ERGONOMIC-BASED INTERVENTION FOR MUSCULOSKELETAL DISORDERS AMONG SUGAR FACTORY WORKERS IN JINJA, UGANDA

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DECLARATION AND APPROVAL

Declaration by the Student

This current thesis is my original work and has not been presented for any degree in any other University or any other award.

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I dedicated this thesis to my parents Alhaji Mudasiru Aremu and Alhaja Mulikat Aremu; thank you for providing me with every opportunity in my life.

ABSTRACT

Despite this long-standing awareness, WRMSDs continue to be the main reason among people with a work-related illness. The study aimed at developing ergonomic based interveion among sugar factory workers to reducec the prevalence of Musculoskletal Disorders. A quasi-experimental study of pre-test and post-test was adopted in this study for six months, using a well-structured standardized Nordic Musculoskeletal disorders questionnaire (NMQ) and Quick Exposure Checklist (QEC). A stratified sampling technique was used. A sample size of 402 was divided equally among the two sugar factories as an experimental group and a control group. Ethical approvals were sought from the relevant bodies before conducting the study. The quantitative data were analyzed using IBM SPSS version 26, while the qualitative data was analyzed using Atlas.ti version 9. Descriptive statistics such as mean, standard deviations, percentages, and frequencies were used. While t-test, Chi-square, and multivariate logistic regression were used as inferential statistics. A higher prevalence of 77.1% was reported among the sugar factories workers in 12 months, lower back region 63.7% and Upper back region 46.3% was the most affected body region among the respondents. All the risk factors have a level of association with either one or some of the anatomical regions under bivariate and Level of education (p=0.034), experience (p=0.011), departments (p=0.011), standing for long (p=0.035), and job time (p=0.001) was shown to be a predictor of WRMSDs at multivariate level. The paired t-test analysis of the QEC total score showed a reduction after the post-intervention and was significantly different before and after the intervention. The majority of the study population in both groups were males and at their youthful age, the prevalence of WRMSDs was higher in the experimental group compared to the control group, and this was due to the mechanized system of work in the control group. The ergonomic intervention resulted in a reduction of the prevalence of WRMSDS among the workers in the Experimental group from 77.1% to 37.0%, which is key to the study findings. This study showed how the risk factors are predisposing the respondent to WRMSDs, and lack of ergonomic knowledge or training was highlighted as major reasons for WRMSDs. **Recommendation:** The results of this study will assist the factories in enhancing the wellness of their workers by reducing the socioeconomic burdens, work-related absenteeism and ultimately increasing factory productivity.

Keywords: Ergonomic, intervention, musculoskeletal disorders, sugar cane, sugarcane products, sugarcane workers

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LIST OF ABBREVIATIONS AND ACRONYMS

WHO: World Health Organization.

DALYs: Disability-adjusted life years

MSS: Musculoskeletal System

WRMSDs: Musculoskeletal Disorders

WRMSDs: Work-related musculoskeletal disorders.

GBDs: Global Burden of Diseases

YLDs: Total years lived with disability

NIOSH: National Institute of Occupational Health and safety

NCDs: Non-Communicable Diseases

RSI: Repetitive strain injury

GBD: Global Burden of Disease

BLS: Bureau of Labour Statistics

BMI: Body mass index.

LBP: Low Back Pain

ICF: International Classification of Functioning

NMQ: Nordic Musculoskeletal Questionnaire

QEC: Quick Exposure Check

IEA: International Ergonomics Association.

TA: Thematic Analysis

UFCIL: Uganda Farmers Crop Industries Limited.

SCOUL: Sugar Corporation of Uganda Limited.

SPSS: Statistical Package for the Social Sciences.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter introduced the study background, problem statements, general and specific objectives of the study, the research question and hypothesis. The significance and scope of the research, the study limitation and delimitation and operational definition of terms were fully explored in this chapter.

1.1 Background to the Study

One of the highest global leading causes of years lived with disability are Musculoskeletal disorders (MSDs) (Global Burden of Disease Study Collaborators, 2015). It is also a complex and multifactorial phenomenon that includes psychological, biological, psychological, and social factors and represents a significant burden for the individual and society. Globally, all MSDs combined account for more than a fifth of the total years lived with disability. This condition of Musculoskeletal disorders affects not only workers but people across the life course in all regions of the world. Musculoskeletal disorders conditions based on the reports from the WHO were known as one of the leading causes of disabilities in four out of the six World Health Organization countries/regions in 2017, it was ranked second in the East Mediterranean Region and third in the African Region). There is an association existing between the prevalence of musculoskeletal disorders, which increases with the age of an individual, younger people are also affected, often during their peak income-earning years (WHO, 2017)

A report from the Global Burden of Disease (GBD) study provides evidence of the impact of musculoskeletal conditions, pointing out the significant disability burden

associated with these MSDs. In a survey by Global Burden of Diseases in 2017, musculoskeletal disorders were rated the highest contributor to the global development of disability among people, thus accounting for 16% of all years lived with disability). Lower back pain has remained the single leading cause of disability since first measured in 1990 (James *et al,* 2017). There is variability in the prevalence of musculoskeletal conditions due to individual age, and the diagnosis of the musculoskeletal disorders' pains between 20%–33% of people across the globe live with excruciating these pains.

A similar study documented from the United States of America suggests that out of two adult Americans live with musculoskeletal disorders – the same number as those with cardiovascular or chronic respiratory diseases combined (Naido *et al,* 2017).

MSDS continues to be one of the most salient health problems that affect not only the private sectors but also the government sectors as well, thereby causing severe occupational disorders and disabilities that are associated with the loss of useful working days, which also have a negative impact like the socioeconomic burden to the individual, the organization and society at large (Aghilinejad *et al.* 2018). Similarly, Jay *et al*. (2018) highlighted that MSDs constitute a significant socioeconomic burden on public health systems in North America and Europe.

In the reviewed literature, it was noted that a very high rate of incidence of MSDs was reported among postal workers, sewing machinists, farmers, and office workers, to mention a few (Warnakulasuriya *et al.* 2016). Similarly, in their findings, two researchers, Moodley and Naidoo 2015, classified the possible risk factors associated with the development of MSDs as ergonomic, work factors (psychosocial risk factors due to job stress), and biomechanical (repetition, awkward postures). A recent statistics report of occupational health and safety executive of Great Britain, 2015 showed that

work-related musculoskeletal disorders (WRMSDs) accounted for 44% of the prevalence of all work-related ill health, and the incidence of WRMSDs was 169,000, an incidence rate of 530 cases per 100,000 people. A total estimate of 9.5 million working days was lost due to work-related musculoskeletal disorders (HSE statistics, 2015). Moreover, most agricultural duties create some awkward body postures, which should be assessed throughout ergonomic evaluation (Jain *et al* 2018). Many farm activities are done manually, especially in developing countries. Manual handling is also acknowledged as one of the main risk factors for musculoskeletal disorders.

In developing countries, MSDs conditions appear to increase due to aging populations and the rise in obesity (Dianat *et al,* 2020). Internationally, a quarter of visits to a primary care physician or accident and emergency department result from WRMSDs symptoms (Brown *et al.,* 2020).

When measuring the burden of diseases, diseases are classified according to the amount of death and disability they cause. Disability-adjusted life years are the total measure of the population's wellness that the global burden of disease uses. This also combines years of life lost due to premature mortality with individuals' years with disability (Vassilaki and Hurwitz, 2014). Musculoskeletal conditions have resulted in the loss of more than 45 000 disability-adjusted life years in South Africa (Brown *et al.,* 2020). A Ugandan study found that for every individual that dies from trauma, 3 to 8 more individuals are permanently disabled due to injury (Brown *et al.,* 2020).

The largest leading producer of sugarcane worldwide is Brazil, followed by India, China, and Thailand. The sugar cane factory is one of the most important agricultural sectors in Uganda and worldwide, which directly contributes to creating employment, income, and social developments in the rural areas of the country. Both skilled with a

certain level of education and unskilled workers with low or no formal education from rural areas are engaged in this sector. Most sugar factories have poor occupational health and safety measures; there are sometimes inadequate policies and infrastructure to meet the health hazards. Hence, the workers are exposed to workplace accidents, repetitive strain injury (RSI), and musculoskeletal disorders (MSDs) in the neck, upper back, lower back, and arms due to continuous movements. (Gourab Biswas, *et al.*, 2016).

To prevent the occurrence of these disorders, ergonomic principles must be infused in all aspects of organizational settings. This would ensure better productivity and job satisfaction among the personnel (Balaji H, Dhanraj D, 2017). However, for practical application of the principle of ergonomics to prevent these disorders, workers must first know the risk factors implicated in their occurrence and how to apply the principles. Ergonomics is an applied science involving processes, procedures, and product design, which ensures work efficiency and the health and safety of the worker. It uses theory, principles, and innovation in an occupational environment to ensure optimal human well-being and overall system performance (Wadhawan *et al.*, 2015). Required goals for applying ergonomics in medical practice include reduced pain and morbidities associated with medical training decreased stress while working. Improved MSDs health and vigor, increased comfort at work, increased productivity while working, career span improvement, and improved quality of life (Shipra N, Rohit N, Aggarwal NG, 2015).

The most recognized interventional strategy globally for workplace Hazards resulting from MSDs is ergonomic interventions; for this reason, several occupational health and safety bodies across the globe have advocated for Ergonomics intervention

(Holtermann, 2018). The ergonomic interventions range from workplace/workplace modifications to long-term educational interventions with the aim and focus of treating and preventing musculoskeletal disorders among workers. One of the significant concerns of ergonomic interventions as opposed to traditional therapeutic interventions is that they target workers' work posture, work behaviors, habits, and the work (Holtermann, 2018). It is evident in many technology companies that offer ergonomic training for their workers because ergonomics interventions have been found to enhance productivity, improve workers' well-being, and reduce the effects of Musculoskeletal disorders among workers (Bazazan et, 2018).

It is essential to have a thorough knowledge of the present work situation and process to execute effective preventive interventions. To survey the work setting, including physical as well as psychosocial conditions, is therefore needful. Also, the prevalence of musculoskeletal disorders will be registered and the characteristics of the work organization. The interventions could have a different focus. It could be focused on an individual level, occupational factors related to risk, the design of equipment, and the workstations.

1.1 Statement of the Problem

The socioeconomics burden of musculoskeletal conditions is significant; looking at the cost of spending on musculoskeletal disorders conditions among workers is so challenging for the employer or organizations to determine due to the vast array of musculoskeletal disorders conditions and its limitations in health surveillance systems. Data on WRMSDs are incredibly scarce in low- and middle-income countries. Musculoskeletal disorders conditions account for the most significant proportion of lost

productivity in the workplace. In 2011, musculoskeletal conditions cost US$ 213 billion – 1.4% of the Gross Domestic Product (Naidoo *et al.,* 2017).

In Uganda, studies on WRMSDs have been conducted among schoolchildren (Mwaka, 2014), and Healthcare workers (Abdulmujeeb, 2017), but an extensive review of the literature did not reveal any studies on the prevalence and risk factors of WRMSDs among farmers, most especially on the sugar factories workers in the country. Sugar factory workers perform detailed tasks that consistently require them to assume prolonged and static working postures, perform fine muscular work in unnatural postures, and use of high-frequency vibration tools, which has been reported to result in the development of WRMSDs (Mrunal S Baxi *et al.,* 2016).

The sugar factory is one of the fastest-growing agro-allied/ agro-processed agricultural products in Uganda and East Africa. Non-availability of information on WRMSDs may deprive policymakers of an accurate estimation that will assist in making well-informed decisions related to resource allocations and subsequent management of those with WRMSDs. It is also incumbent on the sugar factory to reduce the cost of treating WRMSDs among workers, which might have been because of the work exposure. This shows a considerable gap in knowledge since the sugar factory is one of the agriculture sectors in Uganda. The agricultural sector in Uganda is among the dominant economic activity, representing 72 percent of Uganda's workforce, that is 76 percent female (rural women), and 65 percent males (UBOS, 2016). The sector also accounts for 52 percent of the country's total exports (UBOS, 2016).

Over the past century, the world health focuses were primarily focused on communicable diseases (Pinheiro *et al*; 2016). With the world's population growth, people tend to have increased average age (life span) and reduced death rates; people

now live a long healthy life and become increasingly vulnerable to non-communicable diseases, such as musculoskeletal disorders (MSDs).

Additionally, this burden of disability as provided and estimated by these summary measures of health, there is an impact on the individual's quality of life, during their job and outside their jobs, economic independence, and the costs to society due to health and social care and their work absenteeism. Despite this enormous and growing burden, there is a lack of priority and policies focusing on musculoskeletal health (Blyth et al 2019). This needs to change if we are to meet the demands of an aging population that requires us to remain economically independent (Woolf, 2015). Due to enormous and significant physical, psychological and economic costs directly associated with the development of WRMSDs injuries, it is therefore essential to determine the full scope of the risk factors related to the WRMSDs to develop an ergonomic-based intervention for work-related musculoskeletal disorders and reduce the prevalence and risk of WRMSDs among workers. This study, therefore, sought to address a number of challenges regarding WRMSDs, most especially among sugar factory workers.

1.2 Purpose of the Study

The purpose of this study is to develop an ergonomic-based intervention for work-related musculoskeletal disorders and reduce the prevalence and risk of WRMSDs among sugar factory workers. This could be adopted in related industries and organizations to lessen the burden and the impact of work-related musculoskeletal disorders in the general population.

1.3 General Objective

To design an ergonomic-based intervention for musculoskeletal disorders among sugar factory workers in Jinja, Uganda.

1.3.1 Specific Objectives

1. To determine the prevalence and incidence of Work-Musculoskeletal Disorders among sugar factory workers (UFCIL and SCUOL) in Jinja, Uganda.
2. To identify the risk factors associated with the development of Work-related Musculoskeletal Disorders among the sugar factory workers (UFCIL and SCUOL) in Jinja, Uganda.
3. To determine the effect of an ergonomic-based intervention on the risk of developing and progression of WRMSDs among sugar factory workers (UFCIL and SCUOL) in Jinja, Uganda.

1.3.2 Research Questions

1. What are the prevalence and incidence of Work-Musculoskeletal Disorders among sugar factory workers in (UFCIL and SCUOL) in Jinja, Uganda?
2. What are the risk factors associated with WRMSDs among the sugar factory workers (UFCIL and SCUOL) in Jinja, Uganda?
3. What are the effects of an ergonomic-based intervention on the risk of developing and progression of WRMSDs among sugar factory (UFCIL and SCUOL) in Jinja, Uganda.?

