates that assessments during WIL constitute the highest stressor during the WIL, p<.001.

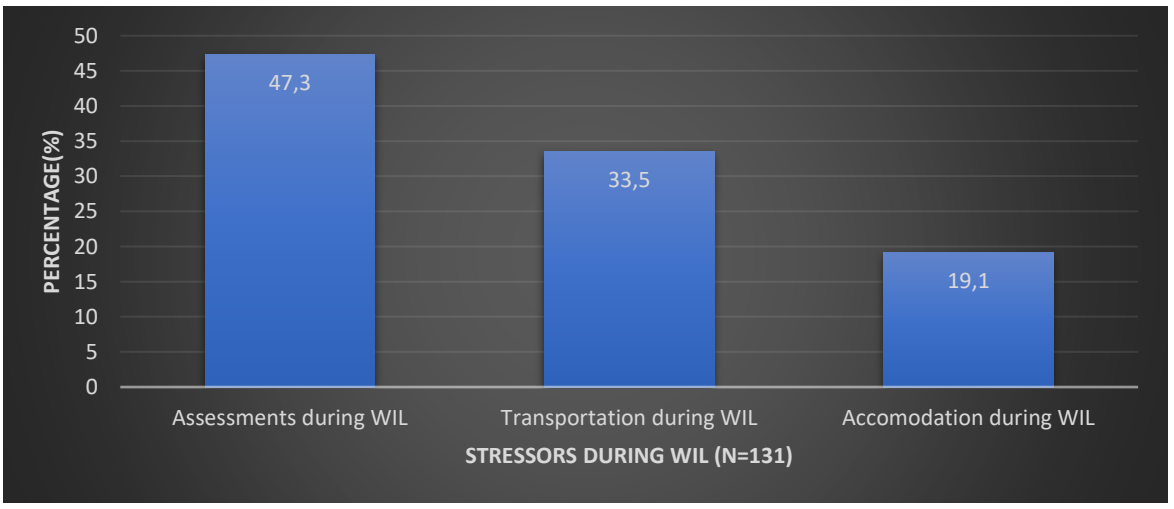


Figure 4.10 showing highest stressor during WIL

4.5.3.3 Stress and Depression In Relation To Level Of Study

Figure 4. 11 show the distribution of stress and depression per year of study, almost half of the third years indicated the prevalence of stress and depression, 41,2% 45,7% respectively. The second and fourth years reported the similar prevalence of depression which is 27,1% on each. Pearson's chi square test was applied to identify any significant association between stress and depression with year of study. No significant relationship was found between stress and year of study (*p*=.664) or between depression and year of study (p=.536).

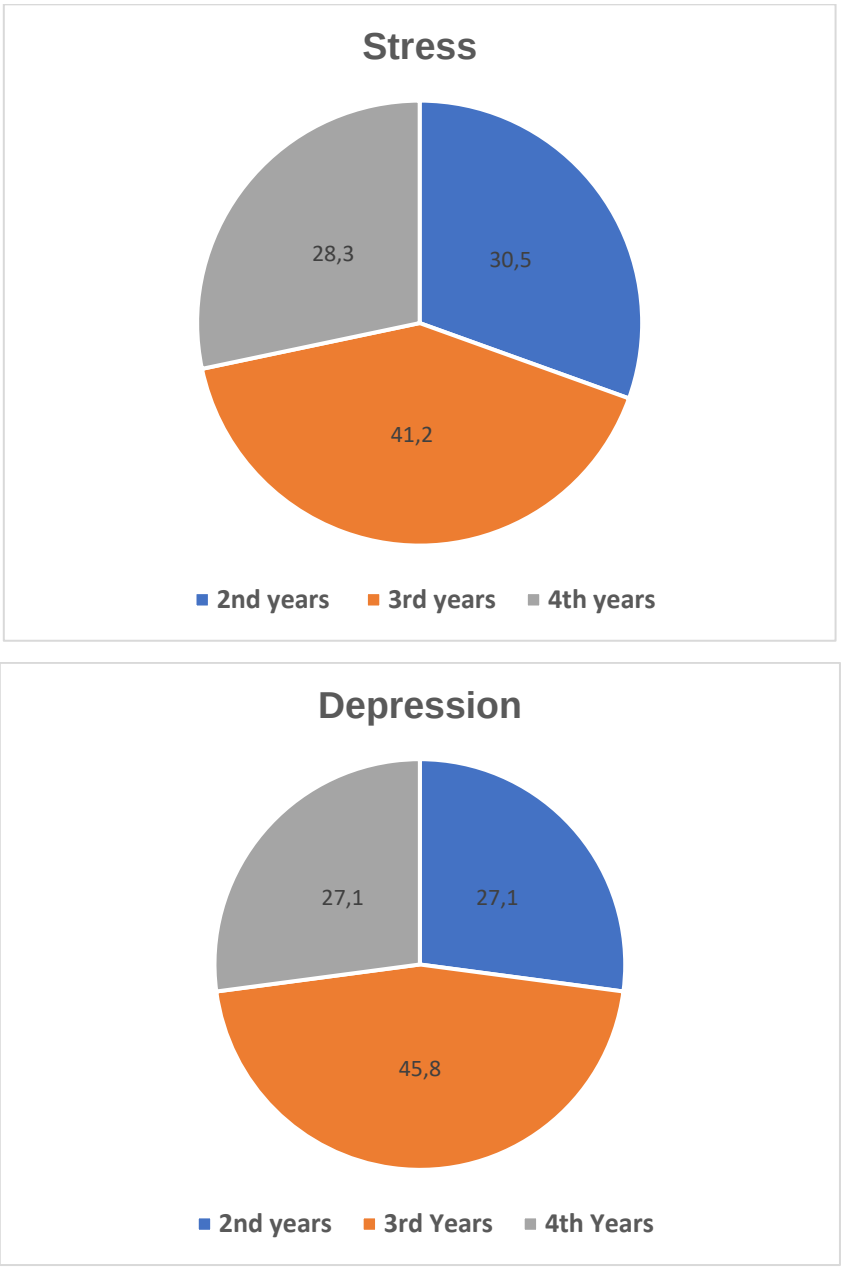


Figure 4.11 shows prevalence of stress and depression during per year of study

4.5.7 Level of Support During WIL

When asked if the respondents get an adequate level of support from the clinical tutor or qualified radiographers during WIL, a significant 61,8% (n=89) answered ‘yes’ while 38,2% (n=55) answered ‘no’ (Figure 4.12), p=.006.

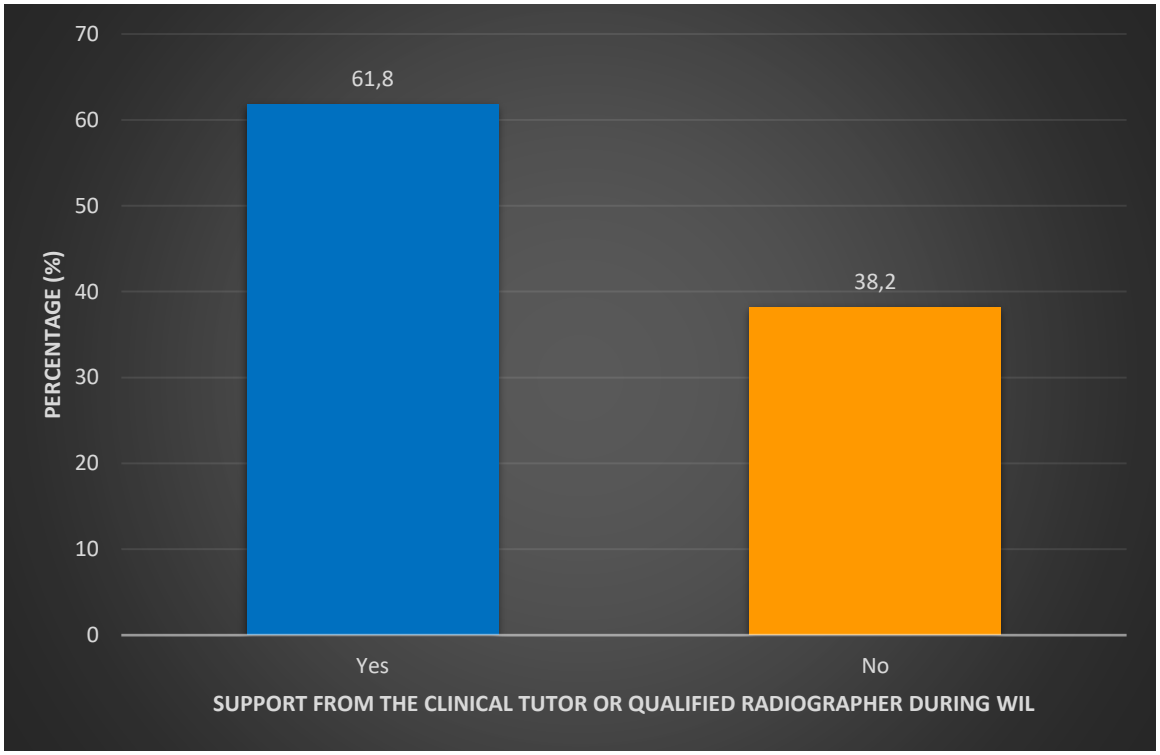


Figure 4.12 Showing whether respondents received adequate support during WIL

4.6 SECTION C MUSCULOSKELETAL DISORDER

This section outlines the prevalence, affected body parts and risks of MSDs among respondents. It will be presented by looking at the objectives of the study. The study had three objectives which are presented in chronological order below.

4.6.1 Objective One: To Determine The Prevalence of MSD Among Undergraduate Radiography Students.

The first objective of the study was to determine the prevalence of MSDs among the undergraduate radiography students during WIL. To determine this, the students were asked to indicate if they had experienced any musculoskeletal pain while attending WIL, the majority (n=133; 9,4%) of respondents indicated ‘yes’, while only 7,6% (n=11) indicated ‘no’ (Table 4.4). According to the table 4.6 indicates that of 133 that had

MSP, fourth years and third years reported highest MSD 95,2% and 94,8% respectively. On the other hand, 86.4% second years indicate that yes, they experience MSDs during WIL.

			Year of study			Total
			2nd	3rd	4th	
Have you ever experienced MSP while attending WIL?	Yes	Count	38	55	40	133
		% within year of study	86.4	94.8	95.2	**92.4**
	No	Count	6	3	2	11
		% within year of study	13.6	5.2	4.7	**7.6**

Table 4.6 showing prevalence of MSP in relation to year of study.

4.6.2 Objective Two: Identify the Parts of the Body that are Most Affected by Musculoskeletal Disorder

The Nordic Musculoskeletal Questionnaire was used to determine in which part of the body are the MSDs localized. Table 4.7 and Figure 4.13 shows that the among all the respondents that had MSD (n=133), the body parts that was most affected during the last 12 months are the lower back n=49 (79,7%) and the neck n=49 (72,2%). The MSP on both shoulders n=60 (45,1%) was indicated by most of the respondents, while the right shoulder n=20 (15%), left n=5 (3,8%). Also, n=68 (51,1%) of the respondents suffered in one or both ankles/feet. Few of the respondents n=23 (32%) suffered pain and discomfort in both elbows and thighs n=42 (31,6%).

On the other hand, table 4.6 show that the most affected body part within the last 7 days was the lower back (n=57,42%) and neck (n= 55, 41,4%). A higher frequency rate was reported for the last 12 months than for the last 7 days.

Table 4.7 show the overall prevalence of MSP by body part/ region

Body parts	Prevalence	
	12 Months n (%)	**7 days n (%)**
Neck	96 (72.2)	57 (42.9)
Shoulder right **Shoulder left** **Shoulder both**	20(15) 5(3.8) 60(45.1)	44(33.1)
Elbow Right **Elbow Left** **Elbow Both**	13(9.8) 3(2.3) 2(1.5)	8(6)
Wrist/Hands right **Wrist/Hands left** **Wrists/Hands both**	17(12.8) 11(8.3) 23(17.3)	33(24.8)
Upper back	72(54.1)	55(41.4)
Lower Back	106(79.7)	69(51.9)
One/both Thighs	42(31.6)	20(15)
One/both Knees	40(30.1)	27(20.3)
One/both Ankles/feet	68(51.1)	48(36.1)

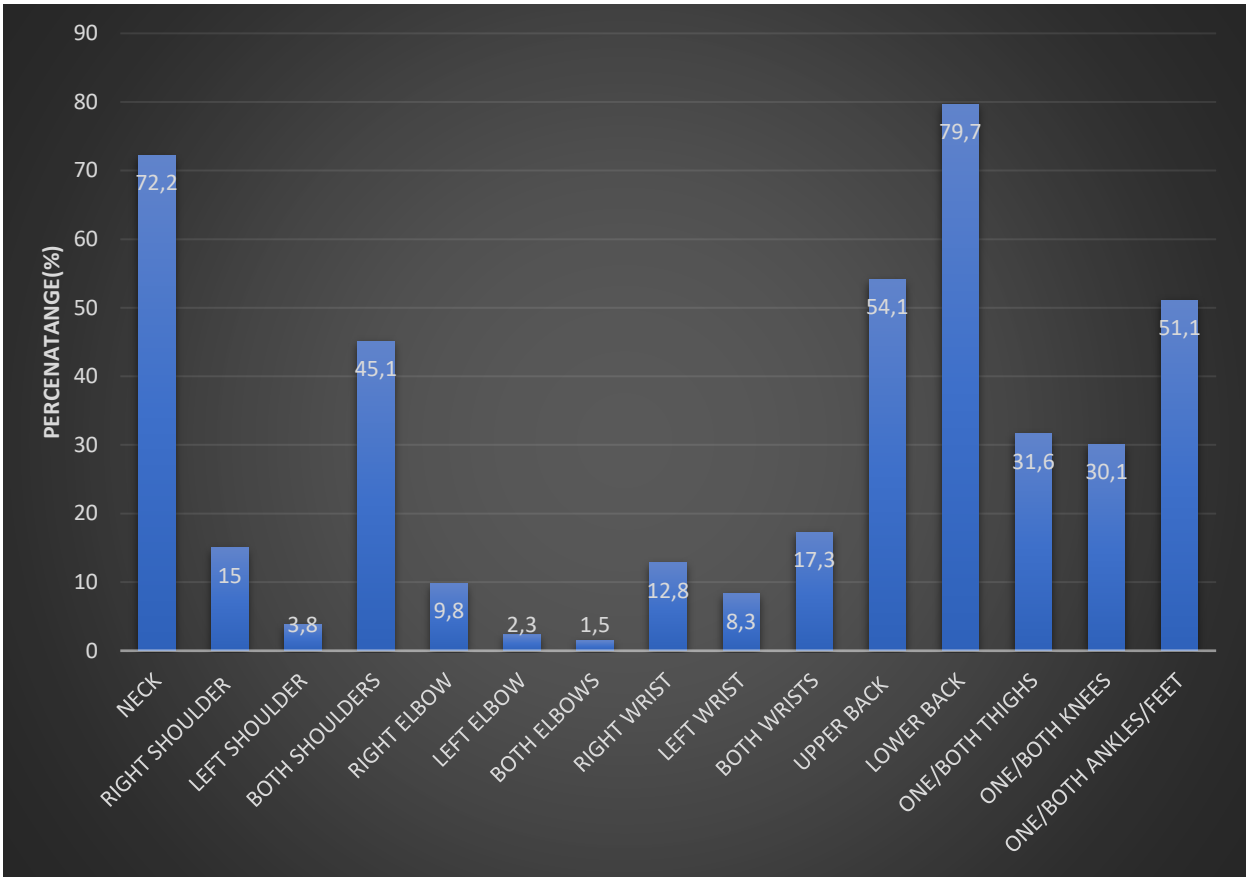


Figure 4.13 prevalence of MSP by body part/ region

4.6.1 Reported MSD Per Year Of Study And Body Part/S Affected

When looking year of study and body parts affected, it was founded that third years reported highest prevalence in most of the body parts (Figure 4.14). Of 106 that had lower back pain, almost half 47(44,3%) was from 3rd year, while 30 (28,6%) and 29(23,8) was from forth and third year respectively. Of 96 that had neck pain 35 (36,4%) was third year while 30(32,3%) and 31(31,3%) was from fourth years and second years. These results were taken with caution because it was noticed that more third years participated in this study.

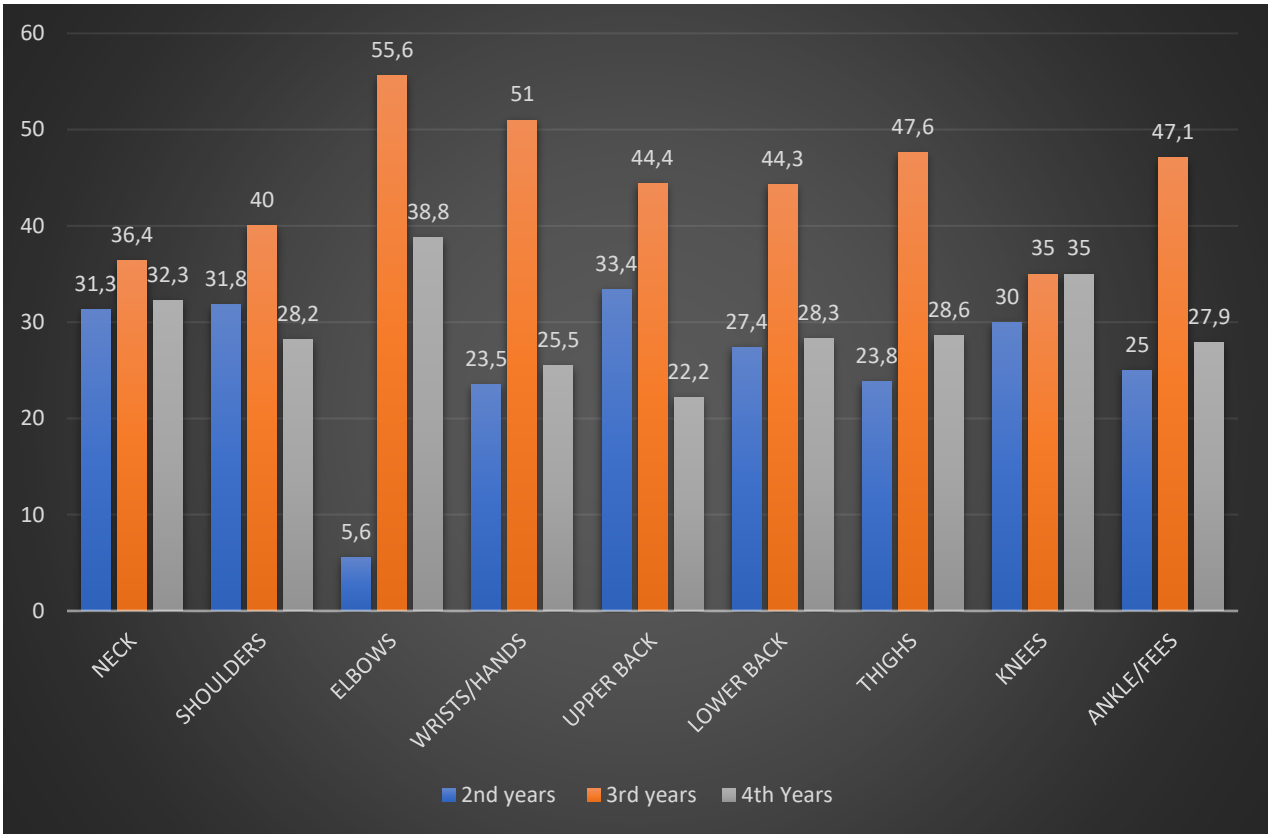


Figure 4.14 show affected body parts per year of study

4.6.3 Objective Three: To determine any association between the prevalence and selected risk factors for musculoskeletal disorder among radiography students

Selected risk factors were socio-demographic, work related and psychosocial risk factors. An analysis was done to determine whether there was any relationship between each of the variables in these risk factors and prevalence of MSD.

4.6.3.1 SOCIO-DEMOGRAPH RISK FACTORS

Gender, race, BMI, year of study, smoking, alcohol consumption and physical exercise were analysed to measure any relationship with reported musculoskeletal disorders. The table below shows analysis of the cross tabulations of socio-demographic factors with MSD.

Table 4.8 show the socio-demographic risk factors in relation to the prevalence of musculoskeletal disorders

Socio-demographic factors	Category	YES MSD n (%)	NO MSD n (%)	p-value
Gender	*Male*	30 (22.6)	4 (36.4)	0.289
	Female	103 (77.4)	7 (63.6)	
Race	*African*	94 (70.7)	9 (81.8)	1.000
	Caucasian	4 (3)	0 (0)	
	Coloured	5 (3.8)	0 (0)	
	Indian	30 (22.6)	2 (18.2)	
Age	*Under 20*	11 (8.3)	1 (9.1)	1.000
	20-24	108 (81.2)	9 (81.8)	
	25-29	14 (10.5)	1 (9.1)	
BMI	*Underweight*	14 (10.5)	0 (0)	0.366
	Normal weight	102 (76.7)	11 (100)	
	Overweight	17 (12.8)	0 (0)	
Year of Study	*2nd Year*	39 (29.3)	5 (45.5)	0.301
	3rd Year	56 (42.1)	2 (18.2)	
	4th Year	38 (28.6)	4 (36.4)	
Smoking	*Yes*	16 (12)	2 (18.2)	0.629
	No	117 (88)	9 (81.8)	
Alcohol Consumption	*Yes*	54 (40.6)	4 (36.4)	1.000
	No	79 (59.4)	7 (63.6)	
Physical Exercise (PE)	*Never*	74 (55.6)	6 (54.5)	0.791
	1-2 times/week	22 (16.5)	1 (9.1)	
	3-5 times/week	35 (26.3)	4 (36.4)	
	Everyday	2 (1.5)	0 (0)	

4.6.3.1.1 Gender, Age, Ethnicity, And BMI Versus Musculoskeletal Disorder

According to table 4.8, females (n = 103, 77,4%) reported higher MSDs during WIL compared to males (n = 30, 22,6%). In terms of age, the data showed that the age group between 20 and 24 (n = 108; 81,2%) reported the highest MSDs. However, the chi square p values suggest that there was no significance between gender (p = 0.289), age (p = 1.000) and ethnicity (p = 1.000) and MSD.

