DEVELOPMENT OF A MULTIFACETED ERGONOMIC EDUCATIONAL PROGRAM TO PREVENT WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG NURSES IN INTERMEDIATE PUBLIC HOSPITALS IN NAMIBIA

A DISSERTATION SUBMITTED IN FULFILMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY IN PUBLIC HEALTH

OF

THE UNIVERSITY OF NAMIBIA

BY

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OCTOBER 2025

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ABSTRACT

Work-related Musculoskeletal Disorders (WRMSDs) are impairments, discomfort, disability, and persistent pain in joints, muscles, bones, ligaments, and tendons. Globally, WRMSDs are common problems and prevalent in the nursing profession. The WRMSDs among nurses have been observed and documented in the Namibian context at some Intermediate Hospitals (IHs), despite the efforts made by the Ministry of Health and Social Services (MoHSS) to develop an Occupational Health and Safety (OHS) policy aimed at preventing WRMSDs in health care workers. The individual OHS policies or single ergonomic interventions have failed to reduce WRMSDs because these disorders are multifactorial in nature and require multiple interventions to address them. This study aimed develop a multifaceted ergonomic educational program to prevent WRMSDs among nurses in IHs in Namibia. The study utilized an explanatory sequential study design with a mixed method approach, comprising quantitative (cross-sectional) and qualitative (exploitative-descriptive) components. The self-administered Standardized Nordic Musculoskeletal Questionnaire was used to collect data from 808 randomly selected nurses at IHs Katutura, Onandjokwe, Oshakati, and Rundu. An interview guide was used to collect data from purposively sampled OHS key informants from MoHSS and nurses at IHs. SPSS Statistics 26 was used for descriptive statistical analysis. The relationship between the independent and dependent variables was analysed using multiple logistic regression analysis, while the interviews were analysed using inductive thematic analysis. The 12-month prevalence rate of WRMSDs among nurses was highest at Katutura Intermediate Hospital (76%), followed by Oshakati (73%), Rundu (69%), and Onandjokwe (65%). Over the 12-month period, the lower back was the most affected body part by WRMSDs, with prevalence rates at Katutura (74%), Onandjokwe (72%), Rundu (71%), and Oshakati (69%) Intermediate Hospitals, respectively. Age, years of experience, high workloads, repetitive manual tasks, awkward postures, manual handling, extensive standing, and sitting were strongly associated with the development of WRMSDs among nurses ($p \leq 0.005$) across all IHs. The study developed a multifaceted ergonomic educational program with five key elements: adequate staffing; training; promotion of physical activity, healthy lifestyles, and hazard analysis; pre-employment screening; and work and equipment modification. The program was evaluated

using the Centres for Disease Control and Prevention (CDC) framework for program evaluation. It was concluded that WRMSDs are a prevalent health problem among nurses at all IHs in Namibia. It is recommended that MoHSS implement the program as it could prevent WRMSDs among nurses and ensure a healthy working team. Further studies are recommended to assess the long-term impact and sustainability of the program in diverse healthcare settings.

Keywords: Educational Program; Ergonomics; Musculoskeletal Disorders; Namibia; Nurses; Occupational Health; Prevention Strategies; Program Development; Public Hospitals; Work-Related Injuries.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND/ OR ACRONYMS

CDC	Centres for Disease Control and Prevention
CTS	Carpal Tunnel Syndrome
DEC	Decentralized Ethical Committee
ED	Executive Director
EHPP	Early Help Prevention and Partnership
GBD	Global Burden of Diseases
HIS	Health Information Systems
ID	Infectious Diseases
IH	Intermediate Hospital
IHs	Intermediate Hospitals
MoHSS	Ministry of Health and Social Services
MSDs	Musculoskeletal Disorders
NCD	Non- Communicable Diseases
NIOSH	National Institute for Occupational Safety and Health
NMQ	Nordic Musculoskeletal Questionnaire
OHS	Occupational Health and Safety
PPE	Provision of Personal Protective Equipment
SADC	Southern African Development Community

S-NMQ	Standardized Nordic Musculoskeletal Questionnaire
TOS	Thoracic Outlet Syndrome
UNAM	University of Namibia
USA	United States of America
WHO	World Health Organization
WRMSDs	Work-related musculoskeletal disorders
MSDs	Musculoskeletal disorders

ACKNOWLEDGEMENTS

I thank God and Jesus Christus, for giving me wisdom, strength, and perseverance to continue with this study until its completion. My heartfelt thanks go to my family for their support and encouragement throughout my study. Special thanks go to my late supervisor Dr Penehafo Angula, my main supervisor, Prof. H. K. Mitonga, and my co-supervisor, Dr. M. Chirimbana, for their guidance and excellent supervision during my study.

DEDICATION

This study is dedicated to the family I have created.

DECLARATIONS

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Ananias Akweetelela Date

CHAPTER 1

INTRODUCTION AND BACKGROUND OF THE STUDY

1.1 INTRODUCTION

Musculoskeletal Disorders (MSDs) have long been recognized as a major cause of occupational ill-health (1) The earliest scientific observation of MSDs in the workplace was documented by Italian physician Bernardino Ramazzini in the early 18th century, in his pioneering work De Morbis Artificum Diatriba (Diseases of Workers), where he described musculoskeletal complaints among manual laborers (1).The MSDs) refer to impairments, discomfort, disability, and persistent pain affecting the joints, muscles, bones, ligaments, and tendons (2,3). These disorders can result from various factors such as repetitive strain, trauma, aging, or systemic conditions. However, when MSDs are caused or aggravated by work-related factors (physical, ergonomic, and psychosocial), they are referred to as Work-related Musculoskeletal Disorders (WRMSDs) (4).

The WRMSDs are common workplace health problems (5,6). The WRMSDs are a significant concern in occupational health, particularly in physically demanding professions like nursing(5,6). WRMSDs are biomechanical in nature, meaning that an employee's body is at risk for injury as they complete their job duties (7,8). The development of WRMSDs is based on the interaction of genetic, morphological, psychophysical and biomechanical factors (7–9). Within each of these categories are many variables and risk factors that create and enable the occurrence of WRMSDs. The development of WRMSDs occurs when there is a disruption of mechanical order within the human biological system (human body) (7,8).

Considering biomechanical factors, when the demand on the body is required to exert excessive force, perform repetitive tasks, or assume postures for extended periods, the muscles and skeletal system are stressed and ultimately develop WRMSDs (8). Regarding psychophysical factors, when employees are understaffed, overloaded with work, or working in poor conditions, they tend to develop stress and burnout, which have long term negative consequences, including the development of WRMSDs (10,11).

The WRMSDs are often occur in the hands, elbows, wrists, neck, and shoulders (12). WRMSDs are categorised into three categories: tendon injury, muscle injury, and nerve injury. Common types of WRMSDs include tendonitis, carpal tunnel syndrome (CTS), back pain, and thoracic outlet syndrome (TOS) (4,12,13). WRMSDs among nurses have also been observed and documented in the Namibian context (14–16).

A recent systematic review recommended a multifaceted ergonomic program that includes components such as knowledge and training about ergonomics, workstation modification, training and surveying ergonomics in the workplace, and regular exercise as one of the effective programs to prevent WRMSDs among nurses at work place (17,18). Therefore, the researcher intends to address this gap by developing a multifaceted ergonomic educational program in Namibia.

1.2 BACKGROUND INFORMATION

WRMSDs were first discovered during the 19th century among industrial workers in Great Britain (1). Over decades, high rates of workplace injuries related to MSDs have been reported in both developed and developing countries. Currently, WRMSDs are a serious

global concern to many organisations, including industries, insurance and health care. These disorders have a high prevalence in countries around the world (1,9).

Although WRMSDs are preventable and treatable, the Global Burden of Diseases (GBD) and World Health Organisation (WHO) revealed in 2021 that around 1.71 billon people have WRMSDs worldwide, leading to disabilities in 160 countries (5). The GBD and WHO further indicated that WRMSDs significantly limit mobility and dexterity, leading to early retirement from work, lower levels of well-being, and reduced ability to participate in society (5). The WRMSDs lead to permanent disability, loss of work hours, medical expenses, and reduced quality of life for those affected (3,19,20). Worldwide, the nursing profession is particularly prone to WRMSDs due to awkward body positions held for extended periods, repetitive movements, and unsafe working conditions (5,9).

According to reported data from around the world, WRMSDs among nurses in various regions are recorded as follows: In Europe WRMSDS ranged from 10% to 50% in France, 89% in Portugal, and 85% in Macedonia; in the Americas, from 35.1% to 47% in the USA and from 32.8% to 57.1 in Brazil; in Asia, 78.6% in China, 85% in Saudi Arabia, 88% in Iran; and in Africa, 80.8% in Uganda (9,14).

The prevalence rate of WRMSDs among nurses worldwide range from 28% to 96% (5,9). The prevalence of WRMSDs is increasing and underreported in low- and middle-income countries, including Africa, because WRMSDs are less prioritised and empirically underrepresented (5,21). This is due to these countries focusing on what they consider more pressing and life-threatening health issues such as non-communicable diseases (NCD) and infection diseases(ID) (5,21). Studies conducted in Africa, including the SADC region, have shown the prevalence of WRMSDs among nurses in some individual public hospitals as

follows: 80.6 in Sub-Saharan Africa, 76.6% in Fako, Cameroon, 82.1% in a large central hospital in Harare, Zimbabwe, 84% in a high-acuity area in a tertiary hospital in South Africa, and 78.2% in Katutura Intermediate Hospital, Namibia (2,4,6,14).

Differences in the estimated prevalence of WRMSDs across countries may reflect differences in working environments, facilities, and the nature of the work, leading to inconsistent reporting of risk factors (4). For example, in Pakistan, risk factors for WRMSDs among nurses include working in the same positions for long periods and attending to an excessive number of patients per day (22). In China, staff shortages and a large number of patients mean that the most common risk factors are a heavy workload and repetitive movements (4).

It is recommended that in every occupational setting, a detailed job analysis be conducted first, to identify all salient risk factors. Following this, a suitable multifaceted ergonomic educational or interventional program should be designed to address all issues that may contribute to WRMSDs (23) Literatures has shown that, considering the higher prevalence of WRMSDs in the nursing profession, applying a multifaceted ergonomic educational and/or interventional program to improve the working conditions of nurses is highly important and more effective compared to single-intervention programs (24).

For example, a single intervention program focused on patient-handling techniques was developed in Hong Kong, China, to prevent WRMSDs of the upper and lower back pain among nurses. However, it failed and the prevalence of WRMSDs remained at 71.2% (25). A study conducted in Turkey in 2020 on the effects of multifaceted ergonomic interventions of musculoskeletal complaints in intensive care units suggested that individual interventions are unlikely to succeed in eliminating WRMSDs (17). Similarly, a study evaluating the

effectiveness of a single intervention program among home care nurses and nurses' aides in Denmark, found no significant difference between the intervention and control groups in terms of WRMSDs prevalence (25).

In contrast, WRMSDs are multifactorial in nature, thus multifaceted ergonomic educational and/or interventional programs have demonstrated a significant reduction in WRMSDs among nurses in many countries (17,18). For example, a study that systematically reviewed 2796 papers, selecting 63 of them, highlighted that multifaceted ergonomic educational programs and/or interventions were beneficial and successful in preventing WRMSDs among nurses, compared to interventions focused on specific programs such as educational training (17). It is recommended that multifaceted ergonomic educational and/ or intervention programs and/or strategies should include elements of engineering controls, administrative controls, as well as training and/or education (26). A study conducted in Turkey in 2020 on the effects of multifaceted ergonomic interventions on musculoskeletal complaints in intensive care units revealed a significant reduction in WRMSDs ($p<0.001$) (17). In Iran, a study on the effect of a multifaceted ergonomic educational and/or intervention program on reducing WRMSDs among healthcare workers proved that such a program can decrease the prevalence of WRMSDs among health care workers (18).

WRMSDs have been recorded in public hospitals in Namibia (14,15,27), but no studies have focused on the development of a multifaceted ergonomic program to prevent WRMSDs. Therefore, the current study seeks to develop a multifaceted ergonomic educational program to prevent work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia.

1.3 STATEMENT OF THE PROBLEM

Nurses at Intermediate Hospitals (IHs) in Namibia are understaffed and overloaded. Due to the shortage of referral state hospitals in the country, district hospitals have been increasingly overwhelmed with referral patients to IHs (28). Working in poor conditions, such as prolonged standing, repetitive movements, and manual handling, place continuous stress on the body and contribute to the development of WRMSDs (29–31) According to the multifactorial model, these physical demands, when combined with psychological pressures such as heavy workloads and low job control, increase strain on the muscles and reduce the body's ability to recover. This interaction leads to fatigue, injury, and long-term pain, all of which are common features of WRMSDs(29–31). In 2020, the Namibian IHs Health Information Systems (HIS) reported that nurses were recorded as MSD patients, being part of the 13,426 outpatients and 8635 inpatients treated for musculoskeletal related conditions at all His (14,15). A study conducted on MSDs at Intermediate Hospital (IH) Katutura in Namibia revealed a high prevalence of 78.2% of nurses with WRMSDs(14). A similar exploratory case study on the well-being of nurses working in the casualty unit at a state hospital in Windhoek, indicated that nurses at IH Katutura are suffering from WRMSDs, such as back pain and neck pain (27). Another study at IH Onandjokwe in Namibia revealed that at least 15 nurses in each department complained of WRMSDs (15). Although the Namibian Labour Act No. 11 of 2007 mandates that employees should work in a safe workplace that does not adversely affect their health, nurses in IHs continue to suffer from painful WRMSDs (32). WRMSDs have resulted in nurses at IHs in Namibia experiencing painful disorders, poor work performance, stress, psychosocial problems, and resignation to other ministries for alternative job opportunities (14,27). In response, the Ministry of Health

and Social Services (MoHSS) developed an Occupational Health and Safety (OHS) policy to guide WRMSD prevention among healthcare workers. However, the prevalence of WRMSDs continues to rise, indicating the limited effectiveness of current intervention (15). In the same vein, the IHs in Namibia lack ergonomic education to address WRMSDs. Critically, the lack of ergonomic knowledge and awareness of multifactorial risk factors among nurses contributes significantly to the development of WRMSDs. Without proper training or education on ergonomic principles such as safe posture, manual handling techniques, and the risks of repetitive movements nurses are unable to identify and manage these hazards effectively in their daily work (14).

Despite evidence showing that multifaceted ergonomic educational approaches can significantly reduce WRMSD prevalence and risk levels ($p = 0.03$), IHs in Namibia still lack such programs (24,33). The reliance on single interventions has proven insufficient, as WRMSDs are multifactorial and require integrated solutions (24,33). To date, no study in Namibia has developed a multifaceted ergonomic educational program tailored to the unique challenges faced by nurses in IHs. This represents a clear knowledge gap. Therefore, this study was proposed to develop a multifaceted ergonomic educational program aimed at preventing WRMSDs among nurses in Intermediate Hospitals in Namibia, ultimately improving occupational health, and nurse well-being.

1.4 THE PURPOSE OF THE STUDY

The purpose of the study was to develop a Multifaceted Ergonomic Educational Program to prevent Work-related Musculoskeletal Disorders among nurses in intermediate public hospitals in Namibia.

1.5 OBJECTIVES OF THE STUDY

The objectives of this study were to:

1. Determine the prevalence of work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia (Phase I).
2. Determine and describe the risk factors associated with work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia (Phase I).
3. Explore the ergonomic interventions that may be suitable and effective in addressing identified risk factors to prevent work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia (Phase II).
4. Develop a multifaceted ergonomic educational program to prevent work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia (Phase III).
5. Evaluate the readiness and applicability of a multifaceted ergonomic educational program (Phase IV).

1.6 RESEARCH QUESTIONS

The research questions were:

1. What is the prevalence of work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia?
2. What are the risk factors associated with work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia?

3. What ergonomic interventions are considered suitable and effective in addressing the identified risk factors to prevent WRMSDs among nurses in intermediate public hospitals?
4. How can a multifaceted ergonomic educational program be developed to address and prevent WRMSDs among nurses in intermediate public hospitals in Namibia?
5. How ready and applicable is the developed multifaceted ergonomic educational program for implementation in intermediate public hospitals in Namibia?

1.7 SIGNIFICANCE OF THE STUDY

The following groups were found to benefit directly from the results of this study:

Benefits to the Ministry of Health and Social Services

The study generated new knowledge by creating a Multifaceted Ergonomic Educational Program that could serve as a tool to guide MoHSS in ensuring health and safety and preventing WRMSDs among nurses.

Benefits to the Nurses at Intermediate Public Hospitals

Nurses may directly benefit from the Multifaceted Ergonomic Educational Program if they fully conform to and implement it. The program has the potential to prevent WRMSDs among nurses, thereby ensuring a healthier workforce with an improved quality of life and higher productivity in serving the public.

Benefits to Public Health

The study generated baseline information on the prevalence and risk factors of WRMSDs among nurses at IHs in Namibia, as well as baseline information on interventions to prevent WRMSDs among nurses. It also opens new areas for further research in the field of public

health. Nurses are likely to be present at work and attend to their patients effectively, as they will not need to seek medical attention for WRMSDs, thanks to the preventive measures of the study programme.

1.8 DESCRIPTION OF THE AREA OF STUDY

The study was conducted in four regions of Namibia Khomas, Oshikoto, Oshana, and Kavango East where the country's four Intermediate Public Hospitals (IHs) are located. Data were collected from nurses working at Katutura, Onandjokwe, Oshakati, and Rundu Intermediate Hospitals, as well as from key informants in the Occupational Health and Safety (OHS) division at the Ministry of Health and Social Services (MoHSS) headquarters. Katutura Intermediate Hospital, located in Windhoek in the Khomas Region, is one of Namibia's largest referral hospitals. It offers a wide range of services, including general medicine, surgery, paediatrics, obstetrics, and emergency care, and serves a diverse population from the capital city and surrounding areas. The Khomas Region has an estimated population of 494,604 (34). Onandjokwe Intermediate Hospital is situated in the Oshikoto Region and serves as a referral facility for several northern districts. It has a strong emphasis on general medical and surgical care, maternal health services, and outpatient consultations. The region's population is approximately 257,302 (34). Oshakati Intermediate Hospital, located in the Oshana Region, is a major referral hospital serving central northern Namibia. It provides a full range of inpatient and outpatient services and acts as a regional training and coordination centre. The Oshana Region has a population of 102,881 (34). Rundu Intermediate Hospital is based in the Kavango East Region, serving a large catchment area

in the northeast of Namibia. It plays a key role in delivering emergency, medical, and surgical services in a region with a population of approximately 218,421 (35).

All four hospitals are part of Namibia's public healthcare referral system and receive patients from surrounding district and regional hospitals. These settings were selected due to their high nurse workloads, diverse patient populations, and central role in delivering healthcare services in their respective regions.

The location of the study areas is shown in Figure 1 below.

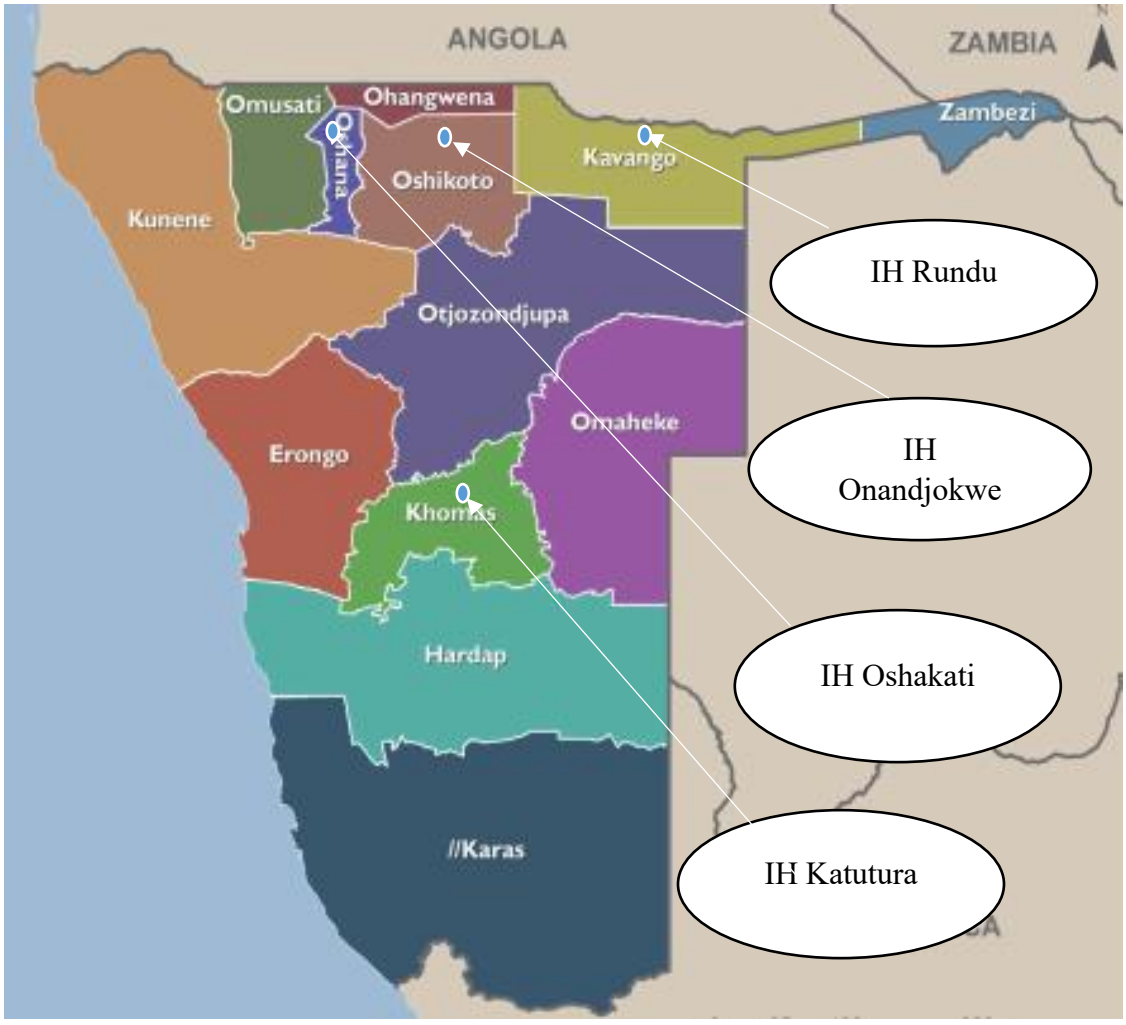

Figure 1: The study areas' regions on the map of Namibia(36).

1.9 PARADIGMATIC PERSPECTIVE

Paradigms are crucial components of research that researchers need to understand. A paradigm refers to a framework for interpreting the world, encompassing a common viewpoint on the complexities of the world and the shared beliefs and values of the researcher (37). It is also referred to as a basic set of beliefs or a worldview that guides research actions or investigations (38). Paradigms influence the nature of the phenomena to be studied as well as the methods and techniques used during research (39). Therefore, all research should be conducted within a specific paradigm (37). In this study, a paradigm was used to understand the worldview and philosophical assumptions as described below.

1.9.1 Worldview

Worldviews are basic belief systems that influence researcher's choice of assumptions and the subsequent methodology of research (39). There are four recognised worldviews: positivism, critical/transformative, interpretivism or constructivism, and pragmatism (37). The pragmatism worldview was used in this study. Pragmatists advocate an approach in which both positivist and interpretivism paradigms are used, resulting in a mixed-method approach (37). Pragmatism is defined as a worldview that focuses on the importance of the question being asked rather than the method used (40). It considers multiple methods of data collection to address the problem under study and the consequences of research (37).

Pragmatism focuses on what works best by using various approaches to achieve the study's aims (41). It combines deductive and inductive reasoning, as quantitative and qualitative data are mixed (37). The quantitative approach is based on the positivist paradigm, where the investigator uses positivist claims to develop knowledge (39). This approach employs

strategies such as experiments and surveys and collects data through predetermined instruments that yield statistical results (37). The qualitative approach, grounded in interpretivism, seeks to acquire knowledge by deeply investigating and analysing phenomena to produce a descriptive analysis and a thorough understanding of those phenomena (41). In this study, the researcher collects open-ended data with the primary aim of developing themes from the data.

In this study, the pragmatism guided the research process and by adopting both quantitative and qualitative approaches in a non-singular reality (38). After data collection, the findings were merged into a single analysis and used for the development of the multifaceted ergonomic educational program to prevent work-related musculoskeletal disorders among nurses at intermediate hospitals in Namibia. Philosophical assumptions were employed to explore the participants' experiences, influencing the methodological assumptions regarding the structure of the study. The pragmatism worldview was used to achieve the objectives of this study, based on the four philosophical assumptions described below.

1.9.2 Philosophical assumptions

It is crucial to have a firm understanding of philosophical assumptions because they comprise the basic assumptions, beliefs, norms, and values held by each paradigm (39). These assumptions are important because, when made explicit, they reveal the underlying beliefs researchers have about their research. This, in turn, influences choices related to the research's purpose, design, methodology, data analysis and interpretation (37). The following philosophical assumptions were used in this study:

1.9.2.1 Ontology

Ontological assumptions concern what constitutes reality and its characteristics (37). The information obtained from participants indicates that reality is multifaceted (38). Ontology is a philosophical belief system that concerns the nature of social reality – what can be known and how it can be known (41).

In this study, the reality was discovered based on the prevalence, and risk factors associated with the development of work-related musculoskeletal disorders (WRMSDs) among nurses at intermediate hospitals in Namibia. This was achieved through a self-administered questionnaire distributed to study respondents from Intermediate Hospitals (IHs) Katutura, Onandjokwe, Oshakati, and Rundu. The aim was to understand the prevalence of WRMSDs among nurses, and the risk factors contributing to these disorders. The reality was also examined by exploring information about interventions used to prevent WRMSDs among nurses at IHs. This was achieved through a semi-structure interviewed guide with participants from IHs and from MoHSS, specifically an occupational health key informant. The goal was to understand what interventions had been implemented but failed to prevent WRMSDs among nurses, in order to discover suitable multifaceted interventions to address the problem.

1.9.2.2 Epistemology

Epistemology is concerned with the acquisition of knowledge and the relationship between the researcher and the researched (37). It is deals with what counts as knowledge and how to justify claimed knowledge (37). It attempts to answer questions about the relationship between the researcher and the subject of study (40). In the epistemological assumptions,

researchers strive to get as close to the respondents being studied as possible (39). Subjective evidence is gathered from participants to help the researcher bridge the gap between themselves and the subject being studied (41).

In this study, knowledge was gathered by reviewing relevant research articles on the following topics: risk factors associated with the development of WRMSDs among nurses, prevalence of WRMSDs among nurses, multifaceted ergonomic interventions to prevent WRMSDS among nurses, and the history of WRMSDs in hospital settings in Namibia, as illustrated in Chapter 2. Knowledge was also gained using an interview guide that explored interventions to prevent WRMSDs among nurses, and through a questionnaire that assessed the prevalence and risk factors associated with the development of WRMSDs among nurses in IHs in Namibia. Epistemologically, the thoughts and experiences of nurses working in intermediate public hospitals, as well as information from key informant OHS personnel at MoHSS, were valuable in creating an effective multifaceted ergonomic educational program. The integration of these two sets of data through an interpretive process by the researcher generated new knowledge in the form of a program that can prevent prevalence and incidence of WRMSDs among nurses.

1.9.2.3 Axiology

Axiology is concerned with the role of values in research and the various perspectives employed (41). The axiology assumption addresses the researcher's ethical and moral behaviours, and how these values influence the research question and design (40).

After obtaining ethical approval from the University of Namibia and MoHSS, the researcher adhered to ethical guidelines to determine and describe the prevalence and risk factors associated with the development of WRMSDs, and to explore suitable interventions to prevent WRMSDs among nurses at IHs in Namibia. Ethical principles such as non-maleficence, beneficence and justice, as well as respect for persons (including informed consent, the right to withdraw, privacy, anonymity and confidentiality), were observed during this study. Informed consent forms were provided and signed by study respondents and participants. The researcher explained that the data obtained would be kept private and that only the researcher and his supervisors would have access to it.

Values are important in interpreting the results for positivist assumptions. The researcher avoided influencing the study results by remaining neutral regarding the respondents' knowledge on the prevalence and risk factors of WRMSDs, as well as on interventions to prevent WRMSDs among nurses. Maintaining a neutral position allowed the researcher to avoid bias, which could have influenced the study's findings. The researcher upheld ethical values throughout the research process by being objective in data collection, data analysis, and results interpretations.

1.9.2.4 Methodology

The methodological assumption refers to the process of conducting research, including selecting the appropriate approach, instruments, data collection methods, and data analysis techniques (37). Every study requires a methodological assumption because the quality of research findings depends on the methodological procedures used by the researcher (40).

The researcher adopted a pragmatic approach to addressing the research objectives. Both objective and subjective data were collected, as factors contributing to the development of WRMSDs are both objective and subjective in nature. Consequently, the study employed an explanatory sequential mixed-method design, which included quantitative (cross-sectional) and qualitative (exploratory, descriptive) components. The cross-sectional study, using a self-administered questionnaire for data collection and SPSS for data analysis, was useful in determining and describing the prevalence and risk factors associated with WRMSDs among nurses at IHs in Namibia. The qualitative study, using a semi-structured interview guide for data collection and ATLAS.ti 23 for data analysis, was useful in exploring multifaceted interventions to prevent WRMSDs among nurses in IHs in Namibia.

1.10 THEORETICAL BASIS OF THE STUDY AND CONCEPTUAL FRAMEWORK

The theoretical foundation is an important component of research, as it guides the research process (42). It includes frameworks, models, and theories that already exist within scientific disciplines (41). The theoretical framework connects the researcher to existing knowledge (37). Models are crucial in research as they guide both theory development and research design. Meanwhile, theories serve as the foundation for scientific explanation, understanding and prediction of phenomena of interest in research (37). In this study, the following theories and frameworks were employed during various phases:

1.10.1 Biomechanical-Structural Model

The study utilised the Biomechanical-Structural Model of prevention for musculoskeletal disorders as its theoretical framework (43). This model was used to guide the development

of multiple interventions to be incorporated into the multifaceted ergonomic educational program, as described in Chapter 2 the literature review.

1.10.2 The framework of contributors to musculoskeletal disorders

The study applied the "Framework of Contributors to Musculoskeletal Disorders" developed by the National Academy of Sciences (44). This framework provided guidance for the development of data collection tools (including a self-administered questionnaire and questions for a semi-structured interview guide), aimed at identifying risk factors associated with the development of WRMSDs among nurses, as discussed in more detail in Chapter 2 of the literature review.

1.10.3 Centre for Disease Control and Prevention (CDC) framework for program evaluation

The six steps of the CDC framework for program evaluation in public health were adopted for evaluating the program (45). The framework includes several participants and criteria that need to be followed during the evaluation, which are fully described in Chapter 7. The multifaceted ergonomic educational program was evaluated by four individual expert ergonomists from different countries.

1.11 DEFINITION OF KEY CONCEPTS

The following concepts were adopted and hereafter operationally defined:

Multifaceted ergonomic educational program

In this study, a multifaceted ergonomic educational program refers to a structured intervention developed based on the study findings to address the multiple risk factors contributing to Work-Related Musculoskeletal Disorders (WRMSDs) among nurses in Namibia's intermediate public hospitals. It consists of five key components: adequate staffing; training on ergonomic practices; promotion of physical activity, healthy lifestyles, and ergonomic hazard analysis; pre-employment screening; and workplace and equipment modification. The program is termed "multifaceted" because it combines several integrated strategies to prevent WRMSDs holistically rather than relying on a single intervention (18).

Work-related musculoskeletal disorders

Work-related musculoskeletal disorders refer to impairments, discomfort, disability, and persistent pain in joints, muscles, bones, ligaments, and tendons, with or without physical manifestations (3,33,46). In this study, it refers to the same conditions, but specifically those that develop as a result of nurses being exposed to work-related risk factors. Examples of common WRMSDs' include low back pain, neck pain, shoulder pain, repetitive strain injuries, and joint pain (knees, wrists and other joints).

Nurses

"Nurses" refers to fully trained and licensed personnel who provide medical care for sick or disabled people in hospital settings (47).

In this study, "nurses" refers to fully trained, registered, and licensed professional nurses who are employed in Namibia's four intermediate public hospitals (Katutura, Onandjokwe, Oshakati, and Rundu). These individuals were directly involved in patient care and met the study's inclusion criteria, having worked at their respective hospitals for one year or more during the data collection period.

Intermediate Hospitals (IHs)

In this study, Intermediate Hospitals (IHs) refers to the four public hospitals in Namibia (Katutura, Oshakati, Onandjokwe, and Rundu) that receive and serve all medically complex referral patients from district hospitals across Namibia (35).

Risk factors

Risk factors are defined as any characteristic, attribute, or exposure of an individual that increases the likelihood of developing an injury or a disease (48) In this study risk factors refer to factors in hospital settings such as:

- Physical risk factors like repetitive manual tasks, extensive sitting, extensive standing, awkward postures, and manual handling of items, including patient handling.
- Job content-related factors such as high workloads, tight deadlines, and lack of control over the work and working methods.

- Organisational characteristics such as poor working relationships with supervisors and colleagues, financially demoralisation, poor work/rest cycle and poor community support.

These factors are likely to put nurses at risk of developing WRMSDs (30,49).

Ergonomics

"Ergon" means work, and "nomos" implying natural laws; together they mean the "science of work". Ergonomics is the study of minimizing injuries by preserving workers' physical well-being through the efficient design of workstations, tools, jobs, and equipment, thereby improving workers' productivity (50).

Understaffing

Understaffing is the state in which an organisation lacks the number of workers necessary to carry out its duties effectively. Understaffing in nursing occurs when there are staff shortages because there are not enough nurses to do the job (51).

Work overload

Work overload occurs when an individual has more work than they can possibly complete in a given period of time (27).

1.12 DISSERTATION ORGANISATION

This study commenced with Chapter 1, which described the introduction and background of the study. Chapter 2 followed with a review of related literature, and Chapter 3 highlighted the research designs and methodology utilised in this study. Chapter 4 presented the quantitative results, qualitative results, and the integration of these results. Chapter 5

discussed the study results in relation to related literature. Chapter 6 outlined the steps and procedures for developing the multifaceted ergonomic educational program to prevent work-related musculoskeletal disorders among nurses at intermediate hospitals in Namibia. Chapter 7 described the process for evaluating the readiness and applicability of the multifaceted ergonomic educational program, developed in Chapter 6. Finally, Chapter 8 covered the conclusion, limitations, recommendations of the study, contributions to the body of knowledge, and the way forward.

1.13 SUMMARY

This chapter provided an orientation to the study, discussing the problem statement, purpose of the study, significance of the study, assumptions of the study, framework and theoretical basis, and a description of the study area. The next chapter, Chapter 2, will review the related literature relevant to this study.

CHAPTER 2

REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

The literature review sets the stage for any scientific research, states the theorem, and identifies gaps that are critical to be filled by the outcome of the study (52). The literature review was conducted to gain insight and validate information obtained from questionnaires and interviews. Information was taken from various literature sources, such as peer-reviewed journals, reports, theses, and books. The focus was to explore data from Africa and other parts of the world on the prevalence and risk factors associated with work-related musculoskeletal disorders (WRMSDs), and interventions or programs to prevent such disorders among nurses. It was also intended to firmly integrate the study into existing knowledge, theories, and theoretical frameworks. The specific focus of the literature review was to determine the prevalence of WRMSDs among nurses, describe the risk factors associated with WRMSDs among nurses, and explore ergonomic interventions that may be suitable and effective in addressing these risk factors to prevent work-related musculoskeletal disorders among nurses.

2.2 THE PREVALENCE OF WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG NURSES

2.2.1 The Prevalence of WRMSDs Over a 12-Month Period in Any Body Part/Region Among Nurses

Work-related musculoskeletal disorders (WRMSDs) is a broad term used to describe harmful conditions caused by the overuse of muscles, ligaments, nerves, tendons, joints, and supporting blood vessels because of work-related activities. Some authors also defined WRMSDs as impairments, discomfort, disability, and persistent pain in joints, muscles, bones, ligaments, and tendons, with or without physical manifestations, where the most common symptom is pain (2,3). The term WRMSDs is synonymous with musculoskeletal injuries. WRMSDs were identified as early as the 18th century by Ramazzini, who described classical cases of such injuries in his book (53). The WRMSDs are further classified as specific and non-specific disorders (53). Specific WRMSDs have clear clinical features, while non-specific WRMSDs present with pain without evidence of a specific disorder (53). Examples of specific WRMSDs include carpal tunnel syndrome, tendinitis, and many more, while examples of non-specific WRMSDs include, but are not limited to, low back pain, shoulder pain, repetitive strain injuries, join pains (knees, wrists and other joints) (4,54–57)**.**

Currently, WRMSDs are a serious global concern for many organisations, including industries, insurance, and healthcare (2,3). The WRMSDs are common and prevalent in the nursing profession (4). According to the World Health Organisation (WHO), WRMSD issues worsen when nurses' daily working activities become hectic and stressful, as this

occupation is one of the most physically demanding (55). The WRMSDs are major public health problems because they significantly affect the quality of life of nurses, resulting in various degrees of disability, stress, high treatment costs, increased financial burden, loss of labour time, and decreased productivity. They also contribute to nurses resigning and transferring to other jobs in different industries (53). Therefore, WRMSDs not only impact the health of nurses but also create a burden on the health system, the economics of health institutions, and lead to social and economic costs associated with addressing their consequences (9).

For instance, in Great Britain, between 2016 and 2017, approximately 8.9 million working days were lost due to WRMSDs. In the state of Washington, from 1999 to 2013, WRMSDs accounted for more than 40% of nurses' compensation claims (4) A study conducted among district nurses in Haiphong, Vietnam found that 37.8% of nurses reported that WRMSDs limited their work (9). WRMSDs affecting the spine, shoulder, and back account for about one-third of all cases of sick leave among healthcare staff, including nurses, in Ethiopia (13). A study on emotional distress as a predictor of WRMSDs in Malaysian nursing professionals reported that 75% of nurses experienced emotional distress, anxiety, and stress (58). In Fako, Cameroon, it was reported that WRMSDs slowed down nurses' activities at work and led to a (50%) decrease in the efficiency of nursing care provided (11). Chang and Peng (2021) found that WRMSDs cause nurses to quit their job (59).

Scholars have published that nursing is ranked as the most affected profession, with the highest incidence of WRMSDs compared to other professions worldwide (55,56,60,61). The prevalence of WRMSDs over a 12-month period in any body part among nurses is estimated to range from 40% to 90% globally (9,14,24). According to reported data from around the

world, nurses exhibit a very high prevalence of WRMSDs. In Europe, the prevalence ranges from 10% to 50% in France, 89% in Portugal, and 85% in Macedonia. In Asia, it ranges from 78.6% in China to 88% in Iran and 85% in Saudi Arabia. In the Americas, prevalence ranges from 35.1% to 47% in the United States and from 32.8% to 59.1% in Brazil. In Africa, the prevalence is 80.8% in Uganda (9,14).

A variety of ergonomic studies have published that workplaces in many countries, both developed and developing, have not adapted to changing technological advances, which may contribute to the higher prevalence of WRMSDs among nurses worldwide (55). Additionally, the high prevalence could be attributed to the fact that nursing is one of the most physically demanding occupations, involving excessive manual handling of patients and sometimes awkward postures during operation (2,3,31).

In the context of Africa and the Southern African Development Community (SADC), including Namibia, various scholars have reported a high prevalence of WRMSDs among nurses in hospital settings (4,14,55,56). This is supported by findings by Yizengaw et al., (2021), which reported that the prevalence of WRMSDs in Africa, including the SADC region, ranges from 15% to 93.6% (13).

In the same vein, similar studies have shown the prevalence of WRMSDs among nurses in various individual public hospitals as follows: 80.6% in Sub-Saharan Africa, 76.6% in Fako, Cameroon, 82.1% in a large central hospital in Harare, Zimbabwe, 79% at the Lekma hospital in Ghana, 84% in a high-acuity area of a tertiary hospital in South Africa, and 78.2% in Katutura Intermediate Hospital in Namibia (2,4,6,14,20).

The prevalence of WRMSDs is very high, increasing, and often underreported because WRMSDs remain a lower priority and are empirically underrepresented in many countries, especially in low- and middle-income countries, Africa, and the SADC region at large(5). This happens because these countries tend to focus on what they consider more pressing and life-threatening health issues, such as non-communicable Diseases (NCDs) and Infection Diseases (IDs) (5). In addition, Africa faces a significant disease burden and has a shortage of qualified nurses to address these issues. With nurses making considerable efforts to meet job demands, this situation has contributed to a higher prevalence of WRMSDs among nurses in Africa (6,62).