1.4 Research Hypothesis.

1. The ergonomic-based intervention does not influence the development and progression of Work-Musculoskeletal Disorders among the sugar factory workers (UFCIL and SCUOL) in Jinja Uganda.

1.5 Justification of the study

The issue of Musculoskeletal Disorders has turned into a serious public health problem that, if left unattended, will have a heavy impact on society, government, and individuals, thereby reducing the quality of life of an individual. Generally,

musculoskeletal disorders have significant effects (in terms of loss of person-hours from work and cost of healthcare) on industries and society more than workers themselves (Hemalatha *et al.*, 2017). While the information available on significant risk factors for NCDs such as WRMSDs are accessible in some low-income countries, this information is sparse for many low-income countries. Unfortunately, the Lack of this information is seriously handicapping efforts to control NCD epidemics, most especially WRMSDs. Despite the wide range of studies conducted in different occupations or sectors that had established a positive relationship between workplace risk factors and WRMSDs, many vital issues regarding the occurrences and prognosis remain a subject of debate (Hemalatha *et al.*, 2017). As far as it is known to the researcher, no ergonomics-based intervention has been conducted in Uganda to establish the prevalence of WRMSDs and to assess physical exposure to work-related musculoskeletal risks. Considering that if unattended to this kind of global issue, it could lead to an increase in the total number of people leaving with disabilities and complications that would affect the productivity of the entire country population.

The results of this study will be an appropriate basis for planning, designing, and implementing an ergonomics-based interventional program in the workplace and for improving workers' health in the sugar-producing industry. The findings from this study will be used to form a baseline in formulating a surveillance framework system on musculoskeletal disorders across the nation; the result will also be used in planning intervention and reducing the burden and impact of the disease.

1.7 Scope of the Study

This study was conducted in Uganda Farmers Crop Industries Limited (UFCIL), and Sugar Corporation of Uganda Limited (SCOUL), one of the largest sugar-producing

companies in Uganda. This study was categorized into two phases; thus, the stage of baseline data collection identified the magnitude of the presumed diseased conditions WRMSDs among the sugar factory workers. The second phase continued the first phase by developing an intervention to reduce the extent of the identified diseased condition. The Criteria for eligibility of respondents will include workers with more than six months of working experience and proven to be affected after the screening exercise. All workers with less than five years of experience and known history of the accident will be excluded from this current study. Finally, the mechanism of musculoskeletal disorders and its comorbid disease was not included in the scope of this study.

1.8. Study Limitations

This thesis had some limitations and barriers that might affect the study's accuracy. These are as follow:

- The physical symptoms of musculoskeletal disorders and the pain mechanism were not being investigated.
- This study relied on self-reported data; the respondents might not have reported all incidences of musculoskeletal disorders, or some level of bias might have set in during the filling of the questionnaire.
- This thesis did not consider the details of the economic impacts of the musculoskeletal disorders among the sugar factories workers. This is due to the duration of the project and the funding available for the proposed research. However, a study on these aspects is warranted in the future.
- Recall biases due to participants recalling episodes of pain or discomfort on their body parts.

1.9 Delimitations

The study will be delimited to:

i. The homogeneity of the data that will be collected among the workers working under the same occupational situations, most especially workers involved in the production units in the Sugar factory. The two study sites selected were due to the exact nature of work and activities. Hence it is easier for a direct comparison.

ii. The inclusion of workers having experience of more than six months in certain activities among the sugar factory workers. It can be concluded and established after 6 months that the workers with the disease conditioned is/are as a result of their current job.

1.10. Assumptions of the Study

The study was based on the assumptions that

1. Workers involved in certain occupational activities in the Sugar factory were prone to develop work-related musculoskeletal disorders.
2. All workers in the production units whose work posture involves awkward postures while performing certain activities were prone to develop work-related musculoskeletal disorders.
3. The individual's work-related and psychosocial factors can contribute to developing work-related musculoskeletal disorders.
4. Workers in SCOUL were not as exposed as workers from UFCIL to situations that predisposed them to the development of WRMSDs.
5. Musculoskeletal disorders can increase the rate of absenteeism among workers in both factories.
6. After the interventions, the researcher will expect a drop in the prevalence rate of WRMSDs among the experimental group.

7. Workers from the control group will show slight variation in the prevalence of WRMSDs at baseline and post-intervention.

1.11 Operational Definition of Key Terms

Awkward posture: Position of the body that deviates from the neutral positions while jobs are being performed in non-neutral positions.

Definition of surveillance: ongoing systematic collection, analysis, interpretation, and dissemination of health data; data are used to describe and monitor health events, set priorities, and assist in the planning, implementation, and evaluation of public health interventions and programs.

Ergonomics interventions: involve adjusting a workers' environment, behavior, and other long-term educational approaches to treat and prevent further damage due to WMSD.

Occupational hazard: This is a hazard that resulted from the work activities of the workers in the workplace. Occupational hazards can also encompass many types of hazards, including chemical hazards, biological hazards, psychosocial hazards, physical hazards, and ergonomic Hazards.

Prevalence: This refers to the total number of individuals in a population who have a disease or health condition at a specific period of time, usually expressed as a percentage of the population.

Risk factors: A risk factor or determinant is a variable associated with an increased risk of disease or infection.

Risk: This can be defined as a probability or threat of damage to workers during their works, injury sustain, liability, loss, or any other negative occurrence that is caused by external or internal

predisposing factors, and that may be avoided through pre-emptive action.

Work-related low back pain – is the low back pain (LBP)that is caused, contributed by, or significantly aggravated (for a preexisting LBP) by the events or exposures in the work environment.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter discusses a literature review on Musculoskeletal disorders universally and their common risk factors. Apart from the theoretical and conceptual framework, more emphasis would be laid on the preventive measures in the form of intervention to reduce and control the prevalence and the effects of Musculoskeletal disorders among the Sugar factory workers in Uganda.

2.1 Empirical literature review

There is no agreeable definition for Musculoskeletal disorders (MSDs), but for this study, it could be defined as a degenerative and inflammatory condition that most affects the human anatomical structures. Such as; the skeletal systems (Joint, Ligaments, bones) the muscular system, the neurovascular bundles (blood vessels, nerve tissues, and the lymphatics), and supporting structures such as cartilage and vertebral discs (Mcmillan *et al,* 2017). The expected consequences of musculoskeletal disorders include sprains, tears, soreness, carpal tunnel syndrome, sciatica, osteoarthritis, and myalgia. The primary functions of the musculoskeletal systems (MSS) are: to avail support for the body, to enable movement, to ensure stability, and to protect the vital organs (Adetiba, 2017). However, the onset mechanisms for musculoskeletal disorders are not established; the presentation seems to be multifactorial, developing from overuse such as repetitive minor traumas and cumulative biomechanical stress (Mosaly, 2016). However, Lau Adetiba, (2017), in his understanding of MSDs, could be a consequence of an acute injury. They are more often associated with routine tasks that contribute to gradual tissue damage. According to the association of The Bone and Joint

Decade, Musculoskeletal complaints, diseases, and injuries can be divided into five categories (Formi, 2015).

(1) Pain and other ailments and altered function of the musculoskeletal system as a result of physical and mental stress

(2) Non-infectious inflammatory (inflammation-like) diseases of the joints, spine, and soft tissue

(3) Degenerative diseases of the joints and spine

(4) Pathological bone loss/osteoporosis with or without osteoporotic fractures

(5) Injuries of the musculoskeletal system, including sequelae as a consequence of such damages.

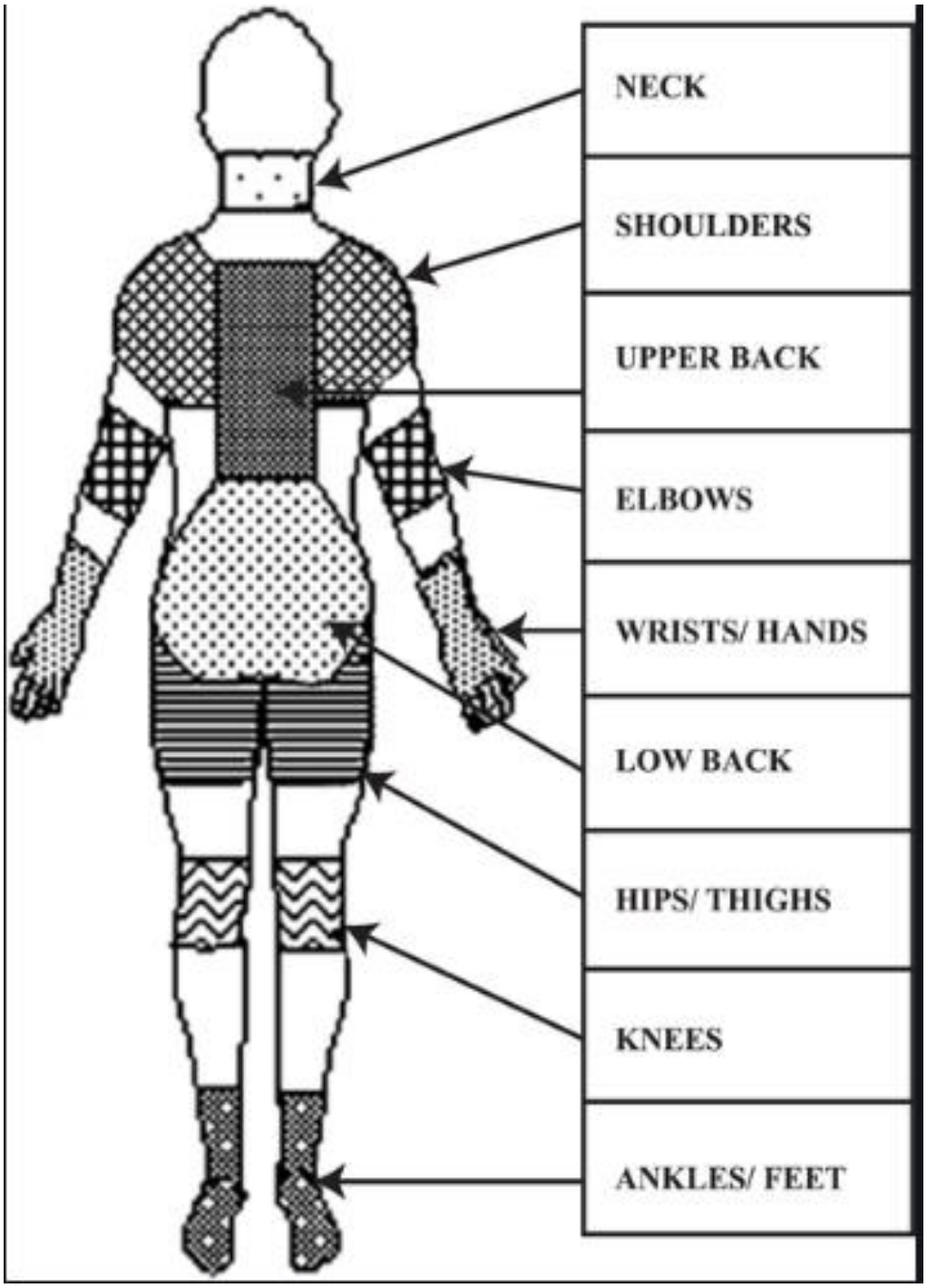


Figure 1: Showing different musculoskeletal disorders region in the body modified based on Standardized Nordic Questionnaire *(Kourinka et al, 1987)*

2.2 Overview of Musculoskeletal Disorders

a). Global perspective: In the international world today, many countries have reported that one of the most prevalent work-related health problems is Musculoskeletal disorders with very high prevalence (Agrawal *et al.*, 2018). The MSDs have been of

high incidence within different groups of occupations over the years. They have also been established as one of the leading work-related health effects amidst forefront health care practitioners, these conditions affecting the musculoskeletal system (MSS) (Chianca, *et al.,* 2020). According to Adetiba, 2017, the musculoskeletal system (MSS) is a multifaceted unit in the human body that comprises human anatomical structures such as muscles, bones, tendons, joints, bursa, ligaments, blood vessels, and nerves. The MSS is known to have two major constituent subsystems in the human body, these being the muscular system and the skeletal system (Wei, *et al.,* 2019). The MSS is also interrelated with all other body systems, such as the muscular systems, the integumentary, the nervous, and the vascular systems. Any dysfunction of one or more of these anatomical systems can potentially affect the MSS. Although human physical activities are of great importance to MSDs, the burden of physically vigorous tasks may pose a threat. Repetitive work, awkward postures, or handling of heavy materials may also impair the MSS, which can lead to MSDs, pain, or fatigue, and consequently affect other areas of the body (*Goode et al.,* 2019). Workers subjected to tasks that involve repetition, precision, and undesirable postures are at risk of upper limb MSDs conditions (Jakobson *et al.,* 2018). Inappropriate MSDs load in the workplace may also lead to MSDs conditions. The incremental increase in computer use in office workers can be attributed to the rise of work-related upper extremity WRMSDs conditions (Esmaeilzadeh, Ozcan, and Capan, 2016).

Work-related Musculoskeletal disorders (WRMSDs) are the major causes of permanent work disability, most especially lower back pain (Rantonen et al., 2016). Individuals affected by WRMSDs involving the shoulder often seek healthcare. Shoulder pain and functionality are difficult as it can take a while to recover. Individuals presenting with unilateral shoulder pain have variable peripheral and central sensitization (Chianca, et

al, 2020). The hands, arms, neck, and associated structures may also be affected by upper limb MSK conditions (Biwas et al, 2016).

2.3 Prevalence and Extent of Musculoskeletal Disorders in General Population

Globally, the prevalence of WRMSDs is explicitly high in many countries, and it has been reported that one of the most prevalent work-related health problems with high economic burdens is Musculoskeletal disorders in both low-income and high-income countries (Briggs*et al*. 2016). They constitute the major causes of severe long-term pain, human physical disabilities, and loss of time from work (Sakzewski and Naser-ud-Din 2015). They affect a lot of the working population; it also led to workers' long-term pains and physical body disabilities throughout the whole world. These disorders were also reported to have caused an increase in the health care expenditure, loss of work, decrease in the quality of life of the employees affected with that of their families, as well as economic loss, which affects the employee, the organization, and society at large (Yasobant and Batham2016).