Moreover, only 17 (12.8%) of the overweight participants reported MSD. The chi-square tests (p = 0.366) show that no statistical difference was noted between body mass index (BMI) and participants with musculoskeletal pain (**Table 4.8**).

4.6.3.1.2 Year of Study Versus Musculoskeletal Disorder

According to the table 4.8 above shown that of 133 that had MSP, 56 (95,2% %) were from fourth years, while 39 (94,8% were from third year and 38 (86.4%) were from second-years. There was a progressive increase MSDs from the second to the fourth year starting with 86.4% in second year and reaching 95,2% in fourth year. The p-value under the Chi-square test for this was 0.301 which showed that the was no significant relationship between year of study and MSDs.

Table 4.9 show neck and lower back pain in relation to year of study. It was noted neck and lower back was more prevalent to third years (n=35(36,4%); n=47(44,3%) compared fourth and second years. However, when chi-square test was conducted the *p* value of 6.180 was found which suggest that there was no significant correlation between neck, lower back and year of study.

Table 4.9 show neck and lower back pain in relation to year of study

		Body region		***P* value**
		Neck n (%)	**Lower back n (%)**	
Year of Study	2nd year	30(31,3)	29(27,4)	6.180
	3rd year	35(36,4)	47(44,3)	
	4th year	31(32,3)	30(28,3)	

4.6.3.1.3 Smoking, Alcohol Consumption And Physical Exercise Versus Musculoskeletal Disorder

There were eighteen (12.5%) respondents who indicated smoking. Sixteen of these respondents (88.9%) suffered from MSD. Moreover, a total of 15 (6%) respondents drank alcohol. Eleven (73%) of the respondents from this group reported WMSDs, which represented five percent of respondents with MSDs. The results showed no significant relationship between smoking and MSD (p = 0.629) and alcohol intake with MSD (p = 1.000). These results were taken with caution as only a few were smoking or drinking alcohol.

In terms of physical exercise, 80 (55.6%) respondents indicated that they do not exercise. Seventy-four (92,5%) of the participants that reported no physical exercise had MSD in more than one body region. Few respondents (n = 2.0%) were involved in everyday structure exercises, and all the participants in this group (100%) complained of MSD. The chi square p value, however, suggested that there was no significant difference between MSD and physical exercise in this study (p = 0.791).

4.6.3.2 WORK-RELATED RISK FACTORS

This section will outline any association between selected work-related risks factors and musculoskeletal disorder. The table below shows analysis of the cross tabulations of work-related risk factor with MSD.

Table 4.10 show the work-related risk factors in relation to the prevalence of Musculoskeletal Disorders.

Work-related risk factors	Category	YES MSD n (%)	NO MSD n (%)	*p*-value
Hospital Sector	*Private*	46 (34.6)	4 (36.4)	1.000
	Public	80 (60.2)	7 (63.6)	
	Both	7 (5.3)	0 (0)	
Duration of teatime	*15 minutes*	63 (47.4)	2 (18.2)	0.112
	30 minutes	70 (52.6)	9 (81.8)	
Duration of lunchtime	*30 minutes*	62 (46.6)	2 (18.2)	0.112
	1 hour	71 (53.4)	9 (81.8)	
Bending	*Never*	1 (0.8)	1 (9.1)	0.247

	Sometimes	22 (16.5)	1 (9.1)	
	Often	45 (33.8)	3 (27.3)	
	Always	65 (48.9)	6 (54.5)	
Overstretching	*Never*	9 (6.8)	0 (0)	1.000
	Sometimes	41 (30.8)	4 (36.4)	
	Often	39 (29.3)	3 (27.3)	
	Always	44 (33.1)	4 (36.4)	
Standing	*Never*	1 (0.8)	0 (0)	0.287
	Sometimes	3 (2.3)	1 (9.1)	
	Often	27 (20.3)	3 (27.3)	
	Always	102 (76.7)	7 (63.6)	
Repetitive movement	*Never*	4 (3)	0 (0)	0.575
	Sometimes	9 (6.8)	1 (9.1)	
	Often	30 (22.6)	4 (36.4)	
	Always	90 (67.7)	6 (54.5)	
Wearing lead apron	*Never*	15 (11.3)	1 (9.1)	0.312
	Sometimes	55 (41.4)	2 (18.2)	
	Often	40 (30.1)	6 (54.5)	
	Always	23 (17.3)	2 (18.2)	
Same posture for long periods	*Never*	1 (0.8)	0 (0)	0.801
	Sometimes	39 (29.3)	2 (18.2)	
	Often	60 (45.1)	6 (54.5)	
	Always	33 (24.8)	3 (27.3)	
Lifting/transferring patients	*Never*	1 (0.8)	0 (0)	0.576
	Sometimes	26 (19.5)	1 (9.1)	
	Often	57 (42.9)	7 (63.6)	
	Always	49 (36.8)	3 (27.3)	
Pulling /pushing mobile X-ray unit	*Never*	4 (3)	0 (0)	0.291
	Sometimes	37 (27.8)	3 (27.3)	
	Often	50 (37.6)	7 (63.6)	
	Always	42 (31.6)	1 (9.1)	
Handling heavy objects	*Never*	8 (6)	1 (9.1)	0.551
	Sometimes	45 (33.8)	3 (27.3)	
	Often	39 (29.3)	5 (45.5)	
	Always	41 (30.8)	2 (18.2)	
Grasping	*Never*	3 (2.3)	0 (0)	0.161
	Sometimes	38 (28.6)	3 (27.3)	
	Often	44 (33.1)	7 (63.6)	
	Always	48 (36.1)	1 (9.1)	

4.6.3.2 .1 Healthcare Sector Versus Musculoskeletal Disorder

Students attending Work Integrated Learning (WIL) at public hospitals reported more MSD (n=80; 34,6%) than students that are attending WIL in private (n=46; 34%) or both (n=7; 5,2%) (Table 4.10). These results were also taken with caution since there were few participants reported that they do WIL at private hospital than public hospitals. Under Chi square test no association was evident between work sector and prevalence of MSD (p=1.000).

4.6.3.2.2 Physical Work Activities Versus Musculoskeletal Disorder

Table 4.10 outlines that of 133 that reported MSD, 102 (76,9%) reported always standing, followed by 90 (67,7%) always moving and 65 (48,9%) always bending. The chi-square tests, however, show that there was no statistical difference found between MSD and physical work activities performed during WIL ($p > 0.05$).

Further analysis was done to measure any association between selected physical work activities and the body regions affected. The selected work activities were bending, standing, and lifting patients. The chi-square tests were applied to test whether there were any significant differences between those selected physical activities and different body parts that did or did not experience symptoms. Table 4.11 and 4.12 below show that a significant number of those whose job "sometimes" involves bending had trouble in their lower back, p =.038. There was no other significant relationship observed between physical activities performed during WIL and body parts affected ($p > 0.05$).

Table 4.11 Relationship between bending and lower back pain

		Bending				**Total**
		Never	Sometimes	Often	Always	
Lower back pain	No	0	5	13	9	**27**
	%	0	22,7	28,9	13,8	
	Yes	1	17	32	56	**106**
	%	100	77,3	71,1	86,2	
Total		**1**	**22**	**45**	**65**	**113**

Table 4.12 show significance between bending and lower back pain

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	8.339[a]	3	.040	.063		
Likelihood Ratio	7.328	3	.062	.074		
Fisher's Exact Test	7.820			.038		
Linear-by-Linear Association	6.168[b]	1	.013	.014	.012	.007
N of Valid Cases	133					

a. 3 cells (37.5%) have expected count less than 5. The minimum expected count is .14.

b. The standardized statistic is 2.483.

4.6.3.3 PSYCHOLOGICAL RISK FACTORS

This section will outline any association between selected psychological risk factors and musculoskeletal disorder. The table below shows analysis of the cross tabulations of psychological risk factors with MS.

Table 4.13 show the psychological risk factors in relation to the prevalence of Musculoskeletal Disorders.

Psychological factors	Category	YES MSD n (%)	NO MSD n (%)	OR [CI]	*p*-value
Stress	*Yes*	123	8 (72.7)	4.613 [1.055; 20.164]	0.028
	No	10 (7.5)	3 (27.3)		
Stress levels	*None*	12 (9)	3 (27.3)		0.274
	Mild	12 (9)	1 (9.1)		
	Moderate	51 (38.3)	3 (27.3)		
	Worst possible	58 (43.6)	4 (36.4)		
Stressors	*Assessments*	58 (47.2)	4 (50)		1.000
	Transportation	41 (33.3)	3 (37.5)		
	Accommodatio	24 (19.5)	1 (12.5)		
	Yes	69 (51.9)	2 (18.2)		0.032

Depression	No	64 (48.1)	9 (81.8)	4.852 [1.010;	
Depression levels	*None*	64 (48.1)	9 (81.8)		0.146
	Mild	17 (12.8)	1 (9.1)		
	Moderate	31 (23.3)	0 (0)		
	Worst possible	21 (15.8)	1 (9.1)		
Support	*Yes*	83 (62.4)	6 (54.5)		0.749
	No	50 (37.6)	5 (45.5)		
Support levels	*None*	8 (6)	0 (0)		0.554
	Mild	39 (29.3)	5 (45.5)		
	Moderate	46 (34.6)	2 (18.2)		
	Worst possible	40 (30.1)	4 (36.4)		

4.6.3.3.1 Musculoskeletal Disorder Versus Stress and Depression

Depression is associated with an increased risk of MSD (p =.032). Significantly more than expected of those who are not depressed and do not have MSD. Analysis shows that those with depression are 4.852 times more likely to suffer from MSD than those without.

Stress is marginally related to the prevalence of MSD (p=.028). Analysis shows that those with stress are 4.613 times more likely than those without the stress to suffer with MSD.

4.6.4 Multiple regression analysis

In order to determine the independent risk factors for MSD among this sample, a Multiple regression analysis was conducted. The regression was completed in 11 steps with the following variables being entered on the first step: stress, depression, smoking, alcohol, gender, year of study.

Multiple regression analysis on the predictors of MSP is shown in Table 4.14. The regression coefficient (r=0.230; p>0.05) suggests a poor causal relationship in the predicted model. None of the measured variables as significant predictors of MSP.

Table 4.14: Multiple regression analysis on predictors of the prevalence of MSP

Predictor	F-value	P-value	R	Beta coefficient	Error	R^2	Predicted	Signif.	Collinearity statistics VIF
Stress	1.947	0.106	0.230	0.130	0.083	0.053	MSP	0.147	1.168
Depression				0.144	0.047			0.108	1.153
Smoking				-0.055	0.071			0.534	1.162
Alcohol				0.034	0.047			0.693	1.092

MSP: Musculoskeletal pain.

4.7 SECTION D: IMPACT OF MUSCULOSKELETAL PAIN

This section highlights the selected impacts of MSDs among respondents. On section four of the questionnaire the participants were asked to outline the effects of MSDs.

4.7.1 Work-Related Absence Caused by Musculoskeletal Pain

When asked if the respondents have ever been absent at work due to their musculoskeletal pains, the majority of the respondents with a prevalence of musculoskeletal pain 82% (n=109) answered ‘no’ while 18% (n=24) answered ‘yes’ (Figure 4.15).

In terms of the number of days the respondents were absent (n=24), the figure 4.16 show that 75% (n=18) were absent from work between 1-5 days, 4 (16,7%) were absent 6-9 days while one (4,2%) were absence 10 and above days.

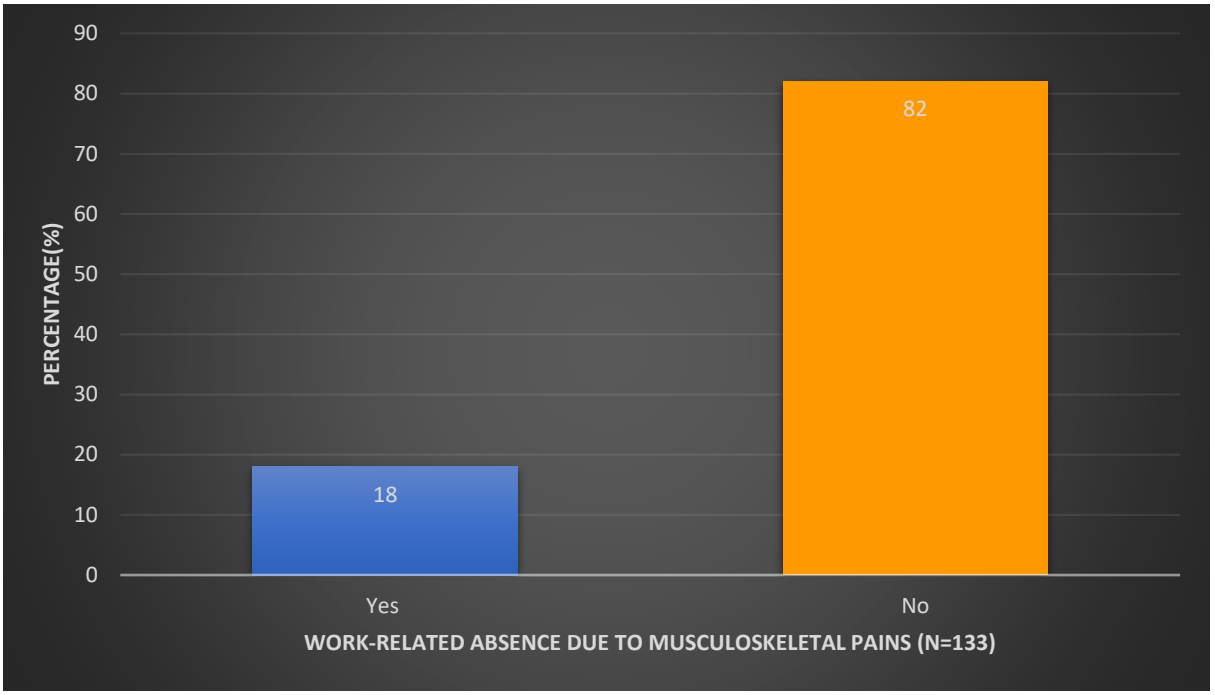


Figure 4. 15 is Showing respondents absence from work due MSDs

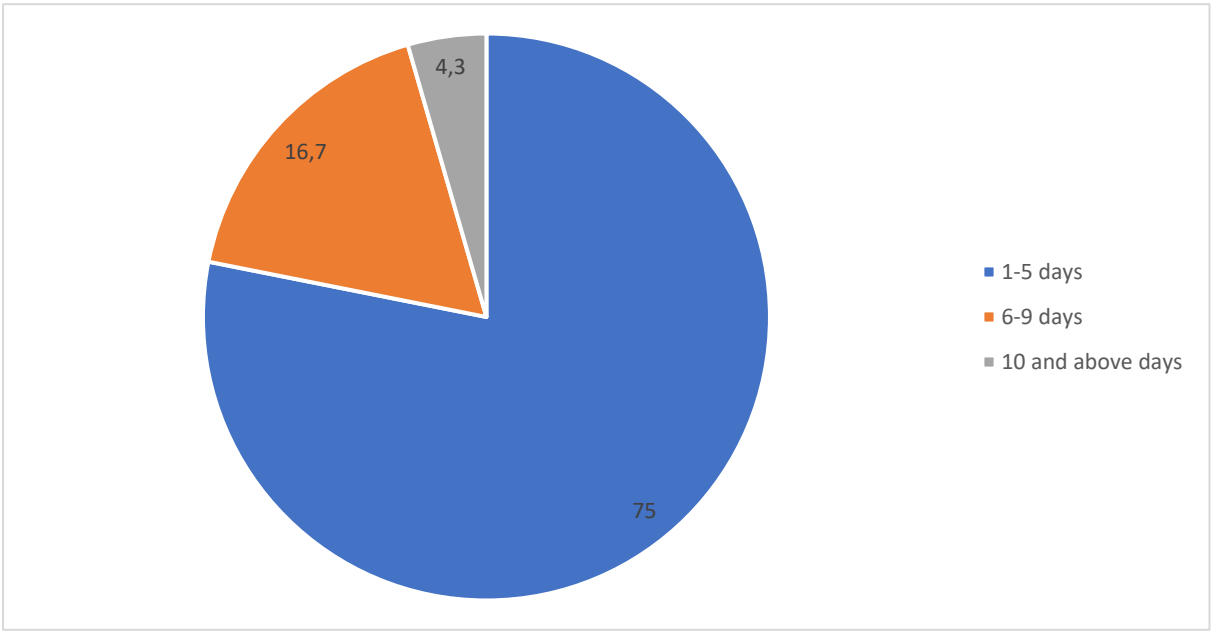


Figure 4.16 show number of days the respondents were absent (n=24)

4.7.2 Consideration to change radiography profession due to musculoskeletal pain

When asked if the respondents with work-related musculoskeletal pain (n=133) have ever considered changing the radiography profession as a result of the musculoskeletal pains, the majority (n=97; 72.9%) answered 'no' while 36 (27,1%) answered 'yes' (figure 4.17).

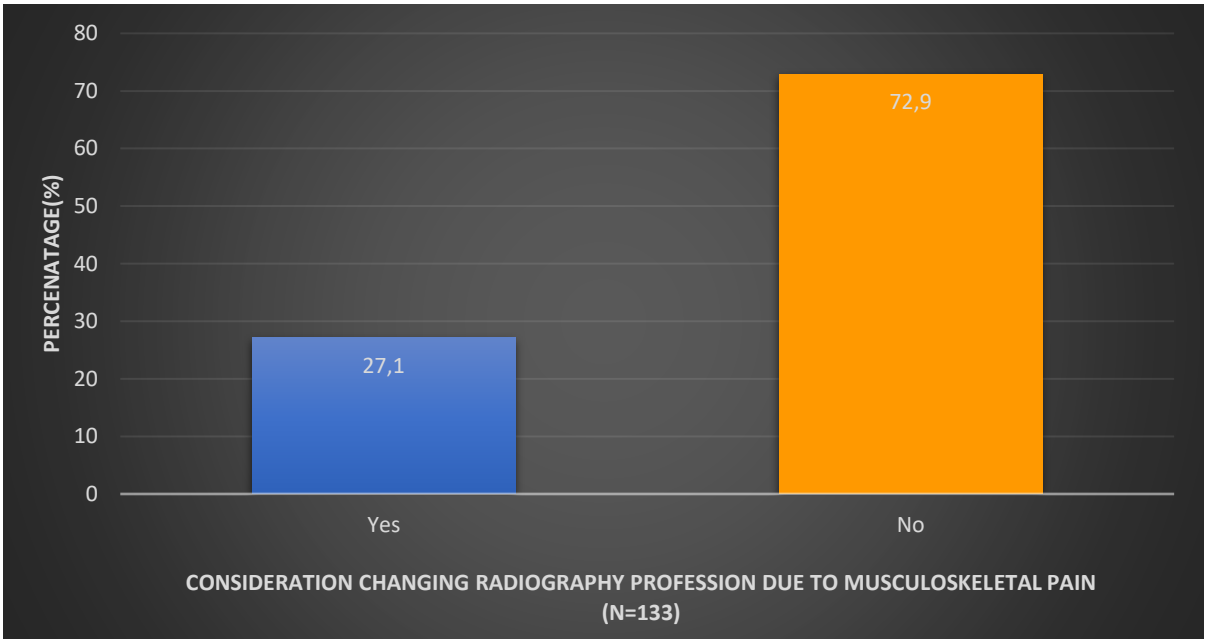


Figure 4.17 show the number of respondents considering changing the radiography profession due to musculoskeletal pain

4.7.3 Received Treatment for Musculoskeletal Pain

As shown in figure 4.18, only 24.1% out of 133 respondents have been to a medical professional for musculoskeletal pain while only 3.8% have ever been admitted to the hospital because of musculoskeletal pain.

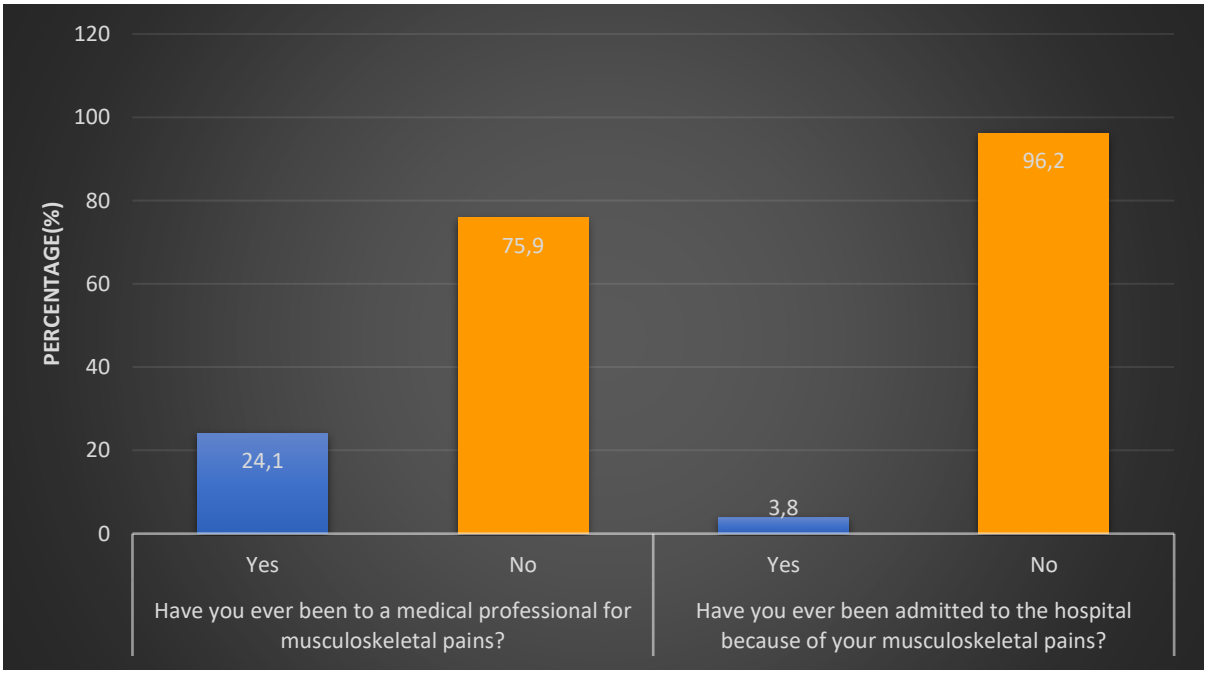


Figure 4. 18 respondents who sought treatment and or were hospitalised due to musculoskeletal pain

4.8 SUMMARY

In summary, the above chapter exhaustively analysed the prevalence of MSP amongst radiography students attending WIL. The descriptive data suggests that many of the respondents were females within the age group 20-24years', who weighed between '60-79 kilograms', measured '150 to 169 cm' in height and were mostly normal weight. It was also uncovered that the majority of the respondents WIL were in public hospitals. Many of them reported being stressed and the main stressor was assessment during WIL. Nearly half of the respondents also reported being depressed. In terms of lifestyle habits, only a few reported smoking while nearly half-consumed alcohol.