2.2.2 The Prevalence of WRMSDs In Specific Body Parts And/ Or Regions Among Nurses

WRMSDs are known to affect various parts and/or regions of the human body, leading to pain and/or disorders in areas such as the neck, shoulder, elbow, wrist/hand, upper back, lower back, one or both hips/ thighs/buttocks, one or both knees, and one or both ankles/feet (4,11,13,57).

Studies have shown that the low back, neck, and shoulder are the most commonly affected body parts and/or regions that are recorded to be most prevalent to WRMSDs (56,63,64). Although WRMSDs are most prevalent in the low back, neck, and shoulder, their prevalence in different body regions or parts can vary among nurses (2–4,20,31). This discrepancy is often attributed to organisational differences between hospitals, differences in instrumentation, and cultural differences in the perception and reporting of pain and/or disorders (14).

For example, studies conducted in Asia have shown WRMSDs in at least one body region or part varies between 40% and 95% among the Asian nursing population. In Western populations, low back, neck, and shoulder pain are the most significantly affected areas, with prevalence rates ranging from 29% to 64%, 34% to 63% and 17% to 75%, respectively (65).

Similarly, a study conducted on WRMSDs among intensive care unit nurses in China showed that low back pain was the most commonly reported WRMSD (80.1%), followed by neck pain (78.6%) and shoulder pain (70.4%) (4). In a similar vein, a study on the prevalence of WRMSDs among nurses in Kakamega County, Kenya, reported that the highest prevalence of WRMSDs over a 12-month period by body site was in the low back (79.9%), neck (53.8%), ankles/feet (48.5%), upper back (47.7%), wrist/hands (46.9%), buttocks (38.5%) and elbow (30.8%) (56).

A similar study conducted on the prevalence of WRMSDs among nurses in Malaysia reported a higher prevalence of WRMSDs in the lower back (86.7%), ankles (86.7%), neck (86.0%), shoulders (85.0%), lower legs (84.7%) and upper back (84.3%) (55). Similarly, a study conducted in Ghana among nurses at the Ho Teaching Hospital revealed that the most prevalent WRMSDs by body region were low back pain (73.3), and upper back pain (55.3) (66). Luan et al (2018) reported a high prevalence of WRMSDs over the past 12 months (74.7%), with low back (44.4%) and neck (44.1%) as the most affected body parts among district nurses in Haiphong, Vietnam (9).

In contrast, a narrative literature review conducted on musculoskeletal disorders over 12 months among female nurses in Turku, Finland showed that the knees (7.5%-77%), and ankle/foot regions (3.2%-100%) were the most affected body parts by musculoskeletal disorders, while low back, neck, and shoulder pain were not significantly affected (67).

Even though many studies have shown variations in WRMSDs' development in different body parts, the literature has proven that WRMSDs are most prevalent in the low back, neck, and shoulders (44,53,68). Therefore, low back pain, neck pain, and shoulder pain are the most important WRMSDs in the nursing profession (55,69). These specific body parts are prone to WRMSDs because of the risk factors nurses are exposed to, and due to nurses' various working environments and job demands (psychosocial risk factors) such as stress (54–56). The common issue with these nursing operations is that the lower back, neck, and shoulders remain in the same posture for a long time, necessitating sustained muscle contraction in these area, resulting in fatigue and potential injury (64). Furthermore, an upsurge in the number of critically ill patients and the demands of an aging population have increased the number of procedures executed regularly. These procedures include changing dressings, daily care, and venepunctures. During these procedures, nurses often need to adopt twisting, bending, and head-bowing postures, which leads to lower back, neck, and shoulder pain (64).

Notably, the prevalence of WRMSDs among nurses is well studied, and published; however it differs from country to country, and even from hospital to hospital, due to variations in organisational differences in various hospital settings in terms of infrastructure, technologies, instrumentation, cultural differences in the perception and reporting of pain and/or disorders, and different existing risk factors in various hospitals (70). Hence, there is a knowledge gap regarding the prevalence of WRMSDs among nurses in intermediate hospitals in Namibia. This knowledge is necessary to develop a suitable multifaceted ergonomic educational program to prevent WRMSDs among nurses.

2.3 THE RISK FACTORS ASSOCIATED WITH WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG NURSES

Work-related musculoskeletal disorders (WRMSDS) are known to be caused by many work-related risk factors (4,30,31,57,71). There are two main groups of WRMSDs risk factors: physical (ergonomic) and psychosocial risk factors (66,72–74) Physical risk factors include repetitive manual tasks, extensive sitting and/or standing, awkward postures and manual handling of items, including patient handling. Job content and organisational characteristic risk factors make up the second division of the psychosocial risk factors (2,3,75).

It is very important to differentiate the two main risk factors as they both have the potential to contribute to the development of WRMSDs among nurses, and the way they contribute to WRMSDs may sometime differ (76). This differentiation is necessary as it may help in determining the appropriate interventions for specific risk factors to prevent WRMSDs among nurses (11,29). The risk factors are thus discussed below.

2.3.1 Physical Risk Factors

Many physical factors affect the health of nurses when performing their tasks in the hospital environment (55). Scholars have shown that when workers are exposed to physical work-related risk factors, their bodies begin to develop WRMSDs (13,54,75,77,78).

These risk factors are known as aspects of the tasks and/or jobs that contribute to the development of WRMSDs when they impose biomechanical stress on the worker (8,79). This means that biomechanical stressors are external and internal forces that exert stress on the human body, increasing the incidence of WRMSDs (8,79).

Literature has shown that WRMSDs occur when the applied load on the body exceeds the failure tolerance and/or strength of the supporting tissues (8,43,79). Human body tissue is defined as a group of cells with a similar structure that act together to perform a specific function in the body (80). The tissues referred to and/or affected are muscle, connective, epithelial, and nervous (80). Studies have shown that the physical risk factors are extensive standing, extensive sitting, awkward postures, repetitive manual tasks, and manual handling, including patient handling (4,11,81).

A similar study conducted on prevalence of WRMSDs, psychological, and physical risk factors among nurses in a hospital in Malaysia reported that WRMSDs were mostly associated with physical risk factors (p-Value 0.05) (55). Similarly, a study conducted in Mulago, Uganda, revealed that the occurrence of WRMSDs among nurses was typically associated with physical risk factors (p-value 0.05) (40%) (82). Akodu and Ashalejo (2019) supported in their study on WRMSDs among nurses in southwestern Nigeria that WRMSDs were mostly associated with physical risk factors (76). The following details how each physical risk factor contributes to the development of WRMSDs among nurses.

Extensive standing and/ or sitting

This risk factor exposes nurses to extensive standing and/or sitting for an abnormally long time while performing their nursing duties (53,76). Extensive standing and/or sitting is an abnormal condition that contributes to the development of WRMSDs among nurses because any human body position can cause discomfort and fatigue if maintained for a long period of time (8,79). Various job tasks, including the improper layout of the work area can make nurses adopt improper sitting body positions, and unusual standing postures, which can lead to the development of WRMSDs (14,82).

A study conducted in the United States on evidence of health risks associated with prolonged standing at work and intervention effectiveness has shown ample evidence that prolonged standing at work leads to adverse health outcomes among healthcare workers, mostly nurses (83). A similar study on musculoskeletal disorder risk factors among nurses in a tertiary hospital in India indicated that working in the same position for long periods (37.10%), was among the most significant risk factors contributing to the development of WRMSDs among nurses (57).

Stanchev and Vangelova (2022) conducted a similar study on musculoskeletal disorders in nurses in 19 hospitals in Sofia, Bulgaria. The results indicated that prolonged standing was among the top risk factors contributing to the high prevalence of musculoskeletal disorders (74.2%) among nurses (84). Similarly, a study conducted on WRMSDs among nursing staff at Tanta University Hospital showed that nurses had a high prevalence of WRMSDs (92.3%) in the past 12 months, primarily because they were working in the same positions for long periods (90.8%) and due to twisting and/or bending the back in an awkward way/posture (85.2%)(3). In the same vein, a study on epidemiological patterns of WRMSDs among healthcare workers in five reference hospitals in the city of Douala, Cameroon, revealed that working in the same position for a long time (AOR=2.90; 95% CI=1.74-4.83; p=0.001) was associated with the development of WRMSDs among healthcare workers(85). A similar exploratory case study on the well-being of nurses working in a casualty unit at a state hospital in Windhoek revealed that nurses at IH Katutura are suffering from WRMSDs, including back pain and neck pain, as a result of extended standing (27). A study conducted in Tunisia on the prevalence and risk factors of WRMSDs among hospital staff found that most nurses suffered from WRMSDs due to prolonged sitting and standing, with probability

values of 0.023 and 0.016, respectively (86). This finding is supported by the multivariate interaction theory, which posits that musculoskeletal disorders are caused by multiple factors (8).

Repetitive manual tasks

Repetitive manual tasks involve performing a certain activity at a specific pace of rotation (13,31,46,66,72).

This type of task requires the use of the same group of joints and/or muscles to complete one cycle of a given motion (11,14,87). Although the time required to complete the task may be less than a few minutes, the cycle can continue for several hours (8,14,79).As a result, the body's muscle biological system does not have enough time to recover from such stress, leading to the development of WRMSDs (8,43).

A similar study conducted on risk factors for WRMSDs among nurses in Kakamega County, Kenya, showed that 76.9% of nurses felt that they developed WRMSDs as a result of attending to a higher number of patients and performing manual orthopaedic techniques, and 81.5% of nurses felt that they developed WRMSDs when they did not have a break or pause while working (repetitive manual task without rest) (87).Thus, there was a significant association ($p<0.005$)between not having enough breaks or pauses during working hours and the development of WRMSDs among the study respondents (87).

In a study conducted in Malaysia on risk factors related to lower back disorders at the workplace, repetitive manual tasks were among the top risk factors indicated to cause WRMSDs of low back pain among nurses (88). A similar study conducted on risk factors that might contribute to the development of musculoskeletal disorders among nurses in tertiary hospitals in India indicated that performing the same task repeatedly was among the

top risk factors contributing to the development of WRMSDs among nurses (57). This finding is supported by cumulative load theory, which indicates that musculoskeletal disorders are caused by the repetition of work tasks, contributing to the development of WRMSDs (8).

Manual handling

Manual handling refers to tasks done with hands or related to the use of hands(11,84). Manual handling tasks, including patient handling, involve tasks such as lifting, carrying, pushing, and pulling, which require certain amount of physical effort to complete (79,89). Some work requires high force loads on the human body, but if the amount of force exceeds the workers' physical capacities, it increases the risk of developing WRMSDs (8). This risk factor can also contribute specifically to biomedical damage to connective tissues, ligaments, and tendons, as they are susceptible to acute injury through exposure to high load (79). As a result of exposure to manual handling, pain attributed to an acute injury to ligaments is also likely to be experienced among nurses when large forces are exerted when a joint is at the end range (79).

A study conducted by Ngunde et al. (2020) on the prevalence, risk factors and effects of WRMSDs on nurses in Fako division, Cameroon, reported that the prevalence of WRMSDs (76.6%) was mostly associated with the lifting of patients and heavy objects (11). A study conducted by Ou et al. (2021) on the relationship between musculoskeletal disorders and work performance of nursing staff showed that medium and high workloads were found to increase the risk of musculoskeletal disorders among nurses (90). Aeni et al. (2020) conducted a similar study on the correlation between physical workload and musculoskeletal disorders complaints among nurses at Indramayu District Hospital, and the study showed

that there was a significant correlation (p-value 0.000) between physical workload and musculoskeletal disorder complaints among nurses (91). The heavier the physical workload, the higher the musculoskeletal disorder (87.5%) complaints among nurses (91).

A similar study conducted on the prevalence of WRMSDs among nurses in the selected intellectual disability unit of the Limpopo Province has shown that nurses developed WRMSDs as a results of lifting patients (60). A study on low back pain among nurses working in public hospitals in eastern Ethiopia has shown that manual lifting of weight >10 kg (AOR=5.260; 95% CI (1.869-14.805) and working in awkward postures (AOR=3.93; 95% CI (1.109-13.924) were significantly associated with low back pain among nurses (63). These scientific explanations are supported by the overexertion theory and differential fatigue theory. The overexertion theory suggests that musculoskeletal disorders are caused by the amount of force exerted by the muscle to complete a task. The greater the force that is put on the task, the greater the level of stress that is put on the musculoskeletal system (8). The differential fatigue theory indicates that different tasks require different levels of force and effort to be completed (8).

Awkward posture

Awkward posture is one of the main contributing factors to the development of WRMSDs among nurses (55). Awkward posture means that the body's natural alignment is out of its original position while working for extended periods of time, which puts stress on the body (30,92,93). Awkward postures involve bending, twisting, and extended reach. Static postures are postures that are maintained for any extended period to perform a particular job task, thereby causing certain body muscles to become fatigued as a result of constantly contracting

to hold the position. This increases the chance for the body to develop WRMSDs (14,44,73,94).

A similar study conducted on musculoskeletal disorders in nurses in hospitals by Stanchev and Vangelova (2022) showed a high prevalence of musculoskeletal disorders (74.2%) among nurses from 19 hospitals in Sofia, Bulgaria, as a result of exposure to awkward working postures, bending, twisting, and stretching (84). A study conducted in India on the assessment of risk factors of WRMSDS among healthcare professionals in a tertiary hospital, indicated that working in awkward positions was the main job risk factor contributing to WRMSDs among nurses (57). A study conducted on WRMSDs among the nursing staff of Tanta University Hospital showed that nurses had a high prevalence of WRMSDs (92.3%) in the past 12 months, due to twisting and/or bending the back in an awkward way/posture (85.2%) (3). A similar study conducted on awkward trunk postures and their relationship with low back pain in hospital nurses showed that the duration of exposure to awkward trunk postures had a significant relationship with low back pain $p<0.05$ (95)**.** A similar study conducted on risk factors of work-related neck and shoulder pain among emergency nurses from 10 regional tertiary hospitals in the northeast of Thailand revealed that shoulder pain was significantly associated with neck bending (awkward posture) (ORadj=2.28, 95% CI: 1. 13-4.62) (73)

2.3.2 Psychosocial Risk Factors

Studies have shown that psychosocial risk factors also contribute to the development of WRMSDs among nurses (11,54,68). Psychosocial risk factors affect employees' psychological responses to their work and workplace conditions and are often related to

individual subjective perceptions of work organisation (30,31,73). These factors involve two main categories: job content and organisational characteristics (9,82). The job content risk factors include high workloads, tight deadlines, and lack of control over work and working methods (13,30,88). Organisational characteristics risk factors encompass poor working relationship with colleagues and supervisors, financial demoralisation, lack of community support, and inadequate rest/work cycle (30,54,68).

Both organisational characteristics risk factors and work organisational risk factors related to job content are psychosocial risk factors contributing to the development of WRMSDs (55,96,97). There is no significant difference between these two categories of risk factors because they both contribute to and influence the development of WRMSDs in a psychosocial manner (14,96). Psychosocial risk factors work in conjunction with physical risk factors, as psychosocial risk factors alone do not typically lead to the development of WRMSDs. The combination of psychosocial and physical risk factors can thus increase the risk of WRMSDs.

Negative perceptions of work can lead to physiological and psychological stress reactions, which may result in physical problems such as muscle tension (19,55,96,97). Additionally, some workers may use inadequate item handling techniques, exert excessive force, neglect to take breaks, and engage in poor working practices, all of which can contribute to the development of WRMSDs (14).

A study conducted on the prevalence of musculoskeletal disorders and associated risk factors in nurses in China revealed that nurses reported a 12-month prevalence of musculoskeletal disorders (84.2%) due to work-related cumulative stress factors, such as time spent in awkward postures, manual material handling, and sustained awkward postures (81).

Similarly, a comparative study conducted in Uganda across five different hospitals found that the nursing population in these hospitals developed musculoskeletal disorders (OR 3.4, 95% Cl 2.17-5.32) as a result of work-related stress (75).

A study by Lukolo et al. (2022) on the effects of workload on nurses' mental health in IH Katutura in Windhoek revealed that a shortage of nurses led to high workloads, which in turn resulted in chronic stress and burnout, potentially leading to the development of WRMSDs (16). A similar study conducted in Malaysia on emotional distress as a predictor of WRMSDs among nursing professionals revealed that stress and anxiety significantly increased the risk of WRMSDs by approximately twofold, contributing to decreased efficiency among nurses due to health problems, as some nurses had to seek medical attention instead of attending to patients (13, 57) Another study by Chin et al. (2021) indicated that the tendency of nurses to have short sleep durations due to high workloads accounted for 8.8% of chronic neck pain discomfort and 8.6% of chronic shoulder discomfort, respectively (98).

Even though WRMSD risk factors are well-studied, known, and published in both developed and developing countries, including Africa and Namibia, differences in the estimated prevalence of WRMSDs across countries may reflect variations in the nature of work, working environments, and facilities. This results in inconsistent reporting of work-related risk factors (4), meaning that risk factors cannot be compared or generalized from one country to another, or from one hospital to another within the same or different regions (56). This is supported by various studies that report differing results of WRMSDs among nurses in their hospital settings across different countries (55,56,99). For example, in Cameroon, WRMSDs are associated with a lack of breaks, lifting of patients and heavy objects, working

in the same position for long hours, and heavy workloads (11). In Kenya, nurses are exposed to WRMSDs due to long hours of hectic work with awkward postures, heavy load lifting, and repetitive movement (87).

In contrast, a study conducted on risk factors among nurses in Pakistan revealed that attending to an excessive number of patients per day and working in the same positions for long periods were the most significant risks associated with WRMSDs. Meanwhile, risky activities such as lifting and transferring patients are often performed by male nursing assistants (61) In China, the high number of patients and staff shortages mean that the most common WRMSD risk factors are repetitive movements and heavy workloads only (31).

These observations underscore the necessity of conducting this study, as there is a knowledge gap regarding the risk factors associated with WRMSDs among nurses in Intermediate Hospitals (IHs) in Namibia. Hence, this study is needed to generate specific background information on these risks and to develop suitable interventions for a multifaceted ergonomic educational program aimed at preventing WRMSDs among nurses.

2.4 THE ERGONOMIC INTERVENTIONS TO PREVENT WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG NURSES

Work-related musculoskeletal disorders (WRMSDs) are painful disorders or injuries that are most prevalent (40%-85%) among nurses worldwide (4,99). This burden of WRMSDs affects the health and quality of life of nurses, thereby impacting the quality of their patient care (100,101). To prevent these pains and disorders, different interventions are needed. It is very important to understand the application of various interventions that were discovered, recommended, and/or utilized by other researchers in their studies to prevent WRMSDs

among nurses at various hospital settings worldwide (102–104). The following details the general interventions to prevent WRMSDs among nurses.

2.4.1 General Intervention to Prevent WRMSDs Among Nurses in Hospital Settings

Scholars have identified four main types of ergonomic interventions (elimination, substitution, engineering, and administration) that have been used either as individual interventions or multifaceted interventions to prevent WRMSDs in hospitals worldwide (24,105,106). The following details the application of these interventions in the workplace in general.

2.4.1.1 Elimination control intervention

Elimination control intervention is the first approach method applied t to prevent and control risk factors associated with the development of WRMSDs. Elimination can be used under engineering and administrative measures/approaches. Hazards are best eliminated at the source (79). Repetitiveness is the main contributor to WRMSDs in the nursing profession. Factors such as applied forces, fixed body positions over extended periods, and the pace of work require repetitive movements of various body parts to complete tasks (43). Therefore, the main effort to protect workers from WRMSDs should focus on avoiding repetitive patterns of work through proper job design, which may include mechanisation, job rotation, job enlargement and enrichment and teamwork**.** Additionally, some non-productive tasks, such as cleaning up waste, may be eliminated by examining the source of waste (79).

2.4.1.2 Substitution control intervention

Substitution means replacing hazards with less hazardous or hazard-free options and/or interventions (79). Substitution is applicable when elimination is practically impossible. Substitution is done by applying preventive strategies such as changing the workplace layout, tools, and replacing poorly designed equipment with better ones (26,89). Most hospitals globally prioritise using mechanical equipment designed to help in manual handling or make the task itself less physically demanding. Examples include lifting belts/sheets, handling slings, stretchers, and sliding boards to substitute hazards and prevent the risk of exposure to manual handling (24,79,102,107)

2.4.1.3 Engineering control intervention

Engineering control is the most desirable control method to reduce risks and involves designing and/or modifying equipment or machinery to reduce the risk of WRMSDs at the source of exposure (79). For example, engineering control involves purchasing and distributing well-designed mechanical aids to reduce the risk of biomechanical hazards, which can be an effective way to control WRMSDs. Purchasing tools is considered to prevent awkward postures and high exertion caused by poorly designed tools. Loads delivered to, handled within, or produced by a workplace are common sources of biomechanical hazards. Thus, implementing mechanical bulk handling systems is an effective design control used in some hospital settings (26,89).

Work areas are an important measure to consider in engineering control. Redesigning workstations to prevent identified risk factors can also help in preventing the development of WRMSDs (79). The design of work areas has a large impact on the risk associated with

biomechanical and/or WRMSDs hazards. For example, limited space, limited clearance in some emergency departments, and restricted access to a spacious work environment are common causes of awkward postures (102,103). Therefore, it is recommended that under engineering control, work should be located at an appropriate height and close to the body. Providing adjustable workstations is also a recommended intervention as they accommodate workers of different sizes. In turn, this will prevent risk factors associated with WRMSDs among nurses (26,89).

2.4.1.4 Administrative control intervention

Administrative controls related to maintenance, workload, job rotation and task variety, team lifting, training, and personal protective equipment are the most common interventions used under administrative measures to prevent WRMSDs among nurses (26,89). The effectiveness of the intervention relies on human behaviour and supervision, and it is more effective when used in combination with other controls (multifaceted approaches). It has been verified that a multifaceted ergonomic program only succeeds depending on the involvement of the targeted professionals (108). The following details each intervention under administrative measures.

Proper job rotation and task variety

WRMSDs' risk factors and hazards can be reduced by rotating nurses between different tasks to increase task variety. This requires that the tasks are sufficiently different to ensure that different body parts are loaded in different ways (79) Alternatively, multiple tasks might

be combined to increase task variety. This in turn, prevents and/or reduces the probability occurrence of WRMSDs among nurses (102).

Managing workload

Reducing shift duration or the pace of work can contribute to effective WRMSDs hazard and risk control in the nursing profession. It may be possible to change the distribution of work across the day and week to avoid a high peak workload (79). The workload can also be managed by ensuring appropriate staff levels are maintained and avoiding understaffing, as these risk factors can results in nurses working repetitively for prolonged periods, becoming stressed, which might lead to the development of WRMSDs (26,89).

Training

Training is an important administrative control regardless of the design controls employed. Training methods to prevent WRMSDs fall into two parts. The first part is education in ergonomics and biomechanical principles to recognize and understand WRMSD risk factors and how to prevent them, as well as to increase awareness of WRMSDs so that safe work methods and healthy lifestyle are adopted (26,89). This may help nurses learn about ergonomics, identify risks in their work environment, and come up with ideas to improve working conditions (26)

The second part is practical training on the job. This approach teaches nurses the correct use of work equipment, such as lifting devices, how to organise work and the workstation ergonomically, safe working postures such as standing, sitting, and reaching, and safe manual work techniques which involve lifting, handling, pushing and pulling loads (26,89).

Provision of personal protective equipment (PPE)

PPE is also considered an intervention used to prevent WRMSDs among nurses, but it is regarded as a last resort and the lowest level of protection due to the risks it entails. Examples of PPE in hospitals may include clothing and other wearable accessories designed to create a barrier against workplace hazards (79).

2.4.2 Single Intervention Vs Multifaceted Interventions to Prevent WRMSDs Among Nurses

Studies have reported that many single-intervention programs have been implemented in various countries to reduce the risk of WRMSDs among nurses. These include, but are not limited to, ergonomic interventions, patient handling and mobility programs, work-related psychosocial coaching, health promotion and protection interventions, physiotherapy, exercise, and more (17,93,103). However, these single interventions have often failed to prevent WRMSDs among nurses in various hospitals worldwide (17,18,23,104).

A systematic review of WRMSD prevention and reduction among nurses indicated that single interventions are insufficient to prevent WRMSDs (93,103). For example, exercise alone or training alone has been shown to have no significant effect on musculoskeletal health (93).

For example, a single intervention program on patient-handling techniques was developed in Hong Kong, China, to prevent WRMSDs of the upper and lower back among nurses. However, it failed, and the prevalence of WRMSDs remained high at 71.2% (25). In the United States, over the past 30 years, most efforts to reduce WRMSDs in nursing have focused on single interventions like body mechanics and lifting techniques. These efforts

have consistently failed, and the prevalence of WRMSDs has not decreased following these applications (105). Similarly, a study evaluating the effectiveness of a single intervention program among home care nurses and nurse aides in Denmark found no significant difference between the intervention and control groups in terms of WRMSDs prevalence (25).

The WRMSDs are caused by a complex and dynamic interaction between physical and psychosocial risk factors, making them multifactorial in nature (103). Consequently, previous studies have emphasized the need for appropriate preventative measures that are multifaceted, systematic, and comprehensive to reduce this burden (89,105).

Beyan et al. (2020) conducted a study on the effect of multifaceted ergonomic interventions on musculoskeletal complaints in intensive care units in Turkey and concluded that individual-level interventions are unlikely to succeed in eliminating manual patient lifting by nurses (17). In support, multicomponent interventions that combine several specific approaches for various determinants have been shown to be more effective than those based just on a single component (93,103).

A recent systematic review concluded that multifaceted interventional programs, with a systematic and integrated approach to work situations, are the most beneficial both in terms of implementation and cost benefits (108). These programs combine ergonomic solutions with organisational policies, training sessions, and specific training to enable nurses to deliver better health care with less risk (108). Similarly, another recent systematic review recommended multifaceted interventions that include components such as healthcare provision, coordination of services, and work accommodation to improve musculoskeletal pain (103).

Yang et al. (2021) reported that some studies have explored combining two or more single-factor intervention programs into a multidisciplinary or multifaceted program for WRMSDs, which may be preferred and effective in preventing WRMSDs(93).

Although multifaceted ergonomic educational programs have proven to be effective, no standards have been set for a standardised multifaceted or multidimensional intervention program that is universally applicable to all hospital settings globally or across different hospital settings in various countries (26). The multifaceted ergonomic educational or training program should be based on the specific risk factors affecting nurses in a particular hospital or region. Such a program can also be customised based on work characteristics, available ergonomic equipment, medical environment characteristics, and national cultural factors (93). Therefore, the literature concludes that there is no single multifaceted intervention program applicable to all hospital settings (17,89,105).

The following details supporting examples of multifaceted ergonomic educational, interventional, and training programs developed and utilised worldwide by scholars, which have been proven effective in preventing WRMSDs among nurses in their specific targeted populations and hospital settings.

A pilot study conducted to investigate a tailored ergonomic intervention program (including training, administrative measures, and equipment design) for community nurses found statistically significant improvements in the intervention group compared to the control group (26). Hignett systematically reviewed 2,796 papers, selected 63, and highlighted that multidimensional interventions based on a risk assessment program are more beneficial compared to interventions focused solely on specific problems, such as training or education (17).

Yang et al. (2021) developed a multidimensional intervention program to improve occupational musculoskeletal disorders among intensive care unit nurses at Changsha, Hunan. Their study found that improving risk perception (p-0.001), health behaviour training (p.0.001), and promoting a safe working environment (p.0.024) were three effective program elements in preventing the occurrence of WRMSDs among nurses (93). WRMSDs educational training should include multifaceted approaches and pay increased attention to specific department functions (93).

Nguyen et al. (2022) conducted a study to evaluate the effectiveness of a multifaceted basic intervention (including education on risk factors and physical exercise) to prevent musculoskeletal disorders among district hospital nurses in Vietnam. The study revealed that the multidimensional interventions were effective in preventing musculoskeletal disorders in four anatomical sites: neck, shoulder/upper arm, wrists/hands, and lower back, with p-values being 0.013, 0.011, 0.038, and 0.009, respectively (89).

Soler-Font et al. (2019) conducted a cluster randomized trial on a multifaceted intervention comprising three evidence-based components: participatory ergonomics, health promotion activities, and case management. The study results revealed that the intervention was effective in reducing neck, shoulder, and upper back pain compared to the control group (OR=0.37;95%Cl=0.14-0.96) (103).

It could be concluded that, to effectively prevent WRMSDs among nurses, measures and strategies should target all specific work-related risk factors contributing to these disorders (93). There is a lack of similar studies conducted in intermediate hospitals in Namibia to determine or explore risk factors associated with WRMSDs among nurses. Furthermore, scholars have revealed that multifaceted ergonomic educational programs are developed

specifically to address risk factors at a particular health institution and cannot be generalised to other hospitals in different regions or areas (26,105). Thus, this study was necessary to close this knowledge gap, by developing a suitable multifaceted ergonomic educational program for preventing WRMSDs among nurses at intermediate hospitals in Namibia.

2.5 THEORETICAL BASIS OF THE STUDY AND CONCEPTUAL FRAMEWORK

The theoretical foundation is an important component of every research as it guides the research process (42). It includes frameworks, models, and theories that already exist in scientific disciplines (41). The theoretical framework connects the researcher to existing knowledge (37). Models are important in research as they guide both theory development and research design. Meanwhile, theories are crucial as they provide the foundation for scientific explanations, understanding and predictions of phenomena of interest (37). In this study, the following theories and frameworks were employed during various phases:

2.5.1 Biomechanical-Structural Model

The study utilized the Biomechanical Structural Model of the development and prevention of occupational musculoskeletal disorders as its theoretical lens (43). This model was proposed by Flexner in 1910and later adopted by Price (2021) in a similar study investigating the development and multidimensional prevention of occupational musculoskeletal disorders (43).

One of this study's objectives was to describe and explore interventions suitable for preventing WRMSDs among nurses in intermediate hospitals in Namibia. Thus, through the application of this adopted model, the researcher was guided in identifying and

implementing suitable interventions for the multifaceted ergonomic educational program for the study.

The Biomechanical-Structural Model is one of the four Osteopathic models for the development and prevention of occupational musculoskeletal disorders (43).

In terms of musculoskeletal disorders development, the Biomechanical-Structural Model views health from the perspective of the musculoskeletal system and its interconnected groups of bones, muscles, tendons, ligaments, and fascia. WRMSDs occur when there is a disturbance in the musculoskeletal system due to prolonged or awkward postures, poor ergonomic design, manual handling of excessive loads, kneeling, reaching, or repetitive movement without adequate recovery time. These disturbances happen when job demands exceed the physiological and structural capacity of tissues, leading to insufficient rest and recovery time (43).

As a result, the Biomechanical-Structural Model demonstrates that musculoskeletal disorders are multifaceted in nature, suggesting that a combination of multiple interventions could effectively prevent WRMSDs among nurses (43).

The model proposed that WRMSDs can be prevented if the multifaceted ergonomic educational program includes a combination of some of the following interventions:

Job-specific pre-placement physical examination: This primary intervention involves examining and identifying any disorders or conditions that may place the employees at risk for injury in the new job environment.

Ergonomic interventions: The use and application of a systematic ergonomic process are needed to eliminate risk factors that could lead to musculoskeletal injuries and to improve employees' performance and productivity. An example of a systematic ergonomic

improvement process is an ergonomic assessment used in conjunction with the job-matching process.

Training and education intervention: This intervention aims to mitigate the risk of WRMSDs by increasing employees' knowledge, thereby altering their behaviours to address biomechanical risks associated with incorrect lifting and poor postures (43).

Job rotation intervention: This is a primary and secondary prevention measure designed to mitigate continuous exposure to risk factors for musculoskeletal disorders. It involves rotating workers between tasks with different physical demands to prevent overloading specific body parts (109).

Strength training intervention: This serves as a primary and secondary prevention measure by preventing the deterioration of work ability among manual workers with chronic pain. It also enhances mental resources and improves perceptions of work demands (43).

Figure 2 below shows the application of the Biomechanical-Structural Model (43). The model highlights how musculoskeletal disorders affect the musculoskeletal system and recommend multidimensional/multifaceted intervention approaches to prevent employees' exposure to risk factors identified in the model.

Figure 2: Biomechanical-Structural Model (43).

2.5.2 The Conceptual Framework for Work-Related Musculoskeletal Disorders

"The Conceptual Framework for Work-Related Musculoskeletal Disorders" by Lee et al (2013), was adopted to guide the development of a multifaceted ergonomic educational program (71). This theoretical framework enabled the researcher to recognise and identify risk factors associated with the development of WRMSDs among nurses(71). It has demonstrated that the occurrence of WRMSDs is influenced by multiple risk factors that alter the body's biomechanics system (71).

This theoretical framework illustrates that the main risk factors for WRMSDs include job characteristics, physical factors, and psychosocial factors (71). Job characteristics refer to aspects such as job title, work status, working shift, and work hours. Psychosocial factors include job demand, job control, job strain, social support, and effort-reward imbalance. Physical factors involve physical workload, working posture, repetitive movement, and patient handling (31,71).

As a result, the workplace organisational factors affect employees' perception of workplace or organisational safety. The climate of workplace safety is also associated with WRMSDs. Additionally, the occurrence of WRMSDs, may impact the perception of risk factors (31,71).

A similar study conducted by Yang et al. (2020) on risk factors for WRMSDs among intensive care unit nurses in China, using a structural equation model approach, adopted the same "Conceptual Framework for Work-Related Musculoskeletal Disorders" by Lee et al (2013) as the theoretical lens for the study (31).

Supporting the literature, this conceptual framework was deemed suitable for this study. Through its application, the researcher was able to integrate the risk factors into the

questionnaire development and gather comprehensive data on risk factors associated with WRMSDs among nurses. This conceptual framework was used as a guide for the development of the multifaceted ergonomic educational program for this study.

Figure 3 below depicts the application of the "Conceptual Framework for Work-Related Musculoskeletal Disorders" in this study, as adopted from Yang et al. (2020).

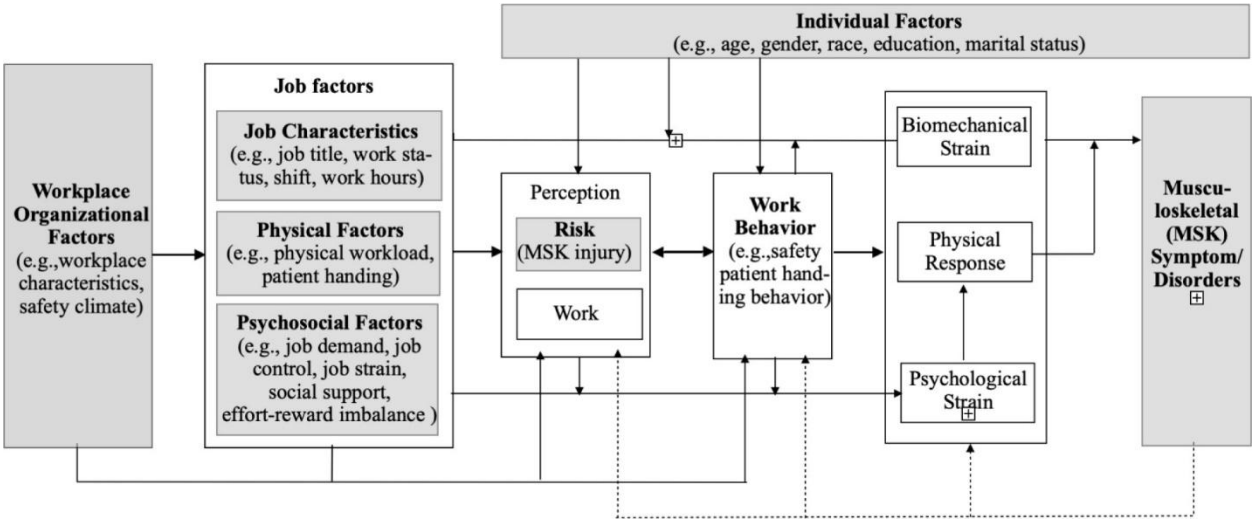

Figure 3: Application of "A Conceptual Framework for Work-Related Musculoskeletal Disorders (71).

2.5.3 Centre for Disease Control and Prevention (CDC) Framework for Program Evaluation

The Centre for Disease Control (CDC) Framework for Program Evaluation was utilised in this study in the evaluation of the multifaceted ergonomic educational program (45). This framework has been proven effective in guiding program evaluation processes by other researchers (37,45). Katjiuanjo et al. (2023) used the CDC Framework for Program Evaluation to assess an adherence improvement program for health professionals in selected

facilities in Namibia, demonstrating its effectiveness (37). Thus, the framework was a suitable tool for this study as it outlines the basic elements of program evaluation through interrelated steps and standard practices. These steps and practices were followed during the evaluation of the multifaceted ergonomic educational program developed in this study. The steps and standard practices for the CDC Framework for Program Evaluation are shown in Figure 4 below.

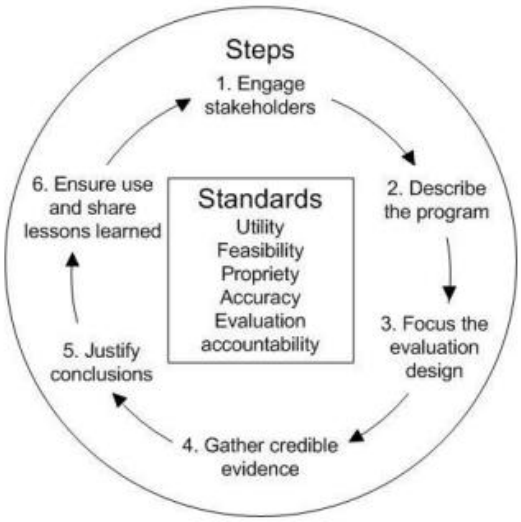

Figure 4: 4 CDC framework for Program Evaluation in Public Health (45)

2.5.3.1 The steps for the CDC Framework for Program Evaluation

Step 1: Engage Stakeholders

This involves identifying and engaging the principal groups of stakeholders who have an interest in or investment in the evaluation and its outcomes (45). This includes, but is not limited to, stakeholders involved in program operations (e.g. program administrators, donors, managers, and personnel engaged in planning and implementation), stakeholders who are served by or affected by the program (either directly or indirectly), and stakeholders

who are the primary users of the evaluation and who will make decisions based on its findings.

Step 2: Describe the program

This step involves describing the program in sufficient detail to ensure a shared understanding of its components and how they will be evaluated (45). This includes outlining the program's need, expected effects, resources, stage of development, and the context in terms of setting and environmental influences relevant to the program or evaluation. It also involves describing the logic model (the knowledge or evidence used to inform program design). The quality of the program description can be improved through consultation with diverse stakeholders to ensure a comprehensive understanding of the program.

Step 3: Focus the Evaluation Design

Not all evaluation designs result in usable information that meets stakeholders' needs. Therefore, the framework indicates that important parameters for the evaluation should be clearly defined, including the program's purpose, users, uses, questions, methods, and agreements.

Step 4: Gather Credible Evidence

The framework identifies five items likely to influence perceptions of the credibility of evidence collected as part of the evaluation (45). These items include:

- Indicators: Measurable pieces of information regarding evaluand

- Sources: Utilising multiple sources of evidence to incorporate different perspectives or understandings of the program being evaluated.
- Quality: Ensuring that the data or information collected meets stakeholders' expectations and thresholds for credibility.
- Quantity: Estimating the amount of data or information needed and ensuring that all collected data matches pre-determined intended uses.
- Logistics: The infrastructure and methods used to collect and handle data or information.

Step 5: Justify conclusions

Conclusions must be well-linked to the evidence and reflect the standards or values agreed upon with stakeholders. The framework outlines five elements necessary to justify conclusions:

- Standards: Criteria or norms against which the program will be judged.
- Analysis and Synthesis: Assessing whether key findings are isolated or combined from various data sources to reach broader conclusions.
- Interpretation: Clarifying what the findings mean.
- Judgments: Making statements regarding the merit of the program, considering the findings, and interpretations of findings, against standards agreed upon with stakeholders
- Recommendations: Highlighting specific actions that should be considered based on the evaluation (45).