Chaiklieng and Suggaravetsiri (2019) conducted a study on risk factors for WRMSDs among school teachers in Thailand and reported high prevalence rates of 54.5% for low back, 41.6% for shoulder 36.1% for the upper back, 34.5% for neck, and 27.9% for the arm. The report further shows an insignificant variation in the prevalence rate between genders and across age groups (Chaiklieng and Suggaravetsiri 2019). The National Bureau of Labour Statistics (BLS) of the USA Department of Labour reported that from the year 1992 to the year 2010, 23-29% of all reported cases of occupational injuries that usually involves some days off from work in both private and public sectors was due to WRMSDs (Bhattacharya 2016). Likewise, in 2013, 33% of all reported cases of occupational injuries in the USA workplace were also due to MSDs. Still in the USA,

MSDs have negatively affected the private sector, with approximately 320,000 workdays lost annually, representing 29% of days lost due to injuries and claims related to illness ((Bhattacharya 2016).

Additionally, the annual economic burden of MSDs was estimated to be between 45 and 54 billion US dollars. The table below shows the prevalence of MSDs among healthcare workers. (Freimann, T. 2017).

Table 1: Showing the Prevalence of Musculoskeletal disorders by Different Body Sites during the Preceding last one year among Nurses from Studies across Countries. (Freimann, T. 2017).

Country	N	Mean age	Low back	Neck	Shoulder	Knee	Any site	Authors
China	282	34	56	45	40	n/a	70	Smith et al. 2004a
China	180	30	57	43	39	31	70	Smith et al. 2004b
Greece	351	37	75	47	37	n/a	n/a	Alexopoulus et al. 2003
Iran	641	32	55	36	40	48	84	Choobineh et al. 2006
Iran	317	34	73	46	49	69	95	Mehrdad et al. 2010
India	212	31	48	33	35	29	81	Anap et al. 2013
Japan	247	33	83	37	61	24	92	Smith et al. 2003a
Japan	305	29	59	28	47	16	78	Smith et al. 2003b
Japan	844	33	71	55	72	n/a	86	Smith et al. 2006
Korea	330	n/a	72	63	75	35	94	Smith et al. 2005
New Zealand	181	46	57	52	39	34	91	Harcombe et al. 2009
Niger	118	36	44	28	13	22	78	Tinubu et al. 2010
Poland	237	36	57	34	24	35	n/a	Jarowek et al. 2010
Sweden	278	43	23	15	22	n/a	48	Nilsson et al. 2010
Sweden	565	37	64	53	60	n/a	84	Josephson et al. 1997
Uganda	741	35	62	37	33	37	81	Munabi et al. 2014
United States	1163	45	47	46	35	n/a	73	Trinkoff et al. 2002

n/a – not available.

Another similar study conducted by Amin *et al.,* (2018) revealed that the anatomical body parts that were most affected in musculoskeletal disorders included the neck, with a high prevalence rate ranging from 34%-54%, the shoulder ranging from (35%-60%) and the lower back ranging from (29%-64%). Amin *et al.* (2018) reported establishing a relationship between work-related musculoskeletal disorders and some certain risk factors like the psychosocial factors conducted in research conducted among healthcare workers in a public hospital in Malaysia. It was reported that over two-thirds of 376 nurses had complained about discomfort and pains at some of the anatomical regions that are for the musculoskeletal disorders sites within the last 12 months. The reported prevalence rate for different body parts was the neck (48.9%) with the highest prevalence, the feet (47.2%) with a slightly higher prevalence as compared to the neck, the upper lumbar (back) (40.69%) with lower prevalence and the lower lumbar (back) having the prevalent to be (35.28%). Similarly, Arsalani*et al*. (2016), in their research conducted among Nursing staff personnel in Tehran, Iran, found the prevalence of MSDs and its associations with various organizational, psychosocial and physical psychosocial working conditions among 520 nursing staff in the hospital. They reported that 88.0% of the nursing staff have complained and experienced musculoskeletal disorders in one of the anatomical regions for MSDs in the last one year, with the lower back having the highest prevalence rate at (65.3%) followed by the knee (56.2%) and the neck (49.8%). Sugar factories and refineries produce raw sugar from the sugar canes. Raw sugar, which is a sugar that still contains molasses, is processed into various products like refined white sugar that is customarily consumed majorly in all households. It could also be sued as an ingredient in making soft drinks and foods Sugar Refinery Authority Control, NDL: 00570455). However, several researchers have conducted studies in the Agricultural sector in Thailand to identify the factors

associated with the higher prevalence of Work-related musculoskeletal disorders, and the research was conducted among the sugarcane plantations workers, they found out that workers in the plantations have suffered severe physical illness symptoms, such as shoulder pain, muscle cramps, and lumbar pain (Nilvarangkul *et al.*, 2018). A similar study by Udom et al., 2018 in a rubber plantation also revealed that the prevalence of WRMSDs in the last year was 87.7% and the previous week to be 65.11%.

The sparse studies on sugar factory workers showed that the workers have characteristics of work situations like high workloads, forceful, extreme repetition, awkward posture continuous body contortions, awkward postures, and high workloads (Smita, & Deepak, 2016). Smita et al (2016) conducted a similar cross-sectional study,. & Deepak, (2016) it was also revealed a very high prevalence of WMD's in sugarcane workers. From their results, they reported that prevalence was more in the lower back (50%), knee (29%), neck (19%), hip (13%), ankle (10%), upper back (13%), shoulders (13%), elbows (10%) and wrists (14%).

2.4 Risk Factors for Musculoskeletal Disorders

Establishing the risk factors responsible for WRMSDs is a complicated and multidimensional problem (Sakzewski and Naser-ud-Din 2015). There are several global health regulatory bodies such as World Health Organization (WHO, 2010) and the regulatory bodies for occupational health and safety institute (NIOSH, 2013), they noted that the risk factors for WRMSDs are multifactorial and exist across the spectrum of the work environments (Sakzewski and Naser-ud-Din 2015).

To analyze the degree of the problem, a more detailed review of the psychosocial, biomechanical, and individual risk factors for WRMSDs among sugar workers will be briefly looked into by the researcher in this proposed study.

One of the most vulnerable occupational groups, especially in agricultural settings, is the sugar factories with many occupational hazards; their work activities involve a lot of tedious work. Despite the advent of mechanized equipment, musculoskeletal disorders remain a severe problem among the workers in sugar factories (Mrunal, *et al.,* 2016). Among notable designs and workstation Sugar factory is the production units, which seem to be the tackiest units with lots of workers in the department. All workers that fall under this category inclusion criterion will be targeted for the research and must have spent five years and above (Gourab *et al.,* 2016).

Manual job in sugar factory involves the separating the sugarcane leaves before it is crushed into the crush rollers, checking the texture of juice extracted, crystallized sugar, comparing the color crystallized sugar from raw sugar, adjusting packages into the machine for packing, loading the packed sugar into trucks to store them into the warehouse. Some of this work can only be achieved by these work situations/conditions in these units, including; the task that involves more repetitive activities, Local mechanical contact stress that involve fingers, palm, elbow, and armpit, so also activities like awkward movements, Karkousha, R. N., &Elhafeza, H. M. (2017).

2.4.1 Psychosocial Risk Factors

Several researches stated psychosocial factors to be a positive predictor of the prevalence of WRMSDs, irrespective of the categories: factors like personal factors such as Gender or age, other factors like organizational and physical factors which include working hours, repetitive work, force (Bernal *et al.*, 2015). Several psychosocial factors are associated with WRMSDs and have a wide variety of conditions that can be grouped into three categories.

i). Category 1: - are factors associated with internal work, also referred to as organizational factors. These include aspects of the job description, like the worker's workload, job control, mental demand, and job clarity. These also involve organizational characteristics, such as interpersonal relationships, work/rest cycle, financial aspect, and community support (Sakzewski and Naser-ud-Din 2015).

ii). Category 2: - are factors related to the external environment where workers carried out their activities, including the specific duties of individual workers outside their workstation of the individual outside work, explicitly concerning their activities and responsibilities regarding their families, friends so also the community. Females are at high risk due to more caregiver demands (Sakzewski and Naser-ud-Din 2015). For example, in many African societies, women do most household tasks; hence, the variation in exposure to risk factors between women and men at work and home may interpret the higher prevalence of WRMSDs in women compared to men.

iii). Category 3: - are the Individual characteristics of the worker, which include Gender, intelligence, culture, educational status, social class, worker's attitude, worker's perception with job satisfaction, personal traits so as their character. These can influence an individual capacity to deal with a potential stressor arising from the workplace (Sakzewski and Naser-ud-Din, 2015).

2.4.2 Biomechanical Risk Factors

A cross-sectional study by Smita (2016) showed the relationship between the factors like biomechanical and musculoskeletal disorders among sugar factory workers, on their common repetitive actions during cutting are extending or twisting the wrist, prolonged standing, stooping, exerting or twisting the torso, lifting objects, which shall be detailed further below here.

2.4.2.1 Repetitive movements: the repetitious movements result from conventional sugar cane cutting among the sugar factory workers, and sugar cane works routines are so tedious that is so difficult on workers, which raises the possibility of musculoskeletal disorders, most especially in the hand and wrist (Smita&Deepak 2016, Sakzewski and Naser-ud-Din 2015). These occur when the same muscle groups and joints are involved repeatedly and whenever a particular movement is done frequently over a prolonged period. As the tendon at the site involves compresses and stretches, blood flow is reduced, resulting in wear and tear (Sakzewski and Naser-ud-Din 2015).

2.4.2.2 Poor or uncomfortable working posture: prolonged, static, and awkward postures are also linked to the development of WRMSDs among Sugarcane workers because they consistently pulled branches sugarcane repetitively, the way the workers lifted the sugarcane, and finally threw it into the trucks for transportation. During these activities, worker continuously controls their body posture and frequently lift their hands above their heads. They continually extend forward on their feet to empty it into the truck (Smita & Deepak, B.A 2016). All these awkward movements can predispose workers to excessive workloads for both their tendons and muscles because they need to maintain their body balance continually. These awkward and static postures generate continuous muscle activities that increase intramuscular pressure, thereby blocking the flow of blood and, consequently, the flow of oxygen to the affected body part, which in turn degenerate into MSDs (Adetiba, 2017).

2.4.3 Sociodemographic/Individual Factors

Demographic parameters like the participant's; age, height, weight, and Gender, other factors like lifestyle (smoking, alcohol, exercise) have been reported to affect the risk factors for MSDs (Abdulmujeeb, 2017).

i) Age: As one ages, several physiological changes occur: the wrist tissues, shoulder, and back become more vulnerable to the damaging effects of awkward postures. There is a decrease in the tissue elasticity; joints may become less flexible, less mobile, and inflamed; the structural changes occur in the spine and load-bearing joints, which are due to the decrease in the fluids of the joints and the wear and tear on the cartilage (Sites *et al.,* 2018). A study by Noone (2017), assessing chronological age, functional age, and work outcomes, found that workers with higher chronological ages experienced increased problems relating to age. Furthermore, their workability scores which indicate the ability to perform work, decreased with age (Noone, 2017). There is a decline in the cognitive process (attention, memory, and primary processing) and sensory-motor response. Generally, many human body components deteriorate with aging, possibly causing an adverse response, leading to MSDs and weakening the tissue because of cumulative exposure (Sites *et al.,* 2018).

ii). Gender is a contributing risk factor for MSDs and could be associated with women's strength, hormones, and lower muscle volume (Rafie *et al*., 2015). The same author reported that the prevalence of MSDs among dental practitioners was prevalent in women compared to then In a study on MSDs carried out among computer users, it was reported that males had the highest prevalence of MSDs in the neck. In contrast, women reported the highest prevalence in the shoulder region (Rafie *et al*., 2015). For low back pain (LBP), Abdulmujeeb (2017) reported that female nurses were 2.26 times more likely to report this than male colleagues. This may be due to the higher physical constraints and demands women face. Besides, most of the machines were designed to suit men's body’s physique, so women tend to fit into these unfitted ergonomics designs, which can also be the reason for the prevalence of MSDs among females.

iii). Cigarette smoking is a habit that impairs and damages the nutrition and structure of the musculoskeletal system through hypoxia and vasoconstriction. It may favor the onset or aggravate the progression of MSDs (James*et et al.,* 2017). To a more considerable extent, the amount of clinical and experimental research shows that cigarette smoking has a debilitating effect on the musculoskeletal system and worsens the prognosis of several orthopedic disorders and surgical procedures (Aube *et al.,* 2019). In a similar study on MSDs conducted among bank workers in Kuwait, smoking was shown to be a significant predictor for the occurrence of MSDs in the previous 12 months to that study (Heidari, *et al.,* 2019).

iv). Alcohol consumption could serve as an immunosuppressant, and when abused, it becomes detrimental to the musculoskeletal system, not only affecting the bones but also the body mass. This results in a decrease in body mass, suppression of skeletal growth, progressive bone loss, and reduced peak bone mass, especially during early adulthood (Emilson et al., 2016). It is estimated that 40– 60% of all adult alcohol addicts show skeletal muscle myopathy. An imbalance causes this myopathy and muscle wasting associated with chronic alcohol abuse in protein metabolism (Emilson *et al.,* 2016). However, Munabi *et al.* (2014) in their study, discussed that intake of alcohol was found to have a protective effect on reported MSDs, and persons who consumed either moderate or excess alcohol said having consulted a practitioner less often than those who did not drink at all.

v). The (BMI), which is also known as the basal metabolic index, is the most frequently used means determine to identify the weight across an individual range of body dimensions in adults (Hassannejad, 2017). It is used to categorize if a personal adult is underweight, overweight, and obesity using the standardized formula by the World

Health Organization guidelines by getting the individual weight in kilogram (kg) dividing it by the individual height in square meters (m^2) (WHO 2019).