With reference prevalence of MSP, it emerged that the majority of students reported having MSP (92.4%)). Also, the majority were affected by MSP in most body part however a significant number of students reported lower back and neck as most affected body parts. The Chi-square test suggests that the prevalence of MSP significantly increases with stress and depression. Also, Chi square test showed a significant relationship between bending and lower back pain experienced by students. The above results also shown that there are few students that reported being absent at work due to MSP. In additional, there are few students that think to change radiography profession due to the effect of MSP.

CHAPTER FIVE: DISCUSSION

5.1 INTRODUCTION

This chapter discusses the findings of the study presented in Chapter Four. In this chapter, the study findings are interpreted and discussed by contrasting the observed similarities and differences to those of the literature, which was presented in Chapter 2. Firstly, there will be a brief discussion of the response rate followed by the demographic factors found in this study. Thereafter, the results will be discussed in the order of each objective of this study. Also, the conceptual model adopted in this study will be realised in this chapter.

5.2 RESPONSE RATE

Survey response rates are important to be discussed for every study since they measure the quality of a survey. The response rate is calculated by dividing the number of usable responses returned by the total number of eligible people in the sample chosen, then multiplying that number by 100 because it should be expressed as a percentage (Fincham 2008: 2). Calculating the study response rate helps to appropriately measure non-responses in the study. And it should be noted that if the rate of nonresponse is high, that increases the chance that the final study estimates may reflect bias (Brick and Williams 2013: 36).

The final response rate for this study was 84.2%. This response rate was higher when compared to other previous studies that were conducted on radiography students with a similar aim. When looking at the South African context, this study achieved a significantly higher response rate than the 50.8% that was achieved by Bensusan (2019:24). It should be noted that the study by Bensusan (2019:24) was based on different health sciences, including radiography students at UJ in Gauteng province. The current study is based only on radiography students at DUT in KwaZulu-Natal.

Furthermore, this response rate was higher compared to the 40.7% that was achieved by Bowles and Quinton (2019:1). The study by Bowles and Quinton (2019:1) was specific to final-year Australian sonography students, while this current study chose the sample from second to fourth years. The high response rate shown by this study is important to ensure that the results are representative of the target sample and the

questionnaire is performing as intended. A higher response rate helps to strengthen the validity and reliability of the results of this study.

It should be noted that this study's response rate is lower than the 100% that was achieved by the Lorusso, Vimercati, and L'abbate (2010:2) study. The reason this study does not attain a 100% response rate is that data was collected during the COVID-19 pandemic. The COVID-19 led to the suspension of face-to-face classes for the rest of the 2020 and 2021 academic years, and the classes and assessments were all taking place online. This was done to prevent and protect all students and staff members from the highly infectious disease (Sahu 2020:2). The suspension of online classes affected the strategy to approach all the students during their lecture and examination times. Even though a plan to approach other students while writing exams was used, other radiography disciplines (radiotherapy and nuclear medicine) were not writing during the data collection of this study and due to time constraints, this study has commenced without the students from this radiography discipline.

In summary, the response rate achieved by this study is higher compared to other studies that have a similar aim. Higher response rates were most preferred since they provide researchers with a more complete picture of the sample and suggest less bias due to nonresponse. Moreover, this higher response rate reflects a high degree of accuracy in the results and is a reflection of the effort and resources invested in the study.

5.3 SOCIO-DEMOGRAPHIC FACTORS OF THE RESPONDENTS

When looking at age distribution, the vast majority of the respondents in this study were between the ages of 20 and 24 years old. This is hardly surprising given that the study is focused on undergraduate student radiographers, the majority of whom have just completed their matriculation. The Department of Higher Education and Training statistics on Post-School Education and Training in South Africa (2019:14) reported that the majority of young people aged 19–24 years old enrolled for undergraduate degrees and undergraduate certificates and diplomas. Similar research on undergraduate radiography students found that the majority of the students in their sample were in this age category (Bensusan 2019:24); Lorusso, Vimercati, and L'abbate (2010:2); Bowles and Quinton (2019:3). According to Society and the College

of Radiographers (2017: 6), even reported that 55% of diagnostic radiography respondents and 47% of therapeutic radiography respondents were around 21 years old at the start of their radiography programmes in the UK.

The majority of participants in this study were female. There were 76.4% female participants in this research study. This corresponds with another study conducted on undergraduate radiographers by Bensusan (2019:24), who reportedly had 79.5% of female participants. Similarly, a study on final-year Australian sonography students found that 88% of their study participants were female (Bowles and Quinton 2019:3). In South Africa, radiography is known to be predominately performed by women. (Davy 2019: 10). According to the literature, women form the backbone of radiography (Anim-Sampong *et al.* 2018: 337). However, other countries reported that radiography is a male-dominated profession (Lorusso, Vimercati, and L'abbate (2010: 1); (Anim-Sampong *et al.* 2018: 337); (Vernuccio *et al.* 2019: 1). According to the Ghana Society of Radiographers, 14.8% of its members are women and 85.2% are men (Anim-Sampong *et al.* 2018: 337).

The marital status of the population was comprised of 99.3% single and 0.3% married participants. This is consistent with Bensusan's (2019:25) findings that 96.6% of radiography students are single and only 7.4% are married. Such findings in this study were not surprising, given that the majority of young adults who attend universities delay marriage until they complete their degree. Maharaj and Shangase's (2020:3) study concluded that the reason students delay marriage is that they believe it is best to postpone it until after completing their education and securing individual and familial financial stability.

Population groups are divided into four broad race categories in South Africa, which were used in the questionnaire, namely, black African, coloured, Indian/Asian, and white. It has been established that Kwa-Zulu Natal (KZN) is the second most densely populated province in South Africa (Statistics South Africa, 2022:10). In almost all provinces of South Africa, black Africans account for more than 80% of the population, with the coloured and white populations accounting for more than 8% each, and the Indian/Asian population accounting for the smallest proportion of the population at 2.47% (Statistics South Africa, 2022:10). Africans accounted for 71.5% of the

population, Indians for 22.2% of the population, coloureds for 3.5% of the population, and whites for 2.8% of the population. These figures are not surprising given the significant increase in the number of Black African students enrolling in South African universities. According to Dlamini (2017:1), black African students accounted for 77.38% of the total student population at Durban University of Technology (DUT).

The radiography profession in South Africa (SA) is represented by diagnostic radiography, nuclear medicine technology, ultrasound, and radiation therapy (Makanjee and Engel-Hills 2018: 201). The vast majority of the participants were from the diagnostic radiography discipline in this study (84%). These findings are also not so surprising because it was observed in most of the studies that diagnostic radiography is predominant. A study by Friedrich-Nel (2015: 27) reported that 63% were diagnostic radiographers; thirteen percent (13%) were radiotherapists; nine percent (9%) were sonographers; two percent (2%) were nuclear medicine radiographers; eight percent (8%). No study has explained why this is the case; however, Motshweneng and Mdletshe (2021: 1) state that previously, diagnostic radiography was the only discipline offered at the undergraduate level, with the other disciplines available as post-basic qualifications.

Regarding the consumption of alcohol and smoking, 40.3% of students said they consume alcohol, and 87.5% reported never smoking. A study conducted among healthcare students, including radiography students, at Durban University of Technology on the Durban campus found that most of the participants did not smoke cigarettes (90.4%), electronic cigarettes (96.3%), use social drugs (91.1%), or drink alcohol (66.7%) (Gevers 2018:78). Another study, conducted with third-year radiography students from a large university in the Apulia region of Southern Italy, found that 27% were smokers and 73% were not smokers, Bowles and Quinton (2019:3). Among radiography students, it is emphasised that the consumption of alcohol in the university environment, within the social and cultural patterns regarded as acceptable, is usually recreational and commonly used as a relaxation mechanism against stress and burnout experienced due to university activities.

Another factor noted in the demographical findings was the high proportion of participants who reported not being involved in any structured exercise (55%). This is

in contrast with a study that reported that most of the students reported that they do physical exercise (Bensusan's 2019:36; Gevers 2018:78). Numerous studies posit that exercise has a positive impact on the body, reducing the prevalence of MSDs (Levy 2018: 17; Serra *et al.* 2018: 62; Soares *et al.* 2019: 415). In this study, only 1.4% of students reported that they were involved in everyday physical exercise. Alkhateeb *et al.* (2019:4) mentioned that one of the possible reasons for a decrease in physical activity or exercise might be related to changes in students' priorities as they face lifestyle changes, so they become less motivated or able to perform the exercise. Moreover, El-Gilany, Badawi, El-Khawaga, and Awadalla (2011: 694) mentioned that the main reason for students' not practising exercise during school years as well as after attending college was time limitations.

In summary, the majority of the participants in this study were single African females aged between 20 and 24 and were diagnosed with diagnostic radiography. The majority were not involved in physical exercise and almost half were drinking alcohol.

5.4 DISCUSSION OF FINDINGS ON RESEARCH OBJECTIVES

5.4.1 Objective one: To determine the prevalence of MSDs among undergraduate radiography students.

The first objective of this study was to determine the prevalence of musculoskeletal pain among undergraduate radiography students during work-integrated learning in the KwaZulu-Natal region. Of the 144 undergraduate radiography students who participated, 133 (86.1%) experienced musculoskeletal pain during WIL. The majority reported a higher 12-month prevalence than the 7-day prevalence.

The results of this study are consistent and comparable to numerous other studies conducted on musculoskeletal pain radiography students. The most comparable study is mentioned by Bowles and Quinton (2019:1), who stated that 97% of ultrasound final year students suffered musculoskeletal pain while scanning during university practical placements in Australia. The prevalence found for this is higher than the 77.8% reported by Bensusan's (2019:25) study based on radiography students in Gauteng province. It is also much higher than the Senarath, Thalwaththe, and Tennakoon (2021:1) study, which was conducted at Sri Lanka's University of Peradeniya.Senarath, Thalwaththe, and Tennakoon (2021:1) studies found that 73%

of the allied health students, including radiography students as participants, reported experiencing musculoskeletal pain.

Surprisingly, the findings of this study contradict those of Lorusso, Vimercati, and L'abbate (2010:2) who discovered a substantially lower incidence (37%) of MSDs in Italian undergraduate radiography students. This lower incidence was unexpected given that the majority of the papers based on MSDs among radiography students indicated a prevalence of more than 60% (Bensusan's 2019:25; Thalwaththe, Tennakoon 2021:1; Bowles and Quinton 2019:1). The possible reason for the reduced incidents of MSDs reported in this study is that it has a smaller percentage of participants compared to the current study. Moreover, the other reason might be the fact that it was specific to only the diagnostic radiography discipline, ultrasound, nuclear medicine, and radiotherapy were not included.

The current study further found out that as the level of study increases, the MSDs experienced also increase. In this study, 86.4% of second years, 94.2% of third years, and 95.2% of fourth years reported MSP during WIL. Similarly, a study by Bensusan (2019:25) highlighted that there was a progressive increase in MSP problems from the first to the fourth year, starting with 72.5% in the first year and reaching 88% in the fourth year. Backberg *et al.* (2014:11) also highlighted a similar pattern among undergraduate nursing students in Sweden, where the final year reported a slightly higher MSP than the second and third years. This means that there is a difference in the distribution of MSDs among different levels of study; as the year of study increases, the MSP prevalence also increases.

5.4.2 Objective two: To Identify the Parts of the Body that are Most Affected by Musculoskeletal Disorders.

Participants were asked to note the occurrence of the MSD complaint in nine different body regions following the SNQ (Kuorinka *et al*. 1987). The authors of SNQ grouped the body into nine regions, with questions on pain or discomfort in the last 12 months or seven days being asked. The results revealed that the most prevalent regions with MSD complaints in the last 12 months were the lower back (79.7%) and neck (72.2%) regions, while the hips/thighs (10.1%) and elbows (12.8%) regions were shown to be the least prevalent.

Many studies in different countries reveal a similar pattern among radiography students. Almhdaw *et al.* (2017: 1291) showed that allied health students, including radiography students, had significantly more neck and back symptoms in Saudi Arabia. According to Almhdaw *et al.'s* (2017: 1291) study, radiography students experience mostly neck pain (64.0%), followed by lower back pain (59.3%). Likewise, in Australia, the most prevalent MSP among X-ray students during the previous year were reported in the neck (57.5%), low back (53.7%), and was least prevalent in the legs (8%) (Lorusso, Vimercati, and L'abbate 2010: 1). Similarly, a study by Senarath, Thalwaththe, and Tennakoon (2021:1) in Sri Lanka found that the highest prevalence in radiography students studying at the University of Peradeniya was the lower back (44%), followed by the neck (37%), and the least reported regions were the hips/thighs (8%) and elbows (5%).

Moreover, it is important to compare the current results with other African studies. The literature is still lacking on the prevalence of MSD among different radiography students in Africa, including South Africa. In the best literature search, only two African studies that were related to MSDs in radiography students were found (Ofori-Manteaw, Antwi, and Arthur 2015: 93; Bensusan's 2019:25). These studies revealed a similar pattern, where most prevalent regions being neck and lower back pain. In Ghana, Ofori-Manteaw, Antwi, and Arthur (2015: 93) highlighted that neck and lower back injuries were the most prevalent MSDs reported by student radiographers. Likewise, in South Africa, Bensusan's (2019:25) reported that MSP prevalence in the lower back was 73.4% and in the neck was 53%. This study has also shown that only a few reported prevalence in thighs at 9.0% and elbows at 1.6%. What makes the two mentioned studies differ from the current study is that they were both not only specific to radiography students, but other health professions were also included. In Ofori-Manteaw, Antwi, and Arthur's (2015: 93) study to assess the ergonomic situation of the various imaging units at the Korle-Bu Teaching Hospital (KBTH), the subjects were final-year student radiographers, qualified diagnostic radiographers, and radiologists at the KBTH. Bensusan's (2019:25) study was aimed at determining the prevalence, the body regions affected, and the risk factors associated with MSDs among

undergraduate students in biomedical technology, environmental health, and radiography departments.

In general, studies reveal that the most commonly reported sites by radiography students are the neck and back areas. Therefore, the result of this study is in agreement with majority of previous studies. However, this pattern was different from those reported for radiography students in the United States. Bolton and Cox (2015:145) showed that the majority of the symptoms were in the shoulder (69.5%), neck (68.5%), and wrist (67.4%). The reason the current study showed different results from Bolton and Cox's (2015:145) study was that it was focused only on third-year sonography students. Interestingly, most of the previous studies mentioned that shoulder pain is more abundant among sonographers (Alshuwaer and Gilman 2019: 392; Bonutto, Kennedy, and Quinton 2020: 238; Murphey 2017: 10).

5.4.3 Objective three: To Determine Any Association Between the Prevalence and Selected Risk Factors for Musculoskeletal Disorder Among Radiography Students

5.4.3.1 SOCIO-DEMOGRAPHY RISK FACTORS

The conceptual model of this study mentioned that there are different socio-demographic and lifestyle risk factors that contribute to MSD. This section examines whether any socio-demographic and lifestyle risk factors were discovered to be associated with MSD among KZN radiography students.

According to the findings of this study, participants aged 20 to 24 years have the highest prevalence of MSD (81.2%), followed by those aged 25 to 30 years (10.5%). Yasobant & Rajkumar (2014: 10) found that healthcare professionals of a lower age (less than 30 years) had a higher probability of developing WRMSDs. However, when looking at the association, current study found that there was no significant relationship noted between MSDs and age ($p = 1.000$). This finding is inconsistent with multiple studies that found that there was a significant relationship between age and MSDs (Bensusan's 2019:99; Moodley and Naidoo 2015: 10 and Yasobant & Rajkumar 2014: 10). According to Alaniz and Veale (2013: 10) pointed that younger muscles are stronger and can withstand injurious forces for a longer period of time than older muscles; thus, younger sonographers may develop MSD more slowly. However, there was no similar pattern noted in the current study. The reason for this, was that majority

of the participants in this current study were between the ages of 20 and 24, so it was difficult to measure any significant relationship between age group and MSDs. Bowles and Quinton (2019:1) reported what almost similar to the current study, according to Bowles and Quinton (2019:1) study there was no correlation between age and MSP among sonography students (p= 0.257)

With regard to gender, there was a higher prevalence of MSD among female participants (77.4%) found in this current study. However, this higher prevalence did not equate to a statistically significant association between MSD and the female gender (p= 0.289). The higher prevalence reported for the female gender in this current study was only because the total sample (n = 144) had more female participants (n = 110) than male respondents (n = 34). This observation adds to the lack of certainty observed in the literature surrounding the impact of gender on MSD (Hasan *et al.* 2018:131; Shamsi *et al*. (2020:72); Moodley, Ismail and Kriel (2020:1); and Bensusan (2019:25). The current study observation differs from the general trend of the studies referenced above, which reported the female gender as being at higher risk for MSD. When relating this finding to local studies, the observations of the current study differ from Bensusan's (2019:87), who reported that there was an association between gender and MSDs under the Chi-square test (p=0.001), as more female participants (79.7%) had MSDs in one or more body regions.

The majority of the participants with MSD were black participants (70.7%) and Indian participants (26.6%). However, ethnicity was not found to be significantly associated with MSD in this current study. These results are consistent with Gevers (2018:166), who finds that ethnicity is not significantly associated with neck pain among first-year health sciences students at DUT.

Body Mass Index (BMI) has been shown to be significantly associated with MSDs in similar studies (Senarath, Thalwaththe and Tennakoon 2021: 4; Tantawy, Rahman and Ameer 2017: 132), however the current study, did not identified it as a risk factor. According to Onyemaechi *et al.* (2016:10), overweight and obesity have been identified as independent risk factors for MSDs. There were few respondents (9.7%) who indicated being overweight or obese in the current study, and there was no correlation observed between participants with increased BMI and MSDs. These

results are consistent with the findings of Bensusan (2019:25) and Bowles and Quinton (2019:1) who also found no correlation between BMI and MSDs among health sciences students.

A low prevalence of eighteen (12.5%) was found in this sample with regards to smoking, and sixteen of these respondents (88.9%) of these participants were smokers and had MSDs. On the other hand, a total of 15 (6%) respondents drank alcohol. Eleven (73%) respondents from this group reported MSDs in more than one body region. Previous research has shown that smoking increases the risk of hypoxia by decreasing blood flow, which results in chemical changes that cause muscle, joint, and disc degeneration (Abete, Vanni, Pantalone, and Salini 2013: 63-69; Kumalo 2014: 19). However, the current study found no significant association between smoking and prevalence of MSDs (p = 0.629) and alcohol consumption and prevalence of MSD (p = 1.000). These results of the current study are consistent with Lorusso, Vimercati, and L'abbate's (2010:1), which found no significant relationship between participant smoking and the prevalence of MSD (p = 0.371).

McDonald and Salisbury (2019: 305) mentioned that stretching and exercise are recommended to prevent WRMSD in sonographers. However, in the current study, there was no relationship observed between exercise and MSP among radiography students. These results are found inconsistency with Lorusso, Vimercati, and L'abbate's (2010:1) study which found a significant association between poor physical activity and the presence of MSDs in Italian radiography students.

5.4.3.2 WORK-RELATED RISK FACTORS

The South African health system is made up of the public and private health sectors. In the current study, the significant majority of the participants were attending WIL at public hospitals. These findings were not surprising since the public is dominating health care sector. The majority of people in South Africa access health services through government-run public hospitals (Mahlathi and Dlamini 2015: 1), which is why the majority of the students are placed in public hospitals. Erasmus (2017: 30) found that qualified radiographers in public hospitals reported a higher prevalence of lower back pain. However, there was no similar pattern observed the current study. The chi-square test for the current study found no significant relationship between the

healthcare sector and the prevalence of MSDs (p=1.000). This means that there was no different distribution of MSDs among radiography students in the two healthcare sectors. The reason different in results obtained by Erasmus (2017: 30) might be the fact that the other study was based on qualified radiographers while the current study was targeted to student radiographers.

Moreover, in terms of physical work activities performed during WIL, the current study identified bending as a risk factor for MSDs. Participants who reported bending more often reported increased pain in the lower back. Similarly, Lunde *et al.* (2019:660) found that forward bending more than 30° at work is associated with a change in low-back pain intensity among healthcare workers. Also, similar findings were reported by Erasmus (2017: 30), who found that more than 82.0% of the qualified radiographers felt that their bending at work aggravated lower back pain. In addition, these results reciprocate with the conceptual model for this study, which mentioned that there are work factors that can contribute to MSDs.

On the other hand, lifting of patients has been shown to be significantly associated with MSDs in most of the previous studies (Moodley, Ismail, and Kriel 2020: 1; Erasmus 2017: 30). It has been reported that the lifting of patients can lead to the prevalence of lower back pain. Erasmus (2017: 30) mentioned that radiographers involved in lifting patients had an 80–100% risk of experiencing lower back pain. Moodley, Ismail, and Kriel (2020: 1) found that nursing students who indicated that they used their backs when lifting patients and heavy equipment (15.6%) has a significance prevalence of MSDs in upper back (p = 0.004) and lower back (p = 0.014). In addition, Bergeron, Wright, and Killion (2016:10) found that 36.0% of all lower back pain symptoms experienced by healthcare professionals occurred during patient handling. Surprisingly, lifting patients the current study was not identified as a risk factor for MSDs (p=0.576)

5.4.3.3 PSYCHOLOGICAL RISK FACTORS

5.4.3.3.1 Stress

A high prevalence of stress symptoms (91%) was observed among the sample, which was related to a mild severity rating when interpreted against the severity rating template provided in the questionnaire. A statistically significant association was found between MSD and stress in this sample (p = 0.009). Moreover, assessments and transportation during WIL were reported as the highest stressors that cause increases in stress for students to varying degrees.