Step 6: Ensure Use and Share Lessons Learned

Preparing for the use of the evaluation requires deliberate action and should begin at the earliest stage of planning (45). The framework includes five elements to prepare for and promote the use of the evaluation. These are design, preparation, feedback, follow-up, dissemination, and additional users:

- Designs: Deals with how the evaluation questions, methods, and process are constructed to achieve the desired use.
- Preparation: Ensures that there is sufficient time and opportunities for primary users to anticipate how evaluation findings may be received or used.
- Feedback: Entails the communication that occurs among all parties involved in the evaluation. This exchange builds trust among stakeholders and keeps the work on track.
- Follow-up: Provides the technical support that users need during the evaluation and upon receipt of findings or recommendations.
- Dissemination: Deals with the process of communicating the procedures or lessons learned from the evaluation to relevant audience in an appropriate manner.
- Additional Users: Refers to changes in thinking or behaviour that occur as a result of participation in the evaluation (e.g., personnel clarifying or establishing a shared understanding of program goals) (45).

2.5.3.2 The Standard Practices for the CDC Framework for Program Evaluation

The CDC framework for program evaluation is guided by five standards: utility, feasibility, propriety, accuracy, and evaluation accountability (45).

- Utility: This standard is intended to increase the extent to which program stakeholders find the evaluation process and products valuable in meeting their needs. This means the evaluation should be conducted by qualified individuals who establish and maintain credibility in the evaluation context.
- Feasibility: This standard aims to increase the effectiveness and efficiency of the evaluation.
- Propriety: This standard supports what is proper, fair, legal, right and just in the evaluation process (45).
- Accuracy: This standard aims to increase the dependability and truthfulness of evaluation representations, propositions, and findings, especially those that support interpretations and judgements about quality. The accuracy standards indicate that the evaluation information should serve its intended purpose and support valid interpretations.
- Evaluation Accountability: This standard encourages adequate documentation of evaluations and a meta-evaluative perspective focused on improvement and accountability for the evaluation process and products (45).

2.6 SUMMARY

The prevalence of WRMSDs over a 12month period ranges from 40% to 90% globally, including in Africa and a few institutions in Namibia. The most affected body parts are the low back, neck, and shoulders. WRMSDs impact nurses by causing increased absenteeism, career changes, loss of working time, and reduced quality of life. These impacts result in both human and economic losses for healthcare institutions. WRMSDs are caused by a

combination of physical and psychosocial risk factors. This study adopted the "Conceptual Framework for Work-Related Musculoskeletal Disorders," which demonstrates that the occurrence of WRMSDs is influenced by multiple risk factors that alter the body's biomechanics system. Additionally, the study utilised the "Biomechanical-Structural Model", which proved that musculoskeletal disorders are multifaceted in nature, suggesting that a combination of multiple interventions can effectively prevent WRMSDs among nurses. The CDC framework for program evaluation was used to evaluate the multifaceted ergonomic educational program developed in this study. Scholars recommended that multifaceted ergonomic educational/interventional programs should be based on specific risk factors affecting nurses in individual hospitals. Such programs should be customised based on work characteristics, available ergonomics equipment, medical environment characteristics, and national cultural characteristics. Therefore, there is no unique multifaceted ergonomic educational program that can be universally applied across all hospitals in different countries and/or regions. Additionally, there is a scarcity of studies on the development of multifaceted ergonomic educational programs in intermediate hospitals in Namibia, making this study crucial for addressing this knowledge gap. The next chapter will present and discuss the research design and methodology.

CHAPTER 3

RESEARCH APPROACHES AND METHODOLOGY

3.1 INTRODUCTION

The previous chapter identified, selected, and critically reviewed literature related to this study. This chapter presents the research designs, methodologies, and approaches that were used in the development of a multifaceted ergonomic educational programme to prevent work-related musculoskeletal disorders (WRMSDs) among nurses in intermediate public hospitals in Namibia.

The study was conducted in four distinct but interconnected phases. Phase I focused on describing the prevalence of WRMSDs and identifying associated risk factors among nurses in Intermediate Public Hospitals (IPHs) in Namibia. Phase II explored ergonomic interventions aimed at addressing the identified risk factors to prevent WRMSDs in this population. Phase III involved the drafting of a multifaceted ergonomic educational programme based on findings from the previous phases. Lastly, Phase IV entailed an expert review of the drafted programme to evaluate its readiness and practical applicability in the healthcare context.

In addition to detailing the design and methodology, this chapter discusses the measures taken to ensure the study's validity, reliability, and trustworthiness, including triangulation strategies. Furthermore, it outlines the ethical considerations that guided the research process, such as ethical clearance and permissions, the principles of self-determination, respect for persons, confidentiality and anonymity, beneficence and non-maleficence, and justice.

3.2 RESEARCH APPROACHES

Selecting the correct research approach is crucial as it assists the researcher in using the correct theories and utilizing the right instruments to thoroughly investigate the area of interest (110,111). Any research being conducted should follow a deductive or inductive approach to research in line with the positivist or interpretivist research paradigm (112). The overall approach to this study was a mixed-methods approach, which involved the combination of quantitative and qualitative methods.

Mixed method approach

Mixed methods research is a research method that combines and integrates qualitative and quantitative research methods in a single research study (112). Mixed methods research is a research design with philosophical assumptions as well as methods of inquiry (110,111). When used in combination, both qualitative and quantitative data yield a more complete analysis, and they complement each other, balancing both the weaknesses of the quantitative and qualitative methods. Further, Creswell argues that using two or more research methods in an investigation provides the opportunity for cross-validation and cross-fertilization, and mixed methods research provides a more complex understanding of a phenomenon that would otherwise not have been accessible by using one approach alone (113).

The research design refers to the overall strategy that a researcher chooses to integrate the different components of the study coherently and logically, to effectively address the research problems through data collection, measurement, and analysis (114). This study employs the explanatory sequential study design of mixed methods, which comprises

quantitative (cross-sectional) and qualitative (exploratory, descriptive) studies, to achieve the objectives of the study (112).

An explanatory sequential design was used in this study, where the researcher first collected and analysed quantitative data to obtain a general overview of the research problem. The findings from the quantitative phase then informed the development of the qualitative phase, particularly the interview guide, to help explain and provide deeper insights into specific quantitative results (110,111). Hence, it was a suitable research approach/method for this study because it made the study findings stronger, compared to other methods.

3.3 SCIENTIFIC REASONING STRATEGIES

The scientific reasoning strategies were necessary in this study as they assisted the researcher in identifying related concepts and gaining an understanding of variables and assumptions by responding to specific questions in an unambiguous manner. The scientific reasoning strategies used in this study are explained below.

3.3.1 Inductive reasoning

Using a questionnaire, inductive reasoning was used to inquire about known facts on the prevalence of WRMSDs and risk factors associated with WRMSDs. Inductive reasoning was also used when the researcher started with the review of known literature. The study investigated and described nurses' and OHS key informants' perceptions of ergonomic

interventions leading to the generation of sub-themes, themes, and concepts needed for the development of the multifaceted ergonomic educational program.

3.3.2 Deductive reasoning

Deductive reasoning was used in this study as it helped the researcher move from general premises to particular conclusions by testing generated ideas in the real world (115). Deductive reasoning was employed in Phase I to describe the prevalence of WRMSDs and to determine and describe risk factors associated with WRMSDs among nurses in intermediate public hospitals in Namibia. This deductive reasoning guided the development of the multifaceted ergonomic educational program.

3.3.3 Inference

Inference is described as the dynamic journey from ideas to data to results, making sense of the data by connecting the dots (115). In this study, inference was ensured as the researcher simplified interpretations and drew conclusions from the data collected from nurses on the prevalence of WRMSDs and risk factors associated with WRMSDs, as well as from the information on ergonomic interventions to prevent WRMSDs collected from nurses and OHS key informants. This process allowed for inference transferability, where generalizations and replicability to other regions could be advocated for in the future, based on the study findings. The inference informed the development of a multifaceted ergonomic educational program.

3.3.4 Bracketing

Bracketing in this study was maintained by employing scientific methods in collecting and analysing qualitative and quantitative data. The bracketing process occurred during data collection, analysis, and interpretation of the findings. In addition, the researcher's methodological assumptions are clarified in Chapter One.

3.3.5 Reflective

Reflective was maintained by reflecting on the discussions conducted with the nurses and OHS key informants, focusing on their beliefs, knowledge, and experiences regarding ergonomic interventions to prevent WRMSDs among nurses. Reflectivity was also ensured by connecting the different ideas gathered during the data collection process, validating these ideas and/or data elements, and either confirming or refuting the information.

3.3.6 Analysis

The analysis conducted in this study employed an explanatory sequential design, which involved the analysis of qualitative and quantitative data during the statistical analysis phase. Analysis in this study helped to break down intricate data pieces into understandable categories, leading to the identification of various concepts and their definitions. This informed the conceptualisation process of this study and subsequently the development of a multifaceted ergonomic educational program.

3.3.7 Derivation

Derivation was applied in this study through the review of existing literature on the prevalence of WRMSDs, risk factors associated with WRMSDS, and interventions used to prevent WRMSDS. It was also applied through the results obtained from self-administered questionnaires and in-depth interviews. In addition, components of related theories and models assisted with the formulation of interrelated concepts, which were then contextualised and later served as a foundation for the development of multifaceted ergonomic educational programmes to prevent WRMSDs.

3.3.8 Synthesis

Synthesis enabled the researcher to provide a blended understanding of what is known and what is not known in the study area after complementing all the concepts and statements derived from the literature and interpreted study findings. Synthesis led to drawing conclusions of this study (116). Through synthesis, the concepts and statements were explained, and relationship statements were constructed. These outcomes then served as the basis of developing the multifaceted ergonomic education program.

3.4 RESEARCH METHODOLOGY

Research method refers to a systematic procedure followed by a researcher, using specific techniques such as self-administered questionnaires and in-depth interview for collecting and analysing data (117,118). Effective and appropriate research methods ensure that a research question is answered as reliably as possible, thereby achieving the study's

objectives (116). This research methodology provides a systematic explanation and description of the procedures used by the researcher to address the research problem. The methodology is structured and discussed according to the four study phases below:

Phase I: Seeks to determine and describe the prevalence and risk factors associated with WRMSDs.

Phase II: Investigates ergonomic interventions to prevent WRMSDs.

Phase III: Summarises the development of a multifaceted ergonomic educational program. It will be described more in Chapter 6.

Phase IV: Summarises the process of evaluating the readiness and applicability of the multifaceted ergonomic educational program. It will be described in more detail in Chapter 7.

All these phases are important as they play a significant role in achieving the ultimate purpose of the study: to develop a multifaceted ergonomic educational program to prevent WRMSDs among nurses in IPHs in Namibia. The methodology of each phase is discussed below, according to their specific objective(s).

3.4.1 PHASE I

1. Determine the prevalence of work-related musculoskeletal disorders among Namibian nurses working in intermediate public hospitals.

2. Identify and describe risk factors for work-related musculoskeletal disorders among Namibian nurses in intermediate public hospitals.

To achieve these objectives, the design, study population, sample and sampling method, data collection, and data analysis are described as follows:

3.4.1.1 Quantitative (Cross-Sectional) Design

A quantitative (cross-sectional) study design was used to gather the study's data. A quantitative cross-sectional study design was chosen because it is well-suited for determining the prevalence of specific health outcomes and identifying associated risk factors within a defined population at a single point in time (119). This approach aligns directly with the study's objectives: (1) to determine the prevalence of work-related musculoskeletal disorders (WMSDs) among Namibian nurses working in intermediate public hospitals, and (2) to identify and describe the risk factors contributing to these disorders. This design enabled the collection of structured numerical data needed to estimate the burden of WRMSDs and examine their relationship with demographic, ergonomic, occupational, and psychosocial variables. Moreover, the analytical nature of the study allowed for the application of inferential statistical techniques, including t-tests and multinomial logistic regression, to assess the strength and significance of these associations. Thus, the selected design provided both descriptive and analytical insights necessary to fully address the research objectives (119). Moreover, this design is cost-effective, time-efficient, and appropriate for generating evidence that can inform immediate policy and workplace interventions without the need for long-term follow-up (119).

3.4.1.2 Study Population

The study population consisted of 1,702 nurses working in intermediate public hospitals across four clusters in four regions of Namibia.

3.4.1.3 Sampling and Sample

Sampling is the process of selecting a subset from the population, and a sample refers to a portion or subset of the larger population selected by the researcher (120,121). In this study, a two-stage random probability and stratified sampling method was used. This approach allowed each of the three intermediate hospitals to contribute a proportional number of participants, who were then randomly selected, ensuring that every participant had an equal chance of being included. A sample size of 808 respondents was drawn from a study population of 1,702 nurses from all four clusters in four regions.

The Yamane (1967) formula, $n = \frac{N}{1+N(e)^2}$ was used to calculate the proportional sample size from the four intermediate hospitals in Namibia, .where n is the sample size, N is the population size, and e is the level of precision (0.05) (122). This formula is well-suited for probability sampling methods, including proportionate stratified random sampling, and is effective in calculating sample sizes from populations with different proportions or clusters (122). It was therefore an appropriate method for this study because the sample was drawn from four clusters in four regions of Namibia. Each sample was calculated for each intermediate hospital within a region (cluster) to ensure the sample's representativeness. The stratification was as follows:

Region	**Facility**	**Study population**	**Formula and calculations**	**Sample size**
Khomas	IH Katutura	526	$n = \frac{N}{1+N(e)^2} = \frac{526}{1+526(0.05)^2}$=227	227
Oshikoto	IH Onandjokwe	332	$n = \frac{332}{1+332(0.05)^2}$=181	181
Oshana	IH Oshakati	558	$n = \frac{558}{1+558(0.05)^2}$=233	233
Kavango	IH Rundu	286	$n = \frac{286}{1+286(0.05)^2}$=167	167
Total		1702	808	**808**

Table 1: Stratification of the study population and samples

3.4.1.4 Participant Recruitment

For the quantitative phase, participants were recruited using a probability-based simple random sampling technique. Recruitment was guided by the inclusion criteria, which required participants to be nurses who had worked for at least one year at one of the four Intermediate Public Hospitals (IPHs) in Namibia. With authorization from the MoHSS and hospital matrons, Health Information System (HIS) personnel at each IPH generated a comprehensive list of all currently employed nurses. This list was filtered to include only those who met the study's inclusion criteria. HIS personnel then assigned random numbers to each eligible nurse using a computer-generated randomization process.

Based on the predetermined sample size for each hospital, participants were randomly selected from the eligible pool. The selected nurses were then contacted individually through their mobile phone numbers, as listed in the hospital system. During this initial contact, the purpose and nature of the study were explained, and nurses were invited to participate. Those who agreed were scheduled to receive a self-administered questionnaire in person. Prior to distribution, written informed consent was obtained from each participant. This recruitment approach ensured both fairness in selection and adherence to ethical standards, while maintaining voluntary participation.

3.4.1.5 Inclusion and Exclusion Criteria

All nurses who had worked for one year or more in any of the four intermediate hospitals in Namibia, and who were available and willing to participate, were included in the study.

Nurses were excluded if they: Had worked in the selected hospitals for less than one year (and therefore lacked sufficient exposure to relevant work-related conditions); Were on extended leave during the data collection period; or declined to give informed consent.

3.4.1.6 Data Collection Method and Procedure

The instrument for data collection and the process for data collection are explained below.

Instrument for data collection

The self-administered, closed-ended, Standardised Nordic Musculoskeletal Questionnaire (S-NMQ) was adapted for this study and used to collect information on socio-demographic factors, the prevalence of WRMSDs, and associated risk factors. The S-NMQ was chosen

for its reliability in assessing the prevalence and risk factors of WRMSDs (123). The questionnaire was written in English because all participants are educated and required to communicate in English at work, which is the official language in Namibia. The questionnaire includes the following sections: A for socio-demographic information, B for the prevalence of WRMSDs, and C for risk factors associated with WRMSDs among nurses at IHs in Namibia.

Procedure for data collection

Research permission letters were obtained from the MoHSS research department and from the Matron of each IPH. Once permissions were granted, the researcher prepared the data collection program and conducted a three-month field visit to the IHs and MoHSS to collect the data. The researcher scheduled face-to-face meetings with the Matron of each hospital to discuss the data collection program and inform them of the researcher's dates of availability at the facility. The purpose of the study was clearly communicated to the study participants, and written informed consent was obtained before any data were collected.

To select participants from their respective hospital populations, the Health Information System (HIS) personnel at each hospital began by generating a list of all employed nurses. This list was then filtered to include only those nurses who had been working for one year or more, in accordance with the study's inclusion criteria. Using this refined list as the sampling frame, HIS personnel assigned random numbers to each eligible nurse through a computer-generated process. Based on the calculated sample size for each hospital, a simple random sampling method was applied using the computer-generated numbers to select the required number of participants. The selected nurses were contacted individually via their

mobile phone numbers, as listed in the system, and invited to participate in the study. Those who consented were provided with a self-administered questionnaire, which the researcher personally distributed in hard copy during both day and night shifts by approaching participants individually at their workstations. Participants were allowed to complete the questionnaires at their convenience, typically within 2 to 5 days, to accommodate their work schedules and workload. The researcher then returned to the facility to collect the completed questionnaires, which were submitted in sealed envelopes to ensure confidentiality.

3.3.1.7 Pilot Study

A pilot study is a small-scale preliminary investigation conducted prior to the main research to assess the feasibility of the study, test the functionality of research instruments, and refine data collection and analysis procedures, if necessary (124). To ensure the overall readiness of the study, a pilot study was conducted with 40 randomly selected nurses (representing approximately 10% of the total study population) from Windhoek Central Hospital. The primary aim of this pilot study was to evaluate the clarity, reliability, and practicality of the questionnaire, assess the feasibility of the study design, and test data collection and analytical procedures. Data collected during the pilot study were analysed using SPSS version 26, not to generate conclusions, but to assess the effectiveness of the research instrument and detect any issues in data flow, structure, and interpretation. The analysis demonstrated that the questionnaire items were understandable, consistent, and aligned with the study's objectives. As a result, no modifications were required for the instrument. Furthermore, the pilot helped confirm that the study design and data analysis plan were suitable for implementation in the full-scale research. Data from the pilot study were not included in the main study, as the

purpose was strictly methodological to strengthen the main study's internal validity by ensuring that the tools and processes were appropriate and robust.

3.4.1.8 Validity and Reliability of the Data Collection Tool

Validity refers to the extent to which the instrument measures what it is intended to measure (125). In this study, several strategies were used to establish different types of validity: Content validity was achieved through an extensive literature review to ensure the questionnaire captured all relevant aspects of WRMSDs and their risk factors. Face validity was enhanced by sharing the questionnaire with three occupational health experts who reviewed the content for appropriateness, clarity, and alignment with the study objectives. Their feedback was used to refine the instrument before piloting. Concurrent validity was ensured by adapting relevant items from the Standardised Nordic Musculoskeletal Questionnaire (SNMQ), a validated and widely used instrument for musculoskeletal research.

Reliability refers to the consistency, stability, and repeatability of a measurement instrument (125). To assess this, the questionnaire underwent pretesting during the pilot study. After pilot data collection, responses were entered into SPSS version 26. Cronbach's alpha coefficients were calculated for key sections of the questionnaire, especially those related to psychosocial, ergonomic, and occupational risk factors. The alpha values ranged from 0.73 to 0.89, indicating acceptable to high internal consistency across sections. These results confirmed that the questionnaire reliably measured the intended constructs.

3.4.1.9 Quantitative Data Analysis

The process of organising, reducing (by summarising and categorising), and finding themes and patterns from a large amount of gathered data is known as data analysis (126). The data were verified for completeness, cleaned and then coded using Microsoft excel 2016 before being exported to the Statistical Package for Social Sciences (SPSS) software version 26 for thorough analysis. Once the data were entered into SPSS, they were manually cleaned to ensure the quality of the extracted data was not compromised. Data were described using proportions, frequencies, and percentages and were summarized in tables and figures. Descriptive statistics were also used to characterise participants' socio-demographics. This addressed Objective 1, by determining the prevalence of WRMSDs.

Multinomial regression analysis with a 95% confidence interval (CI) was used to determine the statistical significance of the dependent variable. This was performed by constructing two-by-two tables for each potential risk factor outcome. The results were considered statistically significant if the P-value was less than 0.05. This addressed Objective 2, by determining and describing risk factors associated with WRMSDs. The study findings are presented in the form of tables and graphs. The results of the study are presented and discussed in Chapter 4.

3.4.2 PHASE II

Specific objective: To explore the ergonomic interventions that may be suitable and effective in addressing identified risk factors to prevent work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia.

To achieve this goal, the design, study population, sampling and sample, data collection, reliability, and data analysis are described as follows:

3.4.2.1 Qualitative Design

The qualitative (explorative and descriptive) study design was used to collect the study's data. Qualitative research produces descriptive data by approaching the empirical world, and provides an understanding of people from their frame of reference and experience of reality (127). This study seeks to explore ergonomic interventions to address identified risk factors to prevent WRMSDs among nurses in IPHs in Namibia. The qualitative (exploitative, descriptive) study was applied by asking detailed and probing questions to obtain the objectives of this study. Explorative studies aim to investigate phenomena, the manner in which they manifest and the factors that surround them, especially in areas where nothing or little is known (110,114). Hence, it was a suitable design to explore the experiences and thoughts of participants on ergonomic interventions to prevent WRMSDs.

3.4.2.2 Study Population

The study population consisted of 1,702 nurses working in intermediate public hospitals in Namibia across all four clusters and regions.

3.4.2.3 Sampling and Sample

Sampling refers to the process of selecting a subset of a population to make observations and statistical inferences about that population, while a sample is a group taken from a larger population for measurement purposes (121). A non-probability purposive sampling method was used to select participants who had extensive knowledge about the phenomena, could explain it in detail, and were likely to provide rich data (128). This approach involved purposively sampling all key informant Occupational Health and Safety (OHS) personnel at MoHSS, and nurses working at IPH in Namibia.

Under the Ministry of Health and Social Services (MoHSS), the role of Occupational health and Safety (OHS) personnel is preventative in nature, focusing on promoting the health of all employees in public hospitals (129). Hence, this target population was deemed suitable for providing detailed information on effective ergonomic interventions to address identified risk factors to prevent WRMSDs among nurses in IPH in Namibia.

Nurses are directly involved in and exposed to work that may involve risk factors associated with WRMSDs. Based on their exposure and working experience, they are likely to have valuable practical insights, knowledge, and skills about ergonomic interventions suitable for preventing WRMSDs in their workplaces. Therefore, using the inclusion and exclusion criteria, data were collected from nurses at all four IPHs in four regions in Namibia to obtain additional in-depth data on ergonomic interventions that may be effective in addressing identified risk factors and preventing WRMSDs among nurses in Intermediate Hospitals (IHs) in Namibia.

In non-probability purposive sampling, the researcher does not know in advance how many participants are needed; therefore, the sample size depends on data saturation (121). Data saturation occurs when there is no new relevant information emerging from the data collection process, and additional data collection becomes repetitive (130).

3.4.2.4 Participant Recruitment

Participants for the qualitative phase were recruited using a purposive sampling strategy, guided by the study's inclusion and exclusion criteria. Key informants, including Occupational Health and Safety (OHS) personnel at the national level and nurses who had been working in the four Intermediate Public Hospitals (IPHs) for at least one year, were identified in consultation with hospital authorities and the Ministry of Health and Social Services (MoHSS) Health Information System (HIS) personnel. The HIS personnel generated a list of all employed nurses from the hospital database and filtered it to include only those who met the inclusion criteria. This filtered list served as the sampling frame for the recruitment process.

Eligible participants were then contacted individually by the researcher, either directly or through hospital administration, to explain the purpose of the study and invite them to participate. The study objectives, expectations, and ethical considerations were clearly communicated, and participants were informed that their involvement was voluntary. Those who agreed to participate were asked to provide written informed consent and were then scheduled for interviews at a time and location of their choosing, with due consideration for confidentiality and privacy. This recruitment approach ensured that all participants met the

criteria relevant to the study and that the process remained ethical, transparent, and respectful of their autonomy.

3.5.2.5 Inclusion and Exclusion Criteria

The study included all key informant Occupational Health and Safety (OHS) personnel at the national level of the Ministry of Health and Social Services (MoHSS), as well as all nurses who had worked in Namibia's four Intermediate Public Hospitals (IPHs) for one year or more and were available and willing to participate.

Participants were excluded if they: Had worked in any of the four IPHs for less than one year, as they may not have had sufficient exposure to occupational conditions relevant to the study; Were on prolonged leave or unavailable during the data collection period; or declined to provide informed consent, despite meeting the inclusion criteria.

3.4.2.6 Data Collection Method and Procedure

The instrument for data collection and the process are explained below.

Instrument For Data Collection

A semi-structured interview guide, developed based on the analysis of the quantitative phase, was used to generate the qualitative findings. This type of in-depth interview explores issues or topics comprehensively (131) whilst allowing respondents to discuss freely around the specific matter under consideration (132). Thus, it was an appropriate data collection instrument for this study.

The interview guide contained two sections of questions, each aimed at a specific group of participants (Section One for OHS personnel, and Section Two for nurses). The purpose was to gather in-depth information on ergonomic interventions that may be suitable and effective in addressing identified risk factors to prevent WRMSDs among nurses in IHs in Namibia. The semi-structured interview guide included two sections: A for socio-demographic information, B for interventions to prevent WRMSDs among nurses at IHs in Namibia. Questions were posed and participants were encouraged to speak freely, with clarity-seeking and probing questions used as needed.

Procedure For Data Collection

The followings were the procedure for data collection

Field preparation and interview process

Once permission to conduct the study was granted by the MoHSS research department and the Matron of each IPH, the researcher made appointments with the respective sampled staff members. After obtaining written informed consent from a participant, the researcher and participant then decided on the venue and time for the interview, with due consideration for confidentiality and privacy. The researcher also sought permission from study respondents to record the interviews. An in-depth interview process was followed to collect data for this objective. Data collection was carried out over three months to provide enough time to accommodate the schedules of all potential participants from the MoHSS and the four IPHs.

The interviews were conducted in English, as all participants were educated and entitled to officially communicate in English at work, as the only official language in Namibia. Hence, no translation of questions or language translators were needed. The interviews were carried

out face-to-face with both groups of participants (OHS personnel and nurses). Each interview session lasted approximately 30 minutes, although participants were also asked to do a second interview if more information was needed from them.

Nurses were interviewed at their respective duty stations, which in most instances their empty consulting rooms in the hospital. The researcher had scheduled the appointments for data collection during both day and night shifts to ensure that nurses working all shifts are equally considered in the data collection process. The OHS key informants were interviewed at their offices at MoHSS. The researcher ensured no disruption to the daily routine of study participants by allowing study participants to decide on the venue and time for the interview, with due consideration for confidentiality and privacy.

Field Notes and Recording During Interviews

The researcher ensured that verbal responses were audio-recorded accurately to provide appropriate feedback and rich data. Brief supporting notes were captured by the researcher during the interview sessions to further assist with the analysis of the recorded data.

Communication Skills and Interpersonal Attitude During Data Collection

Communication skills and interpersonal attitude are important during interviews in order to obtain relevant information from participants without causing harm, as there may be emotional issues involved (133). The communication skills and interpersonal attitude applied during data collection for this study are discussed as follows:

Interpersonal Attitude

Interpersonal attitude refers to the orientation of the researcher that communicates care to the participant. This attitude is essential during conversations to demonstrate warmth, caring, and non-judgmental understanding of the participants. Congruence and acceptance are part of interpersonal attitude and were used in this study.

Congruence refers to the ability of the researcher to be aware of how to interact with participants and to communicate this effectively (133). Congruence in this study was demonstrated by ensuring that both my verbal and non-verbal communication were consistent and authentic throughout the interviews. For example, when discussing sensitive topics such as workplace injuries or stress, the researcher maintained an open and calm tone of voice that matched the seriousness of the participants' experiences. The researcher also paid attention to his body language maintaining eye contact, nodding appropriately, and avoiding distractions to show genuine interest and empathy.

The researcher aligned his words with his actions, and this enabled the researcher to create a safe and trusting environment where participants felt comfortable sharing honest and detailed information. This consistency helped build rapport and encouraged participants to openly discuss their experiences, which was essential for collecting valid and rich data to inform the development of the ergonomic educational program.

Acceptance was actively demonstrated during the interviews by maintaining a non-judgmental stance throughout each conversation. For example, when participants shared personal or sensitive experiences related to their work conditions or musculoskeletal pain, the researcher listened without interrupting, reacting, or expressing agreement or

disagreement. The researcher avoided leading or evaluative questions and instead used open-ended prompts like, “Can you tell me more about that?” or “How did that make you feel?” This approach allowed participants to express themselves freely without fear of being judged.

Moreover, the researcher consciously refrained from showing any verbal or non-verbal cues such as frowning, nodding excessively, or changing my tone that might suggest that certain responses were preferred over others. By doing so, the researcher created a safe space where all perspectives were valued equally, enabling participants to share honest and complete information, which enriched the data collection process.

Communication Skills During Data Collection

Effective communication is crucial for the research process to ensure the smooth flow and freedom of expression of ideas from respondents, thereby obtaining rich data on ergonomic interventions to prevent WRMSDs (116). There are many communication skills (134), but for this study, the researcher used the following applicable communication skills necessary for the qualitative data collection method (interviews).

During the interviews, the researcher actively practiced listening skills by giving participants my full attention maintaining eye contact, minimizing distractions, and allowing them to speak without interruption. The researcher carefully monitored both the content and the tone of their responses to capture not only the facts but also the emotions behind their words. When necessary, the researcher took brief notes to ensure important details were recorded accurately without breaking the flow of conversation. This attentive listening enabled me to understand participants’ experiences deeply and follow up with relevant questions that

enriched the data collected. Clarification was applied during interviews by gently asking participants to explain or elaborate on their statements whenever their meaning was unclear or ambiguous. For example, the researcher used phrases like, “Could you please explain what you meant by that?” or “Can you give me an example to better understand?” This approach helped to avoid misunderstandings and ensured that the researcher accurately captured the participants’ intended messages. Clarification also encouraged participants to reflect more deeply on their responses, leading to richer and more precise data.

Probing was actively used during the interviews by asking follow-up questions that encouraged participants to elaborate or clarify their initial responses. For instance, when a participant gave a brief or vague answer, the researcher would prompt them with questions like, “Can you tell me more about that?” or “What do you think caused that?” This technique helped uncover deeper insights and details that might otherwise have been missed. Probing also allowed the researcher to explore underlying reasons and emotions behind participants’ experiences, which contributed to collecting rich and meaningful data.

During the interviews, the researcher applied paraphrasing by regularly summarizing or rephrasing the participants’ statements and then checking with them to confirm accuracy. For example, the researcher would say, “So, what you’re saying is…,” or “If I understand you correctly, you mean…,” giving participants the opportunity to confirm or clarify their meaning. This ensured that their views were accurately captured without altering their original ideas, and it also helped build rapport by demonstrating active engagement and understanding. Member checking involved providing a brief account of the process, sharing the main points of the discussion, and allowing each study participant to comment on their accuracy (135). During the interviews, the researcher applied member checking by

summarizing the main points discussed and then inviting participants to confirm or correct my understanding. For example, the researcher would say, “Can we conclude then that…?” or “Is this an accurate reflection of what you meant?” This process allowed participants to validate the accuracy of their responses and provide clarifications if necessary. Member checking was conducted immediately after key topics to ensure that the data collected were complete and truly reflected the participants’ perspectives, thereby enhancing the credibility and trustworthiness of the study findings (133).

3.4.2.7 Pilot Study

A pilot study was conducted to pre-test the semi-structured interview guide developed for the qualitative phase. The aim was to assess the clarity, flow, and relevance of the questions and evaluate the feasibility of the data collection procedures. The guide, informed by quantitative findings, included two sections: one for Occupational Health and Safety (OHS) personnel and one for nurses, each addressing demographic details and suitable ergonomic interventions to prevent WRMSDs.

A total of four participants (nurses) from Windhoek Central Hospital took part in the pilot. Interviews were held in a quiet, private space, using real study conditions. Participants responded freely, and the guide was generally well understood. Minor adjustments were made to the sequence and phrasing of a few questions for improved clarity.

The pilot confirmed that the interview guide and process were appropriate and effective. Data from the pilot were not included in the main study, as the purpose was to strengthen

the credibility and dependability of the qualitative research through testing and refinement of the tool and procedures.

3.4.2.8 Trustworthiness

Trustworthiness in this study was assured by applying the criteria of credibility, transferability, dependability, and confirmability (136) which are discussed below.

Credibility

Credibility of the study is achieved when the research findings represent plausible information drawn from the participants' original data and are a correct interpretation of the participants' original views (137). This means credibility can only be achieved if there is a fit between respondents' views and the researcher's interpretation of them (136). The researcher had addressed credibility through:

- Collection of data over three months to ensure that data saturation was reached (prolonged engagement).
- Data collection triangulations by collecting data from two difference sources (OHS personnel at MoHSS and nurses at all four intermediate public hospitals).
- Researcher triangulation, where the researcher and a co-researcher engaged in separate data analyses and then consolidated the analysis.
- Examination of referential adequacy as a means to check preliminary findings and interpretations against the raw data.

Furthermore, member checking was conducted, where the findings were shared with participants during the process of analysis to test if they agreed with the interpretations of the raw data.

Transferability

Transferability refers to the generalisability of the findings, made possible by providing thick descriptions of the context and research methods pursued in this study (136). Transferability was assured by describing the study findings in detail. The researcher addressed the concept of transferability by providing sufficient information about the fieldwork. Transferability was assured through thick, descriptive, and clear criteria when nominating the sample. It was also ensured by providing a rich description of the results, supported by direct quotations from participants during the interviews.

Dependability

Dependability is usually ensured through a research process that is logical, traceable, clearly documented and subjected to judge and/or criticism (136,137). This study was subjected to a review process from the proposal stage to publication in journals and presentations at conferences.

Confirmability

Confirmability is concerned with establishing that the researcher's interpretations and findings are clearly derived from the data of that study, requiring the researcher to demonstrate how conclusions and interpretations have been reached (136). In this study, confirmability was established when credibility, dependability and transferability were all addressed (137).

3.4.2.9 Qualitative Data Analysis

The third objective was to explore the ergonomic interventions that may be suitable and effective in addressing identified risk factors to prevent WRMSDs. Figure 5 below illustrates the inductive thematic analysis/processes utilised in this study.

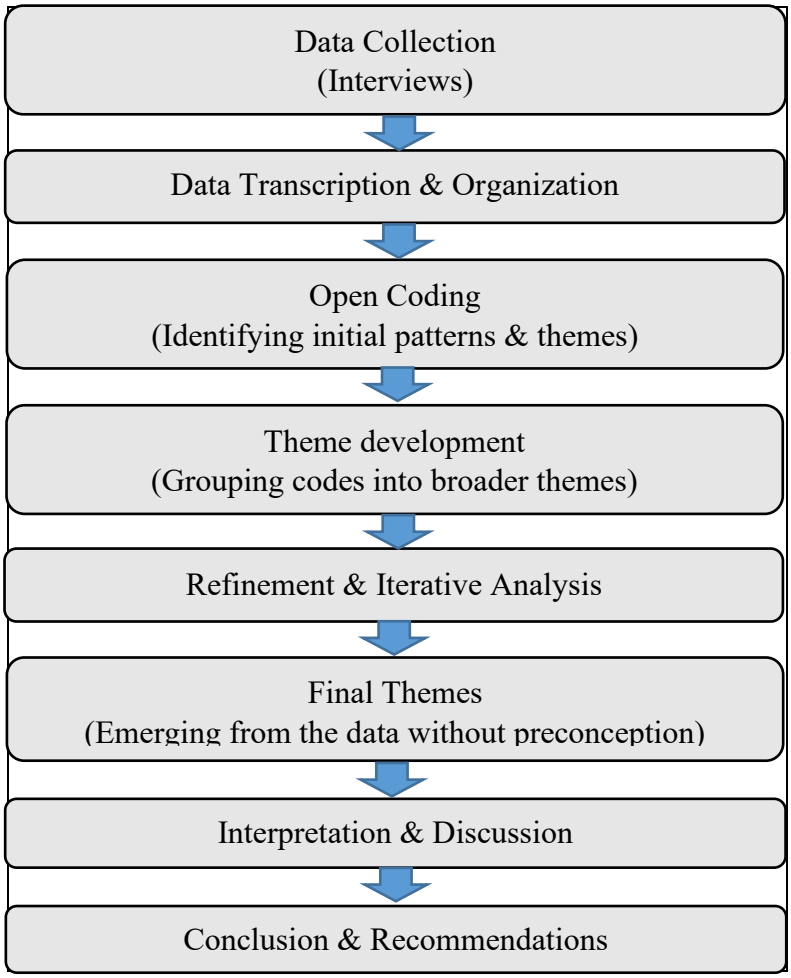

Figure 5: Inductive thematic analysis used in this study *(138)*.

Inductive Thematic Analysis

Consistent with the principles of inductive reasoning previously applied in this study, an inductive thematic analysis approach was adopted during the data analysis phase. The analysis aimed to explore and understand the diverse perspectives of nurses and Occupational Health and Safety (OHS) key informants regarding potential ergonomic interventions effective in mitigating the identified risk factors associated with work-related musculoskeletal disorders (WRMSDs). This approach involved a detailed examination of the collected data without pre-established themes, allowing for the emergence of organic sub-themes, overarching themes, and crucial concepts from the detailed narratives shared by the participants.

By adhering to the inductive reasoning strategy employed earlier in the research design stage, the thematic analysis facilitated an unbiased and comprehensive exploration of participants' insights. This method ensured an understanding of the ergonomic interventions perceived as suitable and potentially effective in addressing the specific risk factors identified to prevent WRMSDs among nurses. It enabled the extraction of valuable insights directly from participants' experiences, contributing to a general view of potential strategies for ergonomic interventions in the healthcare setting.

The qualitative data were captured during the data gathering process using a voice recorder and field notes. Using ATLAS.ti 23, the data were transcribed, coded, and then themes and subthemes were produced in accordance with inductive thematic analysis. Data were coded in an inductive analysis in a way that did not align with the researcher's analytical preconceptions or pre-existing coding framework (138) This method was used to analyse the

data and generate themes naturally occurring to avoid researcher bias. Direct quotes from the different respondents were presented in italics.

3.5 INTEGRATION OF THE QUANTITATIVE AND QUALITATIVE RESULTS

Integration is a process in mixed methods research in which the qualitative and quantitative strands of a study interact with each other (139). It also refers to the process whereby quantitative and qualitative approaches are intentionally combined to enhance the understanding of the topic (139). There are three levels of integration in mixed methods research: study design level, methods level, and interpretation and reporting level. The following table illustrates these various levels of integration within mixed methods research.

Table 2: Levels of integration within mixed methods

Integration Level	*Approaches*
Design	3 Basic designs
	Exploratory sequential
	Explanatory sequential
	Convergent
	4 Advanced frameworks
	Multistage
	Intervention
	Case study
	Participatory—Community-based participatory research, and transformative
Methods	Connecting
	Building
	Merging
	Embedding
Interpretation and Reporting	Narrative—Weaving, contiguous and staged
	Data transformation
	Joint display

Source: Creswell and Clark (2022) (113)

Firstly, integration at the study design level involves the conceptualisation of the study and the implementation of the types of design used to investigate the research topic. Integration at this level is manifested in three fundamental mixed methods designs: exploratory sequential, explanatory sequential, and convergent. It also extends to four advanced frameworks: multistage, intervention, case study, and participatory (113,140).This study utilised an explanatory sequential design, where data were collected and analysed in the in the first phase, which informed the follow-up phase.

Secondly, integration at the methodological level was employed. At this level, integration involves four approaches: establishing connections between databases through sampling (connecting), shaping one database's data collection approach based on another (building), combining two databases for joint analysis (merging), and linking data collection and analysis at multiple points (embedding) (113). This part involved using quantitative data to shape the development of interview guide questions aimed at elucidating the quantitative findings. The quantitative data served as a guiding tool in constructing the sampling frame, enabling purposive selection of key informants (participants) for the qualitative phase of the study, rather than relying on random sampling.

Lastly, at the interpretation and reporting level, the integration of quantitative and qualitative findings was achieved through narrative-contiguous and use of joint display. Integration at this level involves methods such as narrative-contiguous, data transformation, and joint display, where the researcher describes both quantitative and qualitative findings in a single report (141). In this study, the findings were described in a single report using the contiguous approach, with quantitative statistical findings and qualitative findings (themes and sub-

themes) reported in separate sections. Later, both quantitative and qualitative findings were integrated in one section using a joint display discussion to allow the qualitative results to provide more detailed explanations of the quantitative results.