Table 2: Showing BMI classification based on international guidelines (WHO 2019)

BMI Classification	**BMI (kg/m^2)**	
	Principal cut-off points	**Additional cut-off points**
Underweight	<18.50	<18.50
Severe thinness	<16.00	<16.00
Moderate thinness	16.00 - 16.99	16.00 - 16.99
Mild thinness	17.00 - 18.49	17.00 - 18.49
Normal range	18.50-24.99	18.50 - 22.99
		23.00 - 24.99
Overweight	≥25.00	≥25.00
Pre-obese	25.00-29.99	25.00 - 27.49
		27.50 - 29.99
Obese	≥30.00	≥30.00
Obese class I	30.00 - 34.99	30.00 - 32.49
		32.50 - 34.99
Obese class II	35.00 - 39.99	35.00 - 37.49
		37.50 - 39.99
Obese class III	≥40.00	≥40.00

These various classifications of BMI with different categories were standardized and developed to make the standard for the WHO, which is related to the notable healthy risk factors (Van Eerd *et al.,* 2020). With the elevations in fat mass, there is a relative decline in muscle mass and strength of the body. Obesity may create a perfect atmosphere for the skeletal muscle mechanism of catabolism; this can also cause a lowering in physical function (Hashimoto et al, 2016). Bigand, 2018 reported an existing association between MSDs on lower back pain and elevated BMI, but such factors relating to the development of the disorder were not identified. Similarly, Hassannejad, (2017) documented that a high basal mass index, which includes obesity

and overweight, was reported as an essential independent variable and as a risk factor for MSDs. Writing from their study on the relationship established between MSDs symptoms and BMI in the general working population, it was reported basal mass index, which includes obesity and overweight, was moderately related with development and had a very high prevalence of the MSDs in the last one year. The majority of MSDs symptoms were exceptionally high in the lower extremities.

2.5 Ergonomic Based Intervention

Ergonomics comes from the Greek roots *ergon*, meaning "work", and *nomos*, meaning "natural law," with its meaning translated as 'the science of work'. The term Ergonomics and Human Factors are now used as synonymous. According to the International Ergonomics Association (2019), the definition of ergonomics is as a scientific discipline that gives an appropriate meaning of ergonomics as it is concerned with;

*"…the basic understanding of the interactions among individual workers, with the system or workplace, the professionals that apply this theory, principles, data and methods to design to optimally actualize the human overall system performance and well-being" (*IEA, 2019).

Therefore, as an interdisciplinary knowledge field, ergonomics promotes a holistic view. It can be described as consisting of several domains, and the most common is the three main domains: physical, cognitive, and organizational ergonomics (IEA, 2019). The researcher decided to consider the physical, ergonomic domain for this current study.

2.5.1 Physical Ergonomics

The majority of ergonomics issues at the workplace are physical ergonomics related, which typically dominates the public view proper understanding of ergonomics. Physical, ergonomic interventions include providing workspace and equipment based on ergonomic principles and the anthropometry of workers and also considering the essential characteristics of the human body mechanism, the human body physiology, biomechanics, and the body anatomy as all these areas relate to human physical activities. Undoubtedly, it's pertinent to know that the potential outcomes are musculoskeletal for any work that ignores ergonomics preventive measures and principles (Holtermann, 2018).

Nevertheless, reducing MSD risk or decrease in worker's compensation cost is only one of the many goals of physical ergonomics. There are various benefits attributed to physical ergonomics such as; Increased productivity, improving employee wellbeing, Improved quality, Improved efficiency, Reduced downtime, Improved employee morale, reduced turnover, and absenteeism. (Baydur, *et al.,* 2016)

The most recognized interventional strategy globally for workplace Hazards resulting from MSDs is ergonomic interventions; for this reason, several occupational health and safety bodies across the globe have advocated for Ergonomics intervention (Holtermann, 2018). The ergonomic interventions range from workplace/workplace modifications to long-term educational interventions with the aim and focus of treating and preventing musculoskeletal disorders among workers. One of the significant concerns of ergonomic interventions as opposed to traditional therapeutic interventions is that they target workers' work posture, work behaviors, habits, and the work (Holtermann, 2018). It is evident in many technology companies that offer ergonomic training for their workers because ergonomics interventions have been found to enhance

productivity, improve workers' well-being, and reduce the effects of Musculoskeletal disorders among workers (Bazazan et, 2018).

It is essential to have a thorough knowledge of the present work situation and process to execute effective preventive interventions. To survey the work setting, including physical as well as psychosocial conditions, is therefore needful. Also, the prevalence of musculoskeletal disorders will be registered and the characteristics of the work organization. The interventions could have a different focus. It could be focused on an individual level, occupational factors related to risk, the design of equipment, and the workstations.

Furthermore, an intervention can target the employees by individual training, e.g., cognitive-behavioral training and physical coordination (Skarpsno *et al.,* 2019). Some suggested approach for the effectiveness of ergonomics-based interventions was to target the organization level, which includes the size of the workers, their work schedule, and various distributions of their work (Winkel *et al.,* 2017. For an organizational level of ergonomic intervention to work effectively, factors such as different models of leadership they adopt or operate and the organization's structure are crucial. To achieve complete success in ergonomic interventions, the primary emphasis should not be on the individual worker's level alone, and organizational involvement should be considered too (Winkel *et al.,* 2017). All interventional approach that requires ergonomics should always consider the psychosocial work conditions of the workers as of importance. For instance, changes in legislation, weekly working hours, and duration of vacations might also have an interventional effect. The prevention can also follow the same format of disease prevention strategies.

2.6 Theoretical Framework/Models

Different theoretical frameworks on MSDs have been documented in the literature, the pyramid of disability theory was considered in this study. With the theoretical framework not having a definite and clear definition (Antwi-Afari, et al, 2020) looked at the theoretical framework as one of the five components (concepts, assumptions, expectations, beliefs, and theories) of the research design that links and acts together in a non-cyclical and non-linear way. These components support and inform the researcher on the prognosis of MSDs among workers.

2.6.1 Pyramid of Disability

This is a theoretical framework that gives a basis for a framework for designing research studies and testing hypotheses using specific mathematical approaches inform of models. The model describes the progression from no symptoms of MSDs to chronic MSDs and long-term disability. It also considers some factors that can facilitate changes between the pyramid levels (Descatha and Evanoff 2019). This framework is considered appropriate because this study aims to discover the common risk factors associated with the development of MSDs and its prevalence. In contrast, this framework looks at the progression of MSDs.

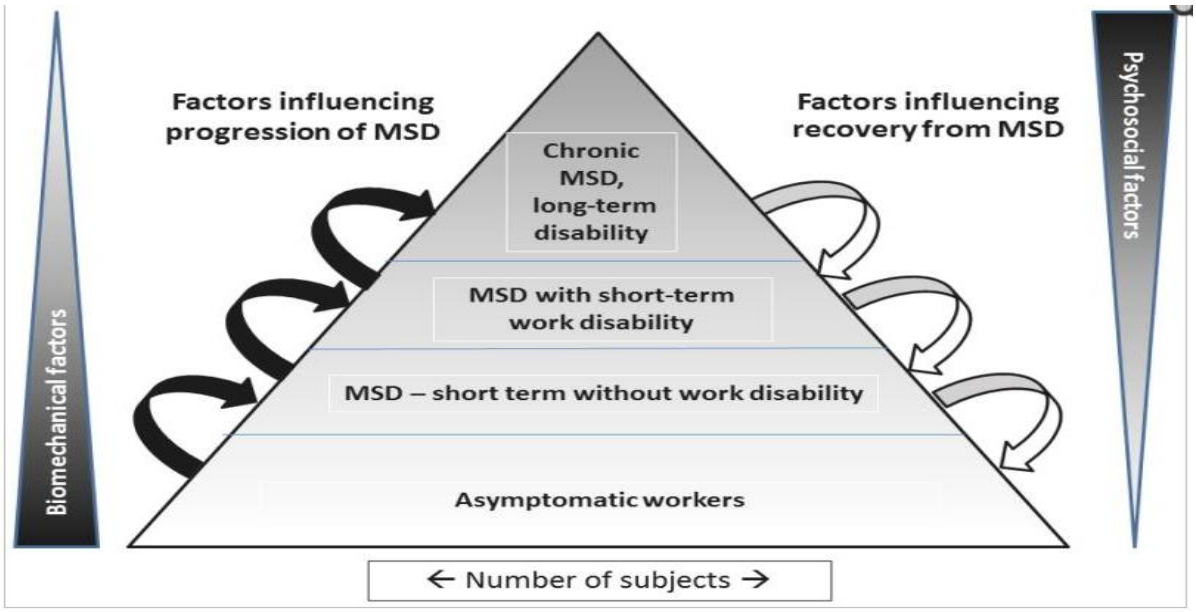


Figure 2: Showing the conceptual model of the pyramid of disability (Evanoff, 2014)

ii. "Linking onset, course, and care". (See the diagram of a pyramid of disability in Figure 2, looking at the base of the pyramid that comprises worker's populations without the symptoms of musculoskeletal disorders. However, few workers further experience the symptoms of musculoskeletal disorders but do not seek medical attention. In contrast, some other fragments do go for treatment, but they experience no disability due to their work. At the same time, some smaller numbers out of the workers will progress to chronic functional impairment or short-term and causes workers to leave with disabilities. Much as the risk involved in the progression and development of MSDs reduces, the tie for recovery of functional ability and reduction of symptoms will occur. Individual workers will return to the lower level of the pyramid's base. The Therapeutic way of interventions, the psychosocial stressors, the work-related workplace policies, the medical co-morbidities. A variety of other individual factors and social factors can help mediate the transitions from asymptomatic to symptomatic, which may be different from factors that most affect the development of MSDs and

disabilities among workers with symptoms. Numerous suggestions from a few short pieces of literature show that work-related biomechanical factors are probably more strongly related to the first incidence of MSD and transitions noted between states of the bottom of the pyramid (Neupane S, 2016).

2.7: Conceptual Framework.

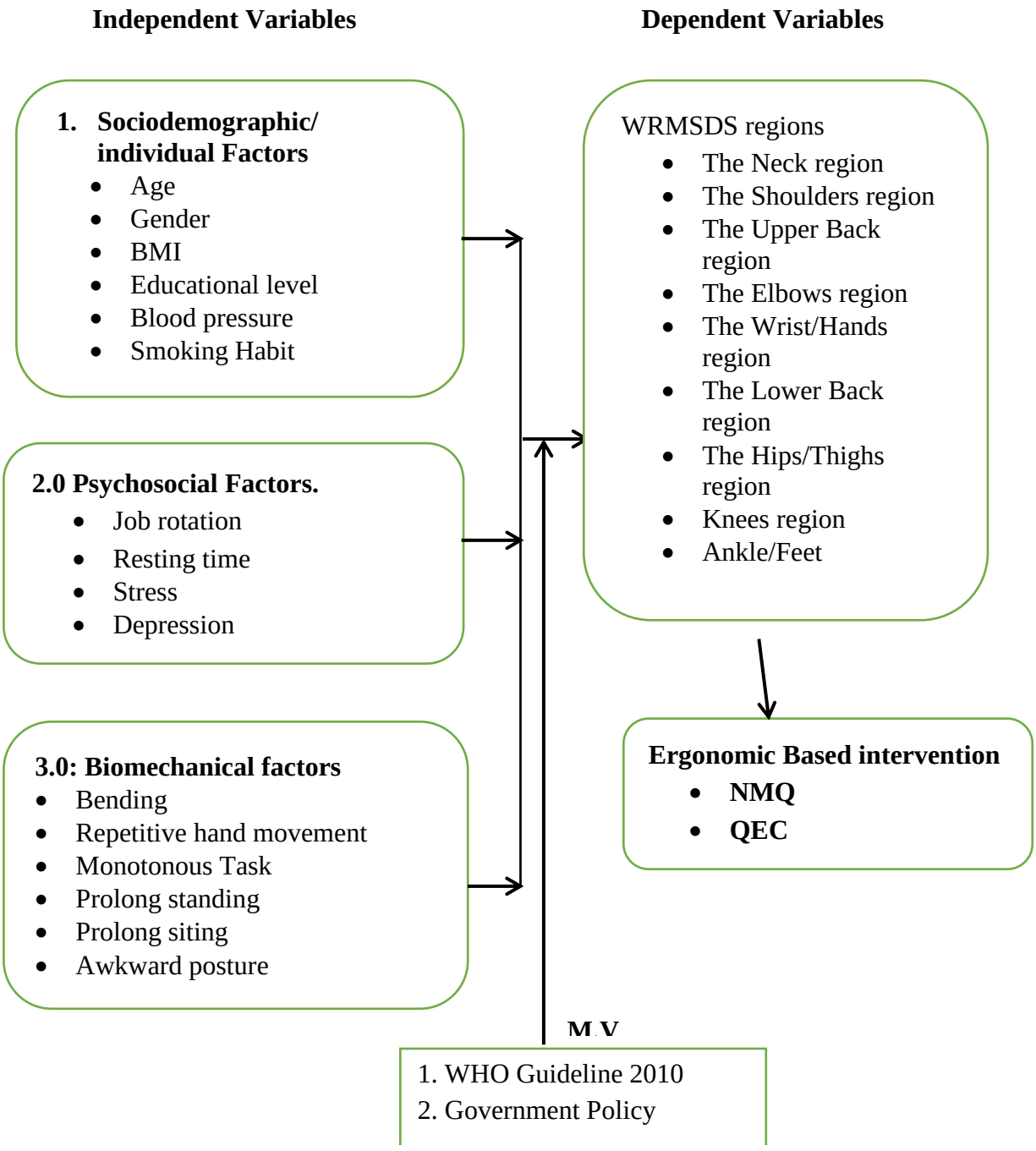


Figure 3: a conceptual framework developed by the researcher.

Following the study objectives, the following variables will be included in this study. The dependent variable is the Musculoskeletal disorders the independent variables of the current study includes: Independent variables

- Individual/sociodemographic factors which include; Age, Gender, Marital Status The educational level will be considered for this study.
- Anthropometric factors like BMI (Height and Weight) and Blood Pressure (Diastolic and Systolic)
- Lifestyle factors include smoking alcohol consumptions.

The ergonomic risk factors include repetitive movements, prolonged sitting, prolonged standing, awkward posture, twisting, resting duration, work procedure, and different machines available.

The conceptual framework shows the two variables, the independent and dependent, the risk factors being the independent, and MSDs the dependent variables. The risk factors have been classified into three key constructs: personal, biomechanical, environmental, and psychosocial factors. Psychosocial factors are associated with WRMSDs and include a wide variety of conditions grouped into three categories.

Category 1: - are factors related to the internal workstation milieu, also known as work organizational-related factors. These relate to some areas of work descriptions, such as the workforce, job control, mental demand, and job clarity. (Sakzewski and Naser-ud-Din 2015).