The data collection for this study was conducted during Covid-19, where students were still learning how to adapt to new ways of coping with online assessment. Therefore, it was not surprising that assessment during WIL found as the highest stressor. Similar findings were reported by the Atta and Almilaibary (2022:35) study, where the prevalence of stress among students taught with an integrated curriculum was high, accounting for 85.5% of all students and its was slight male predominance (86.6%). Atta and Almilaibary (2022: 35) mentioned that the high prevalence of stress may be due in part to curricular changes necessitated by Covid-19.

Moreover, the current study found transportation during WIL as a second stressor among student's radiography students. These results are also not surprising since most of the students attend WIL at hospitals that are distant from their accommodation. The transportation during WIL has always been a problem for students attending WIL at DUT. Khuzwayo and Vahed (2021:91) mentioned that one of the personal challenges faced by DUT students was the distance between the workplace and their accommodation. Similarly, Sibiya and Sibiya (2014:1953) found that DUT nursing students who attend WIL were finding it difficult to reach the clinical placement facilities and the transport was unreliable. The participants in the Sibiya and Sibiya (2014:1953) study mentioned that they had to leave very early for work and arrive home late. Moreover, they sometimes leave the facility late to make up for lost time if they arrive late at the hospital. The above reviewed studies are consistent with the current study with regard to challenges of transport during WIL which in turn increase stress among students

Furthermore, it was interesting to find out that stress was significantly associated with MSDs in this study (p = 0.028). These findings are consistent with the conceptual model of these studies, which highlighted stress as a contributing factor to MSDs. Furthermore, this is also in line with Bensusan's (2019:25) study, which found a significant association between stress and MSDs among health students at the UJ (p =0.001). Also, it is consistent with Almeida and Dumith's (2018: 10) study, which reported that the main exposure variable in this study was stress, which was associated with musculoskeletal symptoms in different anatomical regions. Physiologically, there is evidence that stress releases hormones like cortisol and adrenocorticotrophic, which increase pain perception and cause muscle tension. The occurrence of this tension causes a reduction in the blood flow among the tissues, reducing the exchange of oxygen and nutrients between them. For this reason, there is an accumulation of acid residues in the tissues, resulting in fatigue and muscle pain (Morais *et al.* 2021: 30). In Saudi Arabia, Hendi *et al.* (2021:12) found no association between the onset of MSDs and the level of stress (P = 0.232) among medical students at Taif University. The reason this study differs from the current study is that more participants had normal (well-defined) stress, while the current study shows that the majority of students experience a high level of stress.

When contrasting the prevalence of stress among this sample to the prevalence observed in the previous literature, it was found to be lower in the current study than the 97.5% stress prevalence reported among radiography students at UJ in Gauteng (Bensusan's 2019:25). This discrepancy could be due to the fact that this study had a larger sample of radiography students (n = 239) compared to the current study (n = 144).

5.4.3.3.2 Depression

This study questionnaire indicated that there was a high prevalence of depression in this sample, with over half of the MSD participants (50.1%) indicating that they experienced depression. However, although this prevalence was high among the participants, the average severity of the group was moderate when interpreted against the severity rating template provided on the questionnaire. It was interesting to find a statistically significant association between depression and MSDs in the current study (*p* = 0.032). These findings are consistent with previous research that found a link

between depression and MSDs (Ng, Voo, and Maakip, 2019:1; Fauzi *et al*. 2021: 3269; Gkatzia *et al.* 2021: 1).

Moreover, when contrasting the prevalence rates of depression among this sample to those observed in the literature, it was found to be higher than the 27,7% depression prevalence found in the radiography students at the University of West Attica in Greece (Gkatzia *et al.* 2021:1). In addition, the current study depression prevalence is almost similar to the 51.4% prevalence found in the Malaysian students (Fauzi *et al.* 2021: 3269). The Fauzi *et al.* (2021: 3269) study aimed to address the gap in the literature on stress, anxiety, and depression among Malaysian university health students, including radiography students, and this study reported that 51.4% of the participants were experiencing depression.

5.5 SUMMARY

To summarise the important points of this discussion, it can be said that there is a high prevalence of musculoskeletal disorders among undergraduate radiography students during WIL in the eThekwini Municipality of KwaZulu-Natal. The most affected parts of the body in this study were the lower back and neck. On the other hand, the elbows and thighs were the least affected body regions.

In keeping with the literature and conceptual model of this study, a number of selected factors have been found to be causative of MSDs in this study. it was found that bending can cause lower back pain among students. Also, stress is an independent risk factor for MSD with participants with symptoms of stress being 4.613 times more likely to have MSD than participants with no symptoms of stress. Depression was also found as an independent risk factor of MSD; musculoskeletal pain was 4.852 times higher in students with depression than in participants with no symptoms of depression.

CHAPTER SIX: CONCLUSION, LIMITATIONS, AND RECOMMENDATIONS OF THE STUDY

6.1 INTRODUCTION

This is the final chapter of the study; it will summarise the significant findings in each objective. Moreover, the limitations of the study as well as recommendations will be highlighted in this chapter.

6.2 EVALUATION OF AIMS AND OBJECTIVES OF THE STUDY

Here, an evaluation of the current study is provided by assessing whether the objectives have been met in light of the aims defined for the study.

6.2.1 Aims

The current study aimed to determine the prevalence and risk factors associated with MSDs among undergraduate radiography students at the University of Technology in KwaZulu-Natal. The prevalence of MSDs among the participants in this study was 92.4%, and this prevalence is considered comparatively high. The work-related risk factor associated with MSDs identified in this study was bending, which was significantly associated with the prevalence of lower back pain. On the other hand, stress and depression were observed as psychological risk factors that are significantly associated with the prevalence of MSDs. The associations found between risk factors and MSDs are in line with the conceptual model that was adopted for this study. The conceptual model recognises that there can be a range of risk factors that may affect the physiological tissue response to the load.

6.2.2 Objectives

Objective one was to determine the prevalence of MSDs among undergraduate radiography students at the University of Technology in KwaZulu-Natal. Through the analysis of the study questionnaire that was provided to radiography students, the prevalence of MSDs in this sample was high compared to previous literature. In addition, after analysis of the SNQ, it was observed that the majority of the participants indicated a higher 12-month prevalence compared to a 7-day prevalence.

Objective two was to identify which parts of the body are most affected by MSDs. Analysis of SNQ revealed that MSD was most prevalent in the lower back (79.7%) and neck (72.2%) regions. These results are consistent with the majority of previous literature that studies the prevalence of MSDs in the radiography profession (Bensusan's (2019:25); Thalwaththe, Tennakoon (2021:1); Bowles and Quinton (2019:1).

Objective three was to determine whether there was any association between the prevalence and selected risk factors for musculoskeletal disorder among radiography students. There were different selected risk factors, including sociodemographic factors, work-related factors, and psychological factors. By analysing the study questionnaire and applying certain statistical tests (namely the Chi square test and multiple logistic regression), it was determined that bending was the only work-related factor associated with MSD in the lower back (p = 0.038). On the other hand, stress (p = 0.028) and depression (p = 0.032) were the only socio-demographic risk factors associated with MSD. It was unexpected to observe that socio-demographic characteristics such as age, gender, ethnicity, BMI, smoking, alcohol consumption, and exercise in this study had no relationship with MSD. Multiple Logistic Regression Analysis was used in order to determine if any of the variables were independent risk factors for neck pain. Stress and depression were the only independent risk factors for MSD. This analysis shows that those with depression are 4.852 times more likely than those without depression to suffer from MSD. And those with stress are 4.613 times more likely to have MSD than those without the stress of suffering from MSD.

6.3 LIMITATIONS OF RESEARCH

6.3.1 Limitations

The nature of using a quantitative, descriptive, cross-sectional approach is that the statistical models utilised in the study were only able to determine a correlation of selected risk factors with MSDs. Therefore, risk factors identified in the study are considered to be associated with MSDs but cannot be interpreted as having caused musculoskeletal pain.

The second limitation was the period during the data collection process of this study. The data collection process for this study occurred during the Covid-19 pandemic. During this period, students were not attending campus-based lectures, which poses significant challenges for this study. The initial recruitment plan for the study was altered to fit the Covid-19 rules. Furthermore, it was difficult to locate some of the radiography students during this time period, which influenced the response rate. Additionally, the hours spent by students in WIL were changed during Covid-19, which influenced the frequency of MSDs among students. However, due to time constraints, the researcher needed to complete the study, so it was carried out even during the unfavourable Covid-19 period.

Another limitation of this study is that the questionnaire structure was closed-ended. This method restricts the participants' answers. Some of the responses gathered required some context and justification for the claims being made. However, this information was unavailable due to the design of the study questionnaire.

In addition, since the data collection was performed by means of participants' self-reporting due to resource constraints, the accuracy of the collected data may be compromised. Furthermore, human error should be considered in this study: a participant may have made an error on the questionnaire, failed to interpret a question correctly, or forgotten a significant incident that should have been included in the study results.

6.4 RECOMMENDATIONS

When reaching the end of the research process, several ideas come to mind about how the study could have been done differently, how the study's findings could be used to improve support structures for students, and the direction future research could take based on the study findings. In light of this, a few recommendations for further research, the radiography department, and radiography students are provided below.

6.4.1 Recommendations for Further Research

This study was limited to the point prevalence of MSD among radiography students; the periodic and lifetime prevalence were not included in the study questionnaire.

Therefore, future researchers can alter the questionnaire to get a good picture of the periodic and lifetime prevalence of MSD among radiography students.

The impact of MSDs among radiography students is not extensively investigated in this study, so further research on this topic is recommended. The musculoskeletal disorder has a variety of impacts on healthcare students, including absenteeism and changing employment, being admitted to hospital, developing disabilities, etc. The current study, however, did not go into extensive details about the impact of MSDs among radiography students.

Furthermore, some of the responses obtained needed some background and reasons for the statements, but such information was lacking due to the nature of the study. A study including a qualitative component would therefore be recommended for the future to afford radiographers a platform to express themselves more freely.

Furthermore, this study can be repeated when COVID-19 is less prevalent, and students resume regular WIL, and they attend full-time campus-based classes. The COVID-19 pandemic posed significant challenges to this current study, and the researchers believe that these challenges influenced the study's outcome.

Future studies should be conducted to investigate the underlying stressors during WIL. According to the current study, the majority of participants experience significant high stress during WIL. Regardless of the fact that examinations and transportation were identified as the two biggest stressors, this study did not go into detail on how these aspects contribute to increased stress among students.

6.4.2 Recommendations for the Radiography Department

It has become apparent in this study that the radiography students during WIL experience high MSDs, especially in the lower back and neck. Therefore, it is recommended that the radiography department establish and implement relevant interventions, such as an education program or training on ergonomics practice, in order to minimise the occurrence of MSDs among students. Furthermore, it is recommended that the radiography department employ a full-time chiropractor who will help to prevent musculoskeletal health problems and educate radiography

students on work and lifestyle adjustments in order to reduce the incidence and prevalence of MSDs among radiography students.

In addition, this study found that stress during WIL is common among radiography students. It is recommended that the department encourage students to use the counselling and support services provided by the university in order to receive aid in dealing with stress. Furthermore, the department can make arrangements with one of the counselling and support services departments to visit students while they are on WIL to provide emotional support and techniques to alleviate the stress they are experiencing. The current study found that assessment and transportation during WIL were the two most stressful factors. It is suggested that the department limit the number of assessments given to students while they are attending WIL. It is also advised that the department provide transportation for students during the WIL period. This can greatly help to reduce stress among students.

6.4.3 Recommendations to Research Participants: Radiography Students

From the results of this study, it can be seen that the majority of the individuals did not visit a medical professional for MSDs. Therefore, it is recommended that they pay attention to the MSD symptoms that they experience and, if necessary, attend the institution's chiropractic clinics to be trained on how to prevent MSDs. Furthermore, students must employ preventative measures to alleviate the stress they face throughout WIL. It is recommended that they use the institution's counselling and student support services.

6.5 CONCLUSION

This study concludes that there is a high prevalence of musculoskeletal disorders (92.4%) among undergraduate radiography students at KwaZulu-Natal during work-integrated learning. The most common anatomical locations of injury among students in this study were neck pain and the lower back. Radiology students were more susceptible to MSDs than other students due to bending, stress, and depression during WIL. Multiple Logistic Regression analysis in this study found that stress and depression are independent risk factors for MSD. Surprisingly, most of the demographic and sociodemographic factors, such as age, gender, BMI, ethnicity, level

of study, smoking, alcohol consumption, and physical exercise, had no effect on the prevalence of MSD among students in this study.

There are numerous interventions that can help radiography students reduce the higher prevalence of MSDs they experience during WIL. The radiography department should develop and provide appropriate interventions such as education program/ training on ergonomics practice to reduce the incidence of MSDs among students. In addition, it is recommended that the radiography department employ a Chiropractor that will assist in order to prevent musculoskeletal health problems and educate radiography students on work and lifestyle changes so as to decrease the MSDs incidence and prevalence among radiography students.

7. REFERENCES

Abdulmonem, A., Hanan, A., Elaf, A., Haneen, T. and Jenan, A. 2014. The prevalence of musculoskeletal pain and its associated factors among female Saudi school teachers. *Pakistan Journal of Medical Sciences,* 30(6): 1191-1196. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4320698/ (Accessed 12 April 2021).

Abete, M., Vanni, D., Pantalone, A., and Salini, V. 2013. Cigarette smoking and musculoskeletal diseases*. Muscle, Ligaments and Tendons Journal (online),* 3(2): 63-69. Available: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3711704/ (Accessed 17 November 2020)

Abledu, J.K. and Offei, E.B. 2015. Musculoskeletal disorders among first-year Ghanaian students in a nursing college. *African health sciences*, *15*(2): 444-449. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4480470/ (Accessed 12 April 2021).

Adesi, K.K., Kwadwo, A.W. and Kab, P.R. 2015. A Need Assessment for Prevention of Work-Related Stress Experienced by Radiographers in Ghana. *Adv Tech Biol Med*, 3(124): 1764.Available:https://www.researchgate.net/profile/Kofi_Kyei/publication/279166928_A_Need_Assessment_for_Prevention_of_WorkRelated_Stress_Experienced_by_Radiographers_in_Ghana/links/5654a8e908aeafc2aabbf0e1.pdf (Accessed 17 November 2020).

Adetiba, J.N. 2017. The prevalence and risk of musculoskeletal disorders among dental technicians in South Africa (Doctoral dissertation). Available: https://pdfs.semanticscholar.org/7a0e/1fde2552d22731a4e568e5c5a9ee1b1164fc.pdf (Accessed 10 July 2020).

Aggarwal, N., Anand, T., Kishore, J. and Ingle, G.K. 2013. Low back pain and associated risk factors among undergraduate students of a medical college in Delhi. *Education for Health*, *26*(2):103.Available:https://www.educationforhealth.net/article.asp?issn=13576283;year=2013;volume=26;issue=2;spage=103;epage=108;aulast=Aggarwal (Accessed 28 July 2021).

Akodu, A.K. and Ashalejo, Z.O. 2019. Work-related musculoskeletal disorders and work ability among hospital nurses. *Journal of Taibah University Medical Sciences*, *14*(3): 252-261. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6694919/ (Accessed 10 July 2020).

Akweetelela, A. 2019. *Investigation of the prevalence, risk factors and impact of musculoskeletal disorders among nurses at Katutura Intermediate Hospital, Khomas region, Namibia* (Doctoral dissertation, University of Namibia). Available: https://repository.unam.edu.na/bitstream/handle/11070/2520/akweetelela2019.pdf?sequence=1&isAllowed=y (Accessed 10 July 2020).

Alaniz, J. and Veale, B.L. 2013. Stretching for sonographers: a literature review of sonographer-reported musculoskeletal injuries. *Journal of Diagnostic Medical Sonography*, *29*(4): 188-190. Available: https://doi.org/10.1177/8756479313485286 (Accessed 10 July 2021).

Alhasan, M., Abdelrahman, M., Alewaidat, H., Almhdawi, K. and Nazzal, M. 2014. Work-related stress, musculoskeletal disorder complaints, and stress symptoms among radiographers in the Northern Part of Jordan. *Journal of medical imaging and radiation sciences*, *45*(3): 291-298. Available: https://pubmed.ncbi.nlm.nih.gov/31051981/ (Accessed 15 May 2021).

Alkhateeb, S.A., Alkhameesi, N.F., Lamfon, G.N., Khawandanh, S.Z., Kurdi, L.K., Faran, M.Y., Khoja, A.A., Bukhari, L.M., Aljahdali, H.R., Ashour, N.A. and Bagasi, H.T.2019. Pattern of physical exercise practice among university students in the Kingdom of Saudi Arabia (before beginning and during college): a cross-sectional study. *BMC Public Health*, *19*(1):1-7. Available:https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-019-8093-2 (Accessed 15 May 2021).

Almeida, L.M.D.S. and Dumith, S.D.C. 2018. Association between musculoskeletal symptoms and perceived stress in public servants of a Federal University in the South of Brazil. *Brazilian Journal of Pain*, *1*: 9-14. Available:https://www.scielo.br/j/brjp/a/sL33JMjkPYSdXWFHbJ4TLYg/?lang=en&format=html (Accessed 15 May 2021).

Almhdawi, K.A., Mathiowetz, V., Al-Hourani, Z., Khader, Y., Kanaan, S.F. and Alhasan, M. 2017. Musculoskeletal pain symptoms among allied health professions' students: Prevalence rates and associated factors. *Journal of back and musculoskeletal rehabilitation*, *30*(6): 1291-1301. Available: https://pubmed.ncbi.nlm.nih.gov/28946521/ (Accessed 10 July 2021).

Alshagga, M.A., Nimer, A.R., Yan, L.P., Ibrahim, I.A.A., Al-Ghamdi, S.S. and Al-Dubai, S.A.R. 2013. Prevalence and factors associated with neck, shoulder and low back pains among medical students in a Malaysian Medical College. *BMC research notes*, *6*(1): 1-7. Available: https://bmcresnotes.biomedcentral.com/articles/10.1186/1756-0500-6-244 (Accessed 20 July 2021).

AlShayhan, F.A. and Saadeddin, M. 2018. Prevalence of low back pain among health sciences students. *European Journal of Orthopaedic Surgery & Traumatology*, *28*(2): 165-170. Available: https://europepmc.org/article/med/28856452 (Accessed 20 July 2021).

Alshuwaer, T.A. and Gilman, F. 2019. Prevention of Shoulder Injuries in Sonographers: A Systematic Review. *Journal of Diagnostic Medical Sonography*, *35*(5):392-399. Available: https://journals.sagepub.com/doi/full/10.1177/8756479319850140 (Accessed 20 July 2021).

Anim-Sampong, S., Arthur, L., Nkansah, J.A. and Botwe, B.O., 2018. Women in radiography practice in Ghana: Motivating and demotivating factors. *Radiologic Technology*, *89*(4), pp.337-343.

Antochevis-de-Oliveira, M., Toscani-Greco, P.B., Cassol-Prestes, F., Martins-Machado, L., Bosi-de-Souza-Magnago, T.S. and Rosa-dos-Santos, R. 2017. Musculoskeletal disorders/pain in undergraduate nursing students in a community university in southern Brazil. *Enfermería Global*, *16*(3): 160-174. Available: https://scielo.isciii.es/pdf/eg/v16n47/en_1695-6141-eg-16-47-00128.pdf (Accessed 28 July 2021).

Atta, I.S. and Almilaibary, A. 2022. The Prevalence of Stress Among Medical Students Studying an Integrative Curriculum During the COVID-19 Pandemic. *Advances in Medical Education and Practice*, *13*:35. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8761073/ (Accessed 28 July 2021).

Backåberg, S., Rask, M., Brunt, D. and Gummesson, C. 2014. Impact of musculoskeletal symptoms on general physical activity during nursing education. *Nurse Education in Practice*, *14*(4): 385-390. Available: https://pubmed.ncbi.nlm.nih.gov/24594281/ (Accessed 10 May 2021).

Baek, K., Yang, S., Lee, M. and Chung, I. 2018. The association of workplace psychosocial factors and musculoskeletal pain among Korean emotional laborers. *Safety and health*

at work, *9*(2):216-223.Available: https://www.sciencedirect.com/science/article/pii/S2093791117301531 (Accessed 10 May 2021).

Baker, J. 2011. The “Price” we all pay for ignoring ergonomics in sonography. *SRU Newsl*, *21*: 3-4.

Barros-Gomes, S., Orme, N., Nhola, L.F., Scott, C., Helfinstine, K., Pislaru, S.V., Kane, G.C., Singh, M. and Pellikka, P.A. 2019. Characteristics and consequences of work-related musculoskeletal pain among cardiac sonographers compared with peer employees: a multisite cross-sectional study. *Journal of the American Society of Echocardiography*, *32*(9): 1138-1146. Available: https://pubmed.ncbi.nlm.nih.gov/31227328/ (Accessed 10 May 2021).

Bensusan, H.W. 2019. Prevalence of Musculoskeletal Disorders Among Undergraduate Health Scinces Students at the University of Johannesburg: Biomedical Technology, Environmetal Health, Medical Imaging and Radiation Sciences (Doctoral dissertation, University of Johannesburg (South Africa)).

Bertani, A., Di Paola, G., Russo, E. and Tuzzolino, F. 2018. How to describe bivariate data. *Journal of thoracic disease*, *10*(2): 1133. Available: https://jtd.amegroups.com/article/view/18842/html (Accessed 28 August 2021).

Bezuidenhout, J. 2015. *A work-integrated learning education and training programme for radiography in South Africa* (Doctoral dissertation, University of the Free State).