This integration method (narrative-contiguous and joint display) has been previously utilised, recommended, and proven by researchers conducting similar studies to be suitable for integrating results in an explanatory sequential mixed-methods study design (139). Therefore, it was appropriate for this study for the following reasons:

a) This integration method aligns with the study's multidimensional objectives across distinct phases. Since the research encompasses phases to determine prevalence, identify risk factors, explore ergonomic interventions, develop an educational program, and evaluate its readiness and applicability, a narrative-contiguous approach helps unify diverse findings seamlessly.
b) Given the diverse objectives, integrating both qualitative and quantitative findings ensure a complete understanding of WRMSDs among nurses in IPHs in Namibia. By using joint displays and narrative-contiguous reporting, the study combines statistical evidence with qualitative insights, providing a comprehensive perspective.
c) The chosen method supports the detailed exploration of quantitative results with qualitative insights. This is particularly crucial in a multifaceted study where qualitative data can elaborate on and provide deeper context for quantitative findings related to risk factors, prevalence, and the effectiveness of ergonomic interventions.
d) The effectiveness and suitability of the narrative-contiguous reporting and joint display integration methods have been previously proven in studies with similar

designs (explanatory sequential mixed-methods study design) (142). Leveraging established methods adds credibility and ensures a systematic approach to integrating results.

The integration process utilised in this study (sequential mixed method) is highlighted in Figure 7 below.

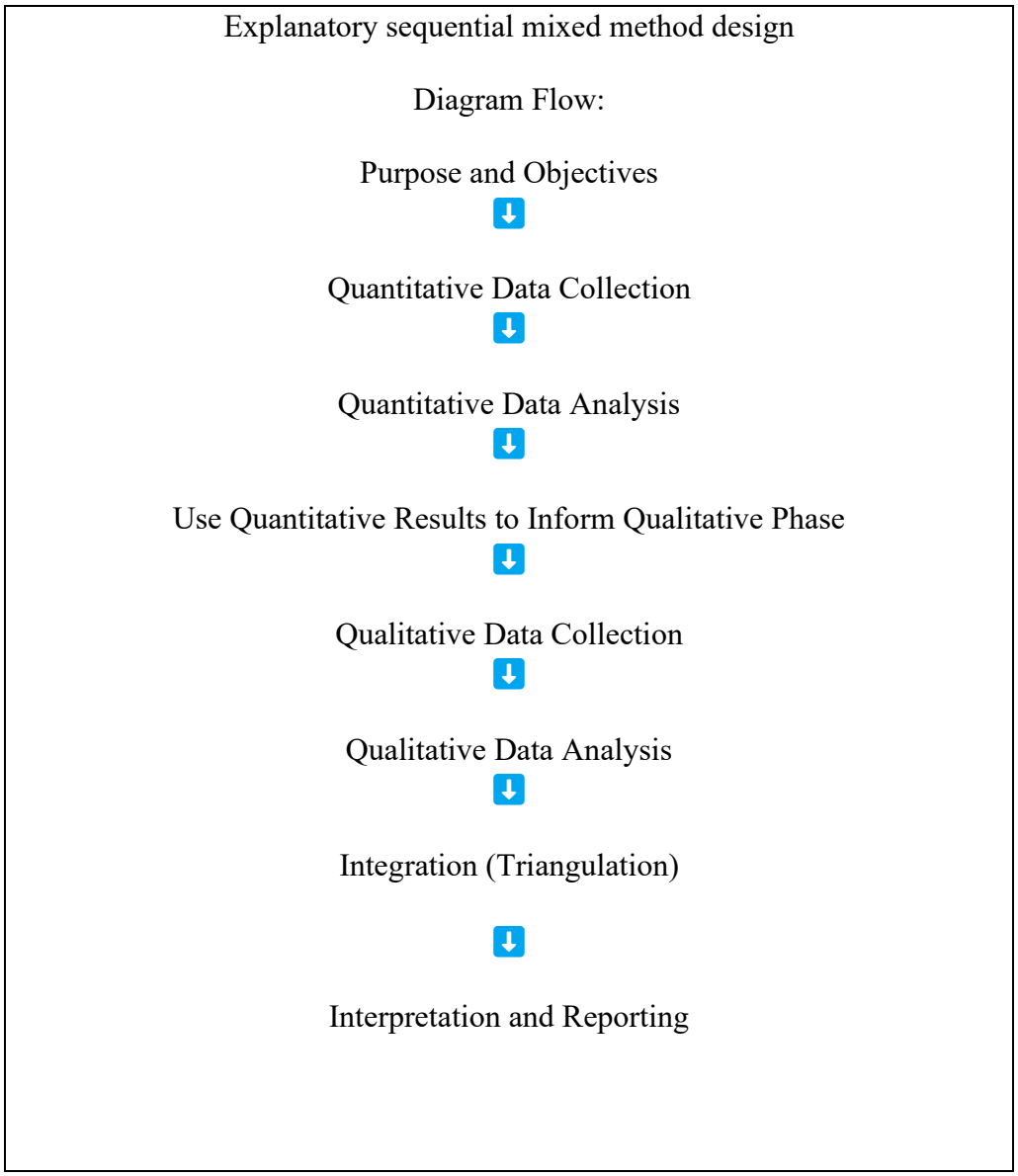

Figure 6: The integration process for this study.

Hence, following analysis of the prevalence of WRMSDs and the associated risk factors as well as the review of OHS personnel and nurses' opinions and experiences regarding ergonomic interventions to address these risk factors and prevent WRMSDs among nurses in IPHs in Namibia, the results were then integrated (both quantitative and qualitative), summarised and interpreted. These results guided the development of a multifaceted ergonomic educational program.

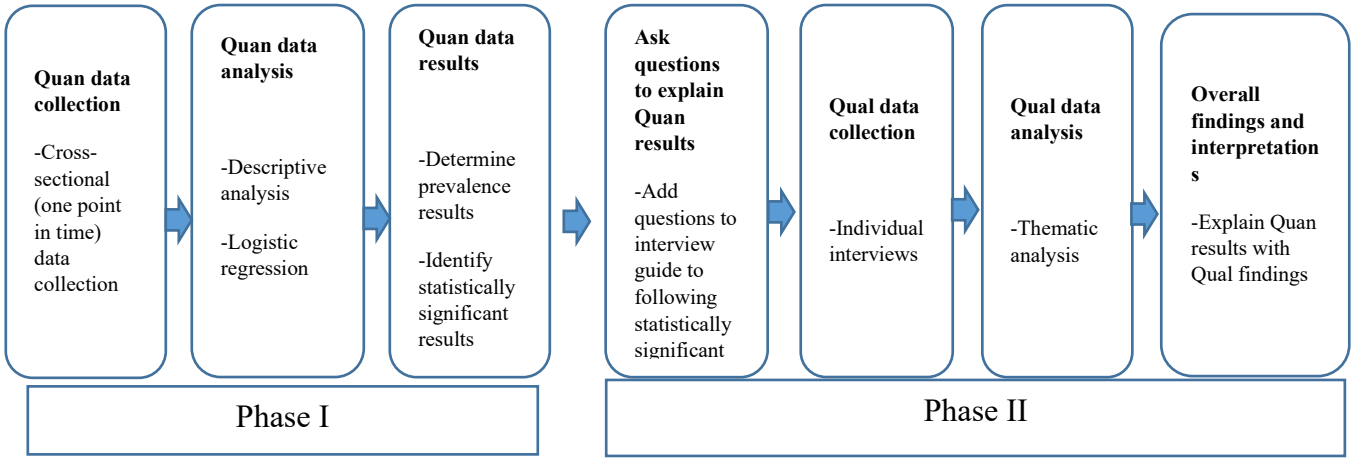

Figure 7: Results integration. *Source: created by author*

3.6 PHASE III

Specific Objective: To develop a multifaceted ergonomic educational program to prevent work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia.

Approach: Drafting of the program

At Phase III, the researchers drafted a multifaceted ergonomic educational program based on the research findings of the Phase I and II, the Biomechanical-Structural Model of development and prevention for musculoskeletal disorders, a conceptual framework for work-related musculoskeletal disorders, and existing literature. This objective is discussed in detail in Chapter 6.

3.7 PHASE IV

Specific Objective: Evaluate the readiness and applicability of the multifaceted ergonomic educational program

Approach: Expert Review

After the program was drafted, an expert review was conducted by purposively sampled ergonomists in Namibia who were available and willing to participate. The purpose of the expert review was to expand on heuristic evaluation by assessing the program design for compliance with heuristics, usability guidelines, correctness, representativeness, and principles of usability in ergonomics to prevent the prevalence and incidence of WRMSDs among nurses (143). The written expert review report from the reviewers was required, and its detailed information and recommendations were used by the researcher to amend the program by making corrections and addressing identified errors. After this review, the multifaceted ergonomic educational program was ready for submission to the MoHSS for implementation. This objective is discussed in detail in Chapter 6.

3.8 ETHICAL MEASURES

Ethics is defined as a system of moral values concerned with the adherence of research procedures to professional, legal, and social obligations to protect the study participants' rights (144). Therefore, the following ethical measure were considered for this study:

3.8.1 Ethical Clearance

Ethical clearance and a research permission letter were obtained from the University of Namibia (UNAM) Decentralised Ethical Committee (DEC), and research permission was issued by the postgraduate research services. Permission to conduct the study was also obtained from the Executive Director (ED) of the Ministry of Health and Social Services (MoHSS), and from medical superintendents of each Intermediate Hospital in the four regions (Khomas, Oshikoto, Oshana, and Kavango). Written informed consent was obtained from all participants and respondents involved in the study.

3.8.2 The Right to Self-Determination

The participants' right to self-determination was respected by seeking informed consent from them before they participated in the study. The researcher provided the participants with a consent form that described the study details and highlighted the participants' expected roles.

3.8.3 Respect, Confidentiality, and Anonymity Principles

Confidentiality was ensured by using anonymous codes on the questionnaires, so that no personal information or responses could be linked and traceable to or traced back to the respondents. Participants were addressed anonymously to respect their rights. Furthermore, respondents were clearly informed that they could withdraw from the study at any time without providing an explanation and had the right to omit or refuse to answer any question without penalty. Collected data were stored on devices that were lockable with passwords. The completed questionnaires and informed consent forms were stored separately in a locked safe for five years if the study is not published, and for two years if the study is published. Only the researcher and supervisor had access to the data to ensure the study's confidentiality.

3.8.4 Beneficence and Nonmaleficence Principles

There was no foreseeable harm to participants in this study, as they were only required to respond without participating in any experiments or interventions. No costs were incurred by participants. Although the participants did not directly benefit, the information collected was used to develop an ergonomic interventional program to prevent WRMSDs among nurses.

3.8.5 Principle of Justice

In this study, the principle of justice was upheld by ensuring that all participants had an equal opportunity to be selected from the target population based on reasons directly related to the research purpose, rather than their accessibility or the potential for manipulation.

3.8.6 Privacy Considerations

The participants' right to privacy was carefully respected throughout all stages of the research process. During the quantitative phase, nurses received self-administered questionnaires individually and in private at their respective workstations. They were given 2 to 5 days to complete the questionnaires at their convenience, and all completed forms were returned in sealed envelopes to protect the confidentiality of their responses. All communication related to participation was conducted privately and respectfully to safeguard participants' personal choices and information.

In the qualitative phase, privacy was maintained by conducting interviews in confidential settings, such as empty consulting rooms for nurses and private offices for OHS personnel. Interview times and venues were arranged in consultation with each participant to minimize work disruptions and ensure a comfortable, private environment. Participants were informed that audio recordings would be made only with their explicit consent, and all recordings and field notes were securely stored and anonymized. These measures ensured that participants could share their views freely while their privacy and autonomy were fully protected.

3.9 SUMMARY

This chapter described the explanatory sequential design of the mixed method approach, which used both quantitative and qualitative study designs. It outlined the scientific reasoning strategies, study population, sampling methods, data collection tools and methods, communication skills and attitudes applicable in data collection, and ethical considerations. The next chapter, Chapter 4, presents the results and discussions of this study.

CHAPTER 4

RESULTS

4.1 INTRODUCTION

This chapter presents the research findings based on the analyses of the data collected both quantitatively and qualitatively. The quantitative results are presented in a descriptive and analytical format according to the objectives of the study. The results are presented in the form of frequencies and percentages, using tables and figures. Multinomial regression analysis was used to determine the significance of various independent variables (risk factors) with the dependent variable (development of WRMSDs). Moreover, a Chi-square (x^2) test was conducted to examine the association between independent variables (socio-demographic information and occupational profile) and the dependent variable (development of WRMSDs). The qualitative data were coded, and themes and sub-themes were generated to explain the quantitative results.

4.2 QUANTITATIVE RESULTS

Quantitatively, the researcher used self-administered, closed-ended questionnaires to collect data from nurses at all four Intermediate Hospitals (IHs) (Katutura, Onandjokwe, Oshakati, and Rundu) in the country. The findings of this study on socio-demographic information, the prevalence of WRMSDs among nurses at intermediate hospitals, risk factors associated with WRMSDs among nurses at IHs, and interventions to prevent WRMSDs among nurses at IHs are presented below.

4.2.1 Socio-Demographic Information and Occupational Profile

Socio-demographic information included gender, age and Body Mass Index (BMI). The occupational profile covered the number of years working in the profession, age of respondents when WRMSDs developed, the duration respondents have been working in the nursing profession versus the development of WRMSDs, average hours of overtime worked per week, and average days off duty per week.

4.2.1.1 Gender

The sex of the study respondents at IHs Katutura, Onandjokwe, Oshakati, and Rundu are shown in Table 3 below.

Table 3: Sex of the study respondents

Sex	Places (frequency (n) and percentages (%)			
	IH Katutura	IH Onandjokwe	IH Oshakati	IH Rundu
Male	32 (14%)	34 (19%)	54 (23%)	45 (27%)
Female	195 (86%)	147 (81%)	179 (77%)	122 (73%)
Total	227 (100%)	181 (100%)	233 (100%)	167 (100%)

Demographic data on gender shows that there are more females in the nursing profession compared to males across all IHs in the country. The results indicate that the gender distribution in the nursing profession at IHs Katutura, Onandjokwe, Oshakati, and Rundu is (14% male: 86% female), (19% male: 81% female), (23% male:77% female), (27% male:73% female), respectively.

4.2.1.2 Age Groups

The age groups of study respondents at IHs Katutura, Onandjokwe, Oshakati, and Rundu are shown in Table 4 below.

Table 4: Respondents' Age Groups

Sex	Places (frequency (n) and percentages (%)			
	IH Katutura	IH Onandjokwe	IH Oshakati	IH Rundu
Age - groups				
<30 years	32 (14%)	31 (17%)	33 (14%)	32 (19%)
30–35 years	86 (38%)	71 (39%)	100 (43%)	57 (34%)
36–40 years	75 (33%)	56 (31%)	84 (36%)	55 (33%)
>40 years	34 (15%)	23 (13%)	16 (7%)	23 (14%)
Total	227 (100%)	181 (100%)	233 (100%)	167 (100%)

Compared to other age groups, most study respondents across all intermediate hospitals (IHs) in Namibia were between the ages of 30 and 35 years. Specifically, this age group made up 43% of respondents at IH Oshakati, 39% at IH Onandjokwe, 38% at IH Katutura, and 34% at IH Rundu. The second most represented age group was between 36 and 40 years. A smaller proportion of respondents were older than 40 years, with 15% reported at IH Katutura, 14% at IH Rundu, 13% at IH Onandjokwe, and only 7% at IH Oshakati.

4.2.1.3 Body Mass Index (kg/m^2) of Study Respondents

The Body Mass Index (BMI) (kg/m^2) of study respondents at IHs Katutura, Onandjokwe, Oshakati, and Rundu is shown in Figure 8.

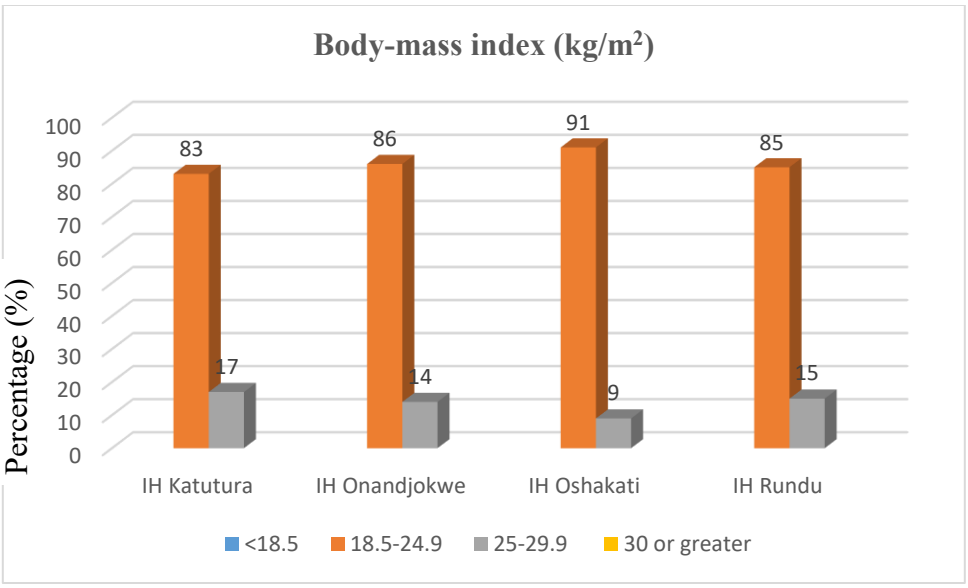

Figure 8: Body-Mass Index (kg/m^2) of Study Respondents at Intermediate Hospitals in Namibia

Most study respondents had a Body Mass Index (BMI) within the normal range of 18.5–24.9 kg/m². Specifically, 91% of respondents at IH Oshakati, 86% at IH Onandjokwe, 85% at IH Rundu, and 83% at IH Katutura fell within this category. A smaller proportion of respondents had a BMI of 25–29.9 kg/m², indicating they were overweight, with 17% at IH Katutura, 15% at IH Rundu, 14% at IH Onandjokwe, and 9% at IH Oshakati. Notably, none of the respondents across the four hospitals had a BMI below 18.5 kg/m² (underweight) or 30 kg/m² or greater (obese).

4.2.1.4 Years of Experience of Respondents

The information about the years of experience of study respondents at IHs Katutura, Onandjokwe, Oshakati, and Rundu is shown in figure 9 below.

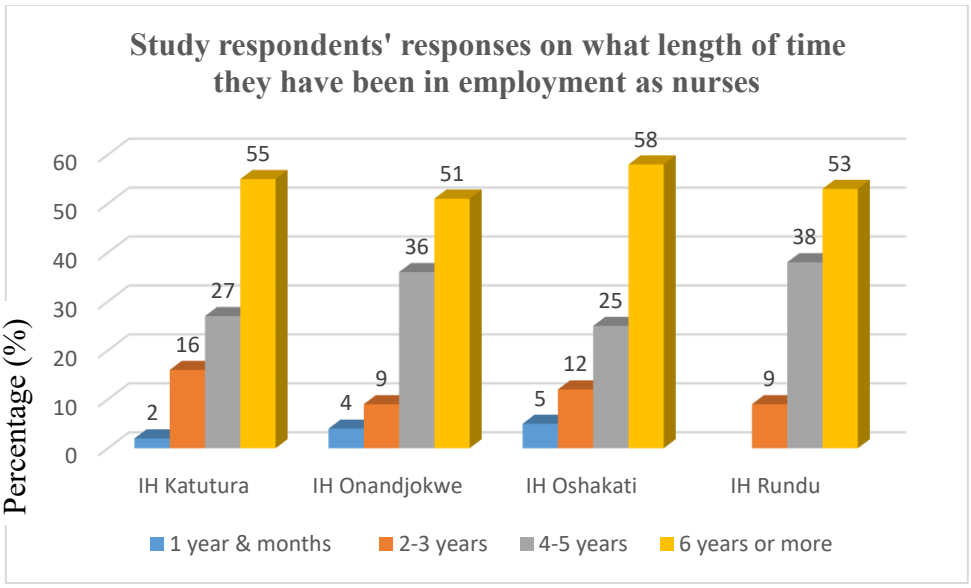

Figure 9: Time worked in Nursing Profession by Study Respondents at Intermediate Hospitals in Namibia

Based on the study respondents' feedback as shown in Figure 8, most nurses had been working in the nursing profession for six years or more. Specifically, this applied to 58% of respondents at IH Oshakati, 55% at IH Katutura, 53% at IH Rundu, and 51% at IH Onandjokwe. The second most common range of experience was four to six years, with 38% of respondents at IH Rundu, 36% at IH Onandjokwe, 27% at IH Katutura, and 25% at IH Oshakati falling into this category. Only a small number of nurses reported having worked for one year or less, or for two to three years, across all four hospitals.

4.2.1.5 Average Hours of Overtime per Week

The average overtime hours that study respondents worked at IHs Katutura, Onandjokwe, Oshakati, and Rundu is shown in Figure 10.

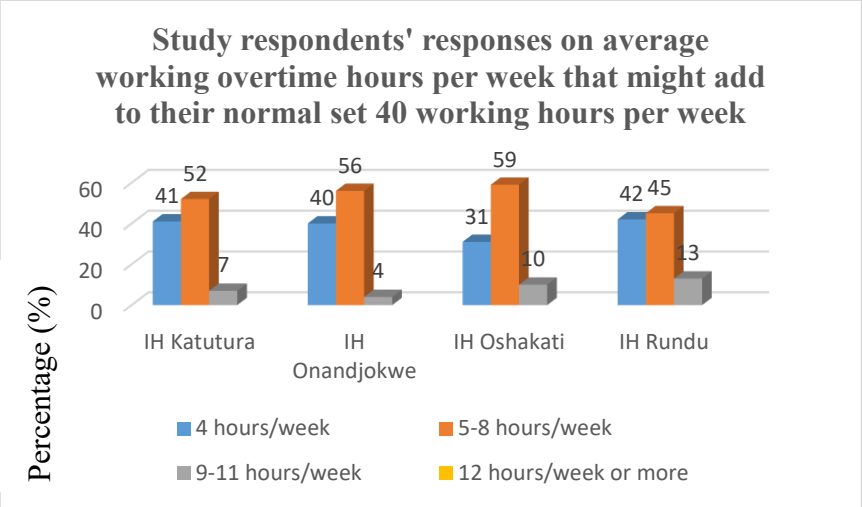

Figure 10: Average Hours of Overtime per Week for Study Respondents at Intermediate Hospitals in Namibia

Most respondents worked five to eight hours of overtime per week, with 59% at IH Oshakati, 56% at IH Onandjokwe, 52% at IH Katutura, and 45% at IH Rundu. The second most common amount of overtime was four hours per week, reported by 42% of respondents at IH Rundu, 41% at IH Katutura, 40% at IH Onandjokwe, and 31% at IH Oshakati. Few respondents indicated working nine to eleven hours of overtime per week, with 13% at IH Rundu, 10% at IH Oshakati, 7% at IH Katutura, and 4% at IH Onandjokwe. None of the respondents at any of the hospitals reported working 12 or more hours of overtime per week.

4.2.1.6 Average Days Off Duty per Week

The information on the average days off duty per week for respondents at IH Katutura, Onandjokwe, Oshakati, and Rundu is shown in Figure 11.

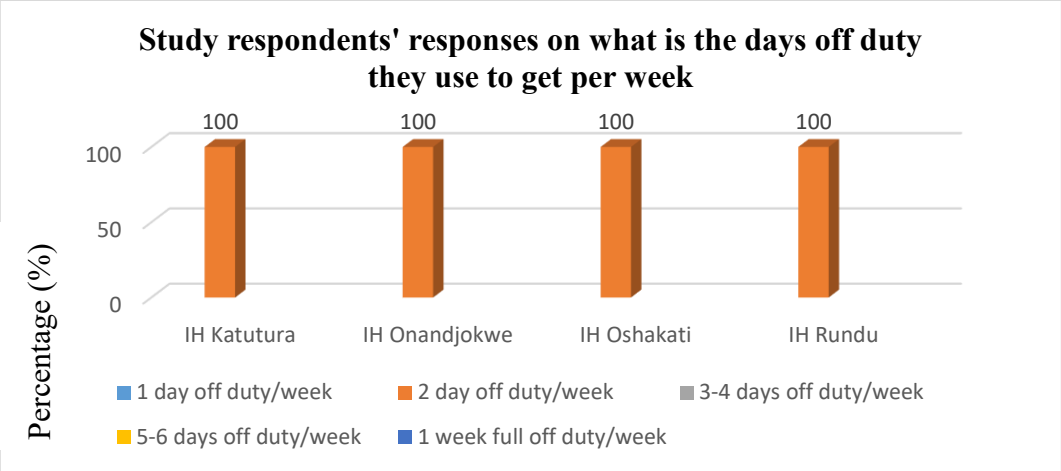

Figure 11: Average Days Off Duty per Week of Study Respondents at Intermediate Hospitals in Namibia

Results show that all study respondents from IHs Katutura, Onandjokwe, Oshakati, and Rundu had two days off duty per week (100%).

4.2.1.7 Measures of Association Between Socio-Demographic Information, Occupational Profile, and WRMSDs

Measures of association between socio-demographic factors (sex, age groups, BMI), and occupational profile (job experience), with WRMSDs (pain) of the study respondents at IHs Katutura, Onandjokwe, Oshakati, and Rundu were determined and presented in Table 5 below. This was done in order to assess whether these factors could contribute to the development of WRMSDs among study respondents.

Table 5: Association Between Socio-Demographic Information, and Occupational Profile with the 12-month Prevalence of WRMSDs.

Place	**Socio-demographic information, and occupational profile**	**Having WRMSDs**		**x^2**	**p-value**
		Yes	**No**		
IH Katutura	Sex				
	Male	34	15	1.117	0.291
	Female	138	39		
	Age				
	Young (18-35 years)	89	29	6.458	0.011*
	Old (36 years and above)	64	45		
	BMI				
	18.5-24.9 normal	142	46	0.082	0.774
	25- 9.9 overweight	28	11		
	Years of experience				
	1-5 years	95	30	5.404	0.020*
	6 years or more	62	40		
IH Onandjokwe	Sex				
	Male	19	15	1.134	0.286
	Female	99	48		
	Age				
	Young (18-35 years)	68	34	9.167	0.001*
	Old (36 years and above)	34	45		
	BMI				
	18.5-24.9 normal	101	55	0.055	0.814
	25- 9.9 overweight	15	10		
	Years of experience				
	1-5 years	56	36	3.989	0.045*
	6 years or more	40	49		
IH Oshakati	Sex				
	Male	41	19	0.589	0.442
	Female	129	44		
	Age				
	Young (18-35 years)	95	38	3.989	0.045*
	Old (36 years and above)	58	42		
	BMI				
	18.5-24.9 normal	154	58	0.107	0.743
	25- 9.9 overweight	14	7		
	Years of experience				
	1-5 years	97	38	4.81	0.028*
	6 years or more	56	42		
IH Rundu	Sex				

	Male	31	19	1.144	0.285
	Female	84	33		
	Age				
	Young (18-35 years)	52	37	5.08	0.024*
	Old (36 years and above)	31	47		
	BMI				
	18.5-24.9 normal	98	44	0.069	0.792
	25- 9.9 overweight	16	9		
	Years of experience				
	1-5 years	61	28	4.482	0.034*
	6 years or more	40	38		

***Significant at P<0.05; x^2- Chi-square**

Results showed that there was no statistically significant association between sex and the development of WRMSDs among nurses across all four hospitals. The chi-square values and p-values were as follows: Katutura (χ^2=1.117, p=0.291), Onandjokwe (χ^2=1.134, p=0.286), Oshakati (χ^2=0.589, p=0.442), and Rundu (χ^2=1.144, p=0.285), all exceeding the 0.05 significance level.

Similarly, no significant association was found between BMI and WRMSDs**.** The findings from Katutura (χ^2=0.082, p=0.774), Onandjokwe (χ^2=0.055, p=0.814), Oshakati (χ^2=0.107, p=0.743), and Rundu (χ^2=0.069, p=0.792) confirmed that BMI was not a contributing factor among the sampled nurses.

In contrast, a statistically significant association was found between age and WRMSDs at all four hospitals: Katutura (χ^2=6.458, p=0.011), Onandjokwe (χ^2=9.167, p=0.001), Oshakati (χ^2=3.989, p=0.045), and Rundu (χ^2=5.08, p=0.024). In each case, a higher proportion of older nurses (aged 36 years and above) reported WRMSDs compared to younger nurses (18–35 years), indicating that older age groups were more affected by musculoskeletal pain**.**

Furthermore, years of work experience were also significantly associated with WRMSDs at Katutura (χ^2=5.404, p=0.020), Onandjokwe (χ^2=3.989, p=0.045), Oshakati (χ^2=4.81, p=0.028), and Rundu (χ^2=4.482, p=0.034). Notably, nurses with longer work experience (6 years or more) reported a higher prevalence of WRMSDs compared to those with 1–5 years of experience, suggesting that employees with more years in service may be more prone to developing WRMSDs due to accumulated exposure to physically demanding tasks over time.

4.2.2 Prevalence of Work-Related Musculoskeletal Disorders Among Nurses

Study respondents indicated the prevalence of WRMSDs in any body part during the past 12 months.

4.2.2.1 Prevalence of Work-Related Musculoskeletal Disorders in any Body Part/Region

The prevalence of WRMSDs among study respondents in any body part in the last 12 months at IHs Katutura, Onandjokwe, Oshakati, and Rundu is shown in Figure 12 below.

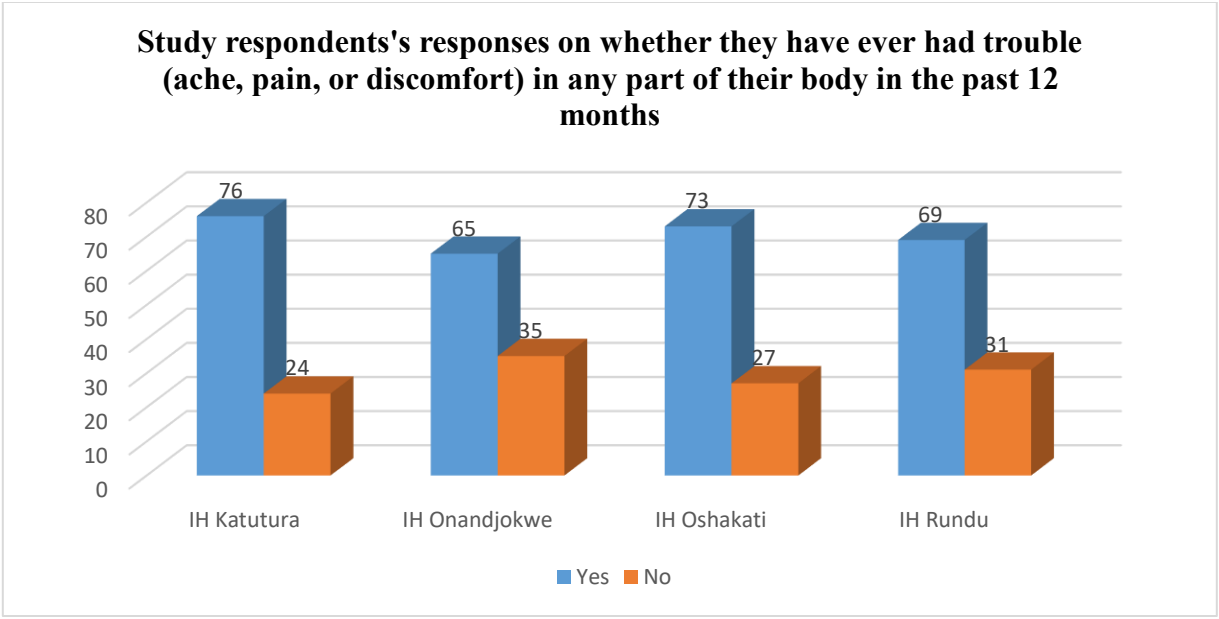

Figure 12: Prevalence of WRMSDs among study respondents at Intermediate Hospitals in Namibia

A high 12 months' prevalence of WRMSDs in any body part was reported as follows: 76% at IH Katutura, 73% at IH Oshakati, 69% at IH Rundu, and 65% at IH Onandjokwe. This high prevalence resulted in an average prevalence of 71% across all four IHs. Conversely, a lower percentage of respondents reported no WRMSDs in any part of their body in the last 12 months: 35% from IH Onandjokwe, 31% from IH Rundu, 27% from IH Oshakati, and 24% Katutura.

4.2.2.2 Prevalence of WRMSDs in Different Body Parts

The prevalence of WRMSDs in various body parts among study respondents at IHs Katutura, Onandjokwe, Oshakati, and Rundu is shown in Figure 13 below.

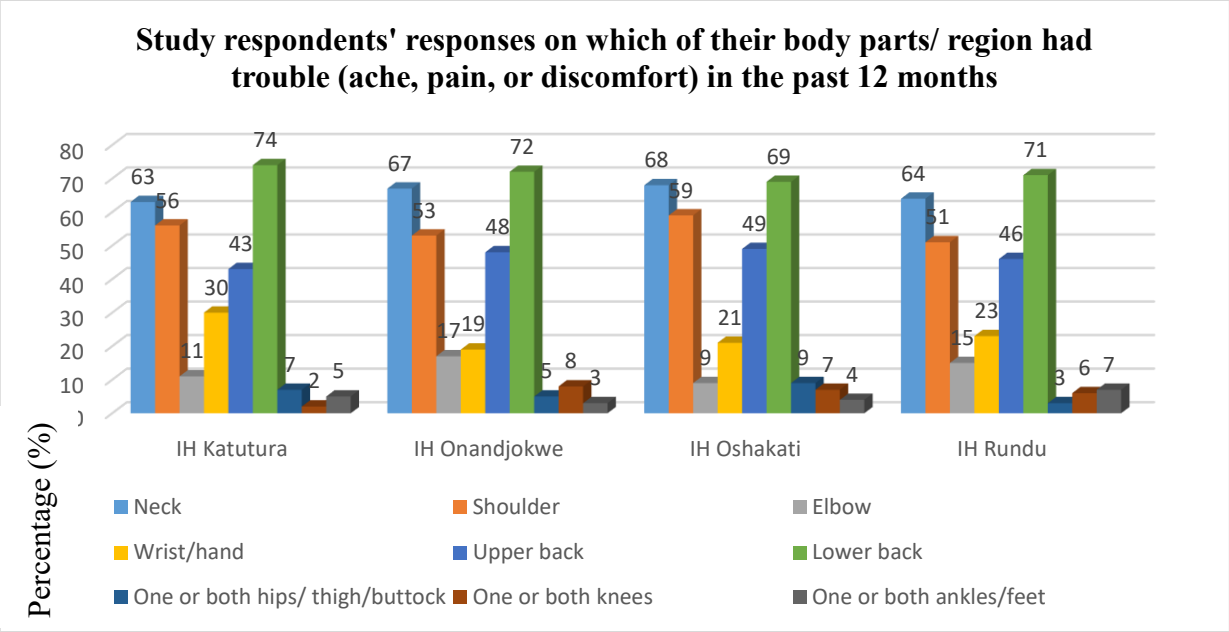

Figure 13: Prevalence of WRMSDs in Specific Body Parts and/or Regions Among Nurses at Intermediate Hospitals in Namibia

The lower back was the most affected body part among study respondents, with a 12-month prevalence of work-related musculoskeletal disorders (WRMSDs) reported at 74% for IH Katutura, 72% for IH Onandjokwe, 71% for IH Rundu, and 69% for IH Oshakati. The second highest prevalence was neck pain, affecting 68% of respondents at IH Oshakati, 67% at IH Onandjokwe, 64% at IH Rundu, and 63% at IH Katutura. The shoulder was the third most affected area, with prevalence rates of 59% at IH Oshakati, 56% at IH Katutura, 53% at IH Onandjokwe, and 51% at IH Rundu. WRMSDs in the upper back were reported by 49% of respondents at IH Oshakati, 48% at IH Onandjokwe, 46% at IH Rundu, and 43% at IH Katutura. Among the body parts listed, the lowest prevalence of WRMSDs was found in the elbow, hips, knees, and ankles/feet. Overall, the highest prevalence rates were observed in the lower back, neck, and shoulders.

4.2.2.3 The Pattern of WRMSDs Pain(s) in Different Body Parts

The pattern of WRMSD pain(s) in different body parts, among nurses at IHs Katutura, Onandjokwe, Oshakati, and Rundu is shown in Figure 14 below.

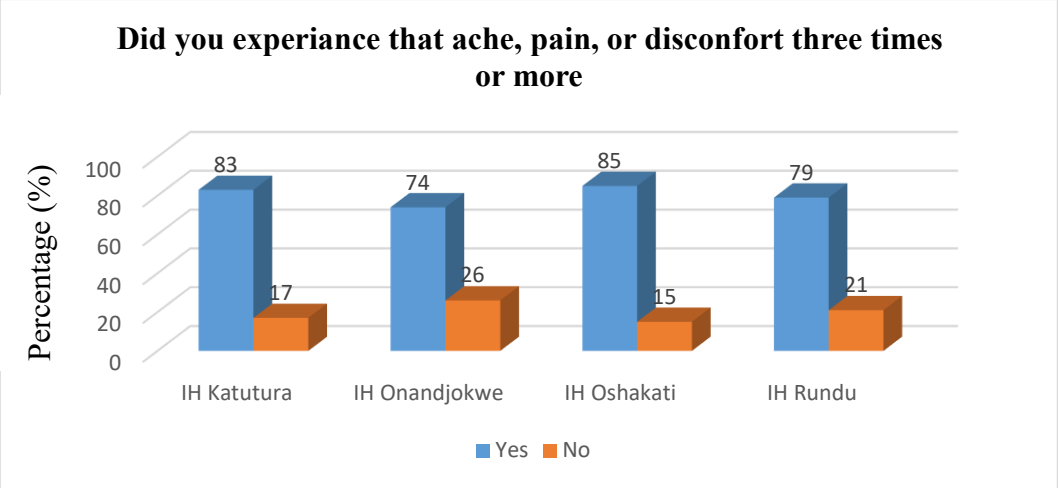

Figure 14: Pattern of Body Pain Linked to WRMSDs Reported in the Last 12 Months at Intermediate Hospitals in Namibia

Among respondents who reported WRMSDs in the past 12 months, 83% at IH Katutura, 74% at IH Onandjokwe, 85% at IH Oshakati, and 79% at IH Rundu experienced trouble, ache, pain, or discomfort in any part of their body three times or more. On average, 80% of respondents across all four IHs reported experiencing such symptoms three times or more during the past year. Conversely, only 26% of respondents at IH Onandjokwe, 21% at IH Rundu, 17% at IH Katutura, and 15% at IH Oshakati reported that they had not experienced trouble, ache, pain, or discomfort in any body part three times or more in the past 12 months.

4.2.2.4 The impacts of WRMSDs Among Nurses at Intermediate Hospitals

The impact of WRMSDs on nurses at IHs Katutura, Onandjokwe, Oshakati, and Rundu is shown in Figure 16 below.