Category 2: - are factors related to the external workstation milieu, including the responsibility of an individual working outside their work environments, explicitly

concerning their roles and responsibilities regarding families, friends, and the community. Females are at high risk as they have more caregiver demands (Sakzewski and Naser-ud-Din 2015)

Category 3: - are the Individual characteristics of the worker, which include Gender, intelligence, culture, educational status, social class, life/work attitude, job satisfaction, personal traits, and character. Biomechanical factors in this framework include everyday repetitive actions during cutting: extending or twisting the wrist, prolonged standing, stooping, exerting or twisting the torso, and lifting objects. Demographic parameters like the participant's; age, height, weight, and Gender, other factors like lifestyle (smoking, alcohol, exercise) have been reported to affect the risk factors for MSDs (Abdulmujeeb 2017). All these factors have been found in the literature to be related to the progression of MSDs among the sugar factory workers during their work activities.

2.8 Critical Review

The literature review has shown an overview of the musculoskeletal system interrelated with other body systems, what WRMSDs are, and some common work-related musculoskeletal injuries, especially those that affect the upper limbs. Included in this review were the possible risk factors for developing WRMSDs, which are psychosocial, biomechanical, and individual. The prevalence and cost of WRMSDs across countries were documented, and it was noted that WRMSDs are the most prevalent and costly occupational health problem.

Another study by Mcmillan et al., 2015 highlighted that numerous risk factors related to the prognosis or progression of work-related musculoskeletal disorders are the most common Agricultural occupational tasks. The nature of the risk associated with different farming activities needed to be fully understood. Obtaining information on

musculoskeletal pain and how it relates to time spent performing everyday farm tasks will assist in understanding such exposure-response relationships. Any confirmed associations could help guide effective interventions that would mitigate occupational hazards and ultimately reduce disabling pain that results from work-related exposures on the farm. Results could also direct future longitudinal analyses that confirm potentially causal associations. These findings may potentially impact agricultural/rural health policy and ergonomics strategies that modify exposures and limit MSD outcomes in farmers (Mcmillan *et al.,* 2015).

2.9 Knowledge Gaps

A detailed review of literature documented that few kinds of research have been conducted among sugar factory workers, most notably an interventional study on musculoskeletal disorders. To the best of the researcher's knowledge, no research has been undertaken among Agricultural industries, including sugar factory workers, conducted in various Uganda research in different sectors. This shows a huge gap in knowledge that the health of workers in the agriculture sector, mainly subsistence, is the dominant economic activity, representing 72 percent of Uganda's workforce. That is 76 percent female (rural women), and 65 percent males (UBOS, 2016). The sector also accounts for 52 percent of the country's total exports (UBOS, 2016).

Table 3: Showing gaps in research on musculoskeletal disorders among sugar factories workers reviewed by Gourab et al., 2016

Years	Review of different research in a sugar company Details of the study in sugar Factory workers	Countries
2010	In North-West Nicaragua, more than 70 deaths per 100,000 sugarcane workers are due to chronic kidney problems. 95% has been suffering from CKD. Determining glomerular filtration rate (eGFR) is decreased during the harvest, varying from (28.6 moles/minute/1.73 meter square) to (25.0 moles/minute/1.73 meter square) depending on some of the categories of the job as compared with other factory workers	North-West Nicaragua
2011	Migrated sugarcane harvest workers of Ahmednagar, Maharashtra, are suffered from ill-health. Well defined policy, medical care, and integrated approach will improve the conditions of the workers, according to Somsundaram and Bangal	Indian
2012	IUF Global Sugar Program and KUSPW had given some recommendations for different risk factors present in the sugar industry of Kenya	Kenya
2013	Sugar workers in Kenya are found dissatisfied about safety training and safety education	Kenya
2014	Malnutrition musculoskeletal and dermatological diseases are also common among the migratory workers of Maharashtra, India. Prevalence of knee (80%) and lower back (73.3%) pain is found among the sugar mill workers aged between 30-60 years carrying and lifting more than 50kg load in Punjab, India	Indian
2014	Water–Rest-Shade program (OSHA) when applied on the sugarcane workers of Central America, significantly reduce health problem related to heat stress and dehydration without decreasing productivity are observed	America
2015	An Epidemic of kidney failure has been present since 1999 among the sugar cane field workers along the Pacific Ocean from Mexico to Costa Rica. Cardiac strain with dehydration during six months of sugarcane cutting may be the cause of illness of the sugarcane cutters from El Salvador of ages varying from 18 to 54 years	Mexico
2016	Decrease of volume with occupational heat stress is the main factor for kidney diseases among sugarcane workers in Nicaragua. Prevalence of decreased pre-shift glomerular filtration rate is observed among the sugarcane cutter in El Salvador	Nicaragua
2016	High rates of the lower back (50%) and knee joint pain (29%) are observed among the sugarcane workers of Ahmednagar.	Indian

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Research Design

This study adopted both quantitative and qualitative methods; the cross-sectional survey and quasi-experimental study designs were for the quantitative, and the focused group discussions addressed the qualitative. The researcher conducted this research in phases. The cross-sectional survey designs were used in Phase 1 to gather the baseline data among the target populations, and phase two was the interventional phase. A cross-sectional survey is used to study a phenomenon at a given time or to gather data from multiple groups at the same time (Francis *et al.,* 2019). This study design was selected as it has been used in previous studies on musculoskeletal disorders (MSDs) among dentists, steelworkers, nurses, and office workers (Youseffi *et al.,* 2017).

3.1 Location of the Study

The study was conducted in Jinja, municipal Uganda; Jinja municipal is comprised of Agro-allied industries where most of the sugar factories are located. This study is in two different factories located in Jinja Uganda, Uganda Farmers Crop Industries Limited (UFCIL), and Sugar Corporation of Uganda Limited (SCOUL).

3.1.1 Uganda Farmers Crop Industries Limited (UFCIL),

The sugar company was one of the earliest agro-industrial enterprises established in Uganda in the 1920s by the pioneer industrialists of Indian origin. At the time of independence in the 1960s, they were the largest sugar-producing factory in Uganda.

UFCIL group of factories has many sites within Uganda; the sugar factories located in buikwe town Jinja Municipal are the main, situated in Uganda's Eastern region. The sugar factory is located by the roadside, and it lies 16 kilometers approximately (9.9

mi), it’s also located to the northeast of Jinja Municipal. UFCIL is a town where the sugar factory is located at approximately (62mi) and 100 kilometers along the roadside east of Kampala, The major capital of Uganda. The Sugar factories has following coordinates for easy accessibility: 0°30'36.0"N, 33°17'24.0"E (Latitude:0.5100; Longitude: 33.2900).

3.1.2 The Sugar Corporation of Uganda Limited (SCOUL).

SCOUL is one of the largest sugar factories in Uganda, and it is ranked the third-largest manufacturer of sugar in Uganda, the SCOUL factory usually produces an estimated 60,000 metric tonnes annually, totaling approximate of 17 percent of the whole national output for Uganda. Lugazi is a town in Jinja where the main company is situated, it’s along the roadside with 48 kilometers of approximately (30 mi), by road, along the roadside east of Kampala, The major capital of Uganda. The Sugar factories have the following coordinates for easy accessibility: 0°22'59.0"N, 32°56'27.0"E (Latitude:0.383056; Longitude:32.940833) (Sabano Jesica, 2018)

3.2 Target Population

All the workers in all Uganda Farmers Crop Industries Limited (UFCIL) units and Sugar Corporation of Uganda Limited (SCOUL) sugar factor were considered during this study. The choice of these two factories for Ergonomic Based Interventional study was due to workers with a lot of similarities in all sugar factories, including departments/Units engaging in similar tasks under the same work procedure. The major tasks include lifting, bending twisting, standing for a long time, and sitting, which are also risk factors for ergonomics interventions (Eurofound, 2017). The constant stability of their work situations usually predisposes them to occupational hazards, most especially Ergonomic Hazards.

3.3 Sample Population

Since the target population in the sugar factory were of workers in all units, all the workers was recruited in the study, the researcher used a single population proportion in determining the formula and also to calculate the sample size that is required for this current study. Besides, the study sites UFCIL and SCOUL comprise of 10,000, the anticipated sample size was calculated as follows using the formula by Schulz and Grimes (2005). The sample size determinations have the following assumptions in calculating the minimum sample size for the two study sites.

$$n = \frac{\left[Z_{\alpha}\sqrt{(1+1/m)\bar{p}(1-\bar{p})} + Z_{\beta}\sqrt{p_0(1-p_0)/m + p_1(1-p_1)}\right]^2}{(p_0 - p_1)^2}$$

The formula above clearly shows the minimum number of subject cases required to identify a true relative risk or an experimental event rate with the power and two-sided type I error probability α (alpha). Typical values for the power (The probability of detecting a real effect of a sample) are 80%, 85%, and 90%, respectively. 5% is mostly the usual choice for α.

β = 1 – power,

nc is the sample size corrected for continuity,

m is the number of control subjects per experimental subject,

p0 is the chances (Probability) of the event in controls occurring,

p1 is the chances (Probability) of the event in an experimental subject will occur,

*Zp*i is designated as the normal standard deviation for the probability *p.* (Dhand *et al.*, 2014).

By inserting in the formula n =366

Having 10% of no response as an assumption, the final sample was 366 + 36.6 = 402

This sample size will be divided equally for the two companies;

UFCIL Sugar Factory n=201, Sugar Corporation of Uganda Limited (SCOUL) n = 201.

3.4 Sampling Procedure

Since the two-study site has the same work conditions and situations as observed by the research from on-site visitations, the UFCIL sugar factory was used as the experimental group while the SCOUL was considered for the control group.

In order to achieve valid and reliable inferences from the study sample, the sampling

methods for this current study and to avoid unbiased results, a probability sampling technique will be adopted.

This current study used stratified and systematic sampling methods as a sampling procedure. The structures of the experimental group are departmentalized, with each of the departments having different numbers of workers.

There exist in the sugar factory four different departments; the Engineering department, Agricultural (Cane department, Manufacturing Department), and Marketing/Account department.

The following steps were followed in this study for stratification of the departments in the sugar factory

1. The research will identify the Target Population.
2. The researcher will use the calculated population sample size.
3. The researcher will Construct Sampling Frame to Define Stratum Boundaries

4. The researcher will determine Sample Size

5.Allocate Sample to Strata

6.Select the Sample Independently in Each Stratum

Each of these units constitutes a stratum, and the sample size will be derived from the calculated total sample size.

$$n\ (N_i/N) = n_i$$

Where n population sample size, N_i is the strata population number, the total population numbers is represented as N, and the strata sample size is described as ni.

The formula used to derive the stratification of each unit from the desired sample size is:

Table 4: Showing stratification of different units within Sugar Factory (UFCIL and SCOUL)

Units/Departments	**Population (N_i)**		**Sample size (n_i)**	
	UFCIL (Ni)	**SCOUL (Ni)**	**UFCIL (ni) Experiment group**	**SCOUL (ni) Control group**
Engineering Units/Department	250	250	10	10
Manufacturing Units/Department	2000	2000	75	75
Cane Unit/Department	2500	2500	101	101
Account Unit/Department	300	300	15	15
Total	N=10000		n=402	

source: literature reviewed by researcher.

The calculated sample sizes were equally among the two companies.

The systematic sampling procedure started by selecting the participant from the unit sample size (**N**), which are listed and to be chosen at random represented as every $\boldsymbol{k}^{th}$ of the participant in each unit was chosen randomly, where ***k*** represents the sampling intervals (Elfil M, Negida, 2017).

The systematic sampling formula is calculated as; $\boldsymbol{k=N/n}$

The sample size is represented by **n**, and the population size as **N**. A starting point was chosen at random among the unit list, and choices after that are at regular intervals.

The prevalence of MSDs among workers in different units/departments was calculated to highlight the main affected department and the staff category.

3.4.1 The research phases

This research was divided into two phases:

Phase I

Phase I will be looking broadly at gathering the baseline information of the participant using the Nordic Standardized questionnaire modified for musculoskeletal disorders and to find out the magnitude of the musculoskeletal disorder among the workers. The screening process for this phase I was as follows: Different questions about musculoskeletal disorders pain was asked among all the two factory workers and the various symptoms during the previous 12 months and the last week before the baseline survey, such as tingling effect, burning sensations, numbness of the regions, stiffness, lack of mobility of the regions e.t.c. This was also achieved by considering the hospital records/register to look at the most frequent complaints or reasons for hospital visitations.

Phase II was an interventional stage; Ergonomic based intervention was adopted for this study. This target the workers exposed to occupational hazards during their works

activities, a choice of modifying worker's attitudes or behavior towards tasks redesign, the work stations, and equipment's modifications or on an individual worker's level, which includes engaging the workers through improvement on their work style, or an individual physical capacity. (Sjøgaard, 2017).

Table 5: Timing Intervention and Data Collection for Impact Evaluations Using Quasi-Experimental Study Designs

Pre-intervention	**intervention**	**Post-intervention**
t-1	T	t+1
Baseline	Intervention (Mid-term survey)	Post-Intervention Endline

t= a given specific period

The quasi-experiment is suitable for comparing the effects of an intervention on a particular programme (UNIECF 2014). The quasi-experimental study designs include the pre-interventional stage, which is the same as phase one of this study, the Interventional stage (the mid-term survey), and the post-intervention stage, as shown in the table below (UNIECF 2014).