Bharadva, N.A., Verma, M.R. and Kantharia, S.L. 2014. Are physiotherapy students at risk of Musculoskeletal Pain? A Study on Physiotherapy students of Government Physiotherapy College, New Civil Hospital, Surat. Available: https://pesquisa.bvsalud.org/portal/resource/pt/sea-176168 (Accessed 10 May 2021).

Bhattacherjee, A. 2019. *Quantitative analysis: Inferential statistics*. Available: https://usq.pressbooks.pub/socialscienceresearch/chapter/chapter-15-quantitative-analysis-inferential-statistics/ (Accessed 10 May 2021).

Bolton, G.C. and Cox, D.L., 2015. Survey of UK sonographers on the prevention of work related muscular-skeletal disorder (WRMSD). *Journal of Clinical Ultrasound*, *43*(3):145-152. Available: https://pubmed.ncbi.nlm.nih.gov/25042992/ (Accessed 23 May 2021).

Bonutto, N., Kennedy, N. and Quinton, A. 2020. Musculoskeletal pain amongst Australian

sonography students and recent graduates and an evaluation of the use of ergonomic education for prevention. *Australasian Journal of Ultrasound in Medicine*, *23*(4):238-247. Available https://onlinelibrary.wiley.com/doi/full/10.1002/ajum.12227(Accessed 23 May 2021).

Bowles, D. and Quinton, A. 2019. The incidence and distribution of musculoskeletal disorders in final-year Australian sonography students on clinical placement. *Sonography*, *6*(4): 157-163. Available: https://onlinelibrary.wiley.com/doi/abs/10.1002/sono.12203 (Accessed 23 May 2021).

Brick, J. M., & Williams, D. 2013. Explaining rising nonresponse rates in cross-sectional surveys. *The ANNALS of the American academy of political and social science*, 645(1), 36-59. Available https://psycnet.apa.org/record/2012-31991-003 (Accessed 23 May 2021).

Canova, S., Cortinovis, D.L. and Ambrogi, F. 2017. How to describe univariate data. *Journal of thoracic disease*, *9*(6): 1741. Available: https://jtd.amegroups.com/article/view/13957/html (Accessed 23 May 2021).

Cartwright, G. 2020. *Prevalence of Musculoskeletal Disorders Amongst Undergraduate Health Sciences Students at the University of Johannesburg: Chiropractic, Homeopathy, Emergency Medical Care and Podiatry* (Doctoral dissertation, University of Johannesburg).

Casser H. R., Seddigh. S. and Rauschmann M. 2016. Acute Lumbar Back Pain: Investigation, Differential Diagnosis, and Treatment. *Deutsches Ärzteblatt International,* 113(13): 223-234. Available:https://www-ncbi-nlm-nih-gov.dutlib.dut.ac.za/pmc/articles/PMC4857557/ (Accessed 14 May 2021).

Chou, R. 2011. Low Back Pain (Chronic). *American Family Physician*. 84(4): 437-438. Available: http://www.aafp.org/afp/2011/0815/p437.pdf (Accessed 14 May 2017).

Coetzee, R.J., 2018. *Work-related upper extremity musculoskeletal disorders among computer programmers in a selected software company in the eThekweni Municipality* (Doctoral dissertation, Durban University of Technology).

Collins, R.M., Janse Van Rensburg, D.C. and Patricios, J.S. 2011. Common work-related musculoskeletal strains and injuries: CPD article. *South African Family Practice*, *53*(3): 240-246. Available:

https://www.tandfonline.com/doi/abs/10.1080/20786204.2011.10874091 (Accessed 14 May 2017).

Creswell, J.W. and Creswell, J.D. 2017. *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Cunningham, C. J., Weathington, B. L. and Pittenger, D. J. 2013. *Understanding and conducting research in the health sciences*. Hoboken, NJ: John Wiley & Sons.

Dachs, R., Roche, S., Vrettos, B., MacIntyre, K., Currin, B., Kruger, N., Walters, J. and Dunn, R. 2014. Assessing musculoskeletal training in South Africa. *SA Orthopaedic Journal*, *13*(3): 57-63. Available: http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S1681-150X2014000300009 (Accessed 14 May 2017).

Daniel, S.V., Umar, M.S., Ahmad, N.M. and Joseph, Z.D. 2018. Work-Related Musculoskeletal Disorders: Prevalence Among Clinical Radiographers in Teaching Hospitals in North-Western Nigeria. *Journal of Radiography & Radiation Sciences*, *32*(1):57-63. Available:https://www.researchgate.net/publication/325345157_Work-Related_Musculoskeletal_Disorders_Prevalence_Among_Clinical_Radiographers_in_Teaching_Hospitals_in_North-Western_Nigeria (Accessed 14 May 2017).

Darvishi, E., Karimi, S., Ebrahimi, H., Charkhandaz Yeganeh, R. and Salimi, S. 2017. Risk factors of musculoskeletal disorders in bus and truck drivers. *Archives of Occupational Health*, *1*(1): 23-28. Available: http://aoh.ssu.ac.ir/article-1-28-en.html (Accessed 28 July 2021).

Darwish, M.A. and Al-Zuhair, S.Z. 2013. Musculoskeletal pain disorders among secondary school Saudi female teachers. *Pain research and treatment*, *2013*. Available: https://www.hindawi.com/journals/prt/2013/878570/ (Accessed 28 July 2021).

Davy, J. 2019. Journal of the Ergonomics Society of South Africa. *Ergonomics SA,* 31 (1):1-52.Available:https://cdn.ymaws.com/www.saioh.co.za/resource/resmgr/docs/2020_docs/ergonomicssa_31_1_2019.pdf (Accessed 28 July 2021).

Department of Higher Education and Training. 2021. Statistics on Post-School Education and Training in South Africa. Available http://www.dhet.gov.za/ (Accessed 10 March 2022).

Desai, M. and Jain, S. 2020. Prevalence of Musculoskeletal Problems in Physiotherapy Students. *Age*, *20*: 2. Available: https://www.semanticscholar.org/paper/Prevalence-of-Musculoskeletal-Problems-in-Students-Desai-Jain/2c5e74ea4377bb31b90acdcaadb9c6957d8ac41e (Accessed 28 July 2021).

Dlamini, P.C., 2017. *The factors associated with student recruitment and student profiles in Dental Technology at a University of Technology* (Doctoral dissertation).

Egger, A.E. and Carpi, A. 2008. Data: analysis and interpretation. *Visionlearning*, (1). Available:http://nnhsbiology.pbworks.com/w/file/fetch/109106275/Data%20Analysis%20and%20Interpretation.pdf (Accessed 28 August 2021).

Eggers, L. 2016. *Prevalence and selected risk factors for neck, shoulder and low back pain among primary school teachers in the Central Durban area: A cross-sectional study* (Doctoral dissertation).

Ekechukwu, E.N.D., Aguwa, E.N., Okeke, T.A., Iroezindu, I.C., Onyia, S.U., Abaraogu, D.O., Ekwo, A.C., Ohiagu, C., Ekechukwu, N., Mgbeojedo, U.G. and Ekediegwu, E.C. 2020. Prevalence, correlates and risk factors of musculoskeletal disorders among Nigerian physiotherapy and architecture undergraduates. *Journal of the Nigeria Society of Physiotherapy*, *19*(1): 8-18. Available: https://academicjournals.org/journal/JNSP/article-full-text-pdf/1C2524165496 (Accessed 28 July 2021).

El Gilany, A.H., Badawi, K., El Khawaga, G. and Awadalla, N. 2011. Physical activity profile of students in Mansoura University, Egypt. *EMHJ-Eastern Mediterranean Health Journal, 17 (8), 694-702.*

Ellapen, T.J. and Narsigan, S. 2014. Work related musculoskeletal disorders among nurses: systematic review. *Journal of Ergonomics*, *4*: 1-6. Available: https://www.longdom.org/open-access/work-related-musculoskeletal-disorders-among-nurses-systematic-review-2165-7556.S4-003.pdf (Accessed 28 July 2021).

Elsayed, A.A. 2019. Work-related musculoskeletal disorders among nursing students during clinical training. *American Journal of Nursing*, *7*(6): 952-957. Available: https://www.researchgate.net/publication/336927786_WorkRelated_Musculoskeletal_Disorders_among_Nursing_Students_during_Clinical_Training (Accessed 18 May 2021).

Elshami, W., Abuzaid, M., Ateeq, E., Al Fozan, S., Bensahraoui, N. and Zira, D. 2018. Prevalence of repetitive stress injuries among radiological technologists in United Arab Emirates. *American Journal of Diagnostic Imaging*, *3*(1): 12-17. Available: https://www.researchgate.net/publication/323860931_Prevalence_of_repetitive_stress_injuries_among_radiological_technologists_in_United_Arab_Emirates (Accessed 18 May 2021).

European Agency for Safety and Health at Work. 2022. *E-fact 17 - The prevention of work-related neck and upper limb disorders (WRULDs) in construction | Safety and health at work EU-OSHA*. Available: http://www.osha.mddsz.gov.si/resources/files/pdf/E-fact_17_-_The_prevention_of_work-related_neck_and_upper_limb_disorders_-WRULDs-_in_construction.pdf (Accessed 18 May 2021).

Fauzi, M.F., Anuar, T.S., Teh, L.K., Lim, W.F., James, R.J., Ahmad, R., Mohamed, M., Abu Bakar, S.H., Mohd Yusof, F.Z. and Salleh, M.Z. 2021. Stress, anxiety and depression among a cohort of health sciences undergraduate students: The prevalence and risk factors. *International journal of environmental research and public health*, *18*(6):3269.

Felemban, R.A., Sofi, R.A., Alhebshi, S.A., Alharbi, S.G., Farsi, N.J., Abduljabbar, F.H. and Farsi, J.M. 2021. Prevalence and Predictors of Musculoskeletal Pain Among Undergraduate Students at a Dental School in Saudi Arabia. *Clinical, Cosmetic and Investigational Dentistry*, *13*: 39. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7900777/ (Accessed 18 May 2021).

Feng, Q., Liu, S., Yang, L., Xie, M. and Zhang, Q. 2016. The prevalence of and risk factors associated with musculoskeletal disorders among sonographers in central China: a cross-sectional study. *Public Library of Science One*, *11*(10): e0163903. Available: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0163903 (Accessed 18 May 2021).

Fincham, J.E. 2008. Response rates and responsiveness for surveys, standards, and the Journal. *American journal of pharmaceutical education*, 72(2): 1-3. Available: https://www.ajpe.org/content/72/2/43.short (Accessed 17 May 2021).

Fisher, T.F. and Wintermeyer, S.F. 2012. Musculoskeletal disorders in EMS: Creating employee awareness. *Professional Safety*, *57*(07): 30-34 Available: https://onepetro.org/PS/article-abstract/57/07/30/33210/Musculoskeletal-Disorders-in-EMS-Creating-Employee (Accessed 18 May 2021).

Friedrich-Nel, H. 2015. Radiographers' opinion on patients' rights to informed consent: results of an online survey: peer reviewed original article. *South African Radiographer*, *53*(1):27-32. Available: https://journals.co.za/doi/abs/10.10520/EJC170977 (Accessed 18 May 2021).

Gam, N.P. 2015. *Occupational stressors in diagnostic radiographers working in public health facilities in the eThekwini district of KwaZulu-Natal* (Doctoral dissertation).

Gevers, G.L. 2018. *The prevalence of and risk factors for neck pain in first year Faculty of Health Science students at the Durban University of Technology* (Doctoral dissertation).

Gheysvandi, E., Dianat, I., Heidarimoghadam, R., Tapak, L., Karimi-Shahanjarini, A. and Rezapur-Shahkolai, F. 2019. Neck and shoulder pain among elementary school students: prevalence and its risk factors. *BMC public health*, *19*(1): 1-11. Available:https://link.springer.com/article/10.1186/s12889-019-7706-0?fbclid=IwAR03DqEPozL3WlkX_6PBcIK6BDp3NTn43dAdocigujZoYmT986OLCq2-Mjk (Accessed 18 May 2021).

Gkatzia, N., Dousi, M., Syrgiamiotis, V., Kechagias, D. and Gogou, L. 2021. Stress, Anxiety And Depression Among Radiography Students During The Covid-19 Pandemic. *International Journal Of Scientific Research*, 74–76.

Golafshani, N. 2015. Understanding Reliability and Validity in Qualitative Research. *The Qualitative Report*, 8(4):597-606. Available: https://mospace.umsystem.edu/xmlui/handle/10355/16034 (Accessed 9 June 2021).

Grove, S. K., Gray, J. R., & Burns, N. 2014. *Understanding Nursing Research: Building an Evidence-Based Practice.* 6th ed. London: Elsevier.

Gyer, G., Michael, J. and Inklebarger, J. 2018. Occupational hand injuries: a current review of the prevalence and proposed prevention strategies for physical therapists and similar healthcare professionals. *Journal of integrative medicine*, *16*(2):84-89. Available: https://pubmed.ncbi.nlm.nih.gov/29526241/ (Accessed 18 May 2021).

Hafeez, M., Saeed, A. and Ghauris, M.W. 2022. Prevalence of Musculoskeletal Disorders and Distribution of Pain Among Female Students of The Islamia University of Bahawalpur. *Age*, *21*: 1-4. Available: https://sjptr.pk/index.php/SJPTR/article/view/10 (Accessed 18 April 2022).

Hafner, N.D., Milek, D.M. and Fikfak, M.D. 2018. Hospital staff's risk of developing musculoskeletal disorders, especially low back pain. *Slovenian Journal of Public Health*, *57*(3):133. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6032181/ (Accessed 27 October 2021).

Haissam, A.M. 2021. What Is Data Capture and Why It Is Important?. Available: https://theecmconsultant.com/what-is-data-capture/ (Accessed 27 October 2021).

Harrison, G. and Harris, A. 2015. Work-related musculoskeletal disorders in ultrasound: Can you reduce risk?. *Ultrasound*, *23*(4): 224-230. Available: https://journals.sagepub.com/doi/abs/10.1177/1742271X15593575 (Accessed 18 May 2021).

Hasan, M.M., Yaqoob, U., Ali, S.S. and Siddiqui, A.A. 2018. Frequency of musculoskeletal pain and associated factors among undergraduate students. *Case Reports in Clinical Medicine*, *7*(2): 131-145. Available: https://www.scirp.org/journal/paperinformation.aspx?paperid=82472(Accessed 18 May 2021).

Hendi, O.M., Abdulaziz, A.A., Althaqafi, A.M., Hindi, A.M., Khan, S.A. and Atalla, A.A. 2019. Prevalence of musculoskeletal disorders and its correlation to physical activity among health specialty students. *International journal of preventive medicine*, *10*. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6528423/ (Accessed 9 June 2021).

Hendi, O.M., Alturkistani, L.H., Bajaber, A.S., Alhamoud, M.A. and Mahfouz, M.E.M. 2021. Prevalence of musculoskeletal disorder and its relation to stress among medical student at taif university, Saudi Arabia. *International Journal of Preventive Medicine*, *12: 1-6*. Available: https://pubmed.ncbi.nlm.nih.gov/34584663/ (Accessed 9 June 2021).

Howarth, S.J., Abbas, A., Hogg-Johnson, S. and Mior, S. 2020. Reported 1-year prevalence of occupational musculoskeletal disorders in Ontario chiropractors. *Chiropractic & manual therapies*, *28*(1): 1-13. Available: https://link.springer.com/article/10.1186/s12998-020-00345-2 (Accessed 9 June 2021).

Hulls, P.M., Money, A., Agius, R.M. and De Vocht, F. 2018. Work-related ill-health in radiographers. *Occupational Medicine*, *68*(6): 354-359. Available: https://academic.oup.com/occmed/article/68/6/354/4998908?login=true (Accessed 9 June 2021).

Ibrahim, N.I. and Mohanadas, D. 2012. Prevalence of musculoskeletal disorders among staffs in specialized healthcare centre. *Work*, *41*(1):2452-2460. Available: https://pubmed.ncbi.nlm.nih.gov/22317086/ (Accessed 9 June 2021).

Imdad, F., Ishaque, F., Yasmeen, S., Lal, W., Sheikh, S.A., Nawaz, U., Fazleazim and Khanzada, S. 2016. Prevalence of low back pain among the undergraduate students of Isra University Karachi campus. *International Journal of Physiotherapy*, *3*(1): 119-123. Available: https://www.ijphy.org/index.php/journal/article/view/169 (Accessed 9 June 2021).

Johnson, S. 2012. Using ultrasound to assess first year sonography students for wrist injury. Available: https://mospace.umsystem.edu/xmlui/handle/10355/16034 (Accessed 9 June 2021).

Kanchanomai, S., Janwantanakul, P., Pensri, P. and Jiamjarasrangsi, W. 2011. Risk factors for the onset and persistence of neck pain in undergraduate students: 1-year prospective cohort study. *BMC public health*, *11*(1): 1-8. Available: https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-11-566 (Accessed 9 June 2021).

Kennedy, C.A., Amick III, B.C., Dennerlein, J.T., Brewer, S., Catli, S., Williams, R., Serra, C., Gerr, F., Irvin, E., Mahood, Q. and Franzblau, A. 2010. Systematic review of the role of occupational health and safety interventions in the prevention of upper extremity musculoskeletal symptoms, signs, disorders, injuries, claims and lost time. *Journal of occupational rehabilitation*, *20*(2): 127-162. Available: https://link.springer.com/article/10.1007/s10926-009-9211-2 (Accessed 23 July 2021).

Khan, R., Ahmad, F. and Merchant, M.S. 2017. Prevalence of work-related musculoskeletal disorders (MSD) among dentists. *International Journal of Contemporary Medical Research*, *483*:.77-2393. Available: https://www.researchgate.net/profile/Rabia-Khan4/publication/317826921_Prevalence_of_Work_Related_Musculoskeletal_Disorders_MSD_among_Dentists/links/594d108445851543382a6abb/Prevalence-of-Work-

Related-Musculoskeletal-Disorders-MSD-among-Dentists.pdf (Accessed 28 July 2021).

Khuzwayo, B.P. and Vahed, S. 2021. An evaluation of wil training for durban University of Technology Civil Engineering-employer and student experience: lessons for the new programme. *South African Journal of Higher Education*, *35*(5): 78-102.

Kim, T. and Roh, H. 2014. Analysis of risk factors for work-related musculoskeletal disorders in radiological technologists. *Journal of physical therapy science*, *26*(9):1423-1428. Available: https://www.jstage.jst.go.jp/article/jpts/26/9/26_jpts-2014-048/_article/-char/ja/ (Accessed 28 July 2021).

Kivunja, C. and Kuyini, A. B. 2017. Understanding and Applying Research Paradigms in Educational Context*. International Journal of Higher Education, 6(5): 34 -45.*

Korhan, O. and Memon, A.A. 2019. Introductory chapter: work-related musculoskeletal disorders. *In Work-related musculoskeletal disorders.* IntechOpen. Available: https://www.researchgate.net/publication/332188362_WorkRelated_Musculoskeletal_Disorders (Accessed 28 July 2021).

Kriel, A. 2019. *Prevalence of Musculoskeletal Disorders among Undergraduate Health Sciences Students at the University of Johannesburg* (Doctoral dissertation, University of Johannesburg (South Africa)).

Kumalo, B.T.E. 2015. *The relationship between work-related musculoskeletal disorders, absenteeism and visits to the staff clinic by nurses in an eThekwini District hospital* (Doctoral dissertation).

Kumar, R. and Kumar, S., 2008. Musculoskeletal risk factors in cleaning occupation—A literature review. *International journal of industrial ergonomics*, *38*(2): 158-170. Available: https://www.sciencedirect.com/science/article/abs/pii/S0169814106000801(Accessed 28 July 2021).

Kumar, R., Anuroopa, P., Nalini, M. and Savita, S. 2014. Prevalence of Musculoskeletal Pain and Assessment of Ergonomic Factors in Undergraduate Dental Students: An Observational Study. *Journal of Health Sciences & Research*, 5(2): 1-5. Available: https://www.researchgate.net/publication/290153531_Prevalence_of_Musculoskelet

al_Pain_and_Assessment_of_Ergonomic_Factors_in_Undergraduate_Dental_Students_An_Observational_Study (Accessed 28 July 2021).

Kuorinka, I., Jonsson, B., Kilbom, A., Vinterberg, H., Biering-Sørensen, F., Andersson, G. and Jørgensen, K. 1987. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. *Applied ergonomics*, 18 (3): 233-237. Available: https://www.sciencedirect.com/science/article/abs/pii/000368708790010X (Accessed 28 July 2021).

Lamprecht, A. and Padayachy, K. 2019. The epidemiology of work-related musculoskeletal injuries among chiropractors in the eThekwini municipality. *Chiropractic & manual therapies*, *27*(1),1-13. Available: https://link.springer.com/article/10.1186/s12998-019-0238-y (Accessed 28 July 2021).

Lestari, A.I. and Palupi, R. 2020. Better Early Prevention: Dental Student's Awareness of Musculoskeletal Disorders. *Systematic Reviews in Pharmacy*, *11*(3): 941-945. Available: https://www.sysrevpharm.org/abstract/better-early-prevention-dental-students-awareness-of-musculoskeletal-disorders-66600.html (Accessed 28 July 2021).

Lorusso, A., Vimercati, L. and L'abbate, N. 2010. Musculoskeletal complaints among Italian X-ray technology students: a cross-sectional questionnaire survey. *BMC research notes*, *3*(1): 1-4. Available: https://link.springer.com/article/10.1186/1756-0500-3-114 (Accessed 28 July 2021).

Luan, H.D., Hai, N.T., Xanh, P.T., Giang, H.T., Van Thuc, P., Hong, N.M. and Khue, P.M. 2018. Musculoskeletal disorders: prevalence and associated factors among district hospital nurses in Haiphong, Vietnam. *BioMed research international*, *2018*. Available: https://www.hindawi.com/journals/bmri/2018/3162564/ (Accessed 28 July 2021).

Lunde, L.K., Koch, M., Merkus, S.L., Knardahl, S., Wærsted, M. and Veiersted, K.B. 2019. Associations of objectively measured forward bending at work with low-back pain intensity: a 2-year follow-up of construction and healthcare workers. *Occupational and environmental medicine*, *76*(9): 660-667.