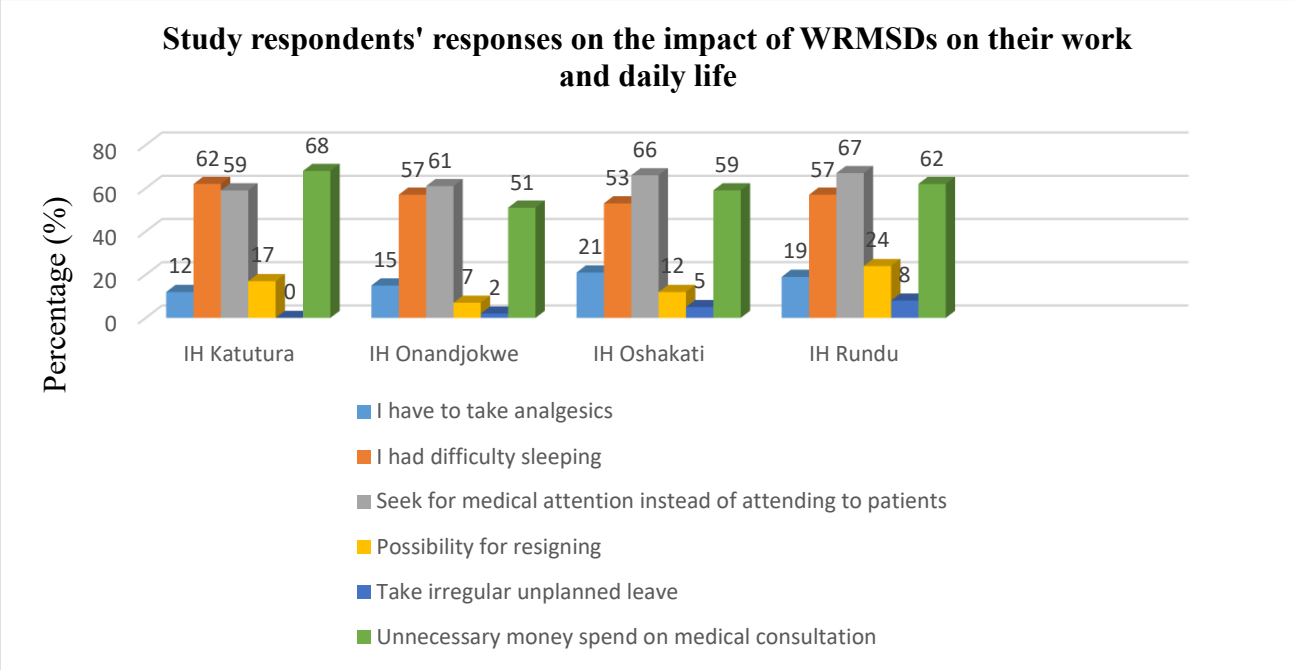

Figure 15: Respondents' Perceptions on the Impact of WRMSDs at Intermediate Hospitals in Namibia

On average, most respondents who experienced WRMSDs in the past 12 months reported that these disorders impacted them by requiring medical attention instead of attending to patients. Specifically, 67% of respondents at IH Rundu, 66% at IH Oshakati, 61% at IH Onandjokwe, and 59% at IH Katutura reported this impact. The second most common impact was unnecessary expenditure on medical consultations, reported by 68% of respondents at IH Katutura, 62% at IH Rundu, 59% at IH Oshakati, and 51% at IH Onandjokwe. Additionally, difficulties sleeping due to WRMSD pain were reported by 62% of

respondents at IH Katutura, 57% at both IH Onandjokwe and IH Rundu, and 53% at IH Oshakati.

4.2.3 Risk Factors Associated with Work-Related Musculoskeletal Disorders Among Nurses

The risk factors contributing and/ or associated with WRMSDs among nurses at IHs in Namibia are detailed bellow.

4.2.3.1 Study Respondents' Perceptions on the Risk Factors Contributing to the Development of WRMSDs

Respondents who experienced ache, pain or discomfort in the past 12 months were asked to identify the risk factors that might have contributed to the development of WRMSDs. The results pertaining to respondents' perceptions of these risk factors among nurses at IHs Katutura, Onandjokwe, Oshakati, and Rundu are shown in Figure 17 below.

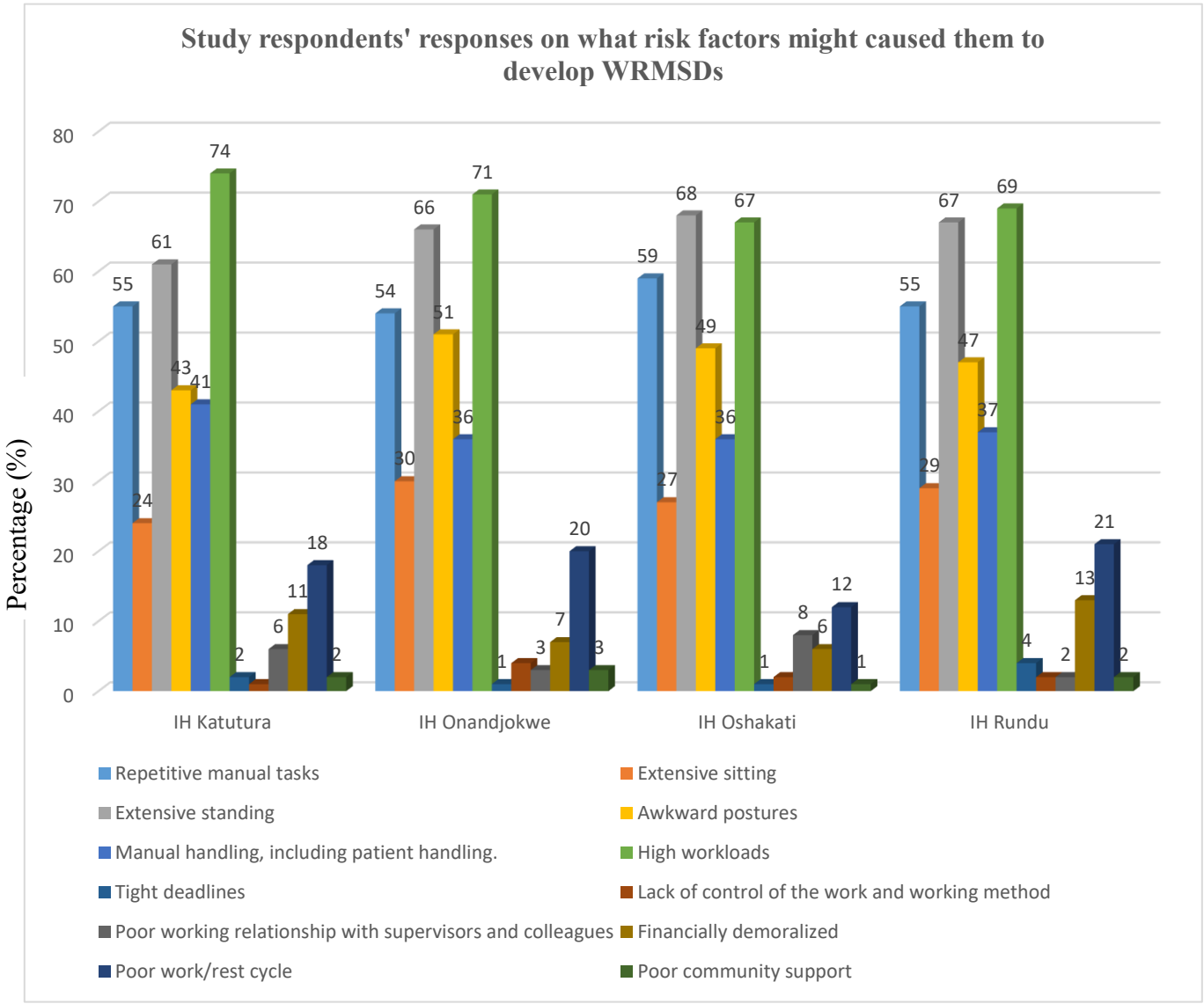

Figure 16: Study Respondents' Perceptions on the Risk Factors Contributing to the Development of WRMSDs at Intermediate Hospitals in Namibia

The study results show that respondents most frequently cited psychosocial and job content risk factors, such as high workloads, as significant contributors to their WRMSDs. These factors were notably reported by 74% of respondents at IH Katutura, 71% at IH Onandjokwe, 69% at IH Oshakati, and 67% at IH Rundu. On average, physical risk factors were the most

prominent contributors to the development of WRMSDs among study respondents. At IH Katutura, nurses reported that WRMSDs developed due to extensive standing (61%), repetitive manual tasks (55%), and awkward postures (43%). Similarly, respondents at IH Onandjokwe identified extensive standing (66%), repetitive manual tasks (54%), and awkward postures (51%) as contributing factors. At IH Oshakati, the main physical risk factors included extensive standing (68%), repetitive manual tasks (59%), and awkward postures (49%). Respondents at IH Rundu reported similar trends, with extensive standing (67%), repetitive manual tasks (55%), and awkward postures (47%) cited as leading contributors. Although various physical risk factors such as repetitive manual tasks, extensive sitting or standing, awkward postures, and manual handling including patient handling were all associated with WRMSDs (as shown in Figure 15), the results clearly indicate that extensive standing, repetitive manual tasks, and awkward postures were the predominant risk factors across all IHs in this study.

4.2.3.2 Multinomial Regression: Development of WRMSDs and Variables (Risk Factors).

The association between risk factors and the development of WRMSDs among nurses at IHs Katutura, Onandjokwe, Oshakati, and Rundu was determined in this study. The multiple regression analysis results are presented in Table 6 below.

Table 6: Association between risk factors with the 12-month prevalence of WRMSDs among nurses at IHs Katutura, Onandjokwe, Oshakati, and Rundu.

Hospitals	**Work-related risk factors**	**WRMSDs**						
IH Katutura, Khomas region			**Yes (n)**	**No (n)**	**Total (n)**	**AOR**	**95% CI**	**P-value**
	Physical risk factors							
	Repetitive manual task	Yes	115	23	138	2.67	1.43-4.99)	0.003*
		No	58	31	89			
		Total	173	54	227			
	Extensive sitting	Yes	95	20	115	2.07	(1.10-3.88)	0.033*
		No	78	34	112			
		Total	173	54	227			
	Extensive standing	Yes	119	27	146	2.20	(1.18-4.10)	0.019*
		No	54	27	81			
		Total	173	54	227			
	Awkward postures	Yes	100	18	118	2.73	(1.44-5.20)	0.003*
		No	73	36	109			
		Total	173	54	227			
	Manual handling, including patient handling.	Yes	98	18	116	2.61	(1.37-4.95)	0.005*
		No	75	36	111			
		Total	173	54	227			
	Psychosocial risk factors							
	High workloads	Yes	121	27	148	2.32	(1.24-4.34)	0.012*
		No	52	27	79			
		Total	173	54	227			
	Tight deadlines	Yes	2	2	4	0.30	(0.04-2.21)	0.516
		No	171	52	223			
		Total	173	54	227			
	Lack of control of the work and working method	Yes	2	2	4	0.30	(0.04-2.21)	0.516
		No	171	52	223			
		Total	173	54	227			
	Poor working relationship with supervisors and colleagues	Yes	10	5	15	0.60	(0.19-1.84)	0.5587
		No	163	49	212			
		Total	173	54	227			

	Financially demoralized	Yes	19	7	26	0.82	(0.32-2.09)	0.8774
		No	154	47	201			
		Total	173	54	227			
	Poor work/rest cycle	Yes	31	5	36	2.13	(0.78-5.80)	0.191
		No	142	49	191			
		Total	173	54	227			
	Poor community support	Yes	3	2	5	0.45	(0.07-2.82)	0.742
		No	170	52	225			
		Total	173	54	227			
IH Onandjokwe, Oshikoto region	**Physical risk factors**							
	Repetitive manual tasks	Yes	78	31	109	2.01	(1.07-3.75)	0.040*
		No	40	32	72			
		Total	118	63	181			
	Extensive sitting	Yes	63	21	84	2.29	(1.21-4.32)	0.015*
		No	55	42	97			
		Total	118	63	181			
	Extensive standing	Yes	81	26	107	3.11	(1.65-5.87)	0.001*
		No	37	37	74			
		Total	118	63	181			
	Awkward postures	Yes	77	30	107	2.06	(1.10-3.85)	0.032*
		No	41	33	74			
		Total	118	63	181			
	Manual handling, including patient handling.	Yes	66	25	91	1.92	(1.03-3.59)	0.054*
		No	52	38	90			
		Total	118	63	181			
	Psychosocial risk factors							
	High workloads	Yes	82	26	74	3.24	(1.71-6.12)	0.001*
		No	36	37	108			
		Total	118	63	73			
	Tight deadlines	Yes	2	2	4	0.52	(0.07-3.82)	0.909
		No	116	61	179			
		Total	118	63	117			
	Lack of control of the work and working method	Yes	5	6	11	0.42	(0.12-1.43)	0.275
		No	113	57	170			
		Total	118	63	181			
	Poor working relationship with	Yes	4	7	11	0.28	(0.07-0.99)	0.081
		No	114	56	170			
		Total	118	63	181			

	supervisors and colleagues							
	Financially demoralized	Yes	8	9	17	0.43	(0.15-1.19)	0.167
		No	110	54	164			
		Total	118	63	181			
	Poor work/rest cycle	Yes	24	12	36	1.08	(0.50-2.34)	0.991
		No	94	51	145			
		Total	118	63	181			
	Poor community support	Yes	3	3	6	0.52	(0.10-2.66)	0.720
		No	115	60	175			
		Total	118	63	181			
IH Oshakati, Oshana region	**Physical risk factors**							
	Repetitive manual tasks	Yes	116	30	146	2.36	(1.30-4.26)	0.006*
		No	54	33	87			
		Total	170	63	233			
	Extensive sitting	Yes	100	26	126	2.03	(1.13-3.65)	0.025*
		No	70	37	107			
		Total	170	63	233			
	Extensive standing	Yes	118	30	148	2.49	(1.38-4.51)	0.004*
		No	52	33	85			
		Total	170	63	233			
	Awkward postures	Yes	110	31	141	1.89	(1.05-3.39)	0.0456*
		No	60	32	92			
		Total	170	63	233			
	Manual handling, including patient handling.	Yes	107	26	133	2.41	(1.33-4.36)	0.005*
		No	63	37	100			
		Total	170	63	233			
	Psychosocial risk factors							
	High workloads	Yes	120	35	155	1.92	(1.05-3.48)	0.0451*
		No	50	28	78			
		Total	170	63	233			
	Tight deadlines	Yes	2	2	4	0.36	(0.05-2.63)	0.635
		No	168	61	229			
		Total	170	63	233			
	Lack of control of the work and working method	Yes	4	2	6	0.73	(0.13-4.11)	1.000
		No	166	61	227			
		Total	170	63	233			
		Yes	14	10	24	0.47		0.144

	Poor working relationship with supervisors and colleagues	No	156	53	209		(0.19-1.13)	
		Total	170	63	233			
	Financially demoralized	Yes	10	7	17	0.50	(0.18-1.37)	0.280
		No	160	56	216			
		Total	170	63	233			
	Poor work/rest cycle	Yes	21	4	25	2.07	(0.68-6.31)	0.282
		No	149	59	208			
		Total	170	63	233			
	Poor community support	Yes	2	2	4	0.36	(0.05-2.63)	0.635
		No	168	61	229			
		Total	170	63	233			
IH Rundu, Kavango region	**Physical risk factors**							
	Repetitive manual tasks	Yes	75	24	99	2.18	(1.12-4.26)	0.031*
		No	40	28	68			
		Total	115	52	167			
	Extensive sitting	Yes	62	17	79	2.40	(1.21-4.78)	0.017*
		No	53	35	88			
		Total	115	52	167			
	Extensive standing	Yes	77	23	100	2.55	(1.30-4.99)	0.009*
		No	38	29	67			
		Total	115	52	167			
	Awkward postures	Yes	74	23	97	2.27	(1.16-4.43)	0.023*
		No	41	29	70			
		Total	115	52	167			
	Manual handling, including patient handling.	Yes	66	11	77	5.02	(2.34-10.74)	0.001*
		No	49	41	90			
		Total	115	52	167			
	Psychosocial risk factors							
	High workloads	Yes	80	21	101	3.3	(1.70-6.67)	0.001*
		No	35	31	66			
		Total	115	52	167			
	Tight deadlines	Yes	5	4	9	0.54	(0.14-2.12)	0.606
		No	110	48	158			
		Total	115	52	167			
		Yes	2	4	6	0.21		0.143

	Lack of control of the work and working method	No	113	48	161		(0.03-1.19)	
		Total	115	52	167			
	Poor working relationship with supervisors and colleagues	Yes	2	3	5	0.28	(0.04-1.78)	0.355
		No	113	49	162			
		Total	115	52	167			
	Financially demoralized	Yes	15	2	17	3.75	(0.82-17.04)	0.122
		No	100	50	150			
		Total	115	52	167			
	Poor work/rest cycle	Yes	24	5	29	2.47	(0.88-6.91	0.119
		No	91	47	138			
		Total	115	52	167			
	Poor community support	Yes	2	2	4	0.44	(0.06-3.23	0.780
		No	113	50	163			
		Total	115	52	167			

***Significant at P<0.05; CI-Confident Interval; AOR-Adjusted Odds Ratio**

The results showed that all physical risk factors - repetitive manual tasks, extensive sitting, extensive standing, awkward postures, as well as manual handling (including patient handling), were significantly associated with WRMSDs ($p<0.05$) among study respondents at IHs Katutura, Onandjokwe, Oshakati, and Rundu, as depicted in Table 6 above.

Among psychosocial risk factors, only the job content risk factor of high workloads was associated with WRMSDs at IH Katutura (AOR=2.32, 955 CI 1.24-4.34, p=0.012), IH Onandjokwe (AOR=3.24, 95% CI 1.71-6.12, p=0.001), IH Oshakati (AOR=1.92, 95% CI 1.05-3.48, p=0.0451), and IH Rundu (AOR= 3.3, 95% CI 1.70-6.67, p=0.001). Psychosocial risk factors such as tight deadlines, lack of control over work and work methods, poor working relationships with supervisors and colleagues, financial demoralization, poor work/rest cycles, and inadequate community support were not associated ($p>0.05$) with WRMSDs among nurses at any of the IHs.

4.2.3.3 Multinomial Regression: Development of types of WRMSDs in specific body regions and variables (risk factors).

The association between risk factors and the types of WRMSDs in the three most affected specific body regions among nurses at IHs Katutura, Onandjokwe, Oshakati, and Rundu, was determined in this study. The multiple regression analysis results are presented in Table 7 below.

Table 7: Association between risk factors and the types of WRMSDs in specific body parts and/or regions among nurses at Katutura, Onandjokwe, Oshakati, and Rundu IPHs

Hospitals	**Work-related risk factors**	**Types of WRMSDs**								
		Neck pain			**Shoulder pain**			**Lower back pain**		
		AOR	**95% CI**	**P-value**	**AOR**	**95% CI**	**P-value**	**AOR**	**95% CI**	**P-value**
IH Katutura, Khomas region	Repetitive manual tasks	1.85	(1.02-3.34)	0.058*	1.84	(1.08-3.13)	0.033*	0.92	(0.49-1.73)	0.931
	Extensive sitting	1.37	(0.79-2.40)	0.321	0.78	(0.46-1.33)	0.450	1.08	(0.58-2.02)	0.926
	Extensive standing	1.149	(0.66-1.99)	0.720	0.75	(0.43-1.29)	0.370	1.98	(1.08-3.65)	0.038*
	Awkward postures	1.95	(1.11-3.40)	0.026*	1.84	(1.07-3.18)	0.038*	1.11	(0.60-2.05)	0.836

	Manual handling	0.65	(0.37-1.11)	0.155	2.08	(1.21-3.54)	0.010*	2.09	(1.14-3.82)	0.023*
	High workloads	0.75	(0.44-1.30)	0.384	2.63	(1.52-4.55)	0.001*	2.47	(1.34-4.55)	0.005*
IH Onandjokwe, Oshikoto region	Repetitive manual tasks	1.93	(1.03-3.61)	0.056*	1.91	(1.06-3.46)	0.044*	0.80	(0.41-1.56)	0.648
	Extensive sitting	0.64	(0.33-1.21)	0.231	1.36	(0.74-2.49)	0.386	0.71	(0.36-1.37)	0.399
	Extensive standing	0.74	(0.39-1.40)	0.451	1.41	(0.77-2.56)	0.325	2.18	(1.12-4.22)	0.030*
	Awkward postures	2.47	(1.31-4.66)	0.008*	1.87	(1.03-3.39)	0.053*	0.68	(0.37-1.25)	0.278
	Manual handling	0.60	(0.32-1.13)	0.161	2.05	(1.12-3.72)	0.026*	0.64	(0.33-1.24)	0.255
	High workloads	1.02	(0.53-1.94)	1.000	2.14	(1.17-3.92)	0.019*	2.07	(1.07-4.01)	0.042*
IH Oshakati, Oshana	Repetitive manual tasks	1.97	(1.12-3.43)	0.024*	1.87	(1.10-3.17)	0.028*	1.19	(0.67-2.08)	0.641
	Extensive sitting	0.95	(0.55-1.66)	0.995	1.60	(0.93-2.75)	0.114	1.21	(0.69-2.12)	0.594

	Extensive standing	1.38	(0.79-2.41)	0.314	1.57	(0.92-2.68)	0.125	2.41	(1.36-4.29)	0.004*
	Awkward postures	1.96	(1.12-3.43)	0.024*	2.38	(1.37-4.13)	0.003*	1.17	(0.67-2.05)	0.672
	Manual handling	1.66	(0.92-2.98)	0.115	1.76	(1.04-2.97)	0.044*	2.48	(1.39-4.40)	0.003*
	High workloads	1.26	(0.70, 2.26)	0.516	1.97	(1.16, 3.35)	0.016*	2.73	(1.51, 4.94)	0.001*
IH Rundu, Kavango region	Repetitive manual tasks	2.58	(1.35-4.96)	0.006*	1.92	(1.03-3.56)	0.055*	2.02	(1.00-4.07)	0.069*
	Extensive sitting	1.22	(0.64-2.32)	0.639	1.75	(0.93-3.26)	0.107	1.16	(0.59-2.27)	0.786
	Extensive standing	1.19	(0.63, 2.24)	0.706	1.43	(0.77, 2.66)	0.327	2.53	(1.27, 5.03)	0.012*
	Awkward postures	2.39	(1.25-4.57)	0.012*	2.08	(1.09-3.97)	0.035*	1.14	(0.58-2.24)	0.822
	Manual handling	1.52	(0.80-2.90)	0.255	2.02	(1.08-3.78)	0.038*	2.42	(1.22-4.80)	0.017*
	High workloads	1.41	(0.74-2.68)	0.375	2.36	(1.26-4.44)	0.011*	2.30	(1.15-4.59)	0.027*

***Significant at P<0.05; CI-Confident Interval; AOR- Adjusted Odds Ratio**

The lower back pain was associated with extensive standing (AOR=1.98, 95% CI 1.08- 3.65, p=0.038), manual handling (AOR =2.09, 95% CI 1.14- 3.82, p=0.023), and high workload (AOR= 2.47, 95% CI 1.34- 4.55), p= 0.005). Neck pain was associated with repetitive manual tasks (AOR=1.85, 95% CI 1.02- 3.34, p=0.058), and awkward postures (AOR=1.95, 95% CI 1.11-3.40, p=0.026). Shoulder pain was associated with repetitive manual tasks (OR=1.84, 95% CI 1.08- 3.13, p=0.033), awkward postures (AOR=1.84, 95% CI 1.07-3.18, p=0.038), manual handling (AOR=2.08, 95% CI 1.21-3.54, p=0.010), and high workload (AOR=2.63, 95% CI 1.52-4.55, p=0.001) at IH Katutura.

Results further revealed that the risk factors associated with lower back, neck, and shoulder pain among study respondents at IHs Onandjokwe, Oshakati, and Rundu are the same as those obtained from IH Katutura, as depicted in Table 7 above. This means that across all IHs - Katutura, Onandjokwe, Oshakati, and Rundu - lower back pain was associated with extensive standing, manual handling, and high workload, while neck pain was associated with repetitive manual tasks, and awkward postures. Shoulder pain was associated with repetitive manual tasks, awkward postures, manual handling, and high workload, as the attained p-values were less than 0.05.

4.2.4 Interventions to Prevent Work-Related Musculoskeletal Disorders

The interventions to prevent WRMSDs among nurses at IHs Katutura, Onandjokwe, Oshakati, and Rundu is shown in Figure 18 below.

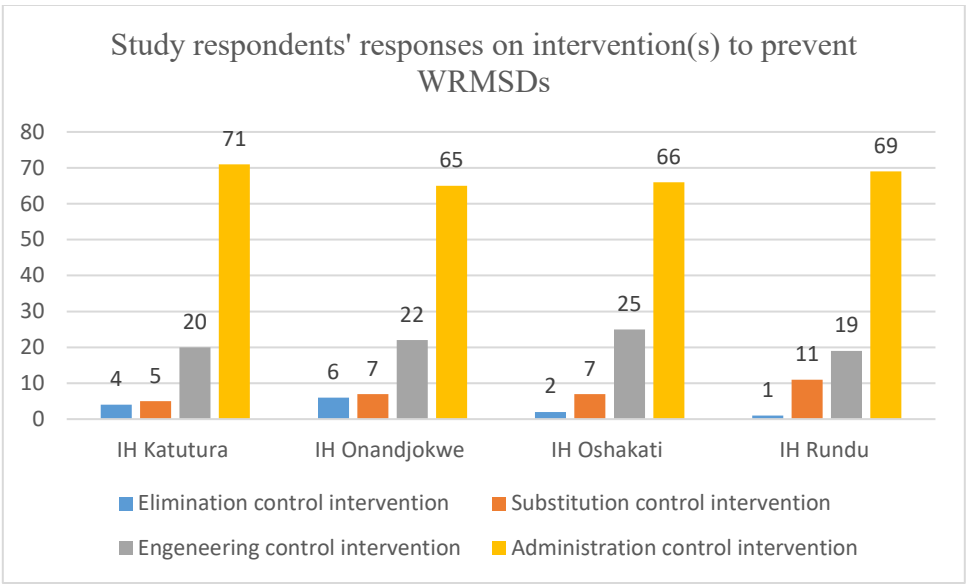

Figure 17: Study respondents' perceptions on the interventions suitable to prevent the development of WRMSDs at Intermediate Hospitals in Namibia

Results showed that administration was the priority intervention measure to prevent WRMSDs among nurses, with 71% of respondents at IH Katutura, 69% at IH Rundu, 66% at IH Oshakati, and 65% at IH Onandjokwe supporting this approach. The second most common intervention was engineering control, reported by 25% of respondents at IH Oshakati, 22% at IH Onandjokwe, 20% at IH Katutura, and 19% at IH Rundu. Substitution and elimination control interventions were the least considered, ranging between 1% and 7% across all IHs, as shown in Figure 18.

4.3 QUALITATIVE RESULTS

In response to the third objective, key informants were in-depth interviewed to primarily explain the results of the quantitative data. Interventions targeting specific risk factors associated with WRMSDs were explored. The researcher used inductive analysis in this

section to identify emerging themes. This method allowed the data to speak for itself as it naturally occurred, avoiding researcher bias by having a predetermined framework when answering the qualitative questions. To achieve this, the researcher engaged with the data from OHS key informants at MoHSS and nurses from all four IHs, immersing himself in it to better understand and develop codes, subthemes, and overall themes from it. Moreover, comparisons were made among participant responses to develop a narrative that connects the emerging themes. The emerging themes from OHS key informants at MoHSS and nurses key informants from all IHs (Katutura, Onandjokwe, Oshakati, and Rundu) are grouped and presented below. Direct quotes from the different respondents are presented in italics.

The qualitative findings are presented under two main headings: socio-demographic characteristics of key informants, and ergonomic interventions to prevent work-related musculoskeletal disorders among nurses.

4.3.1 Socio-Demographic Characteristics of Key Informants

The respondents were requested to provide information on gender, age, hospital/ministry of current work, years of experience, hours of overtime per week, and days off duty per week before the actual interview session. The researcher purposively sampled key informants to participate in the study. There were seventeen (17) respondents, comprising sixteen (16) nurses, and one (1) Occupational Health and Safety (OHS) officer personnel were interviewed. Most of the respondents were female (68%), while a minority were male (32%). Most of the respondents (80%) had 6 or more years of working experience, and 20% had worked for at least for 4-5 years. A total of 96% were nurses, while 4% were OHS personnel. All nurse respondents from all IHs indicated that they typically worked 5-8 hours of overtime

per week (100%), and they usually had 2 days off duty per week (100%). This data was analysed by determining the frequencies and percentages of each item of data, as shown in Table 8 below.

Table 8: Social-Demographic Characteristics of Key Informants

CHARACTERISTIC		NUMBER	PERCENTAGE
GENDER	Male	4	21
	Female	13	79
AGE	<30 years	3	16
	30–35 years	7	39
	35–40 years	5	33
	>40 years	2	12
YEARS OF EXPERIENCE	1-1 Year and months	0	0
	2-3	2	12
	4-5	5	32
	≥ 6 or more	10	56
HOSPITAL/MINISTRY OF CURRENT WORK	IH Katutura	4	24
	IH Onandjokwe	4	24
	IH Oshakati	4	24
	IH Rundu	4	24
	MoHSS-Primary Health care department	1	4
JOB CATEGORY	Nurse	16	94
	OHS	1	6
HOUR OVERTIME PER WEEK	4 hours/week	0	0

	5-8 hours/week	16	100
	9-11 hours/week	0	0
	12 hours/week or more	0	0
DAYS OFF DUTY PER WEEK	1 day off duty/week	0	0
	2 days off duty/week	2	100
	3-4 days off duty/week	0	0
	5-6 days off duty/week	0	0
	1 week full off duty/week	0	0

4.3.2 The Ergonomic Interventions to Prevent Work-Related Musculoskeletal Disorders Among Nurses

This section presents the qualitative findings related to the ergonomic aspects of work-related musculoskeletal disorders (WRMSDs) among nurses working at intermediate hospitals (IHs) in Katutura, Onandjokwe, Oshakati, and Rundu. The findings are structured around three main objectives: (1) the prevalence and impacts of WRMSDs on nurses, (2) the risk factors contributing to the development of these disorders, and (3) the potential interventions to prevent them. The themes and subthemes derived from the participants' responses are summarized in Tables 9, 10, and 11, and are further elaborated in the sections that follow.

4.3.2.1 Impacts of WRMSDs Among Nurses at Intermediate Hospitals

Themes and subthemes generated from the qualitative findings regarding impacts of WRMSDs among nurses at IHs Katutura, Onandjokwe, Oshakati, and Rundu are presented in Table 9.

Table 9: Themes Regarding Impacts of WRMSDs Among Nurses at IHs

Themes	**Sub-themes**
1. Impact of WRMSDs on Nurses' Well-being and Job Performance	1.1 Physical, Emotional, and Professional Consequences of WRMSDs

Theme 1: Impact of WRMSDs on Nurses' Well-being and Job Performance

This theme highlights the significant burden that work-related musculoskeletal disorders (WRMSDs) place on nurses, both physically and psychologically. Participants described how the persistent nature of pain and discomfort interfered with their personal lives, emotional stability, and their ability to perform professional duties effectively. These impacts ranged from physical fatigue and reduced job satisfaction to increased healthcare costs and intentions to leave the profession. The voices of the participants underscored the far-reaching consequences of WRMSDs in the demanding environment of intermediate hospitals.

1.1: Physical, Emotional, and Professional Consequences of WRMSDs

Participants reported a wide range of negative effects stemming from the high prevalence and intensity of WRMSD-related pain. These consequences were experienced not only in their day-to-day personal lives but also in their ability to function optimally in their professional roles.

A common concern raised was the financial strain associated with frequent medical consultations and treatments. One participant shared:

"I think we nurses are actually spending more money when we go for medical treatments due to WRMSDs' pain." (Participant #14)

Beyond the financial implications, many participants expressed frustration at how WRMSDs hindered their productivity and compromised patient care. They noted that the high volume of patients, combined with their physical discomfort, limited the time and energy they could devote to their duties. As one participant explained:

"I think our performance is reduced, as we handle so many influxes of patients from all regional referral hospitals. Sometimes we don't even have enough time to attend to patients because we have to go for medical consultations instead of attending to them." (Participant #11)

Several nurses described how the persistent pain affected their general physical condition, often leading to sleep disturbances and fatigue. One participant stated:

"This pain makes me feel like my muscles are sometimes tired, and I have difficulties sleeping." (Participant #5)

In more severe cases, the cumulative effect of pain, stress, and lack of support led to emotional exhaustion and thoughts of resignation. One participant openly expressed their dissatisfaction:

"I even want to resign to other organisations because here we are just overloaded with work, we are less paid, we are stressed, and we are even not promoted." (Participant #2)

4.3.2.2 Risk Factors Associated with the Development of WRMDs Among Nurses at IHs

The diverse range of risk factors associated with the development of WRMSDs were identified. The themes and subthemes generated from the qualitative findings regarding risk factors associated with the development of WRMSDs among nurses at IHs Katutura, Onandjokwe, Oshakati, and Rundu are presented in Table 10.

Table 10: Themes Regarding Risk Factors Associated with the Development of WRMSDs Among Nurses at IHs

Themes	**Sub-themes**
1. Age	1.1 Years of experience
2. Personal factor	2.1 Physical fitness
3. Contextual factors	3.1 Training 3.2 Understaffing and work overload 3.3 Lack of ergonomist
4. Availability of equipment	4.1 Use of OHS policy

Theme 1: Age

Age contributed to the development of WRMSDs among nurses at the IHs. The older the nurses, the more prevalent WRMSDs were reported among them.

1.1 Years of experience

WRMSDs were more frequently reported among nurses who had been employed for a longer period, compared to younger nurses. This may be attributed to physiological changes associated with aging — such as loss of muscle tone, increased rigidity, reduced bone density, decreased height, and joint deterioration — which can lead to inflammation, pain, stiffness, and deformity. One participant reflected on this by stating:

"I feel I've aged to the point that I easily lose muscular strength to carry on my daily nursing tasks." (Participant #2)

Supporting this perspective, another participant suggested:

"I feel that the more one ages, the less likely for him/her to be physically fit, especially if they do not exercise, and this can easily make the body suffer from WRMSDs." (Participant #9)

Theme 2: Personal Factor

Being physically unfit has nurses more prone to developing WRMSDs, while working.

2.1 Physical fitness

Probing results revealed that some nurses are not physically fit, making their bodies more susceptible to developing WRMSDs while working. Physical exercise can help reduce pain, improve quality of life, and strengthen muscles and joints, thereby preventing the onset of WRMSDs. However, there appears to be no program currently in place aimed at promoting physical fitness to prevent musculoskeletal injuries at work. One participant remarked:

"I don't think we have a physical body training exercise program aimed at promoting fitness to prevent musculoskeletal injuries at work." (Participant #7)

Another participant shared their personal experience and suggested a possible intervention:

"I feel that my body is not physically fit to sustain certain pressures of work, especially handling manual work and patient handling… maybe if the hospital introduced a physical body exercise program, I could improve my body to become physically fit." (Participant #10)

Further highlighting the physical toll of work-related tasks, one participant stated:

"I easily experience back, neck pain, and shoulder pain after carrying heavy load, and working while on extended standing, sitting, and on high leaching postures." (Participant #16)

Theme 3: Contextual factors

The development of WRMSDs among nurses at intermediate hospitals (IHs) in Katutura, Onandjokwe, Oshakati, and Rundu was influenced by several contextual challenges rooted in the hospital settings. Participants pointed to systemic and environmental factors that shaped their daily work conditions and contributed significantly to the risk of WRMSDs. Key issues raised included the lack of adequate training on ergonomic practices, persistent understaffing that led to heavy workloads, and the absence of professional ergonomists in the hospitals. These factors collectively contributed to an environment in which WRMSDs are likely to develop and persist if not addressed. The sub-themes below present the detailed findings.

3.1 Training

Lack of education was one of the most frequently identified risk factors contributing to the development of WRMSDs among nurses. Most respondents expressed that they were not aware of any training regarding manual handling, safe working body postures, patient transfers, or education on hazard identification and risk assessment. The absence of educational training to provide necessary knowledge on the prevention of WRMSDs and to promote a culture of safety among employees has contributed to the development of WRMSDs among nurses. One participant emphasized this concern:

"Educational training on musculoskeletal disorders' risk factors is the core skill needed for our safe clinical practice, but we do not get it." (Participant #10)

Another participant agreed, stating:

"Such important training could even be conducted as part of the orientation process for new nursing staff." (Participant #17)

In support of the above statements, one participant explained:

"Knowledge is power, if you are educated about the hazard, you can easily identify it and report it… but sometimes we do not know." (Participant #6)

Another participant added:

"I think I suffered from musculoskeletal disorders because sometimes I feel pain in my shoulder, ankle, neck, and back, but I think I just work normal, but am not knowledgeable on what could cause those pains in my body." (Participant #11)

3.2 Understaffing and Work Overload

Probing results further revealed that nurses at IHs Katutura, Onandjokwe, Oshakati, and Rundu are understaffed, leading to increased workload. When nurses are understaffed, they become overloaded with work, which exposes them to WRMSD risk factors such as repetitive motion, awkward postures, extended standing, prolonged sitting, and manual handling — including patient handling. This exposure contributed to the development of WRMSDs among many respondents. One participant explained:

"We are understaffed… there are even some vacant positions of nurses in our organogram." (Participant #7)

Agreeing with this, another participant stated:

"Some nurses even left for greener pastures to work in private hospital where they are paid better, and some nurses went for specialisations." (Participant #4)

The results also indicated that nurses at IHs must handle the influx of all referral patients from district hospitals in Namibia, which often exceeds the hospital's accommodating capacity. This further contributes to work overload. One participant described:

"Imagine we handle all referral cases from district hospitals, and we deal with local patients within the vicinity of our intermediate hospital too… this is too much work… more nurses are needed to serve." (Participant #15)

Supporting this view, another participant shared:

"We receive many emergency cases especially at the emergency ward during the end of the month because more injuries are reported and treated here… no time to rest." (Participant #12)

Further emphasizing this concern, one participant highlighted:

"Generally, workloads are getting higher, patients are many at inpatient, outpatient, emergency department, and at the pharmacy to collect their medicine… some are even sent back to come get their medicine the next day." (Participant #14)

When asked about work-related risk factors that may contribute to WRMSDs, one participant responded:

"Long standing and moving from one patient to another and attending to more than 20 patients within an hour is one of the risk factors that make someone develop WRMSDs." (Participant #3)

Another participant noted:

"Understaffing will often cause nurses to get injured… they are short of staff and so they are rushing or there is just not enough of them around to manage a situation." (Participant #10)

Supporting this, another respondent explained:

"There is low staff and therefore… the staff are so pressured they just go the quickest way which might be using less staff than is recommended because it's too hard to get that many people to come and help." (Participant #11)

Finally, the necessity of frequently turning bedridden patients was identified as a significant contributor to WRMSDs. One participant added:

"There is no one else to turn the patient. Only the nurse to bath the patient." (Participant #2)

3.3 Lack of ergonomist

Physiotherapists at the intermediate hospitals (IHs) manage WRMSDs mainly through treatment approaches such as manipulation and manual therapy, exercise therapy, pain management, massage, and electrotherapy. However, there is a notable absence of ergonomists in IHs, despite their crucial role in preventing WRMSDs. Ergonomists are responsible for providing training on WRMSD risk factors, inspecting the workplace for ergonomic hazards, facilitating physical fitness programs, maintaining proper workflow,

ensuring good working posture, and overseeing the correct use of manual handling equipment.

The absence of specialist ergonomists in IHs Katutura, Onandjokwe, Oshakati, and Rundu has resulted in a limited understanding of ergonomic principles among nurses, contributing to the development of WRMSDs. As one participant pointed out:

"When nurses get ill, they are only referred to physiotherapists for treatments." (Participant #9)

Another participant highlighted the poor recording and tracking of WRMSD cases, stating:

"There is poor recording of information because most cases are only generally recorded as occupational injuries… after treatments, nurses are also just recorded as patients you cannot trace their individual treatment cases of WRMSDs." (Participant #1)

This lack of traceability makes it difficult to monitor the prevalence of WRMSDs through the hospitals' health information systems (HIS). Moreover, due to the lack of professional guidance, some nurses are unaware of how to prevent these conditions. One participant admitted:

"I honestly do not know how to prevent myself from my back pain, and neck pain which I sometimes feel when working in the maternity department." (Participant #8)

In support of this view, another participant emphasized the need for regular workplace safety inspections:

"We need someone who will be coming in hospitals to regularly inspect whether our work is safe, and inspect our workload, and observe if we have good ergonomically designed chairs to seat and tools to use without wasting our physical efforts." (Participant #17)

Another participant further recommended:

"We need an ergonomist to inspect our body postures while working, workflow, inspect workplace WRMSDs hazards, and eliminate them and also check if we are lifting heavy loads the right way to prevent work related musculoskeletal injuries… Just those things." (Participant #4)

Theme 4: Availability of Equipment

Availability of equipment was one of the risk factors identified associated to the development of WRMSDs among nurses, as the content applicability of MoHSS' OHS policy seems to have neglected the area of ergonomics.

4.1 Use of OHS Policy

The Ministry of Health and Social Services (MoHSS) has developed an Occupational Health and Safety (OHS) policy intended to guide the prevention of WRMSDs among healthcare workers. However, despite this policy, there has been an increase in the number of WRMSD cases among nurses. This could be attributed to the fact that the current policy places greater emphasis on communicable and infectious diseases, while issues related to non-communicable conditions such as WRMSDs receive limited attention. As a result of this gap in intervention, WRMSDs remain prevalent among nurses. One participant observed:

"You can imagine the content of the OHS policy mostly focuses on communicable and infectious diseases; it does not specifically address issues of musculoskeletal disorders." (Participant #17)

Supporting this perspective, another participant stated:

"I personally do not even know about the OHS policy, maybe the technical personnel to give awareness about it are not there." (Participant #12)

4.3.2.3 Interventions to Prevent WRMDs Among Nurses at IHs

The interventions to prevent WRMSDs among nurses at IHs Katutura, Onandjokwe, Oshakati, and Rundu were identified during interviews. The themes and subthemes generated from the qualitative findings regarding interventions are presented in Table 11 below.