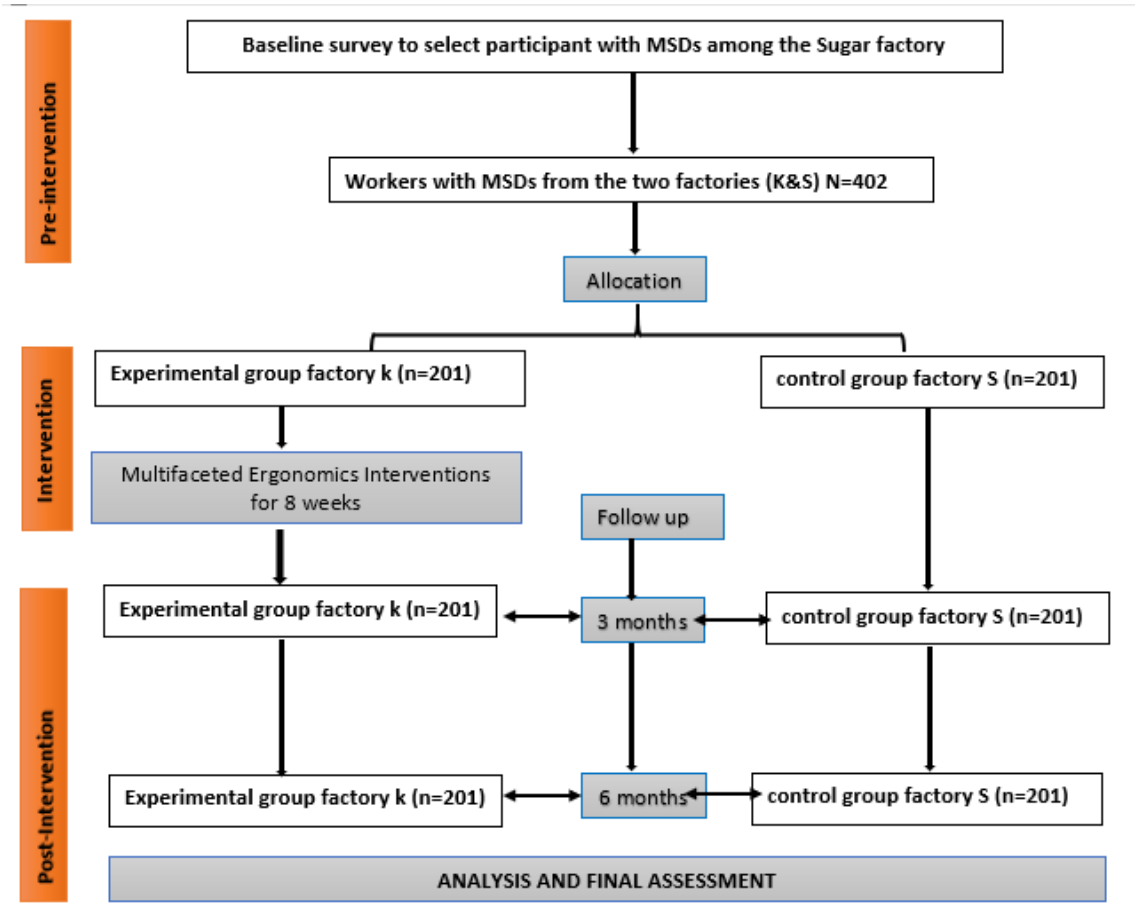


Figure 4: Showing the procedural flow of how the phases of the research flowed

As shown in Figure 7above, after the screening process is over, the real participants screened to have developed MSD were selected using the derived sample size for the study. Therefore, the participants were grouped into two categories, namely, the experimental group, also known as the intervention group, and the control also known as the non-intervention group.

3.4.2 Ergonomics Based intervention

Step 1

The ergonomic intervention program was designed and implemented for 8-week targeting all workers with risk factors for the development of musculoskeletal disorders among the workers in UFCIL Sugar Factory.

These multifaceted interventions were structured in four sections as follows;

1. The Ergonomics Training and Knowledge**:** An educative training session was organized for the selected workers to participate in this current study among the sugar factory workers as part of the Ergonomic Based interventional, which encompassed the ergonomic principles and its risk factors among sugar factory workers.

2. **Individual work process Modifications:** The workers were instructed on how to modify their work posture to suit the best posture to optimally achieve the Ergonomically stable conditions free of hazards at their workstation. The harmful effects of poor posture and awkward posture were made known to them, and also the correct alignment of equipment was also explained to the sugar factory workers.

3. **A Regular Exercise Program:** A training session on physical exercise was introduced by a physical therapist; the component of the training includes stretching movements that affect the neck, shoulder, waist, and bottom of the participants. The Sugar factory workers was instructed to monitor their daily exercise activities in the activities logbook, they were asked to get a book for the daily sports activities in the logbook. The workers were asked to continue the stretching exercise and other ergonomic movements suitable for the workplace.

Step 2

The evaluation was done to measure the effectiveness of the ergonomic-based Intervention among sugar factory workers ergonomic risk factors of musculoskeletal disorders. The Ergonomic intervention continued for three months for the experimental group, and the non-experimental group was exposed to normal body check-ups to avoid bias. The post-interventional assessment was carried out after the first three months of the intervention to see the impact and relevance of the intervention. The evaluations will be conducted using the standardized Nordic questionnaire and Quick assessment (QEC) tools.

Step 3

The last stage of the intervention was analysed after six months. At this final step, the experimental group and the non-experimental group were then compared to see if there is any reduction in MSD among the group under intervention as compared to the group without intervention. The evaluation was at this final stage, too, to measure the effectiveness of the ergonomic-based Intervention among sugar factory workers and ergonomic risk factors of musculoskeletal disorders. The evaluations were conducted using the standardized Nordic questionnaire and Quick Exposure Check (QEC) tools.

3.4.3 Subjects selection

Workers in all the units were randomly selected, and based on their willingness to join the baseline survey, only 402 were included in the study based on the calculated sample size. To achieve 5% of the margin error at 95% of confidence interval level, a minimum of 402 respondents was needed (Elfil M, Negida, 2017). To attain this for analysis, 10% was added to this figure, and so the sample size required was 402. Respondents in the study will be sampled based on full compliance with the inclusion criteria.

3.5 Inclusive criteria

To participate in this study, the following criteria was set:

1. The participant with symptoms of MSD in the last three weeks
2. Age 18 and above
3. The participant with more than six months of working experience.
4. Participants who are willing to join the study

3.5.1 Exclusive criteria

The exclusion criteria for participants in this study were if they did not meet all the above inclusion criteria.

1. The participant with an accident on any of this MSD region within the past 12 months
2. The participant with limb surgery within the past 12 months
3. Females participant who is pregnant
4. Participants who are critically ill and those with comorbid diseases such as TB

3.6 Construction of Research Instruments

The research instrument that was used for data collection is a well-used and validated questionnaire that has been used nationally and internationally in similar studies.

i). **A questionnaire** that has been used nationally and internationally in similar studies. Musculoskeletal Questionnaire (NMQ)- this is comprised well-structured questions that are standardized to evaluate the prevalence of musculoskeletal disorders among the participants and its risk factors. Nordic Musculoskeletal Questionnaire (NMQ)- A self-guided and well-structured questionnaire was given to the participants to evaluate the prevalence of musculoskeletal disorders and their risk factors. The most useful measuring instrument that is always used to evaluate work-related musculoskeletal disorders among workers of different sectors worldwide is the Nordic musculoskeletal questionnaire (NMQ). This involves various experts across the globe to standardize the questionnaire; the NMQ was developed to create a simple, standardized questionnaire. It should be able to be used to detect and analyze the MSDs symptoms of the different anatomical regions of different individual workers (Iti *et al*, 2016). The NMQ has several advantages over other measuring instruments. Some of them are standardized questions, worldwide recognition, and its free, it also provides a basis for self-evaluation among workers and even fast in quick identification of primary symptoms of Musculoskeletal disorders among workers. The NMQ also has broad applicability in a

huge population, and its consistency of its to be used together with some other evaluation tools like Quick assessment check (QEC) (Iti *et al,* 2016). The questionnaire (Appendix I) is made up of three sections. Section A contains questions on personal and lifestyle information. Section B collects data on occupational history. Section C gathers data on symptoms of any musculoskeletal disorder experienced by the respondent within the last seven days to twelve months, classified into nine musculoskeletal regions of the body.

ii) **Focused grouped discussion/interview guides:** - This was in the form of an interview guide to the participant to capture additional data that may miss in the questionnaire. Focus Group Discussions guide was drafted to guide the participant, and the participant was required to participate voluntarily in this study, and they were given the informed consent form designed by the researcher, also to guarantee their confidentiality (Appendix II). The researcher focused on the questions as slated in question guided attached as (Appendix II) to discuss the specific research variables, the risk of developing musculoskeletal disorders resulting from their work activities while working in the factory. This focused group discussion composed 13 people from factories, which will include the top managers and the workers, the audio recording was for a minimum of 15 minutes. The focus group was conducted among selected few workers that will include workers of different hierarchies to get their opinion that might not be captured in the questionnaire, this provides preferences and beliefs that may be a dedicated representative of the general population. The focused group discussions was recorded and treated as confidential.

iii). **Anthropometric measures-** The anthropometric parameters include taking the participant's height and taking their weight using digital weight scale balance The

anthropometric parameters include taking the participant's height and taking their weight using digital weight scale balance. These two parameters (height and weight) was used to calculate the BMI.

To calculate the Basal Metabolic Index, the participants' height in meters square (m2), and the participant's weight in Kilogram (kg).

The basal metabolic index is calculated using this formula:

BMI= Weight of the participant in Kilogram (kg)/ Height of the participants in meters square (m^2)

BMI= kg/ m^2 (*WHO 2019)*

iv). The Quick Exposure Check (QEC) –

The tools and procedure for data collection in this study are concise and systematic to gather information relevant to this current study and its objectives (Grove *et al.,* 2015). The participants recruited in this study were asked to fill up the Nordic Musculoskeletal questionnaire. The standardized Nordic Musculoskeletal Questionnaire is suitable for its applicability in workplaces and a large number of workers because it is very quick and cheap. This Nordic Musculoskeletal Questionnaire (NMQ) includes the nine anatomical body areas: the neck, the shoulders, the back, the elbows, the wrist/hands, the thighs, the knees, and the ankles. There are different tools for evaluating musculoskeletal disorders among workers worldwide. Still, one advantage of the Quick exposure checklist (QEC) is quick to evaluate the exposure of the workers to risks at work that might lead to the development of Musculoskeletal Disorders (Kuzucuoğlu, 2019). Another distinct feature of the QEC method is that it uses a score/checklist sheet that users has to be completed by users, usually known as the observer and workers. The quick exposure check is centralized on the expert's needs who have done major research

on musculoskeletal disorders risk factors. Over 150 experts worldwide have tested the validity of QEC; they also modified it using both in real tasks and simulation.

Various studies confirm that QEC is applicable for a wide range of tasks in all the sectors, with a concise duration of the training and some practice; this can ease the quicker completion of the assessment for each task. Several researchers across the globe have reported a high level of sensitivity and usability with a very large acceptable inter and intraobserver reliability. Besides that, deduction is the study about workers' physical abilities and work demands that translate into musculoskeletal disorders symptoms like neck pain. (Oliv, 2019. it is also documented that QEC has a good reliability score when used for assessment for musculoskeletal disorders, whereas only a few items from the tool show low reliability, which might attract some level of minimum bias risk (Oliv, 2019).

The QEC method is recognized as an observational tool that evaluates four major arrears of the body; back of the body, arm, and shoulder, hand, and wrist. (Oliv, et al, 2019). This method was specifically designed to involve both the evaluator and also the subject in scoring the work task together (Oliv, et al, 2019). The scoring shows the levels of exposure for body posture, repetitive movement, workload, and duration of work task given. The scoring of levels for each exposure will be totally up to get the final score for each of the body parts represented in the tools; also a total score for work stress and vibrations was also generated. (Bulduk et al, 2017). The quick exposure check (QEC) provides an evaluation of an equipment redesign and a workplace environment, which will facilitate the easy redesign. It also helps to prevent different kinds of work-related musculoskeletal disorders from developing and educate the observers about the early risk factors for MSDs at the workplace.

Table 6a: Showing various Exposure scores for body areas by (Ahmed et al., 2013)

	Exposure level			
Score	**Low**	**Moderate**	**High**	**Very High**
Back (static)	8-15	16-22	23-29	29-40
Back (Moving)	10-20	21-30	31-40	41-56
Shoulder/arm	10-20	21-30	31-40	41-56
Wrist/Hand	10-20	21-30	31-40	41-56
Neck	4-6	8-10	12-14	16-18
Driving	1	4	9	-
Vibration	1	4	9	
Workplace	1	4	9	
Stress	1	4	9	16

Source: A literature review by the researcher.

Table 6b: Showing various Risk assessments for QEC exposure level (E) by (Ahmed et al., 2013)

Level of risk	**Total QEC Score (E) (%)**	**Action level**
1 (low)	0-40	Acceptable
2 (moderate)	41-50	Investigate further
3 (High)	51-70	Investigate further and change soon
4 (very high)	>70	Investigate further and change immediately

The letter E stands for exposure level as shown in table 6b and can be calculated as a percentage rate that's in between the participant actual total exposure score denoted as (X) and the maximum possible total (Xmax), which is a standard score for manual handling tasks (XmaxMH=176) and other tasks (Xmax=162).

Exposure score (E)= participant actual total exposure score (X)/ maximum possible total (Xmax) x 100%

E=X/Xmax x 100%

The quick exposure check sometimes does not include methods to combine all the scores into the overall risk score. The following are suggested action levels based on the total score generated from QEC tools are as follows:

1. If the score is Less than 70: **Action Level-** Acceptable,
2. If the score is within the range 70-88: **Action Level-** Investigate further,
3. If the score is within the range 89-123: **Action Level-** Investigate further and change soon.
4. If the score is at 123: **Action Level-** Investigate and change immediately.

3.7 Pilot study

The pilot study was conducted among sugar factory workers to guide my research instruments properly by testing the validity and reliability of the research tools.

The following research tools were included in the research

1. The Nordic Musculoskeletal questionnaire
2. The quick assessment checks (QEC)

10% of the total sample size was 40 (402) considered as the sample size for this pilot study among the workers. These tools were subjected to expert opinions in other to triangulate and standardize the tools (Muhmmed et al., 2015). The researcher will use the pilot study results to make necessary modifications of the research tools due to omission or repetition of questions, and final corrections of the tools will be made at this stage of piloting.

3.8 Validity and Reliability

3.8.1 Testing for Validity

According to Grove et al, (2015), there are no instruments that are is entirely valid, which requires researchers to adequately evaluate the level and degree of validity instead of checking whether validity exists. Polit & Beck, (2017) also referred to validity as the extent to which a particular tool such as a questionnaire or any other method qualitative data collection tools can quickly ascertain a phenomenon that has been studied.

The initial questionnaire has a total of 72 questions in the questionnaire, after the modifications, including removing some redundant questions from the questionnaire. The number of items rated to be relevant in the questionnaire is 65.

To ensure that the instrument collected data as per its intention, the researcher distributed copies to colleagues who is occupational health physician, with more experience to rate the valid items in the instruments.