Maharaj, P. and Shangase, T. 2020. Reasons for delaying marriage: Attitudes of young, educated women in South Africa. *Journal of Comparative Family Studies*, *51*(1):3-17. Available: https://www.jstor.org/stable/26912113 (Accessed 28 July 2021).

Mahlathi, P. and Dlamini, J. 2015. Minimum data sets for human resources for health and the surgical workforce in South Africa's health system: a rapid analysis of stock and migration. *African Institute of Health and Leadership Development*.

Makanjee, C.R. and Engel-Hills, P. 2018. Ethics in diagnostic radiography in South Africa: A complex temporary encounter mediated through text and technology. In *African Perspectives on Ethics for Healthcare Professionals*, 13:201-214. Available: https://link.springer.com/chapter/10.1007/978-3-319-93230-9_15 (Accessed 28 July 2021).

Manchikanti, L., Singh, V., Falco, F.J., Benyamin, R.M. and Hirsch, J.A. 2014. Epidemiology of low back pain in adults. *Neuromodulation: Technology at the Neural Interface*, *17*:3-10.Available:https://www.tandfonline.com/doi/abs/10.1080/20786204.2011.10874091 (Accessed 28 July 2021).

Marras, W.S., Cutlip, R.G., Burt, S.E. and Waters, T.R. 2009. National occupational research agenda (NORA) future directions in occupational musculoskeletal disorder health research. *Applied ergonomics*, *40*(1):15-22.

Marshall, C. & Rossman, G.B. 1999. Designing qualitative research. 3rd ed. London: SAGE.

Marston, L. 2010. *Introductory statistics for health and nursing using SPSS*. Los Angeles, CA: Sage.

McCarthy, B., Trace, A., O'Donovan, M., Brady-Nevin, C., Murphy, M., O'Shea, M., & O'Regan, P. (2018). Nursing and midwifery students' stress and coping during their undergraduate education programmes: An integrative review. *Nurse education today*, *61*, 197-209.

McDonald, M. and Salisbury, H. 2019. Physical Activity, Exercise, and Musculoskeletal Disorders in Sonographers. *Journal of Diagnostic Medical Sonography*, *35*(4): 305-315. Available: https://journals.sagepub.com/doi/full/10.1177/8756479319843883 (Accessed 28 July 2021).

Mishra, S. and Sarkar, K. 2021. Work-related musculoskeletal disorders and associated risk factors among urban metropolitan hairdressers in India. *Journal of Occupational Health*, *63*(1): 12200. Available: https://www.jstage.jst.go.jp/article/joh/63/1/63_e12200/_article/-char/ja/ (Accessed 28 July 2021).

Mohan, V., Inbaraj, L.R., George, C.E. and Norman, G. 2019. Prevalence of complaints of arm, neck, and shoulders among computer professionals in Bangalore: A cross-sectional study. *Journal of family medicine and Primary Care*, *8*(1): 171. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6396627/ (Accessed 28 July 2021).

Moodley, M., Ismail, F. and Kriel, A. 2020. Work-related musculoskeletal disorders amongst undergraduate nursing students at the University of Johannesburg. Health SA Gesondheid (Online), 25:1-9. Available: https://hsag.co.za/index.php/hsag/article/view/1460 (Accessed 28 July 2021).

Morais, B.X., Dalmolin, G.D.L., Pedro, C.M.P., Bresolin, J.Z., Andolhe, R. and Magnago, T.S.B.D.S. 2021. Perceived stress and musculoskeletal pain among undergraduate health students. *Texto & Contexto-Enfermagem*, *30*. Available: https://pubmed.ncbi.nlm.nih.gov/31314863/ (Accessed 28 July 2021).

Motshweneng, O.S. and Mdletshe, S. 2021. Preparing for advanced practice radiation therapy in South Africa: Conceptual and curricular considerations. *Health SA Gesondheid (Online)*, *26*:1-8. Available: https://hsag.co.za/index.php/hsag/article/view/1587 (Accessed 28 July 2021).

Mouton, J. 1996. *Understanding social research*. Pretoria: Van Schaik Publishers.

Mukhtad, A.A., Aminese, H.A., Mansor, M.A., Mansour, H.S. and Elmesmary, H.A. 2018. Ergonomic risk assessment among healthcare laboratory technicians in Benghazi medical centre. *International Journal for Advance Research and Development*, *3*(3): 318-327. Available: https://www.ijarnd.com/manuscript/ergonomic-risk-assessment-among-healthcare-laboratory-technicians-in-benghazi-medical-centre/ (Accessed 28 July 2021).

Munabi, I.G., Buwembo, W., Kitara, D.L., Ochieng, J. and Mwaka, E.S. 2014. Musculoskeletal disorder risk factors among nursing professionals in low resource settings: a cross-sectional study in Uganda. *BMC nursing*, *13*(1): 1-8. Available: https://bmcnurs.biomedcentral.com/articles/10.1186/1472-6955-13-7 (Accessed 28 July 2021).

Murphey, S. 2017. Work related musculoskeletal disorders in sonography. *Journal of Diagnostic Medical Sonography*, 33(5): 354-369 Available: https://journals.sagepub.com/doi/full/10.1177/8756479317726767 (Accessed 28 July 2021).

National Institute for Occupational Safety and Health. 2001. National occupational research agenda for musculoskeletal disorders: research topics for the next decade, a report by the NORA Musculoskeletal Disorders Team. Available: https://www.cdc.gov/niosh/docs/2001-117/pdfs/2001-117.pdf [Accessed 5 Apr. 2022].

Nazari, H., Hosseini Mahjoob, H., Tapak, L. and Mortazavi, S.S. 2017. Prevalence of work-related musculoskeletal disorders and injuries in occupational and physical therapists and its comparison. *Iranian Rehabilitation Journal*, *15*(1): 31-36. Available: http://irj.uswr.ac.ir/browse.php?a_id=598&sid=1&slc_lang=fa (Accessed 28 July 2021).

Ng, A., Hayes, M.J. and Polster, A. 2016. Musculoskeletal disorders and working posture among dental and oral health students. In *Healthcare*, 4(1):13). Multidisciplinary Digital Publishing Institute. Available: https://www.semanticscholar.org/paper/Musculoskeletal-Disorders-and-Working-Posture-among-Ng-Hayes/88beb5dd6a3e0e9c69475341adc5048839b702a6 (Accessed 28 July 2021).

Ng, Y.M., Voo, P. and Maakip, I. 2019. Psychosocial factors, depression, and musculoskeletal disorders among teachers. *BMC public health*, *19*(1): 1-10. Available: https://pubmed.ncbi.nlm.nih.gov/30808335/ (Accessed 28 July 2021).

Ngo, M., Schneider-Kolsky, M. and Baird, M. 2013. The attitudes of Australian radiography students towards the use of assistive transfer devices to reduce biomechanical stress in the clinical setting. *Radiography*, *19*(2): 25-129. Available: https://www.sciencedirect.com/science/article/abs/pii/S1078817413000084 (Accessed 28 July 2021).

Nordin NAM, Singh DKA, Kanglun L. 2014. Low back pain and associated risk factors among health science undergraduates. Sains Malays 43(3):423–428. Available: https://core.ac.uk/download/pdf/19790512.pdf (Accessed 28 July 2021).

Ofori-Manteaw, B.B., Antwi, W.K. and Arthur, L. 2015. Ergonomics and occupational health issues in diagnostic imaging: a survey of the situation at the korle-bu teaching hospital. *Ergonomics*, *19*: 93-101. Available: https://core.ac.uk/download/pdf/234691632.pdf (Accessed 28 July 2021).

Ogunlana, M.O., Govender, P. and Oyewole, O.O. 2021. Prevalence and patterns of musculoskeletal pain among undergraduate students of occupational therapy and physiotherapy in a South African university. *Hong Kong Physiotherapy Journal*, *41*(01): 35-43. Available: https://www.worldscientific.com/doi/full/10.1142/S1013702521500037 (Accessed 28 July 2021).

Oke, K.I. and Adeyekun, A.A. 2013. Patterns of work-related musculoskeletal disorders among sonographers in selected health facilities in Nigeria. *Journal of Applied Medical Sciences*, *2*(4): 67-76. Available: http://www.scienpress.com/Upload/JAMS/Vol%202_4_8.pdf (Accessed 28 July 2021).

Onyemaechi, N.O., Anyanwu, G.E., Obikili, E.N., Onwuasoigwe, O. and Nwankwo, O.E. 2016. Impact of overweight and obesity on the musculoskeletal system using lumbosacral angles. *Patient preference and adherence*, *10*:291.

Pallotta, O.J. and Roberts, A. 2017. Musculoskeletal pain and injury in sonographers, causes and solutions. *Sonography*, *4*(1): 5-12. Available: https://onlinelibrary.wiley.com/doi/full/10.1002/sono.12093 (Accessed 28 July 2021).

Parahoo, K. 2014. Nursing research: principles, process and issues. 3 rd ed. England: Palgrave Macmillan.

Polit, D. and Beck, C. 2012. Nursing Research: Generating and Assessing Evidence for Nursing Practice. 9th ed. Philadelphia: Lippincott Williams and Wilkins.

Pugh, J.D., Cormack, K., Gelder, L., Williams, A.M., Twigg, D.E. and Blazevich, A.J. 2019. Exercise, fitness and musculoskeletal health of undergraduate nursing students: A cross-sectional study. *Journal of advanced nursing*, *75*(10): 2110-2121. Available: https://onlinelibrary.wiley.com/doi/abs/10.1111/jan.13990 (Accessed 28 July 2021).

Ramani, S. L., Samet, J., Franz, C. K., Hsieh, C., Nguyen, C. V., Horbinski, C., & Deshmukh, S. (2021). Musculoskeletal involvement of COVID-19: review of imaging. *Skeletal Radiology*, *50*(9), 1763-1773.

Reed, L.F., Battistutta, D., Young, J. and Newman, B. 2014. Prevalence and risk factors for foot and ankle musculoskeletal disorders experienced by nurses. *BMC musculoskeletal disorders*, *15*(1):1-7. Available: https://bmcmusculoskeletdisord.biomedcentral.com/articles/10.1186/1471-2474-15-196 (Accessed 28 July 2021).

Ribeiro, T., Serranheira, F. and Loureiro, H. 2017. Work related musculoskeletal disorders in primary health care nurses. *Applied nursing research*, *33*: 72-77. Available: https://www.sciencedirect.com/science/article/pii/S0897189716301975 (Accessed 28 July 2021).

Roll, S.C., Selhorst, L. and Evans, K.D. 2014. Contribution of positioning to work-related musculoskeletal discomfort in diagnostic medical sonographers. *Work*, *47*(2): 253-260. Available: https://content.iospress.com/articles/work/wor01579 (Accessed 28 July 2021).

Rousseau, T., Mottet, N., Mace, G., Franceschini, C. and Sagot, P. 2013. Practice guidelines for prevention of musculoskeletal disorders in obstetric sonography. *Journal of Ultrasound in Medicine*, *32*(1): 157-164. Available: https://onlinelibrary.wiley.com/doi/abs/10.7863/jum.2013.32.1.15 (Accessed 28 July 2021).

Rozenfeld, V., Ribak, J., Danziger, J., Tsamir, J. and Carmeli, E. 2010. Prevalence, risk factors and preventive strategies in work-related musculoskeletal disorders among Israeli physical therapists. *Physiotherapy Research International*, *15*(3):176-184. Available: https://onlinelibrary.wiley.com/doi/abs/10.1002/pri.440 (Accessed 28 July 2021).

Sahu, P. 2020. Closure of universities due to coronavirus disease 2019 (COVID-19): *impact on education and mental health of students and academic staff. Cureus*, 12(4):1-6 Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7198094/ (Accessed 17 May 2021).

Sandilands, D.D. 2014. Bivariate analysis. *Encyclopedia of Quality of Life and Well-Being Research; Michalos,*. Available: https://link.springer.com/referenceworkentry/10.1007%2F978-94-007-0753-5_222 (Accessed 27 August 2021).

Senarath, M., Thalwaththe, S. and Tennakoon, S. 2021. Prevalence of selected musculoskeletal disorders among the students of faculty of Allied health sciences, University of Peradeniya. *Journal of Musculoskeletal Disorders and Treatment*, *7*(2).Available: https://clinmedjournals.org/articles/jmdt/journal-of-

musculoskeletal-disorders-and-treatment-jmdt-7-097.php?jid=jmdt (Accessed 27 May 2021).

Serra, M.V.G.B., Camargo, P.R., Zaia, J.E., Tonello, M.G.M. and Quemelo, P.R.V. 2018. Effects of physical exercise on musculoskeletal disorders, stress and quality of life in workers. *International Journal of Occupational Safety and Ergonomics*, *24*(1):62-67. Available: https://www.tandfonline.com/doi/abs/10.1080/10803548.2016.1234132 (Accessed 27 August 2021).

SH, A.N. 2018. The Prevalence of work-related musculoskeletal disorders among x-ray radiographers those working in radiology centers of the hospitals affiliated in AJA university of medical sciences: A cross-sectional study. *Military Caring Sciences Journal*, *4*(3): 198-206. Available: http://mcs.ajaums.ac.ir/article-1-162-en.html (Accessed 27 August 2021).

Shamsi, M., Safari, A., Samadzadeh, S. and Yoosefpour, N. 2020. The prevalence of musculoskeletal pain among above 50-year-old population referred to the Kermanshah-Iran health bus in 2016. *BMC research notes*, *13*(1): 72. Available: https://link.springer.com/article/10.1186/s13104-020-4940-6 (Accessed 27 August 2021).

Sibiya, N.E. and Sibiya, M.N. 2014. Work integrated learning experiences of primary health care post-basic nursing students in clinical settings: a university of technology context: part 1: contemporary issues in nursing. *South African Journal of Higher Education*, *28*(6):1943-1958.

Simon, M. K. and Goes, J. 2013. Assumption, limitations, delimitations, and scope of the study. Dissertation and scholarly research: recipes for success. Available: https://studylib.net/doc/8312011/assumptions---limitations-and-delimitations (Accessed 27 May 2021).

Smith, D.R. and Leggat, P.A. 2007. Prevalence and distribution of musculoskeletal pain among Australian medical students. *Journal of Musculoskeletal Pain*, *15*(4): 39-46. Available: https://www.tandfonline.com/doi/abs/10.1300/J094v15n04_05 (Accessed 27 May 2021).

Soares, C.O., Pereira, B.F., Gomes, M.V.P., Marcondes, L.P., de Campos Gomes, F. and de Melo-Neto, J.S. 2019. Preventive factors against work-related musculoskeletal

disorders: narrative review. *Revista Brasileira de Medicina do Trabalho*, *17*(3):415. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7195879/ (Accessed 27 August 2021).

Society of Radiography. n.d. WATCH YOUR BACK! Guidance to Health and Safety. Representatives & Members on Manual Handling. Availablehttps://www.sor.org/getmedia/7927f885-26a0-4762-afb7-4e27f0427bbf/sor_watchyourback.pdf_1 (Accessed 27 May 2021).

Steynberg, S. 2022. *Subject Guides: Research Guide: Data analysis and findings*. lAvailable: https://library.up.ac.za/c.php?g=485435&p=4425510#:~:text=Data%20analysis%20is%20the%20most(Accessed 27 April 2022).

Swaen, B. 2021. Developing a Conceptual Framework for Research. Available: https://www.scribbr.com/methodology/conceptual-framework/ (Accessed 27 May 2021).

Taherdoost, H. 2016. Sampling methods in research methodology; how to choose a sampling technique for research. *How to Choose a Sampling Technique for Research,* 5(2): 18-27. Available: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3205035 (Accessed 27 May 2021).

Tantawy, S.A., Rahman, A.A. and Ameer, M.A. 2017. The relationship between the development of musculoskeletal disorders, body mass index, and academic stress in Bahraini University students. *The Korean journal of pain*, *30*(2): 126-133. Available: https://pubmed.ncbi.nlm.nih.gov/28416996/ (Accessed 27 May 2021).

Testa, M. A., & Simonson, D. C. (1996). Assessment of quality-of-life outcomes. *New England journal of medicine*, *334*(13), 835-840.

Thabane, L., Ma, J., Chu, R., Cheng, J., Ismaila, A., Rios, L.P., Robson, R., Thabane, M., Giangregorio, L. and Goldsmith, C.H. 2010. A tutorial on pilot studies: the what, why and how. *BMC Medical Research Methodology*,10(1). Available: https://bmcmedresmethodol.biomedcentral.com/articles/10.1186/1471-2288-10-1(Accessed 27 May 2021).

Thambura, M.J. 2016. *An investigation of factors impacting on the retention of radiographers in KwaZulu-Natal* (Doctoral dissertation).

Tinubu, B., Mbada, C.E., Oyeyemi, A.L. and Fabunmi, A.A. 2010. Work-related musculoskeletal disorders among nurses in Ibadan, South-west Nigeria: a cross-

sectional survey. *BMC Musculoskeletal disorders*, *11*(1):1-8. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2823665/ (Accessed 27 May 2021).

Udoh, B.E., Ulu, U.O., Eze, J.C. and Chiegwu, H.U. 2019. Musculo-skeletal symptoms and its severity among radiographers and sonographers in southern Nigeria. *Journal of Advances in Medicine and Medical Research*, *29*:1-7. Available: https://www.researchgate.net/publication/333984047_Musculoskeletal_Symptoms_and_Its_Severity_among_Radiographers_and_Sonographers_in_Southern_Nigeria (Accessed 27 May 2021).

Vernuccio, F., Arzanauskaite, M., Turk, S., Torres, E.T., Choa, J.M.D., Udare, A.S., Haroun, D., Serra, M.M., Shelmerdine, S., Bold, B. and Bae, J.S.2019. Gender discrepancy in research activities during radiology residency. *Insights into imaging*, *10*(1):1-9. Available: https://link.springer.com/article/10.1186/s13244-019-0792-9 (Accessed 27 May 2021).

Watson, E. L., Baker, L. A., Wilkinson, T. J., Gould, D. W., Graham-Brown, M. P., Major, R. W., ... and Smith, A. C. (2020). Reductions in skeletal muscle mitochondrial mass are not restored following exercise training in patients with chronic kidney disease. *The FASEB Journal*, *34*(1), 1755-1767.

Weleslassie, G.G., Meles, H.G., Haile, T.G. and Hagos, G.K. 2020. Burden of neck pain among medical students in Ethiopia. *BMC musculoskeletal disorders*, *21*(1): 1-9. Available: https://bmcmusculoskeletdisord.biomedcentral.com/articles/10.1186/s12891-019-3018-x (Accessed 27 May 2021).

Williams, C.M., Penkala, S., Smith, P., Haines, T. and Bowles, K.A., 2017. Exploring musculoskeletal injuries in the podiatry profession: an international cross-sectional study. *Journal of foot and ankle research*, *10*(1): 1-10. Available: https://jfootankleres.biomedcentral.com/articles/10.1186/s13047-016-0185-y (Accessed 27 May 2021).

World Health Organization (WHO). 2015. Obesity and overweight. Available: http://www.who.int/mediacentre/factsheets/fs311/en/ (Accessed: 12 February 2021).

World Health Organization. 2003. Protecting Workers' Health Series No. 5, Preventing musculoskeletal disorders in the workplace. *World Health Organization*, *71*(4):47-48.

Available:https://apps.who.int/iris/bitstream/handle/10665/42651/924159053X.pdf (Accessed 28 July 2021).

Yasobant, S. and Rajkumar, P. 2014. Work-related musculoskeletal disorders among health care professionals: A cross-sectional assessment of risk factors in a tertiary hospital, India. *Indian journal of occupational and environmental medicine*, *18*(2): 75. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4280781/ (Accessed 17 May 2021).

APPENDICES

Appendix A Provisional Ethical Clearance

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

7 October 2021

Mr S S Masondo
P O Box 3465
Ladysmith
3370

Dear Mr Masondo

Prevalence and Associated Risk Factors of Musculoskeletal Disorders Among Undergraduate Radiography Students During Work Integrated Learning at the University of Technology, in KwaZulu-Natal

I am pleased to inform you that **PROVISIONAL APPROVAL** has been granted to your proposal subject to:

- Piloting of the data collection tool. *Please note that should there be any changes to the data collection tool, in a letter signed by the researcher and supervisor, list the changes to the documents and submit to IREC with the final data collection tool. Even when there are no changes to the data collection tool, IREC has to be notified.*
- Obtaining and submitting the necessary gatekeeper permission/s to Institutional Research Ethics Committee (IREC).

PLEASE NOTE THAT THIS IS NOT A FINAL APPROVAL LETTER. KINDLY SUBMIT THE ABOVE MENTIONED DOCUMENTS WITHIN THREE MONTHS TO THE IREC OFFICE. DATA COLLECTION CAN ONLY COMMENCE WHEN IREC ISSUES FULL APPROVAL

The Proposal has been allocated the following Ethical Clearance number **IREC 203/21**. Please use this number in all communication with this office.

Approval has been granted for a period of **ONE YEAR**, before the expiry of which you are required to apply for safety monitoring and annual recertification. Please use the Safety Monitoring and Annual Recertification Report form which can be found in the Standard Operating Procedures [SOP's] of the IREC. This form must be submitted to the IREC at least 3 months before the ethics approval for the study expires.

Yours Sincerely

Dr K Padayachy
Deputy Chairperson: IREC

Appendix B1: **Letter of Requesting Permission to the Durban University of Technology Research Committee**

PO Box 3465

Hopesland Village

Ladysmith

3370

Durban University of Technology Research Committee,

Ritson Campus,

Durban,

4001.

Dear Dr. Linganiso

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

I am Siyanda Masondo, a registered student for a master's degree in Radiography at the Durban University of Technology. My research topic is: "**prevalence and associated risk factors of musculoskeletal disorders among undergraduate radiography students during work-integrated learning at university of technology, in KwaZulu-Natal.**"

Musculoskeletal disorders (MSDs) refer to an injury or disorder of the nerves, ligaments, muscles, joints, tendons and supporting structures of the upper and lower limbs, neck and spine which are caused by sudden or accumulative exposures to physical exertion. These disorders are common among healthcare professions, and they affect millions of people around the world. During Work Integrated Learning (or clinical placements) most undergraduate health students, including radiography students, are exposed to physical and psychological factors that may trigger the occurrence of MSDs. However, there are few studies noted that reported the MSDs among radiography students.