Table 11: Themes Regarding Interventions to Prevent WRMDs Among Nurses at IHs

Themes	**Sub-themes**
1. Personal factor	1.1 Promotion of physical activity and health lifestyle
2.Administration	2.1 Adequate staffing 2.2 Training

3. Culture of safety	3.1 Change in management approached and hazards analysis 3.2 Pre-employment screening

Theme 1: Personal Factor

Orientation to self-care and the promotion and maintenance of a healthy lifestyle through physical exercise activities may be suitable interventions to prevent WRMSDs among nurses.

1.1 Promotion of physical activity and health lifestyle

The probing findings justified that physical exercise activities can improve muscle strength and balance, protect bones and joints, and ensure the health of the musculoskeletal system. This, in turn, helps nurses perform activities of daily living and improves their overall quality of life. One participant emphasized this by stating:

"I feel that if I'm physically fit my body can maintain work pressure and I cannot get musculoskeletal injuries easily." (Participant #9)

Self-care could be promoted by healthcare organisations, and its effect on the rate of musculoskeletal disorders/injuries among nurses could be further investigated. This includes orientation to self-care, developing habits to prevent injuries, following recommended

workflow practices, and maintaining proper body posture — all of which might help prevent WRMSDs. One participant explained:

"An orientation to self-care, looking after yourself, preventing injuries, making sure that you don't put yourself in a vulnerable position… trying to just mitigate the possibilities of danger for oneself is a good thing to do." (Participant #11)

Encouraging nurses to exercise after work and promoting physical body exercise through the provision of sport facilities near the hospital for off-duty staff could further enhance both physical and mental health, thereby reducing the risk of WRMSDs. One participant proposed:

"If hospital managements make it pilates or whatever the flavour of the month is and if they make it available to us staff at knocking off time, for example, so we do a pilates class before we go home, it can help our body muscle strength and enable us perform our work easily without easily developing WRMSDs – you know." (Participant #5)

Another participant suggested:

"Just provide one room for gyms or sports ground for us to exercise when we have free time on our own... sometimes we are even free some weekends we can exercise for our body fitness and health." (Participant #16)

Theme 2: Administration

Administrative strategies were widely identified by participants as essential interventions in preventing work-related musculoskeletal disorders (WRMSDs) among nurses in

intermediate hospitals. Participants emphasized that institutional support through continuous professional development, structured training, and proper human resource management plays a vital role in reducing occupational risks. The two key administrative factors that emerged were the need for targeted training and ensuring adequate staffing levels. These are discussed in the sub-themes below.

2.1 Training

Education may be an effective way to prevent WRMSDs among nurses. Suggested potential best approaches under education awareness include tackling topics such as injury prevention and sustainable work practices in physically demanding roles. One participant emphasized this by stating:

"Receiving training on manual handling and on safe patient lifting techniques as practical skills gives you the confidence to know that you are doing it correctly." (Participant #12)

Supporting this, another participant added:

"We need training in alternative handling and postures, and on the use and application of equipment in order to use them correctly." (Participant #15)

Education in ergonomics and biomechanical principles may help nurses recognize and understand prevention and control of risk factors associated with WRMSDs, increase awareness of safe working methods, and promote a healthy lifestyle. This is crucial, as some respondents reported suffering from WRMSDs due to a lack of knowledge about risk factors and prevention methods. One participant shared:

"I suffered from musculoskeletal injuries because of poor understanding of not knowing the risk factors and prevention of musculoskeletal disorders." (Participant #8)

Another participant recommended:

"We need to learn about ergonomics and how to look for risks in our work environment so that we report them to management." (Participant #7)

In agreement, a participant noted:

"It would be okay if I happen to be taught about the correct use of work equipment such as lifting devices, how to organize work and the workstation in an ergonomic way because I did not see this happening to us." (Participant #17

One participant expressed:

"You don't tend to go and read a textbook about how to move a patient, but it is more about what you people doing in training and in really work setting." (Participant #6)

Similarly, another respondent stated:

"Even training on safe working postures… proper standing, sitting, and reaching, and also on the safe manual work techniques could help us prevent these injuries among ourselves." (Participant #13)

2.2 Adequate staffing

Ensuring adequate staffing may be an effective intervention to prevent WRMSDs among nurses. Proper staffing can ensure an appropriate nurse-to-patient ratio, which may reduce the burden of work overload that exposes nurses to WRMSDs' risk factors such as repetitive

motion, awkward postures, excessive manual handling, extended standing, and sitting. One participant explained:

"Adequate staffing could enable nurses to divide the workload." (Participant #12)

This was believed to effectively reduce the burden on individual nurses, as another participant suggested:

"Having multiple people will help in carrying heavy load together." (Participant #9)

Supporting this view, a third participant noted:

"Proper staffing will relieve nurses from working under pressured conditions such as working while under awkward postures, extended standing and sitting, repetitive manual task, and even manual handling." (Participant #7)

Probing results also indicated that recruiting ergonomists in intermediate hospitals might be necessary for designing equipment, inspecting workload and workflow, and educating nurses on how to prevent themselves from WRMSDs' risk factors. Nurses are more likely to protect themselves from WRMSDs when they are knowledgeable and practically influenced in the workplace. One participant stated:

"We need ergonomist in our hospitals so that they can ensure that our work runs smoothly and also to educate us on preventing musculoskeletal disorders' risk factors, and musculoskeletal injuries prevention." (Participant #4)

Supporting this, another participant said:

"The ergonomist is needed to conduct regular inspection in the hospital and prevent injuries before they occur to us…..he/she can even train us on how to work without putting our bodies in danger of injuries." (Participant #8)

Another participant highlighted:

"Most countries have ergonomists who design and ensure proper workflow, equipment design, and monitor employees' wellness, and prevent obvious hazards and risks that can cause work-related musculoskeletal disorders to employees." (Participant #17)

Theme 3: Culture of Safety

The findings revealed that establishing a strong culture of safety in intermediate hospitals (IHs) is essential for the prevention of work-related musculoskeletal disorders (WRMSDs) among nurses. Participants emphasized that such a culture involves not only managerial commitment to safety but also inclusive practices where nurses are empowered to participate in decision-making regarding workplace safety. Several interventions were suggested to promote a safety-oriented environment, ranging from changes in management styles to systemic preventive strategies like pre-employment screening. These perspectives highlighted that a collaborative, transparent, and proactive approach is necessary to embed safety into the daily operations and values of healthcare institutions. The sub-themes below explore specific ways to achieve and maintain this culture of safety.

3.1 Change in Management Approaches and Hazard Analysis

The development of a total safety culture may have great potential to prevent WRMSDs among nurses. Results suggested the approach of change management as a way to facilitate a culture of safety, which in turn could prevent WRMSDs among nurses at intermediate hospitals in Namibia. One participant stated:

"Giving us greater control over the techniques we use to keep ourselves safe and including us participating in decision-making can be beneficial and promote a culture of safety in us." (Participant #11)

Supporting this view, another participant noted:

"There's always a lot of management telling the workers what to do rather than going to the workers and saying what we need to do that's going to help you." (Participant #15)

In the same vein, another participant expressed:

"If the staff are given the control of what needs to be put in place to make them safe, they're more likely to follow through instead of management saying this is what you must do." (Participant #15)

Another participant emphasized:

"Assess competence in manual handling to ensure that we are familiar with equipment and that we know when and how to use it, to promote a culture of safety." (Participant #9)

Efforts to protect the health and well-being of nurses may contribute to a culture of safety and, in return, reduce the chance of WRMSDs developing in nurses. One participant suggested:

"There is a need for the hospital system to have early detection of pain and injury so that it can be addressed before becoming a bigger problem." (Participant #11)

Supporting this, another participant said:

"I think we need to be encouraged to report injuries as a method of facilitating early detection of musculoskeletal injuries." (Participant #5)

This approach may introduce, promote, and maintain a culture of safety in intermediate hospitals in Namibia.

3.2 Pre-employment screening

Pre-employment screening may be a useful intervention to identify any musculoskeletal disorders among individuals prior to their recruitment into the nursing profession or at intermediate hospitals. This process would enable the screening and recording of musculoskeletal disorders before recruitment, which might help in the early diagnosis, treatment, and prevention of the recurrence of musculoskeletal disorders among nurses. One participant stated:

"Pre-employment screening may be an option to screen and record musculoskeletal injuries prior employment." (Participant #6)

Another participant supported this view, saying:

"Pre-employment screening may help in early treatment and prevention of the disorder." (Participant #3)

Pre-employment screening may also be used as a reliable tool for addressing any possible compensation claims among nurses. One participant explained:

"If people are screened before employment, it can help the hospital to only compensate those who get musculoskeletal injuries in workplace but not those who got the injuries before recruited." (Participant #15)

4.4 SUMMARY

This chapter presented the study's quantitative and qualitative results, addressing each objective. WRMSDs are prevalent among study respondents across all intermediate hospitals (IHs) Katutura, Onandjokwe, Oshakati, and Rundu. This high prevalence yielded a 71% average prevalence of WRMSDs in any body part among respondents from all four IHs. WRMSDs are associated with psychosocial and physical risk factors. Multiple interventions proposed to prevent WRMSDs among nurses include administrative measures (adequate staffing, training, promotion of physical activity, healthy lifestyles, and hazard analysis, pre-employment screening), and engineering measures (work and equipment modification). Chapter 5 discusses the findings, triangulating the results with current related literature.

CHAPTER 5

DISCUSSION

5.1 INTRODUCTION

In this chapter, the quantitative and qualitative results of this study are triangulated and discussed. The findings are interpreted and contrasted with related current literature to identify observed similarities and differences. The chapter begins with a discussion of the demographic information found in this study, followed by a discussion structured around each objective of the study. The theoretical basis and conceptual framework adopted in this study are also acknowledged in this chapter.

5.2 DISCUSSION OF THE FINDINGS

5.2.1 Socio-Demographic and Occupational Profile Findings

Most respondents and participants in this study were female across all Intermediate Hospitals (IHs) in Namibia. It is reasonable to assume that more women than men work as nurses at these IHs in the country because there are more women than men in Namibia (145). A study conducted on WRMSDs and work ability among hospital nurses in South-West Nigeria showed similar results, with 126 (93.30%) respondents being female, and only 9 (6.70%) male (76). A similar study on WRMSDs among nurses in Mombasa County, Kenya, reported that the majority of respondents were female (77%), while male respondents were fewer (23%)(146). Another study conducted among nurses working in low-resource settings in Uganda showed that the majority of participants were female (85.7%) (82). Since nursing is

a female-dominated profession (147), it is clear that the nursing profession attracts more women than men (146).

When looking at age group, most of the respondents in this study were between the ages of 30 and 35 years old. These study results are consistent with the literature (14). According to the 2021 Namibian Demographic survey update, the country's population is largely composed of young people (145). Young nurses are readily employed after graduation; however, some young nurses are willing to leave the nursing profession and re-educate themselves for a new career (148,149). This may explain why there were so few study participants under the age of thirty. Nurses who are over the age of 40 are more likely to make significant career changes, such as choosing retirement or quitting the nursing profession for another line of employment (150). This could explain why this age group was underrepresented in this study. This study revealed that age was strongly associated with the development of WRMSDs among nurses (p-values≤0.005) at all intermediate hospitals. Qualitative data corroborate these findings, with respondents indicating that WRMSDs are likely to affect older nurses because muscles may become rigid with age and may lose tone, bone may become more brittle and may break more easily, height decreases, and breakdown of the joints may lead to inflammations, pain, stiffness, and deformity. This coincides with a previous study conducted regarding WRMSDs among nurses Malaysi, which has shown that the prevalence of WRMSDs increase with an increase in age (55). Similarly, findings in a study conducted on prevalence of musculoskeletal disorders among healthcare professional: a hospital based study in Ouarzazate, in the southeast region of Morocco, has revealed that MSDs increase with the age (151).

Another study conducted on WRMSD and their associate factors in Nurses in Iran has revealed that there was a significant association between age and WRMSDs in the neck, shoulder, and knees ($p<0.05$) (92). Thus, the older the workers get, the greater the chance of developing WRMSDs.

Most of respondents have been working in the nursing profession for the six years or more across all IHs in Namibia. This study finding is consistent with findings from previous similar studies. A study in Hospitals of Xinjiang Uygur Autonomous Region, has shown that study respondents have been in the nursing profession for six years and more (152). Another similar on WRMSDs among registered general nurses at large central hospital in Harare-Zimbabwe, have shown that most nurses had worked in hospital for more than five years or more (2). Thus, it was concluded that majority of respondents in this study have 6 years or more of working experience. This study revealed that years in employment was strongly associated with the development of WRMSDs among nurses ($p\leq0.005$) at all IHs. This study results is consistence with study results of Akodu (2019) which indicates that there was relatively higher risk of WRMSDs among nurses with more than ten years of clinical experiences (76). A similar study conducted by Yan et all (2020), have shown similar results since their logistic regression analysis indicated that working duration of ≥6 was associated with the prevalence of WRMSDs among nurses (152). Similarly, a study conducted on WRMSDs among nurses in central hospital Harare, have shown that nurses with 5 or more years of working experience had WRMSDs compared to those with less (2).

Most participants across all IHs in this study had a Body-Mass Index (kg/m^2) of 18.5-24.9. This study had shown that there was no association between BMI and the development of WRMSDs among nurses ($p \geq 0.05$.) across all IHs. A BMI <18.5 is classified as underweight,

18.5-24.9 normal, 25.0-29.9 overweight, and 30 or greater is classified as obese (153). Overweight and obese people are at a higher risk of developing WRMSDs (154). Neither of the study respondents had BIM (kg/m^2) of <18.5 and/ 30 or greater. Therefore, BMI could not be related to WRMSDs' development in this study because the BMI (kglm2) of 25-29.9 of most of the respondents, is classified as normal BMI (153).

Most respondents indicated that they typically worked between five to eight hours of overtime per week at IHs Oshakati, Onandjokwe, Katutura, and Rundu. Studies on issues contributing to WRMSDs development indicated that adverse schedules, such as 13+ hours of work per day and overtime, are significantly related to the development of WRMSDs (14,155). Long working hours per shift, as well as working hours above the standard of 40 working hours per week, result in an increased chance of muscle stress and fatigue, less resting time, and less muscle resting recovery time (8,14,19). A study on the effect of long working hours and overtime on occupational health has found that working 12 or more hours per day and 60 or more hours per week increased the risk of occupational injury, such as muscle fatigue, which also lead to the development of WRMSDs (156). Even though working overtime is not a direct standalone, prevailing risk factor, working overtime might worsen the situation of nurses to develop WRMSDs.

In this study, all respondents from all IHs had two days off duty per week (100%). Resting or break time for at least >10 minutes or spending two days off duty per week has been proven to be enough resting time for the body's musculoskeletal system to recover from any pains or situations that might lead to the development of WRMSDs (44,152). The cumulative load theory has proven that musculoskeletal disorders occur as a results of the repetition of work tasks and/or too much load bearing on the tissue with insufficient recovery time;

therefore, sufficient recovery time will prevent WRMSDs from happening (8). Thus, it could be concluded that respondents in this study have adequate resting time, which cannot be linked to the contribution of WRMSD development among nurses at all IHs in Namibia.

5.2.2 Prevalence of Work-Related Musculoskeletal Disorders Among Nurses

5.2.2.1 Prevalence of Work-Related Musculoskeletal Disorders in Any Body Region

The high prevalence of WRMSDs across all the studied hospitals reflects the widespread nature of physical strain among healthcare workers. Rather than isolated cases, these disorders appear to be a persistent challenge, affecting various body regions over extended periods. The data suggest that WRMSDs are not only frequent but also recurrent, indicating chronic exposure to occupational risks. Qualitative insights further support this trend, highlighting how such discomfort has become a routine part of the respondents' work experience. Participants often described the pain as persistent and unresolved, sometimes linked to previously diagnosed conditions. This reinforces the understanding that musculoskeletal strain is not merely episodic but deeply embedded in the physical demands of hospital work. Overall, the integration of both quantitative and qualitative data underscores a clear need for preventive and management strategies in the workplace.

The recurrence of WRMSD symptoms, such as frequent aches, pains, or discomfort in any body part over the last 12 months, indicates the persistence or recurrence of WRMSDs (14,56,82).

The findings of this study are consistent with those of other scholars who have estimated the prevalence of WRMSDs over 12 months in any body part among nurses to range from 40%

to 90% globally (24,52). Additionally, the study is supported by Yizengaw et al. (2021), who reported that the prevalence of WRMSDs in Africa, including SADC countries, ranges from 15% to 93.6% (13).

Similarly, other studies have reported comparable prevalence rates of WRMSDs among nurses in specific public hospitals: 76.6% at Fako Hospital in Cameroon, 79% at the Lekma Hospital in Ghana, 84% in a high-acuity area of a tertiary hospital in South Africa, and 78.2% at IH Katutura in Namibia (2,4,6,14).

The high prevalence rates of 76% at Katutura, 73% at Onandjokwe, 69% at Oshakati, and 65% at Rundu are within the range reported in other studies (4,55,56). This supports the findings of this study, indicating that nurses at IHs Katutura, Onandjokwe, Oshakati, and Rundu are indeed experiencing and/or suffering from WRMSDs.

5.2.2.2 Prevalence of WRMSDs in Specific Body Parts

Musculoskeletal discomfort was particularly concentrated in the lower back, neck, and shoulders across all study sites, reinforcing the idea that these areas are especially vulnerable due to the physical demands of clinical duties. The recurrence of pain in these regions appears to be linked to the nature of nursing work, which often involves prolonged standing, awkward postures, and repetitive movements. Participants' narratives revealed that such pain often intensifies during extended shifts or periods of increased workload, indicating a cumulative effect over time. This convergence of quantitative patterns and qualitative accounts highlights the need for targeted interventions aimed at reducing ergonomic strain in these key anatomical regions.

Low back, neck, and shoulder pain are commonly reported body parts affected by WRMSDs (4,14,56). Similarly, a study conducted on the prevalence of WRMSDs among nurses in Kakamega County, Kenya, reported that the highest prevalence of WRMSDs over a 12-month period for the following body sites: low back (79.9%), neck (53.8%), ankles/feet (48.5%), upper back (47.7%), wrists/hands (46.9%), buttocks (38%), and elbows (30.8%) (56). Another similar study conducted in Malaysia reported even higher prevalence rates for WRMSDs: the lower back (86.7%), ankles (86.7%), neck (86.0%), shoulders (85.0%), lower legs (84.7%) and upper back (84.3%) (55). A similar study on the prevalence of WRMSDs among nurses, through a meta-analysis, revealed that the three anatomical areas with the highest prevalence of WRMSDs were the lower back (59.5%), neck (53.0%), and shoulder (46.8%) (64). Similarly, a study conducted in Ghana among nurses at the Ho Teaching Hospital found that the most prevalent WRMSDs by body region were low back pain (73.3), and upper back pain (55.3) (54). Luan et al. (2018)reported a high prevalence of WRMSDs over the past 12 months (74.7%), among district nurses in Haiphong, Vietnam, with low back pain (44.4%) and neck pain (44.1%) being the most affected body parts (9).

Even though the prevalence of WRMSDs in any body parts is known to be most prevalent in the lower back, neck, and shoulders, the prevalence in different body regions can vary among nurses (2–4). For example, a narrative literature review on musculoskeletal disorders among female nurses in Turku, Finland, showed that knees (7.5%-77%), and ankles/feet (3.2%-100%) were the most affected body parts, while low back, neck, and shoulder pain were not significantly affected (67). The discrepancy in WRMSD rates across various hospitals is attributed to organisational differences, variations in instrumentation, and cultural differences in the perception and reporting of pain and/or disorders (14).

Even though many studies have shown variations in the development of WRMSDs in different body parts, literature has proven that WRMSDs are most prevalent in the lower back, neck, and shoulders (55,56,152). A common issue with nursing operations is that the lower back, neck, and shoulders often remain in the same posture for extended periods, necessitating sustained muscle contraction in these areas, which results in fatigue and potential injury (64). Furthermore, an upsurge in the number of critically ill patients and the demands of an aging population have increased the number of procedures executed regularly, including changes, dressings, daily care, and venepunctures. During these procedures, nurses often need to adopt twisting, bending, and forward-bowing postures, which can lead to pain in the lower back, neck, and shoulders (64). Therefore, the study's findings that low back, neck, and shoulder pain are the most common WRMSDs among nurses at IHs Katutura, Onandjokwe, Oshakati, and Rundu are consistent with the literature (29,55).

The qualitative findings of this study further reinforce the significant personal and professional consequences associated with WRMSDs among nurses. Participants reported challenges such as increased out-of-pocket healthcare expenses, reduced job performance, and disruption of patient care due to frequent medical consultations. The chronic nature of pain also appeared to affect their physical and emotional well-being, often leading to fatigue, sleep disturbances, and decreased job satisfaction. In more severe instances, some nurses expressed feelings of frustration, demotivation, and an intention to leave the profession due to the perceived lack of support and poor working conditions.

These findings support those of similar studies, which indicate that WRMSDs are serious public health issues due to their substantial negative impact on nurses' quality of life.

WRMSDs can lead to a range of problems, including disabilities, stress, high treatment costs, and/or increased financial burdens, lost work time, decreased productivity, and the resignation or transfer of nurses to other industries (60,64,74,157). For instance, 37.8% of nurses in Haiphong, Vietnam, reported that WRMSDs restricted their ability to perform their jobs (9). Furthermore, about one-third of all sick leave cases among Ethiopian healthcare workers, including nurses, are attributed to WRMSDs affecting the spine, shoulder, and back (13). This can reduce hospital productivity, as nurses may seek medical attention instead of attending to patients, as suggested by this study's results. Similarly, a study conducted in Fako, Cameroon reported that WRMSDs slowed down nurses' activities at work and decreased the efficiency of the nursing care provided (50%) (11). Thus, the study's findings on the impact of WRMSDs among nurses at IHs Katutura, Onandjokwe, Oshakati, and Rundu are consistent with other studies.

5.2.3 Risk Factors Associated with Work-Related Musculoskeletal Disorders Among Nurses

Most respondents experienced psychosocial risk factors in the workplace, with high workloads emerging as the most common job content risk factor across the assessed institutions.

In this study, multinomial regression was used to determine which risk factors (psychosocial or physical) contributed to the development of WRMSDs in any body part within the last 12 months. The regression analysis revealed that one psychosocial risk factor (high workload), and all physical risk factors, such as repetitive manual tasks, extensive sitting, extensive standing, awkward postures, and manual handling, were significantly associated with

WRMSDs ($p \leq 0.05$) among nurses across all IHs in Namibia. These risk factors are consistent with "the conceptual framework of contributors to musculoskeletal disorders", utilised in this study (44).

Qualitative data corroborate these findings, with respondents indicating that when nurses are understaffed, they become overloaded with work. This exposure to WRMSD risk factors, such as working under repetitive motion, awkward postures, extended standing, extended sitting, and manual handling, including patient handling, contributes to the development of WRMSDs. These results are consistent with a similar study conducted by Lukolo et al. (2022) on the effects of workload on nurses' mental health at IH Katutura in Windhoek, which revealed that nurse shortages led to high workloads, resulting in chronic stress and burn out (16).

This study's results align with the literature, which demonstrates that psychosocial risk factors work hand in hand with physical risk factors. Psychosocial risk factors alone do not directly lead to WRMSDs but can exacerbate the risk when combined with physical risk factors (19,96,97). The combination of psychological and physical risk factors can thus increase the likelihood of developing WRMSDs (158).

Negative physiological perceptions of work can lead to adverse physiological and psychological stress reactions, potentially resulting in physical problems such as muscle tension (19,158).

A study conducted on the prevalence of musculoskeletal disorders and associated risk factors among nurses in China revealed that nurses reported a 12-month prevalence of musculoskeletal disorders at 84.2%. This prevalence was linked to work-related cumulative stress factors, such as prolonged time in awkward postures, manual material handling, and

sustained awkward postures (81). Similarly, a study in Portugal examined how psychosocial risk factors influence WRMSDs in healthcare workers and found that nurses developed WRMSDs as a result of exposure to both physical (manual handling) and psychosocial risk factors (long work shifts and stress) (96).

In contrast, some studies suggested that WRMSDs are primarily caused by physical risk factors rather than a combination of physical and psychosocial risk factors (9,13,54). When workers are exposed to physical risk factors such as work overload, extensive standing, extensive sitting, awkward postures, repetitive manual tasks, and manual handling (including patient handling), their bodies may develop WRMSDs (11,71,88,92). These disorders occur when the applied load on the body exceeds the failure tolerance and/or strength of the supporting tissues (8,79). A similar study on the prevalence of WRMSDs and associated risk factors among nurses in a hospital in Malaysia reported that WRMSDs were primarily associated with physical risk factors (p-value 0.05) (55). Similarly, a study conducted in Mulago, Uganda, found that the occurrence of WRMDs among nurses was typically associated with physical risk factors (p-value 0.05) (40%) (82). Akodu and Ashalejo (2019) also found that WRMSDs among nurses in south-western Nigeria were predominantly associated with physical risk factors (76).

Even though WRMSD risk factors are well-studied, known, and published in both developed and developing countries including Africa and Namibia, differences in the estimated prevalence of WRMSDs across countries may reflect differences in the nature of work, working environments, and facilities. This results in inconsistent reporting of work-related risk factors, making it difficult to compare or generalise risk factors across countries and hospitals, even within the same region (4).

WRMSDs can be caused by psychosocial risk factors, physical risk factors, or a combination of both, depending on the exposure risks from place to place. This study concludes that WRMSDs were caused by both psychosocial and physical risk factors. This finding supports scholars who indicate that WRMSDs are caused by multiple, complex, and dynamic interactions between physical and psychosocial risk factors, making them multifactorial in nature (93,103).

In this study, multinomial regression was performed to determine the risk factors associated with the development of different types of WRMSDs (lower back, neck, and shoulder pain) among study respondents within the last 12 months. The regression results showed that lower back pain was associated with extensive standing, manual handling, and high workload, while neck pain was linked to repetitive manual tasks and awkward postures. Shoulder pain was associated with repetitive manual tasks, awkward postures, manual handling, and high workload ($p \leq 0.005$). These study findings support the conceptual framework of this study, "The Conceptual Framework for Work-Related Musculoskeletal Disorders" which identifies physical and psychosocial factors as the main risk factors for WRMSDs (4).

The findings are also consistent with the literature (63,73,159,160). For example, a study on low back pain among Ugandan health workers revealed significant associations with lifting ($X2=33.279$, $p<0.001$), standing for long periods ($X2=40.096$; $p \leq 0.001$), being in awkward positions ($X2=15.607$; $p=<0.001$), and pushing patients ($X2=21.999$; $p=0.001$)(159). An exploratory case study on the well-being of nurses working in a casualty unit at a state hospital in Windhoek found that nurses at IH Katutura suffered from WRMSDs, including back and neck pain, as a result of extended standing (27). Similarly, a study on low back pain among nurses at a medical centre in Taiwan revealed that high

workload, mean daily working hours, standing, and walking were associated with lower back pain among nurses ($p<0.005$) (160). A study on low back pain among nurses in public hospitals in eastern Ethiopia has shown that manual lifting of weight >1okg (AOR=5.260; 95% CI (1.869-14.805) and working in awkward posture (AOR=3.93; 95% CI (1.109-13.924) were significantly associated with low back pain (63)**.** Additionally, a study on awkward trunk postures and their relationship with low back pain in hospital nurses showed a significant relationship between the duration of exposure to awkward trunk postures and low back pain $p<0.05$ (95)**.**

Another study by Chin et al,. (2021) indicated that the tendency of nurses to have short sleep due to high workloads accounted for 8.8% of chronic neck pain discomfort and 8.6% of chronic shoulder discomfort (98). A similar study on the risk factors of work-related neck and shoulder pain among emergency nurses from 10 regional tertiary hospitals in the northeast Thailand revealed that shoulder pain was significantly associated with neck bending (awkward posture) (ORadj=2.28, 95% CI: 1. 13-4.62) (73).

These study findings are consistent with the literature. It can be concluded that lower back, neck, and shoulder pain are the most prevalent types of WRMSDs among nurses at IHs in Namibia, and they are associated with both physical and psychosocial risk factors.

5.2.4 Interventions to Prevent Work-Related Musculoskeletal Disorders Among Nurses

In this study, administrative and engineering controls were identified as the two most prioritised interventions by respondents. Qualitative data corroborate these findings, with respondents indicating that multiple interventions are needed to effectively address risk factors associated with the development of WRMSDs. These interventions include personal

factors (promotion of physical activity and health lifestyle), administrative measures (training, and adequate staffing), and a culture of safety (changes in management approach, hazard analysis, and pre-employment screening). These findings support the theoretical basis of this study, the "Biomedical-Structural Model" which has proven that musculoskeletal disorders are multifaceted. Therefore, a combination of multiple interventions, such as job-specific pre-placement, physical examination, ergonomic interventions, job rotation intervention, and strength training intervention could prevent WRMSDs among nurses (43).

This study's findings are consistent with the literature, which reveals that WRMSDs are caused by a complex and dynamic interaction between physical and psychosocial risk factors (93,103). Therefore, appropriate preventative measures that are multifaceted, systematic, and comprehensive have been developed and proved to be effective in reducing WRMSDs (89,105).

A similar study conducted a pilot investigation into a tailored ergonomic intervention program (including training, administrative measures, and equipment design) for community nurses, and found statistically significant improvements in the intervention group compared to the control group(26). Nguyen et al. (2022) evaluated the effectiveness of a multifaceted intervention (educating nurses on risk factors and physical exercise among nurses) to prevent musculoskeletal disorders among district hospital nurses in Vietnam. Their study revealed that the multidimensional interventions were able to prevent musculoskeletal disorders in four body anatomical sites: neck, shoulder/upper arm, wrists/hands, and lower back, with p-values of 0.013, 0.011, 0.038, and 0.009, respectively (89).

Similarly, Soler-Font et al. (2029) conducted a cluster randomised trial on a multifaceted intervention comprising three evidence-based components: participatory ergonomics, health

promotion activities, and case management. The study results revealed that the intervention effectively reduced neck, shoulder, and upper back, compared to the control group (OR=0.37;95%Cl=0.14-0.96) (103). Yang et al. (2021) developed a multidimensional interventional program to improve occupational musculoskeletal disorders among intensive care unit nurses at Changsha, Hunan. Their study findings showed that improving risk perception (p-0.001), health behaviour training (p.0.001), and promoting a safe working environment (p.0.024) were three effective program elements in preventing the occurrence of WRMSDs among nurses (93).

Regardless of the high effectiveness of various multifaceted ergonomic programs, no standards have been set for a standardised multifaceted/multidimensional intervention program that will be applicable to prevent WRMSDs at all hospital settings globally or in different hospital setting of different countries (26,93). The multifaceted ergonomic educational/training program have always been based on the specific risk factors affecting nurses in a specific hospital or region (93). The results of this study on multifaceted ergonomic interventions, including administration (adequate staffing, training, promotion of physical activity, healthy lifestyle, hazard analysis; pre-employment screening), and engineering (work and equipment modification), to prevent WRMSDs among nurses at IHs, are thus consistent with the literature (17,89,93).

5.3 SUMMARY

This section discussed the comprehensive outcomes originating from both quantitative and qualitative aspects of the research. It connects the discoveries obtained from the questionnaire data with insights gathered from interviews conducted with nurses and OHS

personnel. Moreover, it compares the findings of this study with the existing literature in Chapter 2, thereby establishing connections and contrasts with previously reviewed related studies. The subsequent Chapter 6 will deal with the development of a multifaceted ergonomic educational program.

CHAPTER 6

DEVELOPMENT OF MULTIFACETED ERGONOMIC EDUCATIONAL PROGRAM TO PREVENT WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG NURSES IN INTERMEDIATE PUBLIC HOSPITALS IN NAMIBIA

6.1 INTRODUCTION

This chapter presents the development and implementation of a multifaceted ergonomic educational programme to prevent work-related musculoskeletal disorders (WRMSDs) among nurses in Namibia's intermediate public hospitals. The programme integrates education, ergonomic assessment, workstation modification, physical activity, and organisational strategies, and was developed through a Participatory Action Research (PAR) process to ensure contextual relevance, feasibility, and ownership by end users. The chapter describes the problem background, evidence-to-design integration, PAR steps, programme components, intended recipients, implementation plan, and the monitoring and evaluation framework. It also documents the pilot implementation conducted in three hospitals with one control site, and the methods used to evaluate outcomes.

6.2 BACKGROUND

Nurses in Namibia's intermediate hospitals undertake physically demanding tasks such as patient handling, repetitive movements, prolonged standing, and awkward postures that elevate WRMSD risk (14,161). Traditional approaches centred on manual lifting techniques

alone have produced limited and short-lived benefits. Evidence from this study and international practice indicates that multifaceted, system-supported ergonomic programmes combining training, engineering controls, administrative measures, and behaviour change supports are more likely to achieve durable risk reduction related to WRMSDs(25,103). This programme was therefore designed to be practical, ward-integrated, and sustainable, aligned with Namibia's policy environment and resource realities.

6.3 INTEGRATION OF FINDINGS INTO PROGRAMME DESIGN

This study's findings were explicitly translated into the design of the ergonomic educational programme. A convergent evidence-to-design strategy was used, combining quantitative results on the prevalence and risk factors of work-related musculoskeletal disorders (WMSDs) with qualitative insights from interviews and observations. This ensured that each programme component directly addressed the empirical gaps identified.

Key findings and their influence on programme development were as follows:

- High prevalence of low-back and neck pain: Emphasis on safe patient-handling technique, posture maintenance, and early symptom reporting, delivered through ward-based briefings and bedside coaching.
- Inconsistent use of transfer aids: Practical demonstrations on selecting and using available aids (e.g., slide sheets, transfer belts), plus visual job aids and spot checks.
- Time pressure and shift work: Short, on-shift sessions embedded within handovers and mid-shift huddles rather than long classroom workshops.

- Weak safety climate and reliance on informal peer practice: Peer champions and supervisor reinforcement formalised through unit routines and Occupational Health and Safety (OHS) committee oversight.
- Limited self-monitoring and documentation: Introduction of personal ergonomic action plans, self-checklists, and peer review.

The following table maps each key finding to a programme requirement, component, delivery approach, and monitoring indicator to ensure transparency and fidelity.

Table 6.1: Results–Programme Component Traceability Matrix

Key Finding	**Data Source**	**Programme Requirement**	**Programme Component**	**Delivery Mode**	**Monitoring Indicator**
High prevalence of lower back/neck pain	Survey	Close knowledge & skills gap	Safe Patient Handling	Micro-sessions + bedside coaching	Skills checklist (pre/post)
Inconsistent use of transfer aids	Observations	Reinforce correct equipment use	Equipment Use & Setup	Demonstrations + laminated guides	Spot checks & utilisation logs
Time pressure during shifts	Interviews	Minimise disruption to workflow	On-shift Micro-learning	10-min huddles	Attendance and completion rate
Weak safety climate	Survey	Strengthen leadership reinforcement	Supervisor Briefings	Monthly supervisor-led sessions	Mini safety climate survey
Limited self-monitoring	Interviews	Encourage accountability	Action Plans	Personal ergonomic plans	Peer review and goal achievement

6.4 PARTICIPATORY ACTION RESEARCH (PAR) APPROACH

PAR was used as the methodology for programme development to enhance acceptability and sustainability.

- **Stakeholder identification and engagement:** Nurses, ward supervisors, physiotherapists, occupational health practitioners, Human Resources (HR) managers, and hospital administrators participated through key-informant interviews and focus group discussions (FGDs).
- **Co-design workshops:** Mixed groups co-created session outlines, checklists, and feasible ward routines (e.g., when to fit briefings within shifts) and prioritised equipment requests.
- **Pilot testing and refinement:** Draft practices were piloted on two wards per intervention hospital (typically surgical and maternity/medical, depending on caseload). Feedback on clarity, time burden, and practicality informed revisions (e.g., reducing session length; replacing technical jargon with plain-language prompts).
- **Iterative cycles:** The research team met monthly with peer champions and supervisors to review data, agree on adaptations, and confirm responsibilities.
- **Shared ownership:** Final tools (attendance registers, observation checklists, action-plan templates) were endorsed by unit heads and OHS committees to embed accountability.

6.5 KEY CONTRIBUTIONS OF THE PROGRAMME

The programme is designed to fit Namibia's healthcare context. It combines education, workplace design improvements, administrative measures, and behaviour change. It was developed in collaboration with the users and can be gradually expanded to other hospitals and healthcare workers under the supervision of the Ministry of Health and Social Services (MoHSS).

6.6 PROGRAMME OBJECTIVES AND GOALS

Objectives

1. Improve ergonomic knowledge, skills, and confidence among nurses.
2. Promote safe patient handling and ergonomically sound work practices.
3. Reduce the incidence and severity of WRMSD symptoms.
4. Institutionalise ergonomic safety via unit routines, peer support, and OHS governance.

Goals

- Increase awareness of ergonomic risks and controls.
- Enhance comfort, safety, and job satisfaction.
- Enable early identification and management of symptoms.
- Reduce sickness absenteeism and improve quality of care.

6.7 SCOPE AND INTENDED RECIPIENTS

Setting: Intermediate public hospitals in Namibia.

Primary recipients: Frontline nurses in high-risk wards (surgical, maternity, medical, intensive care).

Inclusion: Registered/enrolled/auxiliary nurses; ≥6 months service; ≥50% of shift on direct patient care.

Exclusion: Administrative staff without patient handling; nurses on WRMSD-related medical leave.

The scope allows national adaptation under Ministry of Health and Social Services (MoHSS) with hospital-level tailoring.

6.8 PROGRAMME DESCRIPTION

The programme is presented in two complementary parts:

6.8A. System-Level Strategies for Successful Implementation

(What managers and hospitals must put in place to enable the education to work)

1. **Adequate Staffing and Workload Management**

- Advocate for filling vacancies and balancing nurse-patient ratios in high-demand wards.
- Change work schedules so staff don't keep repeating the same heavy tasks, and make sure they get enough rest breaks.

- Incorporate ergonomic risk as a standing agenda item in unit planning and handovers.

2. **Ergonomic Training Policy and Governance**

- Make ergonomic induction compulsory for new staff and annual refreshers for all.
- Assign peer champions per ward; define their roles (coaching, data logs, liaison with Occupational Health and Safety (OHS) personnel.
- Embed quarterly ergonomic reviews in OHS committee agendas, with actions tracked.

3. **Promotion of Physical Activity, Healthy Lifestyle, and Hazard Analysis**

- Standardise 5-minute stretch routines at shift start and mid-shift, led by shift leaders.
- Institutionalise Job/Hazard Analysis (JHA): routine review of high-risk tasks (e.g., transfers).
- Provide access to brief wellness guidance (hydration prompts, micro-breaks).

4. **Work and Equipment Modification (Engineering Controls)**

- Conduct ergonomic audits of wards and nurse stations (reach distances, heights, space).
- Prioritise procurement requests (height-adjustable beds, slide sheets, transfer belts, wheeled trolleys, adjustable seating and monitor arms in documentation areas).
- Set up simple maintenance and availability checks for assistive devices.

5. **Pre-Employment Screening**

- Check new employees for any past musculoskeletal (MSK) problems and assess whether they can handle the physical tasks required in the ward.
- Where possible, let new employees work under supervision for two weeks to see if the job matches their abilities.
- If any limitations are identified, give them early guidance on safe working methods and adjust their duties to prevent worsening of their condition.

6.8B. Educational Program Components Delivered to Nurses

What nurses learn and practise during implementation, and/ or can be taught and learn during future full program implementation:

1. **Ergonomic Assessments (Ward-Level and Individual)**

- **Workstation Analysis:** Evaluate nurse stations, medication prep areas, documentation desks, and storage to identify ergonomic hazards (awkward reach, prolonged standing, poor screen height).
- **Task and Patient-Handling Assessment:** Observe high-risk tasks (bed-to-chair transfers, repositioning, linen changes) to identify hazardous postures and forceful exertions.
- **Risk Documentation:** Use brief, validated checklists; record hazards and agreed control actions.