The content validity ratio (CVI) was calculated with a formula by Ebadi et al., (2017):

$$CVI = \frac{\text{Number of items rated to be relevant in the questionnaire (n) } 65}{\text{The total number of items in the questionnaire (N) } 72}$$

CVI= 0.903

The initial QEC has a total number of 47 questions in the assessment tools, after the modifications which include removing some redundant questions from the questionnaire. The number of items rated to be relevant in the questionnaire is 46.

The content validity ratio (CVI) was calculated with a formula by Ebadi et al., (2017):

CVI= Number of items rated to be relevant in the questionnaire (n)= 46

The total number of items in the questionnaire (N) (QEC)= 47

CVI= 0.98

The value of CVI obtained to be 0.903 and 0.98, which is a measure of the instrument's validity, was interpreted based on Cohen and Manion (2018) scale. The Validity index of 0.903 and 0.98 was ascertained, which is greater than the Standard Value of 0.7, indicating that the items were extremely relevant and therefore considered acceptable for this study.

3.8.2 Testing for Reliability

The term reliability of an instrument can be defined as the degree to which specific research tools can measure what is supposed to measure consistently. In line with this study, reliability could be referred to as the consistency of the tools in measuring the same phenomena. A reliability of 0.70 or higher was considered acceptable for this study. The NMQ has been translated into various languages and occupations and tested for its validity and reliability (Wang et al, 2017).

The results from the pre-test were entered with the final findings using Pearson's Correlation Coefficient formula. Cohen and Manion (2018) explain that a reliable instrument is expected to give a value of 0.7

The summary below shows how reliability will be calculated using the formula:

$$r = \frac{n\sum XY - \sum X \sum Y}{\sqrt{n(\sum X^2) - (\sum X)^2 . n(\sum Y^2) - (\sum Y)^2}}$$

The following parameters denote as follows:

n = sample size (or number of the tools pairs of pre-test and re-test scores during the study)

X= Pre-test scores from the tools

Y = Re-test scores from the tools

XY = The product of the pre-test scores and the re-test scores from the tools.

$\sum X$ = The sum of the pre-test scores from the tools

$\sum Y$ = Sum of the re-test scores

$\sum XY$ = The sum of the product of pre-test scores and re-test scores

The reliability was calculated using SPSS analysis to compute the Cronbach's Alpha which is 0.878 for 65 the validated items in the questionnaire out of the 72 items before as shown in table 7 below.

Table 7: The SPSS output for the reliability Cronbach's Alpha

Reliability Statistics		
Cronbach's Alpha	**Cronbach's Alpha Based on Standardized Items**	**N of Items**
0.878	0.912	65

A reliability of 0.70 or higher was considered acceptable for this study. The NMQ has been translated into various languages and tested for its validity and reliability (Wang et al, 2017).

For the instrument to be accepted and reliable, the average index should be 0.7 or above (Wang et al, 2017). This value of 0.7 indicates a good degree of reliability of the entire questionnaire (Cohen and Manion 2018). Hence, using the already validated instruments from the questionnaire, it was reasonable to conclude that the questionnaire was suitably reliable for the study.

3.9 Data Analyses

The data analysis for this study included both qualitative and quantitative approaches.

3.9.1 The quantitative data analysis plan

The analysis of this study was done using IBM statistical packages for social science (SPSS) version 26. The prevalence of MSDs for each anatomical region was calculated from the Nordic Musculoskeletal disorders questionnaire (NMQ) data. The incidence rates were calculated as the number of cases of MSD arising during the 6 months in each of the work situations as shown in table 8 below.

The methods of analysis will be presented in the table below concerning the study-specific objectives.

Table 8: Methods of Analysis Used For Each of the Study Objectives

	Specific Objectives	Method of analysis
1	To determine the prevalence and incidence of Work-Musculoskeletal Disorders among sugar factory workers (UFCIL and SCUOL) in Jinja Uganda.	Descriptive statistics
2	To identify the risk factors associated with the development of Work-related Musculoskeletal Disorders among the sugar factory workers (UFCIL and SCUOL) in Jinja Uganda.	Inferential statistics including chi-square test of independence Independent samples t-test.
3	To determine the effect of an ergonomic-based intervention on the risk of developing and progression of WRMSDs among sugar factory workers ((UFCIL and SCUOL) in Jinja Uganda.	Inferential statistics; Anova one-way, A multivariate logistic regression.

The prevalence was calculated for a period of study and will be calculated using the formula (Rajiv, 2018).

Prevalence = ***number of cases of disease (WRMSDs) present in a population during a specific period*** ***Number of persons at risk of having the disease at the specified time***

The above ratio is multiplied by 1,000 or 10,000 to yield more readily interpretable statistics.

Descriptive statistics, namely, Means, Standard deviations, and Percentage frequencies, were used to determine the number of the different anatomical regions affected by WRMSDs.

Inferential statistics which includes in this current study namely,

The researcher used the Chi-square test of independence to determine an association between the two categorical variables. The chi-square test was done to establish if there is an association between WRMSDs and its risk factors among the Sugar factory workers.

Independent samples t-test was used to compare two groups of cases in one variable.

The "Pearson's Product-Moment correlation" was used to establish any correlation between each of the identified risk factors, and the body part most affected by WRMSDs among the Sugar factory workers.

A multivariate logistic analysis was used to determine if the variables and covariates were associated.

A paired t-test will be used to compare the means of the two study groups to see if there is statistical evidence that the associated population means were significantly different.

A significant level of $P \leq 0.05$ was used in this study.

The final results of this study was presented in the forms of graphs, chats, Figures, and use of tables.

3.9.2 Qualitative Data analysis plan.

All data generated from the focused group discussion was analysed qualitatively using thematic analysis. The choice of thematic analysis was its suitability in identifying key themes and addressing the research question. The qualitative data analysis adopted the format of Braun and Clarke's (2006).

Table 9: Showing six phases of thematic analysis by Braun and Clarke's (2006)

Step I	The researcher becomes familiarize with the data.
Step II	Generate initials codes for the data
Step III	Search for the themes of the data
Step IV	Define the themes of the data
Step IV	Review the themes
Step VI	Write-up

Source: Literature review by researcher.

This focused group discussion is composed of 13 respondents 9 males and 4 females from factories, which the two top managers, four supervisors from different units, and the workers.

The recorded responses from the respondents were transcribed verbatim, it was then coded, categorized into themes and subthemes Using Alast.ti version 9.

The themes and categories that emerge from the transcripts of the audio record are summarized and detailed in table 26 below

Table 10: Themes and Categories that emerge from the transcripts.

	Themes	Categories
1.	Effect of Musculoskeletal disorders	I. Difficulty in carrying out work II. Pain in body region among the workers III. Lack of enough exercises
2.	Perceptions on Musculoskeletal disorders	I. Behaviours of health care workers II. Types of services at the factory clinic III. Fear of losing their jobs IV. Support from the supervisors
3.	Treatment of Musculoskeletal disorders	I. Use of medications II. Inadequate resting time III. Use of exercise IV. Presence of pain in the body region
4.	Workstation modifications	I. Lack of support on PPE use II. Shortage of staff III. Inadequate shifting time IV. Minimal resting time V. Advice of work environment modification

3.10 Ethical Consideration

Ethical approval to carry out this research was requested from Mount Kenya University Research and ethical Committee. After that, permission was also obtained from CIUREC and Uganda National Council for Science and Technology (UNSCT) as an ethics review board. Authority from Uganda Farmer Crop limited the experimental group and Sugar corporation of Uganda limited, jinja municipal, Uganda, consent from individual participant workers was also sought.

The following guideline was used to address the ethical issues in the field during the research.

i. The purpose of the study was explained to participants using an information sheet

ii. The participants were assured of strict confidentiality of any information they provided,

iii. Each participant was required to fill an informed, written consent letter.

iv. Anonymity was assured to the participant by using codes for identification instead of their names.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

In this chapter, the qualitative and quantitative results of the study are presented and guided by the study objectives. The first part of the study describes results from the quantitative part, while the second parts describe and interprets the results of the qualitative aspect of the study. The quantitative results of the study populations are presented as follows; socio-demographic characteristics, biomechanical factors, and psychosocial factors. Statistical analysis was done to explore the relationship between WRMSDs and their risk factors among the participant. The descriptive and inferential statistic was used in this study to present quantitative data, and the results were presented with the aid of tables, charts, diagrams, and graphs. The qualitative part of the study was analyzed using thematic analysis under themes and categories.

4.1.1 Response rate in the study

The total population in this study is 402 for both factories that were splitted equally Factory A (The experimental group) n=201, Factory B (Control group) n=201) respectively at baseline, and all the data were retrieved completely. The post-intervention response rate dropped due to loss to follow-up between the baseline and post-intervention in both factories; the drop rate in the experimental group was 27.7% (n=54) and the control group12.9% (n=26). However, due to the loss to follow-up, the following respondent could finish the research process from the experimental group 72.6% (n=146) and control group 87.1% (n=175).

4.1.2 Socio-demographic characteristics (Individual Factors) of the respondents from the experimental group

Table 11 below showed the demographic information of the 201 and 146 respondents involved in the baseline and post-intervention studies, respectively. It can be observed that two-thirds of both groups of respondents were between the ages of 20-29. Similarly, 8 out of every 10 respondents from the intervention and post-intervention were found out to be male, and where relatively half of both groups of respondents were married. Regarding the highest level of education, the majority of the 201 respondents involved in the intervention, 94/201 (46.8%), had certificate/diploma education while 66 of the total 146 of the post-intervention respondents (45.2%) constituted the majority, had primary/basic educational attainment. The mean BMI of the respondents in the experimental group was 22.97 at baseline and 23.06 at post-intervention. Both groups of respondents in the intervention and the post-intervention displayed an average of 122 systolic blood pressure and 77 diastolic blood pressures. More than one-third, 37.8% (76/201) and 41.1% (60/146) of the respondents involved in both the intervention and post-intervention were fieldworkers, and relatively half of them (101/201) 50.2%; 81/146 (55.5%)) works at the manufacturing department of the factories. The majority of the respondents both at the intervention 94.1% (190/201) and the post-intervention 94.5% (138/146) do not smoke at the same time, more than three-quarters 89.1% (179/201) and 88.4% (129/146) of both phases do not drink. Regarding the work experience across, the majority of the respondents at baseline, 77.6% (156/201) and 71.9% (105/146) post-intervention, had less than 5years of work experience. Regarding the working hours per week and per day, the majority of the respondents, 132/201 (65.7%) and 84/201 (41.8%) worked 40-60 hours per week. However, considering working hours per day at baseline, 41.8% (84/201) of the

respondent worked more than five hours per day and 82/146 (56.2%) at the post- (*see table 11*).

Table 11: Socio-Demographic Characteristics of the respondents from the Experimental group

		Baseline (N=201)		Post-intervention (N=146)	
Variables		**(n)**	**(%)**	**(n)**	**(%)**
Age (Years)	20-29	134	66.7%	101	69.2%
	30-39	43	21.4%	27	18.5%
	40-49	17	8.5%	13	8.9%
	50 and above	7	3.5%	5	3.4%
Gender	Male	174	86.6%	127	87.0%
	Female	27	13.4%	19	13.0%
Marital Status	Married	96	47.8%	69	47.3
	Single	105	52.2%	77	52.7%
Educational Status	Non-formal	5	2.5%	5	3.4%
	Primary/Basic	89	44.3%	66	45.2%
	Certificate/Diploma	94	46.8%	63	43.2%
	Degree	13	6.5%	12	8.2%
BMI (Kg/m^2)		**Mean**	**SD**	**Mean**	**SD**
		22.97	3.182	23.06	3.07
Blood Pressure (mmHg)	Systolic	121.45	10.715	121.8	11.69
	Diastolic	76.65	10.320	76.65	10.47
Job Designations	Field workers	76	37.8%	60	41.1%
	Junior staff	74	36.8%	48	32.9%
	Middle staff	43	21.4%	33	22.6%
	Senior manager	8	4.0%	5	3.4%
Department/Unit of the respondents	Administration	15	7.5%	10	6.8%
	Engineering	10	5.0%	10	6.8%
	Manufacturing	101	50.2%	81	55.5%
	Cane	75	37.3%	45	30.8%
Smoking Habit of the respondents	Yes	11	5.5%	8	5.5%
	No	190	94.5%	138	94.5%
Drinking Habit of the respondents	Yes	22	10.9%	17	11.6%
	No	179	89.1%	129	88.4%
Work experience in Years	< 5 years	156	77.6%	105	71.9%
	5-9 years	36	17.9%	35	24.0%
	10 years and above	9	4.5%	6	4.1%
Working hours per week	< 40 hours	55	27.4%	37	25.3%
	40-60 hours	132	65.7%	80	54.8%
	60 hours and above	14	7.0%	29	19.9%
Working hours per day	< 1 hour	46	22.9%	24	16.4%
	2-4 hours	71	35.3%	40	27.4%
	5 hours and above	84	41.8%	82	56.2%

4.1.3 Socio-demographic characteristics of the respondents from the Control group

Table 12 below shows the demographic information of the respondents in the control group where it can be observed that the majority of the respondents were between the age of 30-39, both at the baseline and post-intervention 86/201 (42.8%) and 75/175 (42.9%). Where 8 out of every 10 respondents, 89.1% (179/201) were found out to be male during the baseline data collection, a similar percentage which represents the majority 154/175 (88%), were also reported for males at post-intervention, and three-quarters of both groups of respondents reported to be married. Regarding educational attainment, 83 of the total 201 (41.3%) respondents involved in the baseline study had certificate/diploma education, and more than two-thirds of the 175 participants (37.7%) at post-intervention constituted the majority also had certificate/diploma education. The mean BMI of the respondents in the baseline study was 24.52 **(Kg/m^2),** and that of the 175 respondents that participated in the post-intervention data collection was 24.49. The 201 respondents in the baseline displayed an average of 131 systolic blood pressure and 81 diastolic blood pressure, while 134/82 mean blood pressure was observed for the 175 respondents in the post-intervention. The majority 84/201 (41.8%), are fieldworkers at the baseline; only 63 of the 175 total respondents (36%) were found to be field workers at the post-intervention. The majority of the respondents, 101/201 (50.2%) at the baseline and 90/175 (51.4%) at post-intervention, were from the manufacturing department of the factory. More than 90% of the respondents, both at the baseline and the post-intervention do not have a smoking habit. While three-quarters of the 201 respondents (78.1%) at the baseline do not drink, 8 out of every 10 respondents at the post-intervention do not drink as well. In terms of the work experience, the majority of the respondents 94/201 (46.8%) at the baseline, had a working experience of 10 years and above, while at post-intervention, the majority 80/175 (45.7%) had less than 5years

work experience. Regarding the working hours per week and per day, more than half 119/201 (59.2%) of the respondents and 116/201 (57.7%) worked for 40-60 hours per week and for 5 and more hours per day respectively among the baseline respondents while nearly two-thirds of the total 175 respondents 109/175 (62.3%) at post-intervention worked for 40-60 hours per week, less than half (45.7 of them worked for 5 hours and above per day.