The aim of this study therefore is to determine the prevalence of musculoskeletal disorders, identify the risk factors responsible for the conditions as well as the body parts that are mostly affected. The study population are undergraduate radiography students at Durban University of Technology (DUT). A structured questionnaire which will include validated Standard Nordic Questionnaire will be used to collect data from second to fourth year radiography students at DUT. Confidentiality and anonymity of both the participants and the institution will be maintained at all times. Feedback and recommendations will be given at the completion of the study.

I hereby seek permission to conduct a structured questionnaire with undergraduate radiography students at the Durban University of Technology. The participants' information will be kept confidential and the outcomes will be reported to you. I have provided you with a copy of the summary of the proposal which includes copies of the data collection tools and consent and/ or assent forms to be used in the research process, as well as a copy of the provisional 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 telephonically on 0734624462 or via email address masondo2002@gmail.com or my supervisor Dr. T.E Khoza on thandokuhlek@dut.ac.za. Thank you for your time and consideration in this matter.

Yours sincerely,

Masondo Siyanda

Durban University of Technology

Appendix B2: **Letter of Requesting Permission to the Durban University of Technology Radiography Head of Department**

PO Box 3465

Hopesland Village

Ladysmith

3370

Durban University of Technology Research Committee,

Ritson Campus,

Durban,

4001.

Dear Dr. Nkosi

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

I am Siyanda Masondo, a registered student for a master's degree in Radiography at the Durban University of Technology. My research topic is: "**prevalence and associated risk factors of musculoskeletal disorders among undergraduate radiography students during work-integrated learning at university of technology, in KwaZulu-Natal.**"

Musculoskeletal disorders (MSDs) refer to an injury or disorder of the nerves, ligaments, muscles, joints, tendons and supporting structures of the upper and lower limbs, neck and spine which are caused by sudden or accumulative exposures to physical exertion. These disorders are common among healthcare professions, and they affect millions of people around the world. During Work Integrated Learning (or clinical placements) most undergraduate health students, including radiography students, are exposed to physical and psychological factors that may trigger the occurrence of MSDs. However, there are few studies noted that reported the MSDs among radiography students.

The aim of this study therefore is to determine the prevalence of musculoskeletal disorders, identify the risk factors responsible for the conditions as well as the body parts that are mostly affected. The study population are undergraduate radiography students at Durban University of Technology (DUT). A structured questionnaire which will include validated Standard Nordic Questionnaire will be used to collect data from second to fourth year radiography students at DUT. Confidentiality and anonymity of both the participants and the institution will be

maintained at all times. Feedback and recommendations will be given at the completion of the study.

I hereby seek permission to conduct a structured questionnaire with undergraduate radiography students at the Durban University of Technology. The participants' information will be kept confidential and the outcomes will be reported to you. I have provided you with a copy of the summary of the proposal which includes copies of the data collection tools and consent and/ or assent forms to be used in the research process, as well as a copy of the provisional 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 telephonically on 0734624462 or via email address masondo2002@gmail.com or my supervisor Dr. T.E Khoza on thandokuhlek@dut.ac.za. Thank you for your time and consideration in this matter.

Yours sincerely,

Masondo Siyanda

Durban University of Technology

Appendix C1: Pilot Study Questionnaire

QUESTIONNAIRE

Background

I am conducting research for my master's in Diagnostic Radiography. The research is aimed to examine the prevalence of musculoskeletal disorders (MSDs) among undergraduate radiography students at the DUT. In order to collect data, I would like to ask you questions about your experience of musculoskeletal disorders during Work Integrated Learning (WIL). This should take approximately 15 to 30 minutes of your time.

Instructions

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

Thank you, your co-operation is highly appreciated

Participant code number _____

Section A

1.1 Please indicate your age range

Under 20	
20 – 24	
25-29	
30-34	
35-39	

1.2 Please indicate your gender

Male	Female	Other

1.3 Please indicate your marital status

Single	Married	Widowed	Divorced

1.4 Please indicate your race

African	
Caucasian	
Coloured	
Indian	
Other (Please specify)	

_____

1.5 Please indicate your radiography discipline

Diagnostic	Ultrasound	Nuclear Medicine	Radiotherapy

1.5 Please indicate your study level in radiography

2nd year	3th year	4th year

1.6 Are you right or left-handed?

Right hand	
Left hand	

1.7. Please indicate your weight

kg

1.8 Please indicate your height

1.9 Please indicate your BMI

1.10 Do you smoke?

Yes	
No	

1.10.1 For how many years have you smoked?

[If never smoked, enter zero] _____

1.11 Do you consume alcohol?

Yes	
No	

1.11.1 On average, how many alcoholic drinks do you consume per week?
[If you don't drink alcohol, enter zero]

_____

1.12 Are you currently involved in any structured physical exercises?

Yes	1-2 times per week	3-5 times per week	Every day
No			

Section B

2.1 Where do you attend your Work Integrated Learning (WIL)?

private hospital	
Public hospital	
Both	

2.2 On average, how many hours do you work per day?

_____

2.3 What is the duration of your tea time_____ (i.e. 15mins or 30mins or 1 hour etc.)

2.4 What is the duration of your lunchtime_____ (i.e. 15mins or 30mins or 1 hour etc.)

2.5 Type of radiography system used in your hospital

Digital system	Analog system	Both

2.6 Does your job during WIL involve any of the following?

	Never	**Sometimes**	**Often**	**Always**
2.6.1 Bending				
2.6.2 Overstretching				
2.6.3 Standing				
2.6.4 Repetitive movement				
2.6.5 Wearing lead apron				
2.6.6 Same postures for long periods				
2.6.7 Lifting/transferring patients to chair/bed				
2.6.8 Pulling/Pushing mobile X-ray unit				
2.6.9 Handling heavy objects				
2.9.10 Grasping				

2.7 Do you feel stress during Work Integrated Learning (WIL)?

Yes	
No	

2.8 How can you rate your level of stress? ***(0= no stress at all; highest level of stress)***

0	1	2	3	4	5	6	7	8	9	10

2.9 Which one of the following you can indicate as highest level of stressor during Work Integrated Learning (WIL)?

Assessments during WIL	
Transportation during WIL	
Accommodation during WIL	
Rotation to new hospital	
Lack of support from clinical tutors/qualified radiographers	

2.10 How can you rate overall level of support you get from clinical tutor or qualified radiographer during Work Integrated Learning (WIL)? ***(0= no support at all; 10= best/excellent support)***

0	1	2	3	4	5	6	7	8	9	10

Section C

3.1 Have you ever experienced musculoskeletal pain while attending WIL? Yes | NO

3.2 Please indicate your experience of musculoskeletal disorder below

HAVE YOU AT ANYTIME DURING THE LAST 12 MONTHS suffered with, for example, aching, pains, discomfort etc in…	**To be answered only by those who have suffered in some way**			
	Have you at any time during the last 12 months been prevented from doing normal work because of the suffering?		Have you suffered at any time during the last 7 days	
	NO	YES	NO	YES
1.NECK NO ☐ YES ☐				
3. ELBOWS NO ☐ ☐ Yes Right shoulder ☐ Yes, left shoulder ☐ Yes, both shoulders				
3. ELBOWS NO ☐ ☐ Yes Right elbow ☐ Yes, left elbow ☐ Yes, both elbows				
3. WRISTS/HANDS NO ☐ ☐ Right wrist/hand ☐ Yes, wrist/hand ☐ Yes, wrists/hands				
5. UPPER BACK NO ☐ YES ☐				
6. LOWER BACK NO ☐ YES ☐				
7. ONE OR BOTH THIGHS NO ☐ YES ☐				

8. ONE OR BOTH KNEES NO YES ☐ ☐				
9.ONE OR BOTH ANKLES/FEET NO YES ☐ ☐				

Section D

4.1 Have you ever be absent at work due to these musculoskeletal pains?

Yes	
No	

4.2 If YES to question 4.1, how many days? _____ days

4.3 Have you ever consider changing the radiography profession as a result of your musculoskeletal pains?

Yes	
No	

4.4 Have you ever been to a medical professional for Musculoskeletal pain?

Yes	
No	

4.5 Have you ever been admitted to the hospital because of your musculoskeletal pains?

Yes	
No	

Appendix C2: Letter of information for pilot study

LETTER OF INFORMATION FOR PILOT STUDY

Title of the Research Study: prevalence and associated risk factors of musculoskeletal disorders among undergraduate radiography students during work-integrated learning at university of technology, in KwaZulu-Natal.

Principal Investigator/s/researcher: Mr. SS Masondo (Bachelor of Health Sciences in Diagnostic Radiography)

Brief Introduction and Purpose of the Study:

Dear research participant, thank you for showing interest in this study.

I am a registered student for a master's degree in radiography at the Durban University of Technology, and I would like to invite you to participate in the following research study. All the relevant information about the study can be found below. Please take some time to read through it to better your understanding.

Musculoskeletal disorders (MSDs) refer to a disorder of the nerves, ligaments, muscles, joints, tendons and supporting structures of the upper and lower limbs, neck and spine which are caused by sudden or accumulative exposures to physical exertion. Low back pain, neck and shoulder pain, as well as hand/wrist and foot pains, are all common MSDs that affect millions of people worldwide. Musculoskeletal disorders (MSDs) are the most prevalent among undergraduate healthcare students, including radiography students.

During Work Integrated Learning (WIL), student radiographers are rotated to various hospitals and perform all tasks that pose a significant risk of developing MSDs. However, there is a paucity of international and African literature on the prevalence of MSDs among radiography students during work-integrated learning (WIL). This is surprising given that these students are frequently exposed to risk factors that can lead to the development of MSDs. As a result, the current study is being carried out to determine the prevalence of MSDs among radiography students in KwaZulu Natal.

The primary aim of the study is to determine the prevalence of musculoskeletal disorders among undergraduate radiography students. The secondary aim is to identify the risk factors associated with the development of MSDs among undergraduate radiography students. The results from this study will be used to make recommendations to the department of radiography

to develop and provide appropriate interventions such as education program/ training on ergonomics practice to reduce the incidence of MSDs among students.

Outline of the Procedures:

- Before we can do anything please ensure that you wear your mask properly, use the hand sanitizer provided, also ensure that you keep 1.5m apart from each other. Then you will be given the questionnaire to answer which will take approximately 15 to 30 minutes.
- Before you answer the questionnaire, please read this letter of information and sign an informed consent form which confirms that you fully understand the research. You are encouraged to ask questions about the process to better your understanding before you agree to participate.
- Once you have done, please place these forms in the s ballot boxes labelled “Letters of Information” and “Letters of Informed Consent”, which is provided by the researcher.
- You will then be given a questionnaire. Please answer the questions as honestly as possible and be assured that your answers will be kept strictly anonymous and confidential. I.e. your responses will not be linked to your identity, thus, please do not write your name, identity number, or student number on the questionnaire.
- Once you have completed the questionnaire, please place it in the sealed ballot box labelled “Questionnaires”, which will be provided by the researcher.

Risks or Discomforts to the Participant: No risk is anticipated as the information required for the study is purely for academic use, however, during participation, if an issue arises that makes you feel uncomfortable, you may at any time stop your participation with no further repercussions

Explain to the participant the reasons he/she may be withdraw from the Study:
Non-compliance with the terms and conditions of the research objectives will result in participation withdrawal. During participation if an issue arises that makes you feel uncomfortable, you may at any time stop your participation with no further repercussions.

Benefits: Understanding what factors influence MSDs among radiography students will assist the faculties of health sciences in different institutions and radiography departments to develop and provide appropriate interventions such as education program/ training on ergonomics practice to reduce the incidence of MSDs among students. Moreover, the information from this study will help to encourage the students to take the steps to prevent the risks to MSDs.

Remuneration: There is no remuneration that will be offered for participating in this research.

Costs of the Study: As a participant, you will not be expected to cover any cost towards the research study.

Confidentiality: Confidentiality of all the information given will be assured at all times. No names of participants will be attached to the questionnaires. Consent forms with participant’s names will only be used for the purpose of research accuracy and these will be kept confidential by the researchers. Consent forms will be kept separate from the questionnaires. You will be allocated a code that will be used to identify all the data collected from you. Your name or any part of the collected data will not be given to your lecturer or HOD.

Results: The study will be published, and the findings will be available for both students and radiography departments to read.

Research-related Injury: The study does not have the potential to cause any injury or harm.

Storage of all electronic and hard copies
Questionnaires will be taken away by the researchers at the end of a session. Consent forms will be kept separate from the questionnaires. All collected data will be handled by the researchers only and will be kept under lock and key for 5 years, after which it will be destroyed by shredding.

General:
Please note that there is no obligation for you to participate in this research study, participation is on a volunteer basis. There will be approximately 145-147 participants in the research study. If you choose to participate, you will be required to answer questions. Please answer the questions as honestly as possible and be assured the answers you provide will be kept strictly anonymous and confidential. Copies of this information letter will be available, should you want one.

Persons to contact in the Event of Any Problems or Queries, please contact:
The researchers: Masondo SS, 073 462 4462 -
Supervisors: Dr. T.E Khoza, Tel: 031 373 3092
Institutional Research Ethics Administrator: 031 373 2375.
Complaints can be reported to the Director: Research and Postgraduate Support Dr L Linganiso on 031 373 2577 or researchdirector@dut.ac.za.

Thank you for the time you have taken to read through this information pertaining to the study. If you have any questions, please do not hesitate to ask. If you wish to participate in this study, please read and sign the **consent form** attached

Appendix C3: Consent Form for Pilot Study

CONSENT FOR PILOT STUDY

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Siyanda S Masondo, 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, Siyanda Siphesihle Masondo 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 C4: Code of Conduct for Pilot Study Participants

Code of Conduct for Pilot Group

This form needs to be completed by every member of the pilot study prior to the commencement of the pilot study.

As a member of this committee I agree to abide by the following conditions:

1. All information contained in the research documents and any information discussed during the pilot study meeting will be kept private and confidential. This is especially binding to any information that may identify any of the participants in the research process.

2. Due respect to be given to every suggestion and comment by any member of the pilot study and be debated with reference to the outcomes of the research.

3. The information gathered from this pilot group by the researcher will be made public in terms of a mini dissertation and journal publication. The researcher will ensure that any participants in the pilot study and research remain anonymous and confidential.

MEMBER REPRESENTS	MEMBER'S NAME	SIGNATURE	CONTACT DETAILS

Appendix C5: Confidentiality Statement for Pilot Study Participant

Confidentiality Statement Pilot Study

IMPORTANT NOTICE:

THIS FORM IS TO BE READ AND FILLED IN BY EVERY MEMBER PARTICIPATING IN THE PILOT STUDY, BEFORE THE PILOT STUDY CONVENES.

1. All information contained in the research documents and any information discussed during the pilot study will be kept private and confidential. This is especially binding to any information that may identify any of the participants in the research process.
2. The returned questionnaires will be coded and kept anonymous in the research process.
3. None of the information shall be communicated to any other individual or organisation outside of this specific expert group as to the decisions of this expert group.
4. The information from this pilot study will be made public in terms of a journal publication, which will in no way identify any participants of this research.
5. Once this form has been read and agreed to, please fill in the appropriate information below and sign to acknowledge agreement.

MEMBER REPRESENTS	MEMBER'S NAME	SIGNATURE	CONTACT DETAILS

APPENDIX C6: Pilot Study Questionnaire Evaluation Form

Pilot Study Questionnaire Evaluation Form

The purpose of this evaluation form is to use your feedback to streamline the questionnaire and tomake it appropriate for the participants that it will be tested on (Radiography Students). Please fill in the evaluation form honestly and critically.

Please mark only one box with a ✓or a **x** that provides the most correct answer for each question.

1. Please indicate the clarity of the Letter of Information you received:

- ☐ 1.1 Very Clear (X2)
- ☐ 1.2 Clear (X1)
- ☐ 1.3 Adequate
- ☐ 1.4 Unclear
- ☐ 1.5 Needs revising

If you ticked boxes “Adequate”, “Unclear”, or “Needs revising”, please indicate what you found confusing in the document by highlighting the relevant section on the Letter of Information and in thespace below, suggest how it could be improved:

NO ADDITIONAL COMMENTS

2. Please describe your overall response to the content presented in this questionnaire:

- ☐ 2.1 Extremely interesting
- ☐ 2.2 Interesting (X3)
- ☐ 2.3 Average
- ☐ 2.4 Boring
- ☐ 2.5 Very boring

Please indicate, in the space provided, which questions (if any) you found to be boring: (e.g. SectionA: Q’s 1.1, 1.2 and 1.9 or Section C: Q’s 3.1 and 3.4 etc.)

NO ADDITIONAL COMMENT

3. On the whole, do you think the topics raised in this questionnaire are relevant to thenature of the research study, as described in the Letter of Information?

☐ 3.1 Yes (X3)
☐ 3.2 No

Please indicate which topic(s) (if any) you believe to be irrelevant to this study:SMOKING (X1)
ALCOHOL CONSUMPTION (X2)

4. On the whole, do you think each topic raised in this questionnaire was adequatelycovered?

☐ 4.1 Yes (X3)
☐ 4.2 No

Please indicate which topic(s) (if any) could be covered in greater depth:

NO ADDITIONAL COMMENTS

5. Please give a rating of the instructions, on the whole, which accompanied eachquestion:

☐ 5.1 Very clear (X3)
☐ 5.2 Clear
☐ 5.3 Adequate
☐ 5.4 Unclear
☐ 5.5 Needs revising

Please indicate which instructions (if any) were unclear by writing the question number below,followed by your suggestion as to how they could be improved:

NO ADDITIONAL COMMENTS

6. Please describe your response to the wording of the questionnaire overall:

- ☐ 6.1 The meaning of all of the questions is absolutely clear (X2)
- ☐ 6.2 The meaning of most of the questions is clear (X1)
- ☐ 6.3 Too much Radiographic / medical terminology is used
- ☐ 6.4 Most of the questions were difficult to understand
- ☐ 6.5 The questionnaire needs to be revised because it is generally unclear

Please indicate which question(s) (if any) were unclear and should be reworded. Where possible, please provide a suggestion of better wording / phrasing to make the question more understandable:

NO ADDITIONAL COMMENTS

7. Do you think the questionnaire was too long?

- ☐ 7.1 Yes, but I felt that the length was necessary in order to generate a thoroughunderstanding of the research sample
- ☐ 7.2 Yes, I think the questionnaire needs to be shortened (X1)
- ☐ 7.3 No (X2)

8. Please describe your experience with regard to answering this questionnaire:

- ☐ 8.1 I really enjoyed answering this questionnaire
- ☐ 8.2 I enjoyed answering this questionnaire (X3)
- ☐ 8.3 I feel neutral about answering this questionnaire
- ☐ 8.4 I did not enjoy answering this questionnaire
- ☐ 8.5 I really did not enjoy answering this questionnaire

9. Do you think other radiography students would be willing to fill in this questionnaire?

- ☐ 9.1 Yes (X3)
- ☐ 9.2 No

If you selected “No”, please elaborate on your answer by giving a reason:

NO ADDITIONAL COMMENTS

10. If you have any other comments or suggestions that you would like to make about thisquestionnaire, please feel free to do so in the space provided below.

I THINK FOR SMOKING AND ALCOHOL CONSUMPTION QUESTION SHOULD BE REMOVED THEY AREIRRELEVANT.

MOST STUDENTS WILL NOT KNOW THEIR HEIGHT AND WEIGHT SO BRING WEIGHT AND HEIGHT SCALE

Appendix D1: Permission letter from Faculty of Health Sciences to Access the Undergraduate Radiography Students at the Durban University of Technology

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

13th October 2021
Siyanda Masondo
c/o Department of Radiography
Faculty of Health Sciences
Durban University of Technology

Dear Mr Masondo

PERMISSION TO CONDUCT RESEARCH AT THE DUT

Your email correspondence in respect of the above refers. I am pleased to inform you that the Institutional Research and Innovation Committee (IRIC) has granted **Gatekeeper Permission** for you to conduct your research "Prevalence and Associated Risk Factors of Musculoskeletal Disorders Among Undergraduate Radiography Students During Work Integrated Learning at the University of Technology, in Kwazulu-Natal." at the Durban University of Technology. **Kindly note that this letter must be issued to the IREC for approval before you commence data collection**.

The DUT may impose any other condition it deems appropriate in the circumstances having regard to nature and extent of access to and use of information requested.

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

Kindest regards.
Yours sincerely

_____
DR LINDA ZIKHONA LINGANISO
DIRECTOR: RESEARCH AND POSTGRADUATE SUPPORT DIRECTORATE

APPENDIX D2: Permission letter from Radiography Heard of Department to Access the Undergraduate Radiography Students at the Durban University of Technology

Department of Radiography
Faculty of Health Sciences
Durban University of Technology

DH1102 (MS94) Gate 6, Ritson Campus
11 Steve Biko Road
DURBAN, 4001

P O Box 1334, DURBAN, 4000
South Africa
Tel: (031) 373 2450/3763
Fax to email: 086 674 0892/086 5809590

www.dut.ac.za

13th October 2021

Mr S Masondo

c/o Department of Radiography

Faculty of Health Sciences

Durban University of Technology

Dear Mr S Masondo

PERMISSION TO CONDUCT RESEARCH AT THE DUT

Your email correspondence in respect of the above refers. I am pleased to inform you that the Department of Radiography has granted **Gatekeeper Permission** for you to conduct your research "prevalence and associated risk factors of musculoskeletal disorders among undergraduate radiography students during work-integrated learning at university of technology, in KwaZulu-Natal." **Kindly note that this letter must be issued to the IREC for approval before you commence data collection.**

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

Kindest regards.

Yours sincerely

-

Dr PB Nkosi

Head of Department: Radiography

Email:paulinen1@dut.ac.za

APPENDIX E: Full Ethical Clearance for the Study

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: lenkal@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

18 October 2021

Mr S S Masondo
P O Box 3465
Ladysmith
3370

Dear Mr Masondo

Prevalence and Associated Risk Factors of Musculoskeletal Disorders Among Undergraduate Radiography Students During Work Integrated Learning at the University of Technology, in KwaZulu-Natal
Ethics Clearance Number: 203/21

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 letters.