2. **Training and Education (Ward-Embedded, Equipment-Light)**

- **Ergonomic Principles:** Neutral spine, safe base of support, push vs. pull, keeping loads close, using body weight rather than arms only.
- **Role-Tailored Coaching:** Short, practical demonstrations at bedside/ward areas, adapted to each unit's common tasks.
- **Workstation Modification Skills:** How to adjust bed height, set up documentation stations, and position devices to reduce twisting and reaching.
- **Early Symptom Reporting:** Recognising early signs of WRMSDs and using agreed reporting channels.

3. **Workstation Modifications (Practical Application)**

- **Equipment Adjustments:** How to set optimal bed height for transfers; correct use of slide sheets and transfer belts; adjusting chairs and monitor height at nurse stations.
- **Layout Optimisation:** Simple re-arrangements to reduce unnecessary steps, awkward reaches, and manual lifts (e.g., frequently used supplies at waist height).

4. **Regular Exercise and Micro-Breaks**

- **Stretching Sequences:** Brief routines targeting neck, shoulders, lumbar spine, and wrists, integrated into shift rhythms (start, mid-shift, after heavy tasks).
- **Active Recovery:** Encouraging short micro-breaks, alternating tasks where possible, and simple mobility during documentation to minimise static postures.

5. **Personal Ergonomic Action Plans**

- Each nurse sets 2–3 concrete goals (e.g., “raise bed to hip height before turning,” “use slide sheet for all lateral transfers”) and reviews progress with a peer champion monthly.

6.9 METHODOLOGICAL APPROACH AND DEVELOPMENT PROCESS (PAR + PILOT)

Study design: A PAR-guided development with a pilot implementation in four intermediate hospitals.

Sites:

- **Intervention hospitals (3):** Intermediate Hospital Katutura, Intermediate Hospital Oshakati, and Intermediate Hospital Rundu.
- **Control hospital (1):** Intermediate Hospital Onandjokwe (selected randomly to minimise cross-contamination).

Participants: Sixty (60) nurses selected using stratified and systematic sampling, at least 15 per hospital. Inclusion: age 20–50; ≥1 year full-time employment; WRMSD symptoms in ≥1 body region during the previous 12 months. Exclusion: severe health conditions or recent musculoskeletal treatment.

Pilot structure and timeline:

- **Baseline (Month 0):** Ergonomics awareness survey and Standardised Nordic Musculoskeletal Questionnaire (NMQ); initial ward audits and consultations.
- **Co-design & Preparatory Phase (Months 1–2):** PAR workshops; development of checklists, briefing scripts, and action-plan templates; selection and orientation of peer champions and supervisors.
- **Implementation (Months 3–10) in intervention sites:**
    - Ward-based briefings integrated into handovers and mid-shift huddles (10–20 minutes).
    - Bedside coaching during routine care; practical demonstrations of safe techniques and workstation adjustments.
    - Monthly stretch-routine reinforcement; quarterly ergonomic audits with quick-win layout fixes.
    - Personal action plans initiated by Month 4 and reviewed monthly.
- **Midline Review (Month 6):** Repeat awareness survey/NMQ; qualitative feedback FGDs; adjust pacing, session timing, and job aids.
- **Consolidation (Months 11–12):** Refresher briefings; documentation of lessons learned; preparation for potential scale-up.
  The control site participated in baseline, midline, and endline assessments only, without exposure to educational activities during the pilot period.

6.10 IMPLEMENTATION PLAN (ROUTINE DELIVERY MODEL)

The programme is designed for routine integration into ward work without reliance on specialised training booklets or equipment.

1. **Preparation**

- Nominate 1–2 peer champions per ward; provide a concise orientation on coaching, observation, and record-keeping.
- Orient ward supervisors on their reinforcement role (scheduling, feedback, escalation of equipment issues).
- Incorporate a simple schedule into rosters (e.g., 10–15 minutes during morning handover; 10 minutes mid-shift).

2. **Initial Delivery**

- Conduct short ward-based briefings on ergonomic principles and common tasks, followed by bedside demonstrations during real care episodes.
- Begin workstation checks (bed/documentation station heights, supply placement) and implement quick fixes.

3. **Reinforcement**

- Supervisors lead weekly mini-briefs reinforcing one practice at a time (e.g., “raise the bed before turning”).
- Peer champions provide on-the-job coaching and maintain observation logs; OHS committee reviews data quarterly.

4. **Consolidation**

- All staff maintain personal ergonomic action plans with monthly peer reviews.
- Refresher sessions quarterly; update layouts/equipment lists based on audit findings and incident reports.

6.11 MONITORING AND EVALUATION FRAMEWORK

Purpose: Assure fidelity, track adoption, and measure outcomes for continuous improvement.

Monitoring (implementation/fidelity):

- **What:** session occurrence, attendance, duration; number of bedside coaching interactions; workstation check completions; availability/use of transfer aids; proportion of staff with current action plans.
- **How:** attendance registers; session/observation checklists; peer champion monthly logs; simple equipment availability checks.
- **Who/Frequency:** peer champions (weekly logs); ward supervisors (monthly summaries); OHS committee (quarterly review).

Evaluation (effectiveness):

- **Short-term (0–6 months):** Knowledge scores; observed technique adherence; self-efficacy for safe handling.

- **Medium-term (6–12 months):** Self-reported discomfort (NMQ regions), frequency of safe practices, near-miss/incident patterns.
- **Long-term (≥12 months, if data available):** WRMSD incidence, sickness absenteeism, staff retention.
- **Methods:** Pre/post questionnaires (ergonomics awareness tool; NMQ), structured observations, FGD feedback, routine OHS data.
- **Feedback loops:** Findings shared in ward meetings and OHS committees; action items documented with responsible persons and timelines; adaptations recorded for learning.

6.12 INSTRUMENTS AND DATA ANALYSIS

Two instruments were used: (1) a self-administered ergonomics awareness questionnaire (baseline, midline, endline) and (2) the Standardised Nordic Musculoskeletal Questionnaire mapping pain/discomfort across nine anatomical regions. Data were analysed in SPSS v26 using descriptive statistics, χ^2 tests for categorical associations, ANOVA for mean comparisons, and logistic regression for predictors of improvement. Significance was set at $p < 0.05$.

6.13 ETHICAL CONSIDERATIONS

Ethical approval was obtained from the Ministry of Health and Social Services Ethics Board and participating hospital committees. Written informed consent was secured from all

participants. Video/photographic observations were explained in advance; confidentiality and anonymity were maintained. Participation was voluntary with the right to withdraw at any time without penalty.

6.14 POST-INTERVENTION EVALUATION (PILOT FINDINGS)

After 12 months, intervention hospitals reported:

- Knowledge gains on ergonomic principles and safe handling.
- Improved observed practices (raising bed height before repositioning; greater use of slide sheets when available).
- Reduced self-reported musculoskeletal discomfort, particularly in the lower back and shoulders.
- High acceptability of brief, ward-integrated training and bedside coaching. The control site did not show comparable improvements during the same period.

6.15 CONCLUSION

This chapter detailed the evidence-informed, PAR-developed multifaceted ergonomic educational programme tailored for Namibia's intermediate hospitals. By combining system-level strategies (staffing, governance, engineering controls, screening) with practical educational components (assessment, training, workstation modification, and micro-exercise), and embedding a clear monitoring and evaluation pathway, the programme offers a scalable, sustainable approach to preventing WRMSDs among nurses. The subsequent chapter addresses readiness for broader institutionalisation and scale-up.

CHAPTER 7

EVALUATE THE READINESS AND APPLICABILITY OF THE MULTIFACETED ERGONOMIC EDUCATIONAL PROGRAM

7.1 INTRODUCTION

This chapter presents the findings of the evaluation of the multifaceted ergonomic educational program which was developed in Chapter Six. The Centres for Disease Control and Prevention (CDC) defines program evaluation as a systematic way to improve and account for public health actions by involving procedures that are feasible, useful, ethical, and accurate (45). The preferred approach is to select an evaluation team that includes internal program staff, external stakeholders, and/or consultants with evaluation expertise (45).

The researcher utilised the CDC framework for program evaluation in public health, as described in Chapter 2 (Literature Review) of this study. Using the framework, sometimes referred to as the "easy evaluation framework," focusses the program evaluation on the identified interventions and the expected outcomes. According to CDC, there are several types of evaluations that can be conducted, namely formative, process/implementation, outcome/effectiveness, and impact evaluations (45). In this study, the formative evaluation method was utilised, as it ensures that a program or program activity is appropriate, feasible, and acceptable before it is fully implemented. The formative evaluation is typically conducted when a new program or activity is being developed or when an existing one is being adapted or modified. This type of evaluation assesses whether the proposed program

elements are likely to be needed, understood, and accepted by the recipients of the program (45). Hence, it was a suitable approach for evaluating the multifaceted ergonomic educational program, a new program developed to prevent WRMSDs among nurses at Intermediate Hospitals (IHs) in Namibia. The CDC evaluation framework is based on six-steps or principles: engage stakeholders, describe the program, focus the evaluation design, gather credible evidence, justify conclusions, and ensure used and share lessons (45). A group of experts, as described below, conducted this final evaluation.

7.2 SELECTION OF EXPERTS AS EVALUATORS

To ensure the credibility and practical applicability of the proposed multifaceted ergonomic educational program, expert review was sought from four ergonomists with established academic and professional credentials. The selection of these experts was conducted through purposive sampling, targeting institutions and organisations globally recognised for their expertise in ergonomics and human factors. A comprehensive internet search was carried out to identify such organisations, focusing on those involved in workplace ergonomics from both academic and applied practice perspectives.

Formal invitations were sent via email to ergonomists affiliated with selected institutions, including the Chartered Institute of Ergonomics and Human Factors (UK), the Human Factors and Ergonomics Society (USA), the Ergonomics and Human Factors Unit at Western Sydney University (Australia), and The Ohio State University College of Medicine (USA). These experts were chosen specifically for their background in human factors engineering, occupational ergonomics, and ergonomic program implementation, with the

aim of gathering diverse and informed feedback relevant to both the design and field application of the program.

Each email included an informed consent form, a detailed description of the proposed ergonomic education program, and graphic representations of the program's structure. Experts who voluntarily agreed to participate returned signed consent forms via email. In total, four ergonomists consented and agreed to serve as external evaluators. These included a Professor of Human Factors Engineering from The Ohio State University College of Medicine; an ergonomist affiliated with Western Sydney University's Workplace Health, Safety & Wellbeing program; a member of the Chartered Institute of Ergonomics and Human Factors in the United Kingdom; and a professional from the Human Factors and Ergonomics Society in the United States.

To engage the experts meaningfully in the evaluation process, each was provided with a structured evaluation package via email. This included the full written program document, visual/graphic illustrations, and a standardised evaluation form developed by the researcher. The evaluation form comprised both closed-ended and open-ended questions designed to assess the clarity, relevance, structure, and practical feasibility of the program content. Experts were requested to review the program in detail and provide written feedback using the evaluation form.

The closed-ended questions allowed for systematic scoring, while the open-ended sections enabled the experts to elaborate on specific strengths, weaknesses, and recommendations for improvement. This approach ensured that both quantitative and qualitative data were collected, allowing for a comprehensive review of the program content. The expert

evaluations were used to inform the refinement of the program prior to its implementation, thereby enhancing its validity and relevance within occupational settings.

7.3 REVIEW OF THE PROGRAMME

It is essential to evaluate whether these strategies have led to intended adoption, implementation, and sustainability outcomes (37). Process and implementation evaluation can answer questions such as who the program reached, to what extent it was delivered as planned (to whom, with what level of fidelity, and whether theory and evidence-based change methods were applied correctly (37). The purpose of reviewing the program was to ensure that the program components were of achievable quality. The proposed program, as discussed in Chapter 6, was submitted to individual expert ergonomists for review. The review group was purposively selected to include expert professionals (ergonomists) from government and academic fields to obtain broader input based on the expert reviewers' job descriptions and their exposure to workplace/organisational practices. The evaluation employed four criteria: relevance, appropriateness, coherency, and sustainability to assess the program's objectives, strategies, and activities.

Relevance relates to determining whether the objectives of the intervention programme are clearly defined, realistic and feasible, and whether the results are verifiable and aligned with current international standards for the development interventions (37). When assessing relevance, the organisational capacity and capability of implementing the program are also considered (45).

Appropriateness is a criterion aimed at determining whether the objectives of a program are suitable, given what is already known about the social, economic, or environmental context

or needs of the issue, and whether the program's strategies will assist in achieving the objective(s) (45). It is necessary that appropriateness evaluations be undertaken during a program's initial design (37).

Coherency examines the extent to which the multifaceted ergonomic educational program is both internally and externally coherent and well aligned with other Ministry of Health and Social Services (MoHSS) policies and programs (45).

Sustainability relates to the need for generating lasting impacts, such as the continued or sustained implementation of the program's activities (45). In the context of the multifaceted ergonomic educational program, activities are sustainable when they continue to function effectively in the near future. The sustainability can be achieved through high levels of acceptance, participation and implementation of the program by the targeted group, using resources available from MoHSS.

Table 12: Evaluation Criteria Used for Assessment of the Program

Criteria	Guiding questions
Relevance	Are the program objectives addressing the needs that motivated the creation of the program? To what extend do the intervention strategies ensure their relevance in relation to the principles and objectives set in the occupational health and safety policy of MoHSS?

	Does the program continue to be consistent with organizational priorities?
Appropriateness	To what extent are the intervention strategies sufficient and are sufficiently covered to achieve the multifaceted ergonomic educational program objectives? Is there a need for the multifaceted ergonomic educational program? Do the desired outcomes address the need? Are the desired outcomes consistent with the catchment population and government priorities? Are the proposed strategies going to deliver the desired outcomes?
Coherency	To what extent are the objectives and intervention strategies of the multifaceted ergonomic educational program externally consistent/coherent? a) Is there correspondence between the multifaceted ergonomic educational program and MoHSS health objectives?

	b) Is there correspondence between the program and other public interventions, e.g., national health policies and program?
Sustainability	To what extent will the program be sustained with the human, fiscal and technical resources available? Will the program's interventions be institutionalized and continued as part of the normal services to be delivered?

The evaluators were provided with a sheet of criteria and questions to guide them in the evaluation. They were asked to evaluate the program objectives in relation to the intervention strategies, rating them on a Likert scale as shown in Table 13below.

Table 13: Multifaceted Ergonomic Educational Program Scores and Evaluation Criteria

Score	Evaluation criteria
4	Complete, clear, well formulated, and highly applicable
3	Applicable, but needs reformulation
2	Unclear, applicability questionable
1	Irrelevant, not applicable

Sources: Katjiuanjo (2024)

Table 14: Description of the Separate Scores from the Individual Evaluators.

Evaluator 1	Program Intervention Strategies (PIS)				
	1	2	3	4	5
Criteria					
Relevance	4	4	3	4	4
Appropriateness	3	4	3	4	3
Coherence	4	3	3	3	4
Sustainability	4	4	3	4	3
Total score/16	15	15	12	15	14

Evaluator 2	Program Intervention Strategies (PIS)				
	1	2	3	4	5
Criteria					
Relevance	4	4	4	4	3
Appropriateness	3	4	3	4	3
Coherence	3	4	3	3	4
Sustainability	3	4	3	3	4
Total score/16	13	16	13	14	14

Evaluator 3	Program Intervention Strategies (PIS)				
	1	2	3	4	5

Criteria					
Relevance	4	4	4	3	3
Appropriateness	3	4	4	4	3
Coherence	4	3	3	3	4
Sustainability	3	3	4	3	3
Total score/16	14	14	15	13	13

Evaluator 4	Program Intervention Strategies (PIS)				
	1	2	3	4	5
Criteria					
Relevance	4	3	4	3	3
Appropriateness	4	4	4	4	3
Coherence	3	3	4	3	4
Sustainability	4	3	4	3	4
Total score/16	15	13	16	13	14

Table 15: description of the scores from the evaluation group

Program	Evaluator	Evaluator	Evaluator	Evaluator	Mean
Total score	1	2	3	4	score
Strategy 1	15	13	14	15	14.25
Strategy 2	15	16	14	13	14.5
Strategy 3	12	13	15	16	14

Strategy 4	15	14	13	13	13.75
Strategy 5	14	14	13	14	13.75

Most of the evaluators scored 4, with a few ergonomic educational intervention strategies receiving scores of 3. Scores of 4 were accepted, while those of 3 were reformulated. There were no scores of 2 or 1 given by the evaluators. The reformulated strategies were reflected in the previous chapter as part of the final multifaceted ergonomic educational program.

Most evaluators agreed or strongly agreed that the program was relevant, appropriate, and sustainable. Coherency was also generally agreed upon by the evaluators. Despite these positive findings, the evaluation uncovered some criticism regarding the wording of certain actions under the strategies, and some intervention strategies were found to be too general.

The evaluators found significant synergies between multiple interventions proposed for the program as an effective approach in addressing identified ergonomic risk factors. However, some evaluators expressed concerns that some interventions were narrower and less focused, necessitating adjustments. Recommendations were made to make the strategies more detailed and focused. Overall, evaluators found the program to be relevant, appropriate, coherent, and sustainable. However, they suggested that the MoHSS seek funding from development partners to provide technical assistance during implementation phase of the program to ensure effective and secure program sustainability.

7.4 SUMMARY

This chapter provided an account of the evaluation of the multifaceted ergonomic educational program designed to prevent work-related musculoskeletal disorders among nurses at intermediate hospitals in Namibia. The developed program was evaluated and reviewed by experts in the field of ergonomics from different countries around the world. The results of the program evaluation indicate strong relevance, appropriateness and sustainability. The outcome evaluation indicates that the panel of experts found the program worthwhile and expressed confidence in the outcomes of the program. The subsequent chapter will draw conclusive remarks, delineate limitations encountered during the study, outline recommendations based on the research findings, indicate this study's contribution to the body of knowledge, and outline the way forward.

CHAPTER 8

CONCLUSION, CONTRIBUTION, LIMITATIONS, RECOMMENDATION OF THE STUDY

8.1 INTRODUCTION

The previous chapter discussed the evaluation of the multifaceted ergonomic educational program aimed at preventing work-related musculoskeletal disorders among nurses. This chapter presents the study's conclusions in accordance with the various study phases. The possible limitations and delimitations encountered in this study, recommendations emanating from the study's findings, and areas for further research are specified. This chapter also specifies the study's contribution to the body of knowledge and highlights the way forward.

8.2 CONCLUSIONS

The purpose of this study was to develop a multifaceted ergonomic educational program to prevent work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia. The developed grogram was based on research findings that determined and described the prevalence, and risk factors associated with the development of work-related musculoskeletal disorders (WRMSDs) among nurses. The program developed program was also based on study findings that explored suitable interventions to prevent WRMSDs among nurses. The specific objectives of the study were:

- Determine the prevalence of work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia **(phase I).**
- Determine and describe risk factors associated with work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia **(phase I).**
- Explore ergonomic interventions that may be suitable and effective in addressing identified risk factors to prevent work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia **(phase II).**
- Develop a multifaceted ergonomic educational program to prevent work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia **(phase III).**
- Evaluate the readiness and applicability of the multifaceted ergonomic educational program **(phase IV).**

8.2.1 Phase 1, Objective 1: Determine the prevalence of work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia.

This objective was achieved. The study findings concluded that WRMSDs among nursing personnel at IHs Katutura, Onandjokwe, Oshakati, and Rundu are a major occupational health problem, with an average prevalence rate of WRMSDs in any body region being 71%. The prevalence of WRMSDs among nurses over 12 months at IHs Katutura, Oshakati, Rundu, and Onandjokwe was 76%, 73%, 69%, and 65%, respectively. Nurses mostly suffered from lower back, neck, and shoulder pain, as types of WRMSDs.

WRMSDs impact nurses' work and daily life significantly. The main impact of WRMSDs is unnecessary spending on medical consultations, and nurses may contribute poorly to the hospital's output, since they must seek for medical attention instead of attending to patients. Nurses also had difficulty sleeping due to WRMSDs' pain.

8.2.2 Phase 1, Objective 2: Determine and describe risk factors associated with work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia

This objective was achieved. The study findings concluded that that socio demographic factors (age, and years of experience), psychosocial factors (high workloads), and physical factors (repetitive manual tasks, extensive standing, awkward postures, and manual handling), were strongly associated with the development of WRMSDs among nurses (p-values$\leq$0.005), across all IHs in Namibia.

Lower back pain was associated with extensive standing, manual handling, and high workload, while neck pain was associated with repetitive manual tasks and awkward postures. Shoulder pain was associated with repetitive manual tasks, awkward postures, manual handling, and high workload ($p \leq 0.005$), across all IHs in Namibia.

8.2.3 Phase 2, Objective 3: Explore the ergonomic interventions that may be suitable and effective in addressing identified risk factors to prevent work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia.

This objective was achieved. The study findings concluded that WRMSDs are multifactorial in nature, caused by multiple, complex, and dynamic interactions between physical and

psychosocial risk factors. Thus, administrative interventions (adequate staffing; training; promotion of physical activity, healthy lifestyle, and hazards analysis; pre-employment screening), and engineering interventions (work and equipment modification), are the multifaceted ergonomic interventions this study proposed. These multiple approaches are deemed appropriate as they aim to address all identified risk factors to prevent WRMSDS among nurses and ensure a healthy working team at IHs.

8.2.4 Phase 3, Objective 4: Develop a multifaceted ergonomic educational program to prevent work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia.

The program was successfully developed based on guidance and references from this study's results, the reviewed related literature, the Biomechanical-Structural Model of the development and prevention of occupational musculoskeletal disorders, and a conceptual framework for work-related musculoskeletal disorders. The program incorporated five key elements: administration (adequate staffing; training; promotion of physical activity, healthy lifestyle, and hazard analysis; pre-employment screening), and engineering (work and equipment modification).

8.2.5 Phase 4, Objective 5: Evaluate the readiness and applicability of the multifaceted ergonomic educational program.

The program was successfully evaluated by various purposively selected expert ergonomists, who were identified through a Google search and were available and willing to participate in the study voluntarily. In total, four evaluators were used for this exercise to

assess the five proposed multifaceted ergonomic educational interventions/strategies. The evaluators used five evaluation criteria (completeness, applicability, clarity, and relevance). The highest mean score was obtained for strategy 2 (14.5). The lowest mean scores were obtained for strategy 4 (13.75) and strategy 5 (13.75).

8.3 RECOMMENDATIONS

The recommendations are based on the results of the study, with an emphasis on preventing work-related musculoskeletal disorders among nurses at intermediate hospitals in Namibia.

8.3.1 Recommendations for Intermediate Hospitals in Namibia.

This study revealed that work-related musculoskeletal disorders are most prevalent among nurses at intermediate hospitals Oshakati, Onandjokwe, Oshakati, and Rundu. To address this issue, the following recommendations are provided:

- Any nurse reported to suffer from WRMSDs should be assessed, diagnosed, treated, and the diagnosed types of WRMSDs should be recorded accurately, rather than generalising WRMSDs as occupational injuries or other conditions in the hospital's Health Information System (HIS). This will enable the IHs to maintain proper records of WRMSDs, determine trends, and guide physiotherapists and/or ergonomists in addressing the problem with appropriate interventions.

This study also revealed that work-related musculoskeletal disorders are associated with psychosocial risk factors (e.g., high workload), and physical risk factors (e.g., repetitive

manual tasks, extensive sitting and standing, awkward postures, and manual handling). The following recommendations are given to address the identified risk factors:

- Increase awareness campaigns regarding WRMSDs, emphasising preventive measures and collaborative efforts within healthcare settings in Namibia.
- Implement the multifaceted ergonomic educational program and its interventions, which aim to mitigate risks, remove hazards, seek early treatment, and provide training aiming to increase knowledge about WRMSD prevention among nurses. All five program intervention elements such as administration (adequate staffing; training; promotion of physical activity, healthy lifestyle, and hazard analysis; pre-employment screening), and engineering (work and equipment modification), should be implemented as they target various specific identified risk factors.

The study had shown that work-related musculoskeletal disorders impact nurses' daily lives, causing them to spend unnecessary money on medical consultations and perform poorly in hospital outputs as they need to seek medical attention instead of attending to patients. To address these impacts, the following recommendation is made:

- It is strongly recommended that scientific methods be used to determine workloads to calculate adequate staffing levels.

8.3.2 Recommendations for Nurses/Healthcare Workers

The study findings revealed a high prevalence of WRMSDs among nurses at intermediate hospitals in Namibia. To address this, the following recommendations are provided:

- Engage in regular exercise when off duty to promote body fitness, which helps reduce the risk of WRMSDs.
- Pay attention to pain: change positions and/or stop activities whenever they cause discomfort.
- Take frequent breaks from any sustained posture every 20-30 minutes and stretch stiff muscles.

The study also revealed that psychosocial and physical risk factors contribute to WRMSDs among nurses. To address this issue, the following recommendation is given:

- Nurses and healthcare workers are encouraged to fully participate in and sustain the multifaceted ergonomic education program to mitigate risks and increase knowledge about WRMSD prevention.

8.3.3 Recommendations for the Ministry of Health and Social Services (MoHSS)

This study revealed that psychosocial (e.g., high workload) and physical risk factors (e.g., repetitive manual tasks, extensive sitting and standing, awkward postures, and manual handling) are associated with the development of WRMSDs among nurses. The following recommendations are provided to address these identified risk factors:

- Ensure full implementation and monitoring of the outcomes of the multifaceted ergonomic educational program developed to prevent WRMSDs among nurses.
- Increase awareness campaigns regarding WRMSDs, emphasising preventive measures and fostering collaborative efforts within healthcare settings in Namibia.

- Review and update the Occupational Health and Safety (OHS) policy to comprehensively address WRMSDs in hospital settings in Namibia.

The study also showed that work-related musculoskeletal disorders impact nurses' daily lives, causing them to spend unnecessary money on medical consultations and perform poorly in hospital outputs as they seek medical attention instead of attending to patients. To address these impacts, the following recommendations are provided:

- Foster collaborative efforts between healthcare institutions, policymakers, and professional bodies to create a supportive workplace culture that prioritises nurses' physical and psychosocial well-being and mitigates the effects of WRMSDs.
- Give strong attention to the scientific determination of workload to calculate adequate staffing levels.

8.3.4 Area for further research

- There is a need to conduct similar studies in health institutions at lower levels than intermediate hospitals, such as district hospitals, clinics, and health centres to gain insights into the prevalence of WRMSDs among nurses in those specific health institutions in Namibia.
- While this study focused on effective interventions to prevent WRMSDs among nurses, further research is needed to explore effective treatment methods for WRMSDs in health institutions in Namibia.

- This study utilised an explanatory sequential study design of mixed-methods design. Similar research in the same study setting, using different study methods, is needed to compare the outcomes.

8.3.5 Recommendations for Educational Institutions and Public Health Policy

The findings of this study highlight the urgent need to address WRMSDs through both educational and public health policy frameworks. Therefore, the following recommendations are made:

A. Educational Institutions (Nursing Schools and Health Sciences Faculties):

- Integrate occupational health and ergonomics education into the core nursing and allied health sciences curricula. This should include modules on safe patient handling, ergonomic principles, WRMSD prevention strategies, and psychosocial risk awareness.
- Incorporate practical training sessions in simulated clinical environments to equip students with hands-on experience in ergonomic practices and risk mitigation techniques before entering the workforce.
- Encourage collaborative projects and research initiatives between nursing students and lecturers focusing on workplace safety, WRMSDs, and ergonomic interventions relevant to the Namibian healthcare setting.

B. Public Health Policy Makers and Regulatory Bodies:

- Advocate for the formal inclusion of WRMSDs in the national occupational health and safety policy framework, ensuring specific guidelines for WRMSD prevention, surveillance, and reporting within the health sector.
- Mandate the regular training of healthcare workers on WRMSD prevention through continuous professional development (CPD) initiatives endorsed by national regulatory councils.
- Promote inter-ministerial collaboration between the Ministry of Health and Social Services (MoHSS), Ministry of Labour, and Ministry of Higher Education to align educational content with national health priorities and workforce safety needs.
- Establish a national surveillance system to track the prevalence and trends of WRMSDs among healthcare workers, particularly nurses, and to guide policy responses based on real-time data.

8.4 CONTRIBUTION TO THE BODY OF KNOWLEDGE

This study contributes to the body of scientific knowledge in the following ways:

8.4.1 Prevalence of Work-Related Musculoskeletal Disorders Among Nurses at Intermediate Hospitals in Namibia

This study established baseline information regarding the prevalence of work-related musculoskeletal disorders among nurses at intermediate hospitals in Namibia. Conducted in phase one, using a mixed-method explanatory sequential study design), this research fills a

gap as no similar study has been conducted in Namibia to determine the prevalence of work-related musculoskeletal disorders across all intermediate hospitals in the country. Thus, this study provides valuable baseline data on the prevalence of work-related musculoskeletal disorders in all five intermediate hospitals (Katutura, Onandjokwe, Oshakati, and Rundu), in Namibia.

8.4.2 Risk factors Associated with the Development of Work-Related Musculoskeletal Disorders Among Nurses

This study contributed to the body of knowledge by providing baseline information on the risk factors associated with the development of work-related musculoskeletal disorders among nurses at intermediate hospitals in Namibia. Using a mixed method explanatory sequential study design, the research was conducted in Phase One (quantitative study design) and Phase Two (qualitative study design). Similar studies in the Namibian context, particularly at intermediate hospitals, were limited. The information obtained will serve as a valuable reference for other researchers.

8.4.3 Development of a Multifaceted Ergonomic Educational Program to Prevent Work-Related Musculoskeletal Disorders Among Nurses at Intermediate Hospitals in Namibia

This study contributed to the body of knowledge by developing a program that addresses work-related musculoskeletal disorders through five key intervention elements necessary for prevention among nurses in intermediate hospitals in Namibia. This program was developed in Phase Three of the study.

Additionally, the multifaceted ergonomic educational program created by this study will serve as a reference and guide for other researchers conducting similar studies.

8.4.4 Evaluation of a multifaceted ergonomic educational program

The program was evaluated by a panel of expert ergonomists. The experts used specific evaluation criteria and indices, and the resulting information will contribute to the body of knowledge as it can be used by other researchers.

8.5 WAYS FORWARD

Following this study, the researcher will disseminate the findings as proposed below.

8.5.1 Dissemination of information

The results will be disseminated in the form of presentations at public conferences in Namibia and internationally. Additionally, the results will be published in an accredited peer-reviewed journal. This dissemination will contribute to the body of knowledge, as sharing knowledge and information is essential.

8.5.2 Proposed Publications

The following manuscripts are being considered for publication:

- **Prevalence of Work-Related Musculoskeletal Disorders Among Nurses in Intermediate Public Hospitals in Namibia** (quantitative study design).

- **Risk Factors Associated with Work-Related Musculoskeletal Disorders Among Nurses in Intermediate Public Hospitals in Namibia** (mixed-method explanatory sequential study design).
- **Ergonomic Interventions That May Be Suitable and Effective in Addressing Identified Risk Factors to Prevent Work-Related Musculoskeletal Disorders Among Nurses in Intermediate Public Hospitals in Namibia** (qualitative study design).
- **Multifaceted Ergonomic Educational Program to Prevent Work-Related Musculoskeletal Disorders Among Nurses in Intermediate Public Hospitals in Namibia** (mixed-method explanatory sequential study design)

8.5.3 Paper Publication

The following journals will be considered for paper publication:

- BMC Public Health
- BMC nursing
- INQUIRY
- BMC Musculoskeletal disorders
- Applied Ergonomics
- PubMed Central

8.5.4 Multifaceted Ergonomic Educational Program Implementation

It is proposed that the multifaceted ergonomic educational program developed by the researcher will be submitted to the Ministry of Health and Social Services (MoHSS) for implementation and evaluation of its effectiveness.

8.6 LIMITATION OF THE STUDY

Identifying the limitations of the study is essential for meaningful interpretation of the findings. Despite the study's success, some limitations were encountered during its execution. They are described below.

8.6.1 Population Limitations

The study was limited to nurses working in intermediate hospitals in Katutura, Onandjokwe, Oshakati, and Rundu.

8.6.2 Methodological Limitations

- Accessing the entire sample size of participants during the daytime was challenging due to day-night work shifts. The researcher addressed this limitation by distributing the data collection tools during both day and night shifts.

8.6.1.3 Recall Bias

- This study examined 12-month and lifetime experiences of WRMSDs, which may have led to some misclassification due to recall bias. It is possible that some

respondents classified their musculoskeletal conditions as WRMSDs regardless of whether these conditions were related to their nursing jobs. As with other explanatory studies, there is a possibility that respondents provided vague or exaggerated answers regarding their WRMDs.

8.7 SUMMARY

This chapter presented the conclusions, possible study limitations, and recommendations. All objectives were addressed respectively. The WRMSDs affecting any body part over a 12-month period were found to be highly prevalent among respondents at intermediate hospitals in Namibia. Lower back, neck, and shoulder pain were the main types of WRMSDs affecting nurses across all four IHs in the country. Age, years of experience, high workloads, repetitive manual tasks, awkward postures, extensive standing and manual handling were strongly associated with the development of WRMSDs among nurses. WRMSDs negatively impact nurses' daily lives and work, leading to unnecessary spending on medical consultations and diminished contributions to hospital outputs. This study proposed five intervention elements, including administration (adequate staffing, training, promotion of physical activity, healthy lifestyle, hazards analysis, and pre-employment screening), and engineering (work and equipment modification), to address the identified risk factors with the aim of preventing WRMSDs among nurses. It is recommended that all targeted personnel and organisations implement the elements of the multifaceted ergonomic educational program accordingly. Reducing WRMSDs among nurses may improve their productivity at work and their overall quality of life.

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APPENDICES

APPENDIX A: ETHICAL CLEARANCE CERTIFICATE FROM THE UNIVERSITY OF NAMIBIA

UNAM
UNIVERSITY OF NAMIBIA

ETHICAL CLEARANCE CERTIFICATE

Ethical Clearance Reference Number: DEC OSH 0012 Date: 04/04/2022

This Ethical Clearance Certificate is issued by the University of Namibia Ethics Committee (REC) in accordance with the University of Namibia's Research Ethics Policy and Guidelines. Ethical approval is given in respect of undertakings contained in the Research Project outlined below. This Certificate is issued on the recommendations of the ethical evaluation done by the ethics committee.

Title of Project: DEVELOPMENT OF MULTIFACETED ERGONOMIC EDUCATIONAL PROGRAM TO PREVENT WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG NURSES IN INTERMEDIATE PUBLIC HOSPITALS IN NAMIBIA

Principal researchers: ANANIAS AKWEETELELA

Staff Number/ Student number: 201118416

Remarks: Low Risk – Approved

Centre for Research Services

Take note of the following:

1. Any significant changes in the conditions or undertakings outlined in the approved Proposal must be communicated to the ethics committee. An application to make amendments may be necessary.
2. Any breaches of ethical undertakings or practices that have an impact on ethical conduct of the research must be reported to the ethics committee
3. The Principal Researcher must report issues of ethical compliance to the ethics committee (through the Chairperson) at the end of the Project or as may be requested by the ethics committee
4. The ethics committee retains the right to:

i) Withdraw or amend this Ethical Clearance if any unethical practices (as outlined in the Research Ethics Policy) have been detected or suspected,

ii) Request for an ethical compliance report at any point during the course of the research.

The ethics committee wishes you the best in your research.

Prof Hans J Amukugo (Oshakati Campus Chairperson Decentralized Ethics Committee)

Prof. Davis Mumbengegwi (Head, Multidisciplinary Research)

APPENDIX B: RESEARCH PERMISSION LETTER FROM THE UNIVERSITY OF NAMIBIA

CENTRE FOR RESEARCH SERVICES
Office of the Pro-Vice Chancellor: Research, Innovation & Development
University of Namibia, Private Bag 13301, Windhoek, Namibia
340 Mandume Ndemufayo Avenue, Pioneers Park, Office F223 - Fblock, Second Floor
☎ +264 61 206 4673; E-mail:kmbulu@unam.na; URL.: http//www.unam.edu.na

UNAM
UNIVERSITY OF NAMIBIA

RESEARCH PERMISSION LETTER

Date: 22/04/2022

Student Name: ANANIAS AKWEETELELA

Student Number: 201118416

Programme: DOCTOR 0F PHILOSOPHY IN PUBLIC HEALTH

Approved Research Title: Development of Multifaceted Ergonomic Educational Program to Prevent Work-Related Musculoskeletal Disorders Among Nurses in Intermediate Public Hospitals in Namibia.

TO WHOM IT MAY CONCERN

I hereby confirm that the above-mentioned student is registered at the University of Namibia for the programme indicated. The proposed study met all the requirements as stipulated in the University guidelines and has been approved by the relevant committees.

The proposal adheres to ethical principles as per attached Ethical Clearance Certificate. Permission is hereby granted to carry out the research as described in the approved proposal.

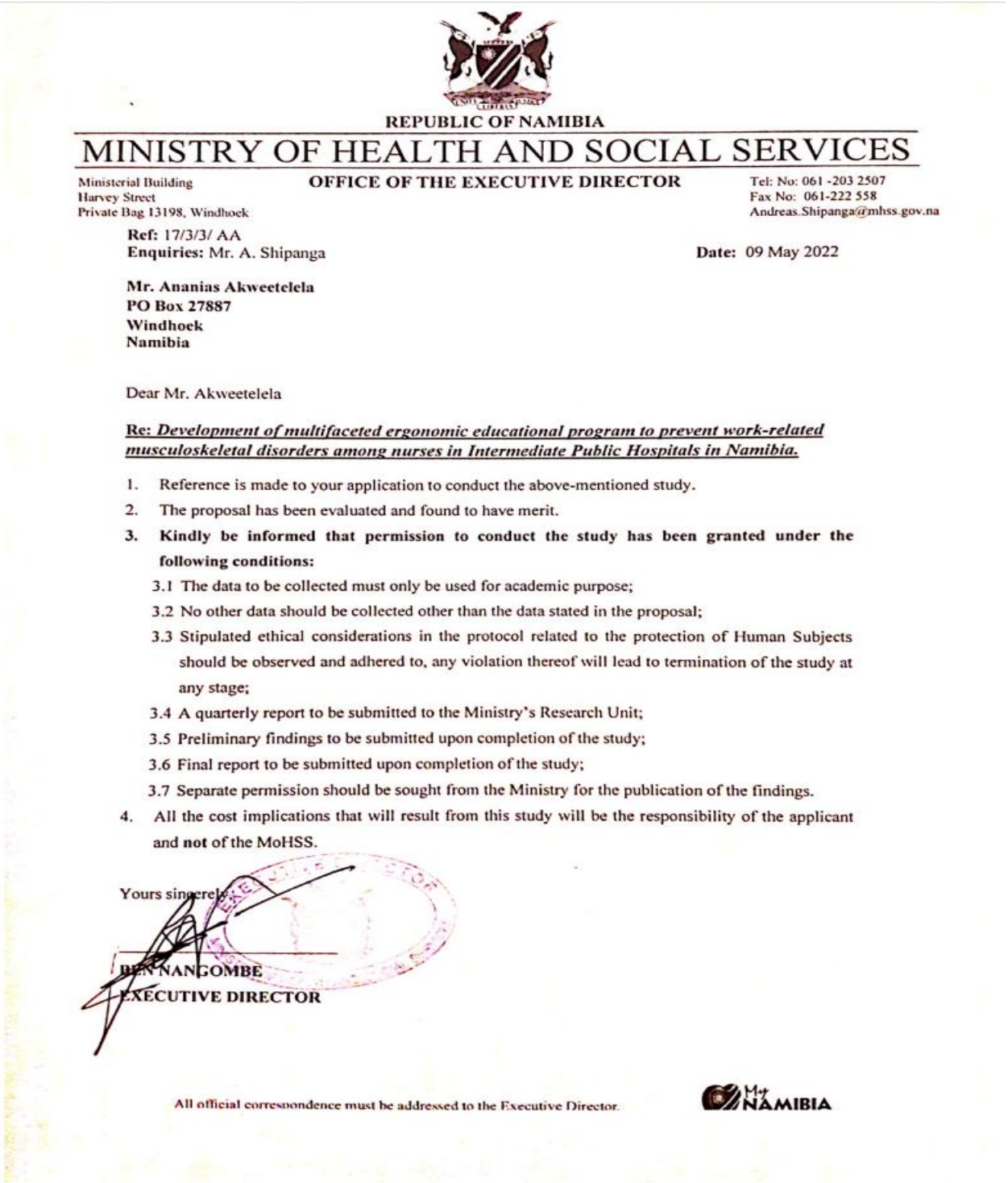
Best Regards

Dr. AEE Shikongo
Head: Postgraduate Support Services
Tel: +264 61 206 3129
E-mail: aeshikongo@unam.na

CENTRE FOR RESEARCH SERVICES
Office of the Director
2022 -04- 22
University of Namibia
UNAM

APPENDIX C: OTHER RELEVANT PERMISSIONS

(i) Permission letter from the Ministry of Health and Social Services



REPUBLIC OF NAMIBIA

MINISTRY OF HEALTH AND SOCIAL SERVICES

OFFICE OF THE EXECUTIVE DIRECTOR

Ministerial Building
Harvey Street
Private Bag 13198, Windhoek

Tel: No: 061 -203 2507
Fax No: 061-222 558
Andreas.Shipanga@mhss.gov.na

Ref: 17/3/3/ AA
Enquiries: Mr. A. Shipanga

Date: 09 May 2022

Mr. Ananias Akweetelela
PO Box 27887
Windhoek
Namibia

Dear Mr. Akweetelela

Re: *Development of multifaceted ergonomic educational program to prevent work-related musculoskeletal disorders among nurses in Intermediate Public Hospitals in Namibia.*

1. Reference is made to your application to conduct the above-mentioned study.
2. The proposal has been evaluated and found to have merit.
3. **Kindly be informed that permission to conduct the study has been granted under the following conditions:**
   - 3.1 The data to be collected must only be used for academic purpose;
   - 3.2 No other data should be collected other than the data stated in the proposal;
   - 3.3 Stipulated ethical considerations in the protocol related to the protection of Human Subjects should be observed and adhered to, any violation thereof will lead to termination of the study at any stage;
   - 3.4 A quarterly report to be submitted to the Ministry's Research Unit;
   - 3.5 Preliminary findings to be submitted upon completion of the study;
   - 3.6 Final report to be submitted upon completion of the study;
   - 3.7 Separate permission should be sought from the Ministry for the publication of the findings.
4. All the cost implications that will result from this study will be the responsibility of the applicant and **not** of the MoHSS.

Yours sincerely,

BEN NANGOMBE
EXECUTIVE DIRECTOR

All official correspondence must be addressed to the Executive Director.

My NAMIBIA

Scanned with CamScanner

(ii) Permission letter from Intermediate Hospital Katutura

Republic of Namibia

Ministry of Health and Social Services

Private Bag 13215
WINDHOEK
Namibia

Intermediate Hospital Katutura
Independence Avenue
WINDHOEK

Telephone (061) 203 4004/5
Telefax (061) 222706

Enquiries: Sr. I. Thele

Date 05 September 2022

OFFICE OF THE MEDICAL SUPERINTENDENT

MR. ANANIAS AKWEETELELA
UNIVERSITY OF NAMIBIA (UNAM)
WINDHOEK

Ms. Akweetelela

RE: DEVELOPMENT OF MULTIFACETED ERGONOMIC EDUCATIONAL PROGRAM TO PREVENT WORK-RELATED MUSCULOSKELETAL DISORDER AMONG NURSES

The above mentioned subject refers:

This office hereby grants you permission to do a research on the development of multifaceted ergonomic educational program to prevent work-related musculoskeletal disorder among nurses at Intermediate Hospital Katutura, Windhoek, Khomas Region, Namibia.

Please provide this office with a copy of your findings.

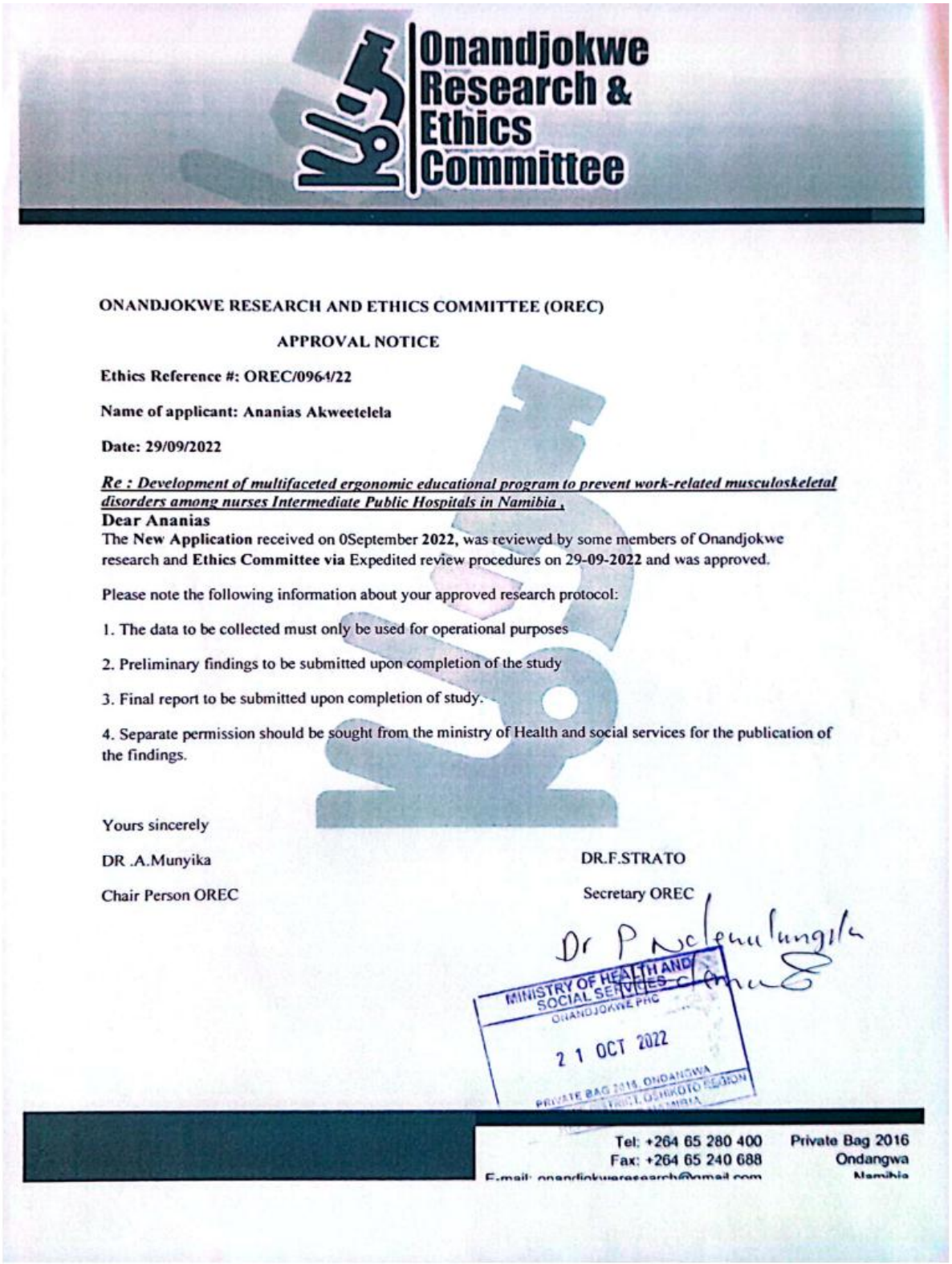
Thank you

Yours in Health,

DR. N. T. AMAGULU
MEDICAL SUPERINTENDENT

MINISTRY OF HEALTH
AND SOCIAL SERVICES
P/BAG 13215
WINDHOEK NAMIBIA
12 -09- 2022
INTERMEDIATE HOSPITAL KATUTURA

(iii) Permission letter from Intermediate Hospital Onandjokwe



Onandjokwe Research & Ethics Committee

ONANDJOKWE RESEARCH AND ETHICS COMMITTEE (OREC)

APPROVAL NOTICE

Ethics Reference #: OREC/0964/22

Name of applicant: Ananias Akweetelela

Date: 29/09/2022

Re : Development of multifaceted ergonomic educational program to prevent work-related musculoskeletal disorders among nurses Intermediate Public Hospitals in Namibia ,

Dear Ananias

The **New Application** received on 0September **2022,** was reviewed by some members of Onandjokwe research and **Ethics Committee via** Expedited review procedures on **29-09-2022** and was approved.

Please note the following information about your approved research protocol:

1. The data to be collected must only be used for operational purposes
2. Preliminary findings to be submitted upon completion of the study
3. Final report to be submitted upon completion of study.
4. Separate permission should be sought from the ministry of Health and social services for the publication of the findings.

Yours sincerely

DR .A.Munyika
Chair Person OREC

DR.F.STRATO
Secretary OREC

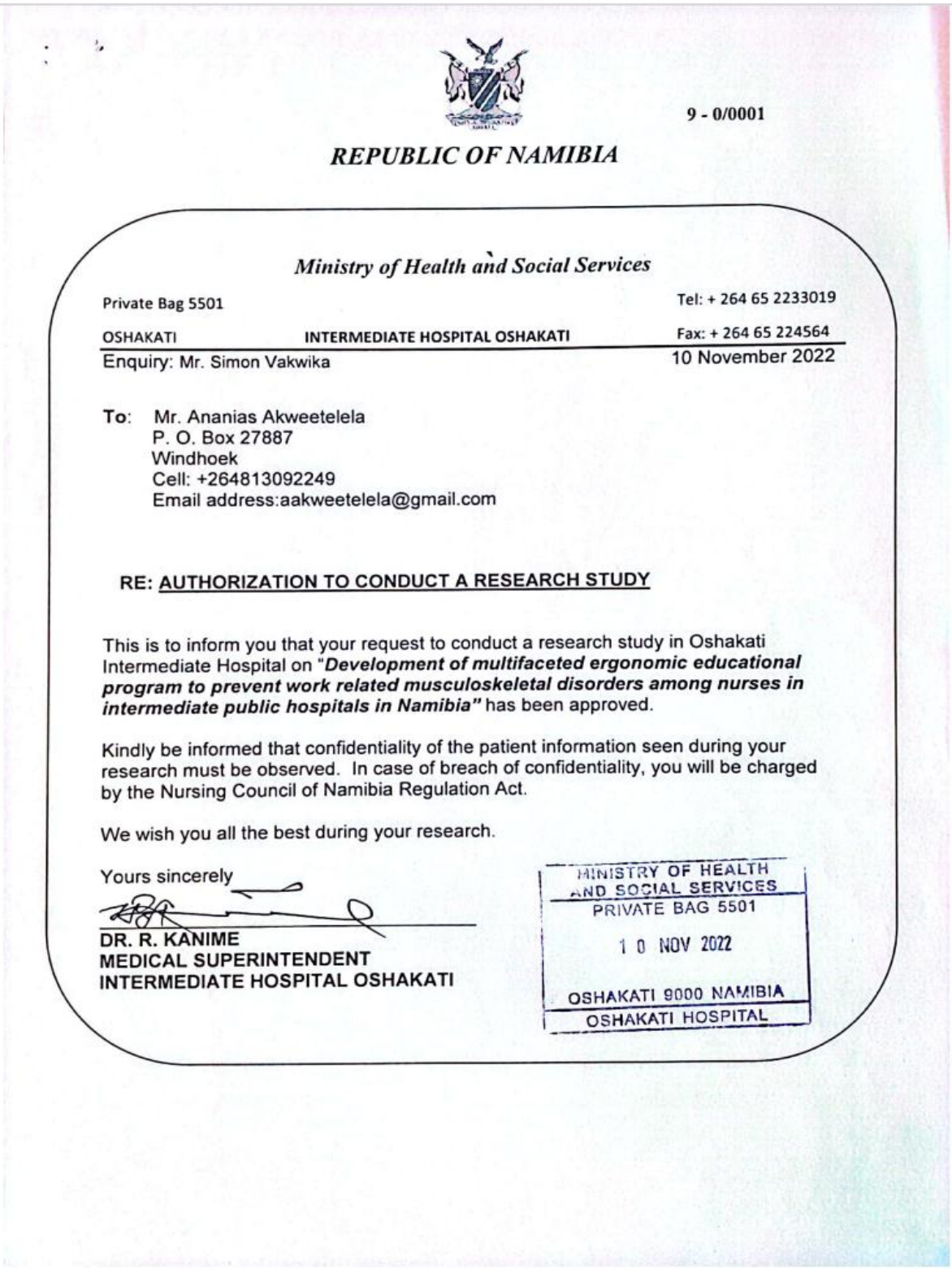
Dr P Nelumungila

MINISTRY OF HEALTH AND SOCIAL SERVICES
ONANDJOKWE PHC
21 OCT 2022
PRIVATE BAG 2016, ONDANGWA

Tel: +264 65 280 400
Fax: +264 65 240 688
E-mail: onandjokweresearch@gmail.com

Private Bag 2016
Ondangwa
Namibia

(iv) Permission letter from Intermediate Hospital Oshakati



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REPUBLIC OF NAMIBIA

Ministry of Health and Social Services

Private Bag 5501 Tel: + 264 65 2233019

OSHAKATI **INTERMEDIATE HOSPITAL OSHAKATI** Fax: + 264 65 224564

Enquiry: Mr. Simon Vakwika 10 November 2022

To: Mr. Ananias Akweetelela
P. O. Box 27887
Windhoek
Cell: +264813092249
Email address:aakweetelela@gmail.com

RE: AUTHORIZATION TO CONDUCT A RESEARCH STUDY

This is to inform you that your request to conduct a research study in Oshakati Intermediate Hospital on "***Development of multifaceted ergonomic educational program to prevent work related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia"*** has been approved.

Kindly be informed that confidentiality of the patient information seen during your research must be observed. In case of breach of confidentiality, you will be charged by the Nursing Council of Namibia Regulation Act.

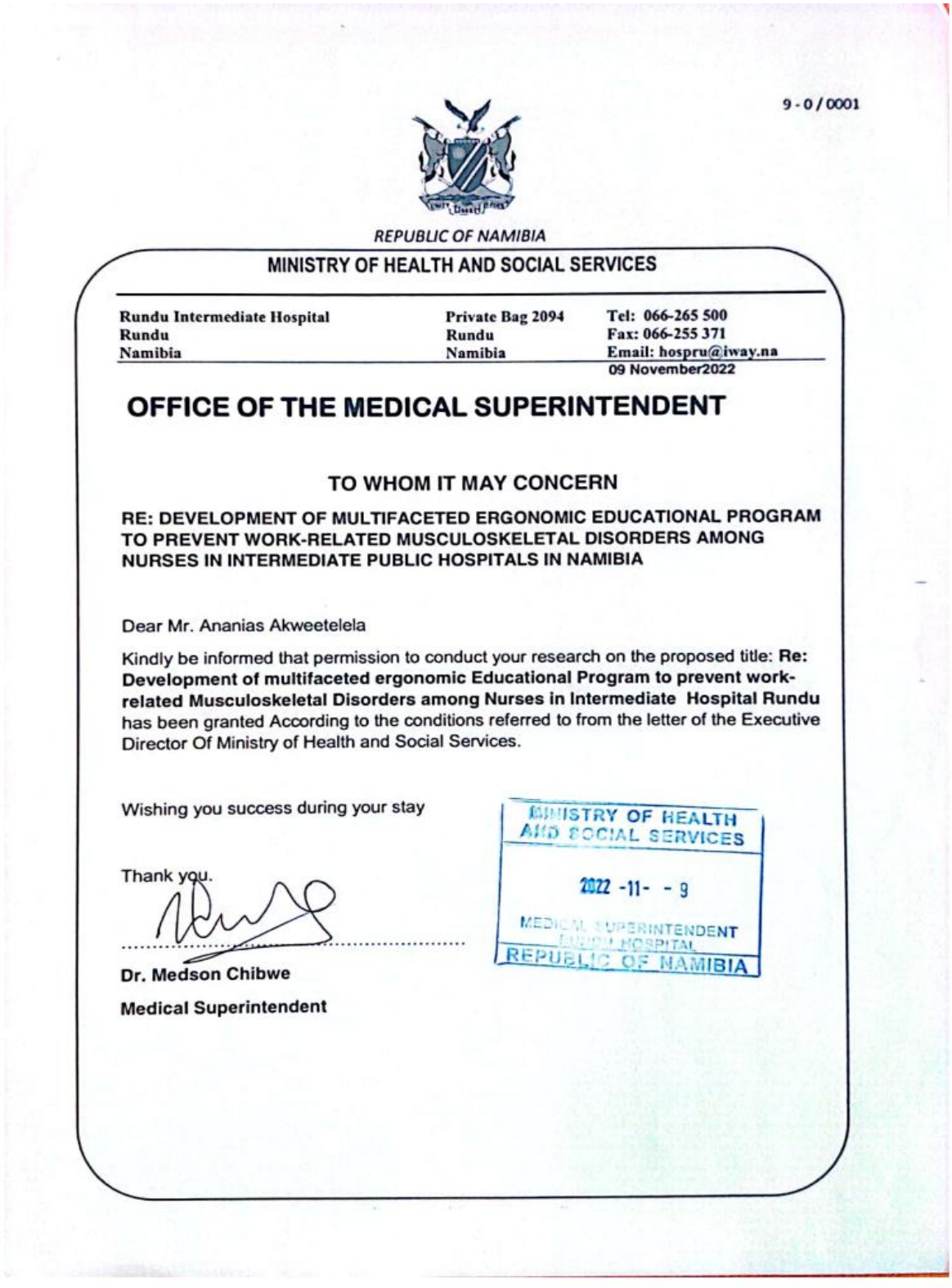
We wish you all the best during your research.

Yours sincerely

DR. R. KANIME
MEDICAL SUPERINTENDENT
INTERMEDIATE HOSPITAL OSHAKATI

MINISTRY OF HEALTH AND SOCIAL SERVICES
PRIVATE BAG 5501
10 NOV 2022
OSHAKATI 9000 NAMIBIA
OSHAKATI HOSPITAL

(v) Permission letter from Intermediate Hospital Rundu



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REPUBLIC OF NAMIBIA

MINISTRY OF HEALTH AND SOCIAL SERVICES

Rundu Intermediate Hospital
Rundu
Namibia

Private Bag 2094
Rundu
Namibia

Tel: 066-265 500
Fax: 066-255 371
Email: hospru@iway.na

09 November2022

OFFICE OF THE MEDICAL SUPERINTENDENT

TO WHOM IT MAY CONCERN

RE: DEVELOPMENT OF MULTIFACETED ERGONOMIC EDUCATIONAL PROGRAM TO PREVENT WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG NURSES IN INTERMEDIATE PUBLIC HOSPITALS IN NAMIBIA

Dear Mr. Ananias Akweetelela

Kindly be informed that permission to conduct your research on the proposed title: **Re: Development of multifaceted ergonomic Educational Program to prevent work-related Musculoskeletal Disorders among Nurses in Intermediate Hospital Rundu** has been granted According to the conditions referred to from the letter of the Executive Director Of Ministry of Health and Social Services.

Wishing you success during your stay

Thank you.

MINISTRY OF HEALTH AND SOCIAL SERVICES
2022 -11- - 9
MEDICAL SUPERINTENDENT
REPUBLIC OF NAMIBIA

Dr. Medson Chibwe

Medical Superintendent

(vi) Informed consent document

INFORMED CONSENT FORM

RESEARCH TOPIC: DEVELOPMENT OF A MULTIFACETED ERGONOMIC EDUCATIONAL PROGRAM TO PREVENT WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG NURSES IN INTERMEDIATE PUBLIC HOSPITALS IN NAMIBIA

My name is Ananias Akweetelela. I am a PhD candidate in Public Health at UNAM. As part of the requirements for the fulfilment of the degree, I am conducting research **on the DEVELOPMENT OF A MULTIFACETED ERGONOMIC EDUCATIONAL PROGRAM TO PREVENT WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG NURSES IN INTERMEDIATE PUBLIC HOSPITALS IN NAMIBIA.**

The information gathered through this questionnaire and interview will be useful in an effort to compile a research project on the **DEVELOPMENT OF A MULTIFACETED ERGONOMIC EDUCATIONAL PROGRAM TO PREVENT WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG NURSES IN INTERMEDIATE PUBLIC HOSPITALS IN NAMIBIA**.

Participation in this component of the research is voluntary. In addition, information provided

will be treated as confidential, and will only be used for the purposes of the study. Your

participation or non-participation will not result in any disadvantage to you.

Yours

Ananias Akweetelela

APPENDIX D: DATA COLLECTION INSTRUMENTS

(I): SELF-ADMINISTERED CLOSE–ENDED QUESTIONNAIRE

Student Name: Ananias Akweetelela

Main Supervisor: Prof. H. K. Mitonga

Co-Supervisor: Dr Moses Chirimbana

Dear Respondent

This self-administered close-ended questionnaire will be used for a research project on the DEVELOPMENT OF A MULTIFACETED ERGONOMIC EDUCATIONAL PROGRAM TO PREVENT WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG NURSES IN INTERMEDIATE PUBLIC HOSPITALS IN NAMIBIA. This questionnaire will be used for academic purposes only, and the information will be treated with the greatest confidentiality. Participation in this study is voluntary, and all ethical considerations will be strictly adhered to. Your assistance in completing this questionnaire would be greatly appreciated. Kindly sign and date below. Thank you.

Signature……Date……Participant number ☐

INSTRUCTIONS

Tick (√) in the appropriate box, and specify answer(s) where applicable by filling in the space provided.

SECTION A: SOCIO-DEMOGRAPHIC INFORMATION

1. Gender

a) Male [ ]

b) Female [ ]

2. Age

a) Less than 30 years [ ]

b) 30–35 years [ ]

c) 35–40 years [ ]

d) More than 40 years [ ]

3. Body mass index kg/m^2

a) <18.5 [ ]

b) 18.5-24.9 [ ]

c) 25-29.9 [ ]

d) 30 or greater [ ]

4. Years of employment?

a) One year [ ]

b) Two-three years [ ]

c) 4-5 years [ ]

d) 6 years or more [ ]

5. The name of the intermediate hospital you are currently working at?

a) Intermediate hospital Katutura [ ]

b) Intermediate hospital Oshakati [ ]

c) Intermediate hospital Rundu [ ]

d) Intermediate hospital Ondangwa [ ]

6. The department you are currently working in the hospital? [ ]

a) Head injury [ ]

b) Stroke unit [ ]

c) Acute care [ ]

d) Gynaecology ward [ ]

e) Main theatre [ ]

f) Casualty [ ]

a) Medical ward (male and female) [ ]

b) Surgical ward [ ]

c) Maternity [ ]

g) TB [ ]

a) Orthopaedic ward [ ]

b) Paediatric ward [ ]

7. How often do you rotate from one department to the other?

a) Daily [ ]

b) Weekly[ ]

c) Monthly[ ]

d) Annually [ ]

e) Never [ ]

8. Apart from the normal set 40 working hours per week, indicate the number of average working overtime hours per week that might add to your normal working hours per week.

a) 4 hours/week [ ]

b) 5-8 hours/week [ ]

c) 9-11 hours/week [ ]

d) 12 hours/week or more [ ]

9. Indicate the most average days off duty you get per week. Just choose one answer.

a) 1 day off duty [ ]

b) 2 day off duty [ ]

c) 3-4 days off duty [ ]

d) 5-6 days off duty [ ]

e) 1 week full off duty [ ]

SECTION B: PREVALENCE OF WORK-RELATED MUSCULOSKELETAL DISORDERS

The approximate position of the parts of the body referred to in the questionnaire are shown in the picture below

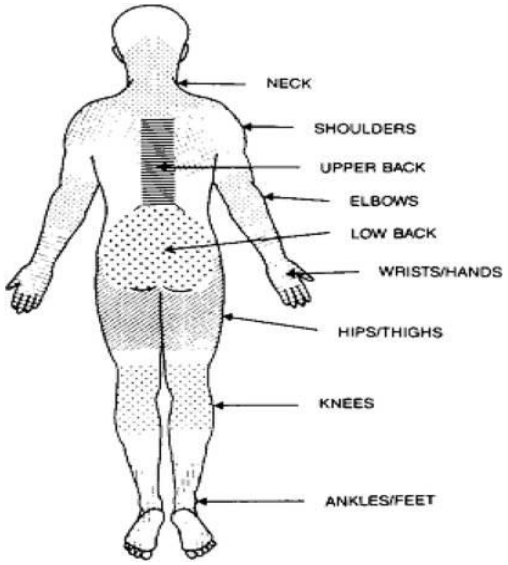


Figure 1: Position of the parts of the body

10. Have you ever had trouble (ache, pain, or discomfort) in any part of the body listed below in the past 12 months? Yes [ ] No [ ]	**11. Over the last 12 months, did you experience trouble (ache, pain, or discomfort) in body parts listed above 3 times or more?** a) No [ ] b) Yes [ ]

Please tick all parts that you ever had trouble with (ache, pain, or discomfort) in the past 12 months among parts that are listed below	If yes, please specify in the specific appropriate box below, for each specified body part
Body parts	**Rate of recurrence of trouble (ache, pain, or discomfort) of body parts**
a) Neck [ ]	a) Continuously [ ] b) Every day [ ] d) Once a week [ ] e) 6 months and/ more [ ]
b) Shoulder [ ]	a) Continuously [ ] b) Every day [ ] d) Once a week [ ] e) 6 months and/ more [ ]
c) Elbow **[ ]**	a) Continuously [ ] b) Every day [ ] d) Once a week [ ] e) 6 months and/ more [ ]
d) Wrist/hand **[ ]**	a) Continuously [ ] b) Every day [ ] d) Once a week [ ] e) 6 months and/ more [ ]
e) Upper back **[ ]**	a) Continuously [ ]

	b) Every day [ ] d) Once a week [ ] e) 6 months and/ more [ ]
f) Lower back **[ ]**	a) Continuously [ ] b) Every day [ ] d) Once a week [ ] e) 6 months and/ more [ ]
g) One or both hips/ thigh/buttock **[ ]**	a) Continuously [ ] b) Every day [ ] d) Once a week [ ] e) 6 months and/ more [ ]
h) One or both knees **[ ]**	a) Continuously [ ] b) Every day [ ] d) Once a week [ ] e) 6 months and/ more [ ]
i) One or both ankles/feet **[ ]**	a) Continuously [ ] b) Every day [ ] d) Once a week [ ] e) 6 months and/ more [ ]

12. Apart from any experienced trouble (ache, pain, or discomfort) in any part of the body listed above, do you have any diagnosed and recorded work-related musculoskeletal disease/condition in the past 12 months?

a) Yes [ ]

b) No [ ]

13. If **yes, please choose specific work-related musculoskeletal disease/from the list below. You are free to choose more than one answer.**

a) Carpal tunnel syndrome. [ ]

b) Tendinitis. [ ]

c) Rotator cuff injuries (affects the shoulder) [ ]

d) Epicondylitis (affects the elbow) [ ]

e) Trigger finger. [ ]

f) Muscle strains and low back injuries. [ ]

g) Osteoarthritis [ ]

h) Rheumatoid arthritis

i) Others specify……..... [ ]

SECTION C: RISK FACTORS ASSOCIATED WITH WORK-RELATED MUSCULOSKELETAL DISORDERS

14. Have you ever recorded a work-related musculoskeletal disorder?

a) Yes [ ]

b) No [ ]

15. If yes, what group of work-related risk factors do you think contributed to your development of musculoskeletal disorders? Please specify the risk factor under the group of your choice. You are allowed to choose more than one answer.

15.1 Work related risk factors: physical risk factors

a) Repetitive manual tasks [ ]

b) Extensive sitting [ ]

c) Extensive standing [ ]

d) Awkward postures [ ]

e) Manual handling including patients handling. [ ]

15.2 Work related risk factors: Psychosocial risk factors (the job content risk factors and the organisational characteristics risk factors)

15.2.1 The job content risk factors:

a) High workloads [ ]

b) Tight deadlines [ ]

c) Lack of control of the work and working methods [ ]

15.2.2 The organisational characteristics risk factors:

a) Poor working relationship with supervisors and colleagues [ ]

b) Financially demoralized [ ]

c) Poor work/rest cycle [ ]

d) Poor community support [ ]

16. Risk factors associated with the development of work-related musculoskeletal disorders

You are allowed to choose more than one answers.

Exposure vs outcome

Risk factors	**16.1 Do you think you are exposed to this risk factor(s) at work in the past 12 months?**	**16.2 Do you think this risk factor(s) is the one causing you to experience trouble aches, pain or discomfort in any body parts in the past 12 months?**
Repetitive manual tasks	Yes [ ]	Yes [ ]
	No [ ]	No [ ]
Extensive sitting	Yes [ ]	Yes [ ]
	No [ ]	No [ ]
Extensive standing	Yes [ ]	Yes [ ]
	No [ ]	No [ ]
Awkward postures	Yes [ ]	Yes [ ]
	No [ ]	No [ ]
Manual handling	Yes [ ]	Yes [ ]
	No [ ]	No [ ]
High workloads	Yes [ ]	Yes [ ]
	No [ ]	No [ ]

Tight deadlines	Yes [ ]	Yes [ ]
	No [ ]	No [ ]
Lack of control of the work and working methods	Yes [ ]	Yes [ ]
	No [ ]	No [ ]
Poor working relationship with supervisors and colleagues	Yes [ ]	Yes [ ]
	No [ ]	No [ ]
Financially demoralized	Yes [ ]	Yes [ ]
	No [ ]	No [ ]
Poor work/rest cycle	Yes [ ]	Yes [ ]
	No [ ]	No [ ]
Poor community support	Yes [ ]	Yes [ ]
	No [ ]	No [ ]
	Yes [ ]	Yes [ ]
	No [ ]	No [ ]

17. Risk factors associated with the development of specific types of work-related musculoskeletal disorders

You are allowed to choose more than one answer.

Exposure vs outcome												
17.1 Did you experienced trouble aches, pain or discomfort in specific body parts	**17.2 Do you think this risk factor(s) is/are the one(s) causing you to experience those trouble aches, pain or discomfort in specific body parts in the past 12 months?**											
	Repetitive manual tasks	Extensive sitting	Extensive standing	Awkward postures	Manual handling	High workloads	Tight deadlines	Lack of control of the work and working methods	Poor working relationship with supervisors and colleagues	Financially demoralized	Poor work/rest cycle	Poor community support

listed below in the past 12 months?												
Neck Yes[ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes[ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes[ ] No[ ]	Yes[ ] No[ ]	Yes [ ] No[ ]	Yes[ ] No[ ]
Shoulder Yes[ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes[ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes[ ] No[ ]	Yes[ ] No[ ]	Yes [ ] No[ ]	Yes[ ] No[ ]
Elbow Yes[ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes[ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes[ ] No[ ]	Yes[ ] No[ ]	Yes [ ] No[ ]	Yes[ ] No[ ]

Wrist /hand Yes[ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes[ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No [ ]	Yes[ ] No[ ]	Yes[ ] No[ ]	Yes [ ] No[ ]	Yes[ ] No[ ]
Upper back Yes[ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes[ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No [ ]	Yes[ ] No[ ]	Yes[ ] No[ ]	Yes [ ] No[ ]	Yes[ ] No[ ]
Lower back Yes[ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No[ ]	Yes[ ] No[ ]	Yes [ ] No[ ]	Yes [ ] No [ ]	Yes[ ] No[ ]	Yes[ ] No[ ]	Yes [ ] No[ ]	Yes[ ] No[ ]
One or	Yes [ ]	Yes [ ]	Yes [ ]	Yes [ ]	Yes [ ]	Yes[ ]	Yes [ ]	Yes [ ]	Yes[ ]	Yes[ ]	Yes [ ]	Yes[ ]

both hips/ thigh/ butto ck Yes[ ] No[ ]	No[ ]	No[ ]	No[ ]	No[ ]	No[ ]	No[ ]	No[ ]	No [ ]	No[ ]	No[ ]	No[ ]	No[ ]

(II) SEMI-STRUCTURED INTERVIEW QUIDE

Student Name: Ananias Akweetelela

Main Supervisor: Prof. H. K. Mitonga

Co-Supervisor: Dr Moses Chirimbana

Dear Participants

This semi-structured interview quide will be used for a research project on: DEVELOPMENT OF MULTIFACETED ERGONOMIC EDUCATIONAL PROGRAM TO PREVENT WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG NURSES IN INTERMEDIATE PUBLIC HOSPITALS IN NAMIBIA. This semi-structured interview quide will be used for academic purposes only, and information will be treated with the greatest confidentiality. Participation in this study is voluntary, and all ethical considerations will be strictly adhered to. Your assistance in responding to this interview would be greatly appreciated. Kindly sign and date below. Thank you.

Signature……Date……Participant Number

INSTRUCTIONS

These in-depth interviews will take place between the data collector and the respondents. The data collector will verbally pose questions and respondents are allowed to talk freely about the specific matter under discussion, and ask for any clarification if needed. Authorisation for audio recording will be sought from each respondent. Each interview will last for about 10 minutes.

Objective 3: Explore the ergonomic interventions that may be suitable and effective in addressing identified risk factors to prevent work-related musculoskeletal disorders among nurses in intermediate public hospitals in Namibia

Part I Demographic Information

Ask and/or observe and record the following demographic information:

- Age of participant……
- Gender……
- Hospital/ministry of current work……

Part II Nurses

1. What are your experiences of WRMSDs?

2. Probing questions: Have you ever been diagnosed with WRMSDs at work? Do you think you are exposed to and suffering from WRMSDs?

3. If yes, while working, what are the work-related risk factors do you think you are exposed to and might make you develop WRMSDs?

4. Probing questions: explain how you have been exposed to those risk factors

5. What are the interventions you were told/know and applied at your work place to prevent WRMSDs?

6. What could be the reason why WRMSDs are still prevalent among nurses?

7. What do you suggest should be done (different ergonomic interventions) at work to control those risk factors, and prevent you from developing WRMSDs?

Part III Occupational health and safety personnel (OHS)

1. Based on your office database statistics and/or observation during hospital nurse job inspection visits, what are the types of work-related risk factors that might be causing nurses to develop WRMSD at intermediate hospitals?

2. Probing question: kindly describe those risk factors in more detail?

3. What are the intervention(s) you were applying to prevent WRMSDs among nurses?

4. Explain how you were implementing those/that intervention(s)?

5. What do you think could be the reason why WRMSDs are still prevalent among nurses?

6. What do you think are the specific ergonomic interventions to be developed and applied to tackle each group of risk factors to prevent WRMSDs among nurses?

7. Probing question: Motivate why you are suggesting those specific ergonomic interventions; how do you want those interventions to be proposed and implemented?

(III) EXPERT PROGRAM REVIEW

Student Name: Ananias Akweetelela

Main Supervisor: Prof. H. K. Mitonga

Co-Supervisor: Dr Moses Chirimbana

Dear Participant

This program review will be used for a research project on THE DEVELOPMENT OF A MULTIFACETED ERGONOMIC EDUCATIONAL PROGRAM TO PREVENT WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG NURSES IN INTERMEDIATE PUBLIC HOSPITALS IN NAMIBIA. This program review will be used for academic purposes only and the information will be treated with the greatest confidentiality. Participation in this study is voluntary, and all ethical considerations will be strictly adhered to. Your assistance in evaluating the applicability and readiness of this program would be greatly appreciated. Kindly sign and date below. Thank you.

Signature……Date……Participant Number

INSTRUCTIONS

1. PHASE IV

Specific Objective: Evaluate the readiness and applicability of the multifaceted ergonomic educational program.

Approach: Expert review

After the program was drafted, an expert review of the program will be conducted by purposively sampled ergonomists from around the world who are available and willing to help in reviewing the program. The purpose of the expert review is to expand on heuristic evaluation by assessing the program design for compliance with heuristics, usability guidelines, correctness, representativeness, and principles of usability in the field of ergonomics in order to prevent the prevalence and incidence of WRMDs among nurses. A written expert review report from the reviewers is required, and its detailed information and recommendations will be used by the researcher to amend the program by making corrections and addressing identified errors for correctness. After this review, the multifaceted ergonomic educational program will be ready for submission to the Ministry of Health and Social Services (MoHSS) for implementation.

(IV): PROGRAM QUESTIONNAIRE 1

Please indicate your answer (by ticking or circling the appropriate response) using the following 2-point scale:

1= yes

2= no

	YES	**NO**
1. Do you know what kind of disease is a WMSD?		
2. Have you experienced any musculoskeletal-related pain lasting for a week?		
3. Have you experienced any musculoskeletal-related pain lasting for 1 month or more?		
4. Can WMSDs be prevented or controlled?		
5. Do you know how to adjust the height of your office chair to make yourself more comfortable?		
6. Do you know the correct posture to use at your desk?		
7. Do you know the correct posture for working while standing?		
8. Do you know what the optimal elbow angle for typing or writing is?		
9. Should you leave space between the front seat and the back of your legs when working in a sitting position?		
10. Is the optimal chair height up to the position of knee?		
11. Would you ever do some extra stretching exercises during work?		
12. Do you think there is a necessity to hold WRMSD knowledge lectures and training activities?		

13. Would you pay special attention to maintaining the optimal posture at work?		
14. Do you think the positive effects of the occupational health education lectures and ergonomics training on WRMDS can last?		

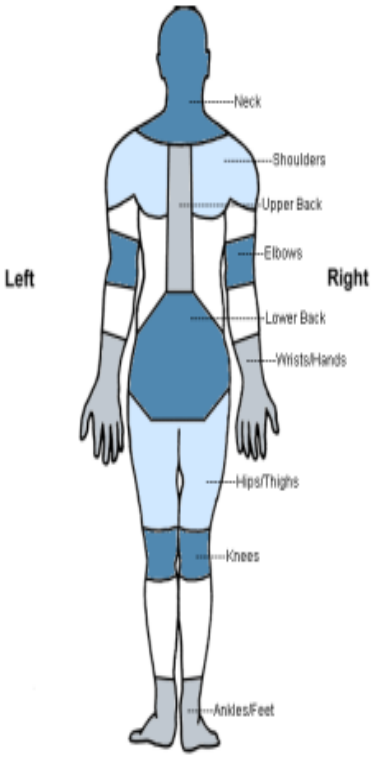
(V): PROGRAM QUESTIONNAIRE 2

Musculoskeletal Discomfort Form (Based on the Nordic Questionnaire (Kourinka et al. 1987)) **Employee ID:**_____

Job/Position: _____ Gender: M F Age: _____ Height: ___ ft.___ in. Weight: _____
How long have you been doing this job? ___years ___ months How many hours do you work each week? ____

How to answer the questionnaire:

Picture: In this picture you can see the approximate position of the parts of the body referred to in the table. Limits are not sharply defined, and certain parts overlap. You should decide for yourself in which part you have or have had your trouble (if any).



Back View

Table: Please answer by putting an "X" in the appropriate box - one "X" for each question. You may be in doubt as to how to answer, but please do your best anyway. Note that column 1 of the questionnaire is to be answered even if you have never had trouble in any part of your body; columns 2 and 3 are to be answered if you answered yes in column 1.

To be answered by everyone	**To be answered by those who have had trouble**	
Have you at any time during **the last 12 months** had trouble (ache, pain, discomfort, numbness) in:	Have you at any time during the **last 12 months been prevented from doing your normal work** (at home or away from home) because of the trouble?	Have you had trouble at any time during **the last 7 days?**
Neck ☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
Shoulders ☐ No ☐ Yes, right shoulder ☐ Yes, left shoulder ☐ Yes, both shoulders	☐ No ☐ Yes	☐ No ☐ Yes
Elbows ☐ No ☐ Yes, right elbow ☐ Yes, left elbow ☐ Yes, both elbows	☐ No ☐ Yes	☐ No ☐ Yes
Wrists/Hands ☐ No ☐ Yes, right wrist/hand ☐ Yes, left wrist/hand ☐ Yes, both wrists/hands	☐ No ☐ Yes	☐ No ☐ Yes
Upper Back ☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
Lower Back (small of back) ☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
One or Both Hips/Thighs ☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
One or Both Knees ☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
One or Both Ankles/Feet ☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes

(VI) LANGUAGE PROOFREADING LETTER

31 July, 2024

Dear Sir/Madam,

I hereby acknowledge that I have edited Mr. Ananias Akweetelela's dissertation submitted in fulfillment of the requirements for a Degree of Doctor of Philosophy in Public Health, titled, "Development of A Multifaceted Ergonomic Educational Program to Prevent Work-Related Musculoskeletal Disorders Among Nurses in Intermediate Public Hospitals in Namibia."

The editing focused on the following areas: grammar; sentence structure/order; clarity of ideas; punctuation; elimination of repetitive content; and the overall organisation of the paper.

I trust you will find this in order.

Yours Sincerely,

31/07/2024.

Saara Mupupa

+264 812 855 125