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

Appendix F1: Letter of information for the Study

LETTER OF INFORMATION FOR the STUDY

Title of the Research Study: prevalence and associated risk factors of musculoskeletal disorders among undergraduate radiography students during work-integrated learning at university of technology, in KwaZulu-Natal.

Principal Investigator/s/researcher: Mr. SS Masondo (Bachelor of Health Sciences in Diagnostic Radiography)

Brief Introduction and Purpose of the Study:

Dear research participant, thank you for showing interest in this study.

I am a registered student for a master's degree in radiography at the Durban University of Technology, and I would like to invite you to participate in the following research study. All the relevant information about the study can be found below. Please take some time to read through it to better your understanding.

Musculoskeletal disorders (MSDs) refer to a disorder of the nerves, ligaments, muscles, joints, tendons and supporting structures of the upper and lower limbs, neck and spine which are caused by sudden or accumulative exposures to physical exertion. Low back pain, neck and shoulder pain, as well as hand/wrist and foot pains, are all common MSDs that affect millions of people worldwide. Musculoskeletal disorders (MSDs) are the most prevalent among undergraduate healthcare students, including radiography students.

During Work Integrated Learning (WIL), student radiographers are rotated to various hospitals and perform all tasks that pose a significant risk of developing MSDs. However, there is a paucity of international and African literature on the prevalence of MSDs among radiography students during work-integrated learning (WIL). This is surprising given that these students are frequently exposed to risk factors that can lead to the development of MSDs. As a result, the current study is being carried out to determine the prevalence of MSDs among radiography students in KwaZulu Natal.

The primary aim of the study is to determine the prevalence of musculoskeletal disorders among undergraduate radiography students. The secondary aim is to identify the risk factors associated with the development of MSDs among undergraduate radiography students. The results from this study will be used to make recommendations to the department of radiography to develop and provide appropriate interventions such as education program/ training on ergonomics practice to reduce the incidence of MSDs among students.

Outline of the Procedures:

- Before we can do anything please ensure that you wear your mask properly, use the hand sanitizer provided, also ensure that you keep 1.5m apart from each other. Then you will be given the questionnaire to answer which will take approximately 15 to 30 minutes.

- Before you answer the questionnaire, please read this letter of information and sign an informed consent form which confirms that you fully understand the research. You are encouraged to ask questions about the process to better your understanding before you agree to participate.
- Once you have done, please place these forms in the s ballot boxes labelled “Letters of Information” and “Letters of Informed Consent”, which is provided by the researcher.
- You will then be given a questionnaire. Please answer the questions as honestly as possible and be assured that your answers will be kept strictly anonymous and confidential. I.e. your responses will not be linked to your identity, thus, please do not write your name, identity number, or student number on the questionnaire.
- Once you have completed the questionnaire, please place it in the sealed ballot box labelled “Questionnaires”, which will be provided by the researcher.

Risks or Discomforts to the Participant: No risk is anticipated as the information required for the study is purely for academic use, however, during participation, if an issue arises that makes you feel uncomfortable, you may at any time stop your participation with no further repercussions

Explain to the participant the reasons he/she may be withdraw from the Study:
Non-compliance with the terms and conditions of the research objectives will result in participation withdrawal. During participation if an issue arises that makes you feel uncomfortable, you may at any time stop your participation with no further repercussions.

Benefits: Understanding what factors influence MSDs among radiography students will assist the faculties of health sciences in different institutions and radiography departments to develop and provide appropriate interventions such as education program/ training on ergonomics practice to reduce the incidence of MSDs among students. Moreover, the information from this study will help to encourage the students to take the steps to prevent the risks to MSDs.

Remuneration: There is no remuneration that will be offered for participating in this research.

Costs of the Study: As a participant, you will not be expected to cover any cost towards the research study.

Confidentiality: Confidentiality of all the information given will be assured at all times. No names of participants will be attached to the questionnaires. Consent forms with participant’s names will only be used for the purpose of research accuracy and these will be kept confidential by the researchers. Consent forms will be kept separate from the questionnaires. You will be allocated a code that will be used to identify all the data collected from you. Your name or any part of the collected data will not be given to your lecturer or HOD.

Results: The study will be published, and the findings will be available for both students and radiography departments to read.

Research-related Injury: The study does not have the potential to cause any injury or harm.

Storage of all electronic and hard copies
Questionnaires will be taken away by the researchers at the end of a session. Consent forms will be kept separate from the questionnaires. All collected data will be handled by the researchers only and will be kept under lock and key for 5 years, after which it will be destroyed by shredding.

General:
Please note that there is no obligation for you to participate in this research study, participation is on a volunteer basis. There will be approximately 145-147 participants in the research study. If you choose to participate, you will be required to answer questions. Please answer the questions as honestly as possible and be assured the answers you provide will be kept strictly anonymous and confidential. Copies of this information letter will be available, should you want one.

Persons to contact in the Event of Any Problems or Queries, please contact:

The researchers: Masondo SS, 073 462 4462 -

Supervisors: Dr. T.E Khoza, Tel: 031 373 3092

Institutional Research Ethics Administrator: 031 373 2375.

Complaints can be reported to the Director: Research and Postgraduate Support Dr L Linganiso on 031 373 2577 or researchdirector@dut.ac.za.

Thank you for the time you have taken to read through this information pertaining to the study. If you have any questions, please do not hesitate to ask. If you wish to participate in this study, please read and sign the **consent form** attached

Appendix F2: Consent Form for the Study

CONSENT FOR THE STUDY

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Siyanda S Masondo, 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, Siyanda Siphesihle Masondo 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: Final Study Questionnaire

QUESTIONNAIRE

Background

I am conducting research for my master's in Diagnostic Radiography. The research is aimed to examine the prevalence of musculoskeletal disorders (MSDs) among undergraduate radiography students at the DUT. In order to collect data, I would like to ask you questions about your experience of musculoskeletal disorders during Work Integrated Learning (WIL). This should take approximately 15 to 30 minutes of your time.

Instructions

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

Thank you, your co-operation is highly appreciated

Participant code number _____

Section A

1.4 Please indicate your age range

Under 20	
20 – 24	
25-29	
30-34	
35-39	

1.5 Please indicate your gender

Male	Female	Other

1.6 Please indicate your marital status

Single	Married	Widowed	Divorced

1.5 Please indicate your race

African	
Caucasian	
Coloured	
Indian	
Other (Please specify)	

_____

1.5 Please indicate your radiography discipline

Diagnostic	Ultrasound	Nuclear Medicine	Radiotherapy

1.5 Please indicate your study level in radiography

2nd year	3th year	4th year

1.7 Are you right or left-handed?

Right hand	
Left hand	

1.7. Please indicate your weight (kg)

40-59	60-79	80-99	100-119	120-139	140+

1.8 Please indicate your height (cm)

150-169	170-189	190-199	200+

1.9 Please indicate your BMI

(BMI = weight/ Height^2)

Underweight	Healthy weight	Overweight	Obese
< 18.5	18.5 - 24.9	25 - 29.9	30 - 39.9

1.10 Do you smoke cigarettes?

Yes	
No	

1.10.1 For how many years have you smoked?

[If never smoked, enter zero] _____

1.12 Do you consume alcohol?

Yes	
No	

1.12.1 On average, how many alcoholic drinks do you consume per week?
[If you don't drink alcohol, enter zero]

_____

1.12 Are you currently involved in any structured physical exercises?

Yes	1-2 times per week	3-5 times per week	Every day
No			

Section B

2.1 Where do you attend your Work Integrated Learning (WIL) mostly?

Private hospital	
Public hospital	
Both	

2.2 During WIL, how many hours do you work per day? _____

2.3 What is the duration of your teatime?

15 minutes	
30 minutes	
Other (please specify)	_____

2.4 What is the duration of your lunchtime?

30 minutes	
1 hour	
Other (please specify)	_____

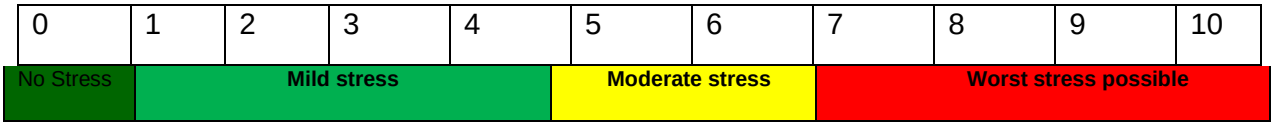
2.5 Does your job during WIL involve any of the following?

	Never	Sometimes	Often	Always
2.5.1 Bending				
2.5.2 Overstretching				
2.5.3 Standing				
2.5.4 Repetitive movement				
2.5.5 Wearing lead apron				
2.5.6 Same postures for long periods				
2.5.7 Lifting/transferring patients to chair/bed				
2.5.8 Pulling/Pushing mobile X-ray unit				
2.5.9 Handling heavy objects				
2.5.10 Grasping				

2.6 Do you feel stress during Work Integrated Learning (WIL)?

Yes	
No	

2.7 Please use the scale below to your rate your level of stress during WIL? ***(0= no stress at all;10= highest level of stress)***



2.8 Which one of the following you can indicate as highest stressor during Work Integrated Learning (WIL)?

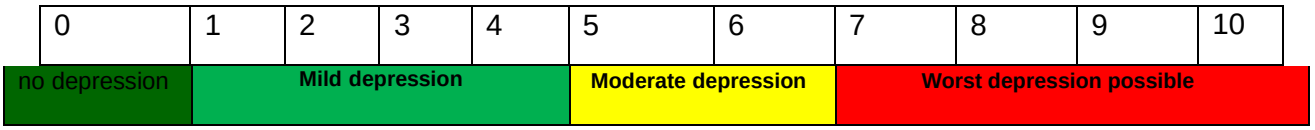
Assessments during WIL	
Transportation during WIL	
Accommodation during WIL	
Rotation to new hospital	
Other (Please specify)	

_____

2.9 Do you feel depressed during Work Integrated Learning (WIL)?

Yes	
No	

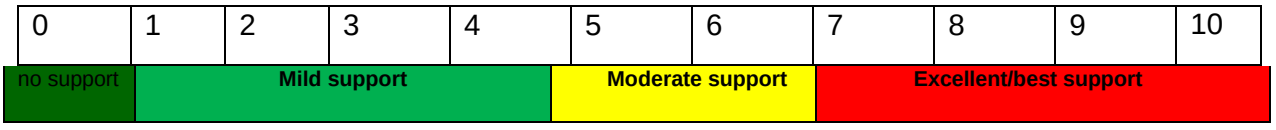
2.10 Please use the scale below to rate your level of depression during WIL? ***(0= no depression at all;10= highest level of depression)***



2.10 Do you think you get adequate level of support from the clinical tutor or qualified radiographers during WIL

Yes	
No	

2.10 Please use the scale below to rate your overall level of support you get from clinical tutor or qualified radiographer during Work Integrated Learning (WIL)? ***(0= no support at all; 10= best/excellent support)***



Section C

3.1 Have you ever experienced musculoskeletal pain while attending WIL?
(Musculoskeletal pain can be any neck, shoulder, hands, feet or back pains)

Yes	NO

3.2 Please indicate your experience of musculoskeletal disorder below (using this STANDARDIZED NORDIC QUESTIONNAIRE FOR ANALYSIS OF MUSCULOSKELETAL SYMPTOMS (Kuorinka *et al.* 1987)

HAVE YOU AT ANYTIME DURING THE LAST 12 MONTHS HAD TROUBLE *(for example* aching, pains, discomfort*)* IN...	**To be answered only by those who have suffered in some way**	
	Have you at anytime during the last 12 months been prevented from doing normal work because of the trouble?	Have you had any trouble at anytime during the last 7 days?
1.NECK NO ☐ YES ☐	NO ☐ YES ☐	NO ☐ YES ☐
2. SHOULDER NO ☐ ☐ Yes Right shoulder ☐ Yes, left shoulder ☐ Yes, both shoulders	NO ☐ YES ☐	NO ☐ YES ☐
3. ELBOWS NO ☐ ☐ Yes Right elbow ☐ Yes, left elbow ☐ Yes, both elbows	NO ☐ YES ☐	NO ☐ YES ☐
4. WRISTS/HANDS NO ☐ ☐ Right wrist/hand ☐ Yes, wrist/hand ☐ Yes, wrists/hands	NO ☐ YES ☐	NO ☐ YES ☐
5. UPPER BACK NO ☐ YES ☐	NO ☐ YES ☐	NO ☐ YES ☐
6. LOWER BACK NO ☐ YES ☐	NO ☐ YES ☐	NO ☐ YES ☐
7. ONE OR BOTH THIGHS NO ☐ YES ☐	NO ☐ YES ☐	NO ☐ YES ☐
8. ONE OR BOTH KNEES NO ☐ YES ☐	NO ☐ YES ☐	NO ☐ YES ☐
9.ONE OR BOTH ANKLES/FEET NO ☐ YES ☐	NO ☐ YES ☐	NO ☐ YES ☐

Section D

4.1 Have you ever be absent at work due to your musculoskeletal pains?

Yes	
No	

4.2 If YES to question 4.1, how many days? _____ days

4.3 Have you ever consider changing the radiography profession as a result of your musculoskeletal pains?

Yes	
No	

4.4 Have you ever been to a medical professional for Musculoskeletal pain?

Yes	
No	

4.5 Have you ever been admitted to the hospital because of your musculoskeletal pains?

Yes	
No	

THE END

THANK YOU FOR PARTICIPATING IN THIS STYUDY

Appendix H: Final Questionnaire *(Coding)*

QUESTIONNAIRE

Background

I am conducting research for my master's in Diagnostic Radiography. The research is aimed to examine the prevalence of musculoskeletal disorders (MSDs) among undergraduate radiography students at the DUT. In order to collect data, I would like to ask you questions about your experience of musculoskeletal disorders during Work Integrated Learning (WIL). This should take approximately 15 to 30 minutes of your time.

Instructions

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

Thank you, your co-operation is highly appreciated

Participant code number _____

Section A

1.7 Please indicate your age range

Under 20	(1)
20 – 24	(2)
25-29	(3)
30-34	(4)
35-39	(5)

1.8 Please indicate your gender

(1)	(2)	(3)
Male	Female	Other

1.9 Please indicate your marital status

(1)	(2)	(3)	(4)
Single	Married	Widowed	Divorced

1.6 Please indicate your race

African	(1)
Caucasian	(2)
Coloured	(3)
Indian	(4)
Other (Please specify)	(5)

_____

1.5 Please indicate your radiography discipline

(1)	(2)	(3)	(4)
Diagnostic	Ultrasound	Nuclear Medicine	Radiotherapy

1.6 Please indicate your study level in radiography

(1)	(2)	(3)
2nd year	3th year	4th year

1.7 Are you right or left-handed?

Right hand	(1)
Left hand	(2)

1.8 Please indicate your weight (kg)

(1)	(2)	(3)	(4)	(5)	(6)
40-59	60-79	80-99	100-119	120-139	140+

1.9 Please indicate your height (cm)

(1)	(2)	(3)	(4)
150-169	170-189	190-199	200+

1.10 Please indicate your BMI

(BMI = weight/ Height^2)

(1) Underweight	(2) Healthy weight	(3) Overweight	(4) Obese
< 18.5	18.5 - 24.9	25 - 29.9	30 - 39.9

1.11 Do you smoke cigarettes?

Yes	(1)
No	(2)

1.11.1 For how many years have you smoked?

[If never smoked, enter zero] _____

(1) =0

(2) = 1-9yrs (Mild)

(3) = 10-19yrs (Modarate)

(4) = 20+(Heavy)

1.12 Do you consume alcohol?

Yes	(1)
No	(2)

1.12.1 On average, how many alcoholic drinks do you consume per week?

[If you don't drink alcohol, enter zero]

_____

(1)=0

(2)= 1-4/week (mild)

(3)=5-9/week (moderate)

(4)=10+/week

1.13 Are you currently involved in any structured physical exercises?

Yes	1-2 times per week (1)	3-5 times per week (3)	Every day (4)
No	(2)		

Section B

2.10 Where do you attend your Work Integrated Learning (WIL) mostly?

Private hospital	(1)
Public hospital	(2)
Both	(3)

2.11 During WIL, how many hours do you work per day? _____

(1)= 7-8hrs/day

(2)= 9+ hrs/day

2.12 What is the duration of your teatime?

15 minutes	(1)
30 minutes	(2)
Other (please specify)	(3) _____

2.13 What is the duration of your lunchtime?

30 minutes	(1)
1 hour	(2)
Other (please specify)	(3) _____

2.14 Does your job during WIL involve any of the following?

	Never	Sometimes	Often	Always
2.5.1 Bending	(1)	(2)	(3)	(4)
2.5.2 Overstretching	(1)	(2)	(3)	(4)
2.5.3 Standing	(1)	(2)	(3)	(4)
2.5.4 Repetitive movement	(1)	(2)	(3)	(4)
2.5.5 Wearing lead apron	(1)	(2)	(3)	(4)
2.5.6 Same postures for long periods	(1)	(2)	(3)	(4)
2.5.7 Lifting/transferring patients to chair/bed	(1)	(2)	(3)	(4)
2.5.8 Pulling/Pushing mobile X-ray unit	(1)	(2)	(3)	(4)
2.5.9 Handling heavy objects	(1)	(2)	(3)	(4)
2.5.10 Grasping	(1)	(2)	(3)	(4)

2.15 Do you feel stress during Work Integrated Learning (WIL)?

Yes	(1)
No	(2)

2.16 Please use the scale below to your rate your level of stress during WIL? ***(0= no stress at all;10= highest level of stress)***

0	1	2	3	4	5	6	7	8	9	10
no depression	**Mild depression**			**Moderate depression**			**Worst depression possible**			
(1)	(2)			(3)			(4)			

2.17 Which one of the following you can indicate as highest stressor during Work Integrated Learning (WIL)?

Assessments during WIL	(1)
Transportation during WIL	(2)
Accommodation during WIL	(3)
Rotation to new hospital	(4)
Other (Please specify)	(5)

If participants indicated they did not have stress, I inserted **'0"** for this question.

_____

2.18 Do you feel depressed during Work Integrated Learning (WIL)?

Yes	(1)
No	(2)

2.10 Please use the scale below to rate your level of depression during WIL? ***(0= no depression at all;10= highest level of depression)***

0	1	2	3	4	5	6	7	8	9	10
no depression	**Mild depression**			**Moderate depression**			**Worst depression possible**			
(1)	(2)			(3)			(4)			

2.11 Do you think you get adequate level of support from the clinical tutor or qualified radiographers during WIL

Yes	(1)
No	(2)

2.12 Please use the scale below to rate your overall level of support you get from clinical tutor or qualified radiographer during Work Integrated Learning (WIL)? ***(0= no support at all; 10= best/excellent support)***

0	1	2	3	4	5	6	7	8	9	10
no depression	**Mild depression**			**Moderate depression**			**Worst depression possible**			
(1)	(2)			(3)			(4)			

Section C

3.1 Have you ever experienced musculoskeletal pain while attending WIL?

Yes (1)	NO(2)

3.2 Please indicate your experience of musculoskeletal disorder below ***((If participants indicated they did not have musculoskeletal pain, I inserted "0" on the following questions).***

HAVE YOU AT ANYTIME DURING THE LAST 12 MONTHS HAD TROUBLE *(for example* aching, pains, discomfort*)* IN... **3.2(a)**	**To be answered only by those who have suffered in some way** Have you at anytime during the last 12 months been prevented from doing normal work because of the trouble? **3.2 (b)**	Have you had any trouble at anytime during the last 7 days? **3.2(c)**
3.2.1.NECK NO (2) YES (1)	NO (2) YES (1)	NO (2) YES (1)
3.2.2. SHOULDER NO (2) (1) Yes Right shoulder (3) Yes, left shoulder (4) Yes, both shoulders	NO (2) YES (1)	NO (2) YES (1)
3.2.3. ELBOWS NO (2) (1) Yes Right elbow (3) Yes, left elbow (4) Yes, both elbows	NO (2) YES (1)	NO (2) YES (1)
3.2.4. WRISTS/HANDS NO (2) (1) Right wrist/hand (3) Yes, wrist/hand (4) Yes, wrists/hands	NO (2) YES (1)	NO (2) YES (1)
3.2.5. UPPER BACK NO (2) YES (1)	NO (2) YES (1)	NO (2) YES (1)
3.2.6. LOWER BACK NO (2) YES (1)	NO (2) YES (1)	NO (2) YES (1)
3.2.7. ONE/BOTH THIGHS NO (2) YES (1)	NO (2) YES (1)	NO (2) YES (1)
3.2.8. ONE/BOTH KNEES NO (2) YES (1)	NO (2) YES (1)	NO (2) YES (1)
3.2.9.ONE/BOTH ANKLES/FEET NO (2) YES (1)	NO (2) YES (1)	NO (2) YES (1)

Section D

4.1 Have you ever be absent at work due to your musculoskeletal pains?

Yes	(1)
No	(2)

4.2 If YES to question 4.1, how many days? _____ days

(1) =0 days
2= 1-5 days
3= 6-9 days
4= 10+ days

4.3 Have you ever consider changing the radiography profession as a result of your musculoskeletal pains?

Yes	(1)
No	(2)

4.4 Have you ever been to a medical professional for Musculoskeletal pain?

Yes	(1)
No	(2)

4.5 Have you ever been admitted to the hospital because of your musculoskeletal pains?

Yes	(1)
No	(2)

THE END

THANK YOU FOR PARTICIPATING IN THIS STYUDY

Appendix I: Statistician Invoice

Gill Hendry B.Sc. (Honours), M.Sc. (Wits); PhD (UKZN)
Mathematical and Statistical Services

Cell: 083 300 9896
Email: gillhendrystats@gmail.com

Invoice No.

22745

INVOICE

Customer

Name Siyanda Masondo

Date 24 March 2022

Description	TOTAL
Check current analysis and redo, where necessary (13 hrs)	R
Less discount	R

TOTAL R