Table 12: Socio-Demographic characteristics of the respondent from the Control group

		Baseline (N=201)		Post-intervention (N=175)	
Variables		**(n)**	**(%)**	**(n)**	**(%)**
Age (Years)	20-29	55	27.4%	46	26.3%
	30-39	86	42.8%	75	42.9%
	40-49	39	19.4%	34	19.4%
	50 and above	21	10.4%	20	11.4%
Gender	Male	179	89.1%	154	88.0%
	Female	22	10.9%	21	12.0%
Marital Status	Married	156	77.6%	138	78.9%
	Single	44	21.9%	37	21.1%
	Others	1	0.5%	-	-
Educational Status	Non-formal	21	10.4%	20	11.4%
	Primary/Basic	65	32.3%	59	33.7%
	Certificate/Diploma	83	41.3%	66	37.7%
	Degree	30	14.9%	28	16.0%
	Masters	2	1.0%	2	1.1%
BMI (Kg/m^2)		**Mean**	**SD**	**Mean**	**SD**
		24.52	3.734	24.49	3.76
Blood Pressure (mmHg)	Systolic	130.89	14.817	133.99	21.80
	Diastolic	80.72	9.165	81.87	12.12
Job Designations	Field workers	84	41.8%	63	36.0%
	Junior staff	73	36.3%	61	34.9%
	Middle staff	35	17.4%	46	26.3%
	Senior manager	9	4.5%	5	2.9%
Department/Unit of the respondents	Administration	10	5.0%	10	5.7%
	Engineering	15	7.5%	9	5.1%
	Manufacturing	101	50.2%	90	51.4%
	Cane	75	37.3%	66	37.7%
Smoking Habit of the respondents	Yes	8	4.0%	13	7.4%
	No	193	96%	162	92.6%
Drinking Habit of the respondents	Yes	44	21.9%	32	18.3%
	No	157	78.1%	143	81.7%
Work experience in Years	< 5 years	80	39.8%	80	45.7%
	5-9 years	27	13.4%	42	24.0%
	10 years and above	94	46.8%	53	30.3%
Working hours per week	< 40 hours	71	35.3%	65	37.1%
	40-60 hours	119	59.2%	109	62.3%
	60 hours and above	11	5.5%	1	0.6%
Working hours per day	< 1 hour	43	21.4%	37	21.1%
	2-4 hours	42	20.9%	58	33.1%
	5 hours and above	116	57.7%	80	45.7%

4.1.4 Biomechanical factors of the respondents from the Experimental group

Table 13 below displayed the biomechanical factors of the study respondents, demonstrating that the majority of the respondents, 140/201 (69.7%) and 118/146 (80.8%) at baseline and post-intervention, respectively, engaged in bending, twisting, and awkward posture during tasks. Two-thirds of the total 201 respondents (69.7%) from the baseline do overstretch during their tasks and the majority 110/146 (75.3%) also reported such at post-intervention. The majority of the respondents both during the baseline 182/201 (90.5%) and the post-intervention 137/146 (93.8%) reported engaging in a monotonous task, while more than half of the participants in the baseline 113/201 (56.2%) and the post-intervention (89/146 (61%)) always engage in Carrying Heavy load during the task. Where more than two-thirds of the 201 respondents in the baseline (72.1%) and more than three-quarters of the post-intervention respondents 118/146 (80.8%) do stand for long during the majority of their tasks of the respondents at baseline 158/201 (78.6%), do not sit for long during their tasks and 8 out every 10 respondents from the post-intervention 121/146 (82.9%) also do not sit for long during their task. Where 8 out every 10 respondents and 9 out of every 10 respondents at baseline and post-intervention respectively engaged in repetitive hand movement during their tasks, more than 80% of respondents from both phases used to be in the same postures for long periods during their task.

Table 13: Biomechanical factors of the respondent from The experimental group

		Baseline (N=201)		Post-intervention (N=146)	
Variables		**(n)**	**(%)**	**(n)**	**(%)**
Bending, twisting and Awkward posture during the task	Yes	140	69.7%	118	80.8%
	No	61	30.3%	28	19.2%
Overstretching during the task	Yes	133	69.7%	110	75.3%
	No	68	30.3%	36	24.7%
Monotonous Task	Yes	182	90.5%	137	93.8%
	No	19	9.5%	9	6.2%
Carrying Heavy load during the task	Yes	113	56.2%	89	61.0%
	No	88	43.8%	57	39.0%
Standing for long during the task	Yes	145	72.1%	118	80.8%
	No	56	27.9%	28	19.2%
Sitting for long during the task	Yes	43	21.4%	25	17.1%
	No	158	78.6%	121	82.9%
Repetitive hand movement during the task	Yes	177	88.1%	136	93.2%
	No	24	11.9%	10	6.8%
Same postures for long periods during the task	Yes	161	80.1%	121	82.9%
	No	40	19.9%	25	17.1%

4.1.5 Biomechanical factors of the respondents from the Control group

Table 13 displays the biomechanical factors of the study respondents. It was demonstrated that the majority of the respondents 140/201 (69.7%) and 136/175 (77.7%) at baseline and post-intervention, respectively engaged in bending, twisting, and awkward posture during tasks. Two-thirds of the total 201 respondents (68.2%) from the baseline do overstretch during their tasks, while the majority 114/175 (65.1%) also reported such from the post-intervention data collection. The majority of the respondents, both during the baseline 127/201 (63.2%) and the post-intervention 120/175 (68.6%), reported engaging in a monotonous task. More than half of the participants in the baseline 117/201 (58.2%) and the post-intervention (93/175 (53.1%)) do not engage in Carrying Heavy load during the task. In the situation where 51.7% of the respondents in the baseline reported not to stand for long during their tasks, while 117/175 (66.9%) of the respondents during post-intervention reported standing for long during their tasks. Similarly, half of the respondents during the baseline 102/201

(50.7%) sit for long during their tasks, and relatively half of the respondents 92/175 (52.6%) during the post-intervention do not sit for long during their task. Where 8 out every 10 respondents in both phases of data collection engaged in repetitive hand movement during their tasks. However, the majority 120/201 (59.7%) at during the baseline and 114/175 (65.1%) during post-intervention, used to be in the same postures for long periods during their task.

Table 14: Biomechanical factors of the respondents from the Control group

		Baseline (N=201)		Post-intervention (N=175)	
Variables		**(n)**	**(%)**	**(n)**	**(%)**
Bending, twisting and Awkward posture during the task	Yes	140	69.7%	136	77.7%
	No	61	30.3%	39	22.3%
Overstretching during the task	Yes	137	68.2%	114	65.1%
	No	64	31.8%	61	34.9%
Monotonous Task during the task	Yes	127	63.2%	120	68.6%
	No	74	36.8%	55	31.4%
Carrying Heavy load during the task	Yes	84	41.8%	82	46.9%
	No	117	58.2%	93	53.1%
Standing for long during the task	Yes	97	48.3%	117	66.9%
	No	104	51.7%	58	33.1%
Sitting for long during the task	Yes	102	50.7%	83	47.4%
	No	99	49.3%	92	52.6%
Repetitive hand movement during the task	Yes	164	81.6%	155	88.6%
	No	37	18.4%	20	11.4%
Same postures for long periods during the task	Yes	120	59.7%	114	65.1%
	No	78	38.8%	61	34.9%

4.1.6 Psychosocial Factors of the respondent from The experimental group

The psychosocial factors of the respondents were displayed in table 15 below, of which relatively half of the respondents 109/201 (54.2%). The majority of the respondents during the baseline 114/201 (56.7%) reported using painkillers to relieve themselves from the pain of musculoskeletal disorder, while the majority of the respondents 65/146 (44.5%) during the post-intervention also used painkillers to relieve themselves of MSD pain. In comparison, 85/146 (58.2%) at intervention and post-intervention have never visited a doctor, physiotherapist, or a Nurse, due to MSD. Similarly, more than 90% of the total 201 and 146 respondents from the baseline and post-intervention have never been hospitalized due to these pains or problems. Where 9 out of every 10 respondents both at baseline and post-intervention had never changed jobs due to MSD, more than 80% of respondents from both phases have also not been off from work in the last 12 months due to pain or discomfort.

Regarding the break time during work, 48% of the 201 respondents involved in the intervention do have a break once a day, and 66% of the respondents (63/146) in the post-baseline respectively do not have a break at all during the day. Most of the respondents do not feel tense during their task (59% and 66% at baseline and post-intervention, respectively. Relatively two-thirds of the respondents 133/201 (66.2%) involved in the baseline often feel very tired after work due to their tasks. Half of the 146 respondents (54.8%) from the post-intervention reported not constantly feeling tired after work due to their tasks. Where the majority of the respondents from the baseline (64%) regularly feel tired after getting up in the morning, half of the respondents from the post-intervention (56.2%) at the other hand do not periodically feel tired after getting up in the morning.

Table 15: Psychosocial Factors of the respondent from The experimental group

Variables		(n)	(%)	(n)	(%)
Ever visit a doctor, physiotherapist, or a Nurse, due to these pains or problem	Yes	92	45.8%	61	41.8%
	No	109	54.2%	85	58.2%
Ever been hospitalized due to these pains or problem	Yes	9	4.5%	6	4.1%
	No	192	95.5%	140	95.9%
Relieved from this pain of the musculoskeletal disorder	Painkillers	114	56.7%	65	44.5%
	Local herbs	8	4.0%	10	6.8%
	Exercise others	10	5.0%	22	15.1%
		69	34.3%	49	33.6%
Ever had to change jobs due to these pains or problem	Yes	18	9.0%	4	2.7%
	No	183	91.0%	142	97.3%
Ever been off from work in the last 12 months	Yes	31	15.4%	28	19.2%
	No	170	84.6%	118	80.8%
Off from work due to pain or discomfort	Yes	27	13.4%	29	19.9%
	No	174	86.6%	117	80.1%
Days off from work	1-3 days	8	4.0%	16	11.0%
	4-7 days	8	4.0%	31	21.2%
	8-12 days	2	1.0%	2	1.4%
	>14 days	11	5.5%	1	0.7%
	Not applicable	172	85.6%	96	65.8%
Break time	Once a day	97	48.3%	51	34.9%
	Twice a day	36	17.9%	32	21.9%
	Not all	68	33.8%	63	43.2%
Feel tense during your task	Yes	83	41.3%	49	33.6%
	No	118	58.7%	97	66.4%
Often very tired after work during your task	Yes	133	66.2%	66	45.2%
	No	68	33.8%	80	54.8%
Regularly feeling tiredness after getting up in the morning	Yes	128	63.7%	64	43.8%
	No	73	36.3%	82	56.2%

4.1.7 Psychosocial Factors of the respondents from the Control group

The psychosocial factors of the respondents were displayed in table 16 below, of which the majority of the respondents 124/201 (61.7%) and 117/175 (66.9%) at baseline and post-intervention, respectively, have never visited a doctor, physiotherapist, or a Nurse, due to MSD. Similarly, 88% of the total 201 and 175 respondents from the baseline and post-intervention have never been hospitalized due to these pains or problems. The majority of the respondents during the baseline 121/201 (60.2%) reported using painkillers to relieve themselves from the pain of musculoskeletal disorder, and the majority of the respondents 81/175 (46.3%) during the post-intervention do not use any

of the listed means to relieve themselves of MSD pain. Where 9 out of every 10 respondents both at the baseline and post-intervention had never changed jobs due to MSD, more than 80% of respondents from both phases have also not been off from work during the last 12 months due to pain or discomfort. Regarding the break time during work, 60% and 72% of the respondents involved in the baseline and post-intervention do have breaks twice a day. The majority of them do not feel tense during their task (65% from both baseline and phase ii, relatively half of the respondents 116/201 (57.7%) involved in the baseline often feel very tired after work due to their tasks. Two-thirds of the 175 respondents (66.9%) from the baseline reported the same. Both respondents (67% from the baseline and 58% from phase ii) do not regularly feel tired after getting up in the morning.

Table 16: Psychosocial Factors of the respondents from the Control group

Variables		(n)	(%)	(n)	(%)
Ever visit a doctor, physiotherapist, or a Nurse, due to these pains or problem	Yes	77	38.3%	58	33.1%
	No	124	61.7%	117	66.9%
Ever been hospitalized due to these pains or problem	Yes	21	10.4%	21	12.0%
	No	176	87.6%	154	88.0%
Relieved from this pain of the musculoskeletal disorder	Painkillers	121	60.2%	68	38.9%
	Local	9	4.5%	3	1.7%
	herbs	19	9.5%	23	13.1%
	Exercise	52	25.9%	81	46.3%
	Not applicable				
Ever had to change jobs due to these pains or problem	Yes	15	7.5%	16	9.1%
	No	186	92.5%	159	90.9%
Ever been off from work in the last 12 months	Yes	51	25.4%	63	36.0%
	No	150	74.6%	112	64.0%
Off from work due to pain or discomfort	Yes	36	17.9%	25	14.3%
	No	165	82.1%	150	85.7%
Days off from work	1-3 days	16	8.0%	14	8.0%
	4-7 days	12	6.0%	9	5.1%
	8-12 days	9	4.5%	-	-
	>14 days	12	6.0%	2	1.1%
	Not applicable	152	75.6%	150	85.7%
Break time	Once a day	54	26.9%	32	18.3%
	Twice a day	121	60.2%	126	72.0%
	Not all	26	12.9%	17	9.7%
Feel tense during your task	Yes	71	35.3%	62	35.4%
	No	130	64.7%	113	64.6%
Often very tired after work during your task	Yes	116	57.7%	117	66.9%
	No	85	42.3%	58	33.1%
Regularly feeling tiredness after getting up in the morning	Yes	67	33.3%	73	41.7%
	No	134	66.7%	103	58.3%

4.1.8 Prevalence of Work-related Musculoskeletal Disorders among the experimental group in Factory A.

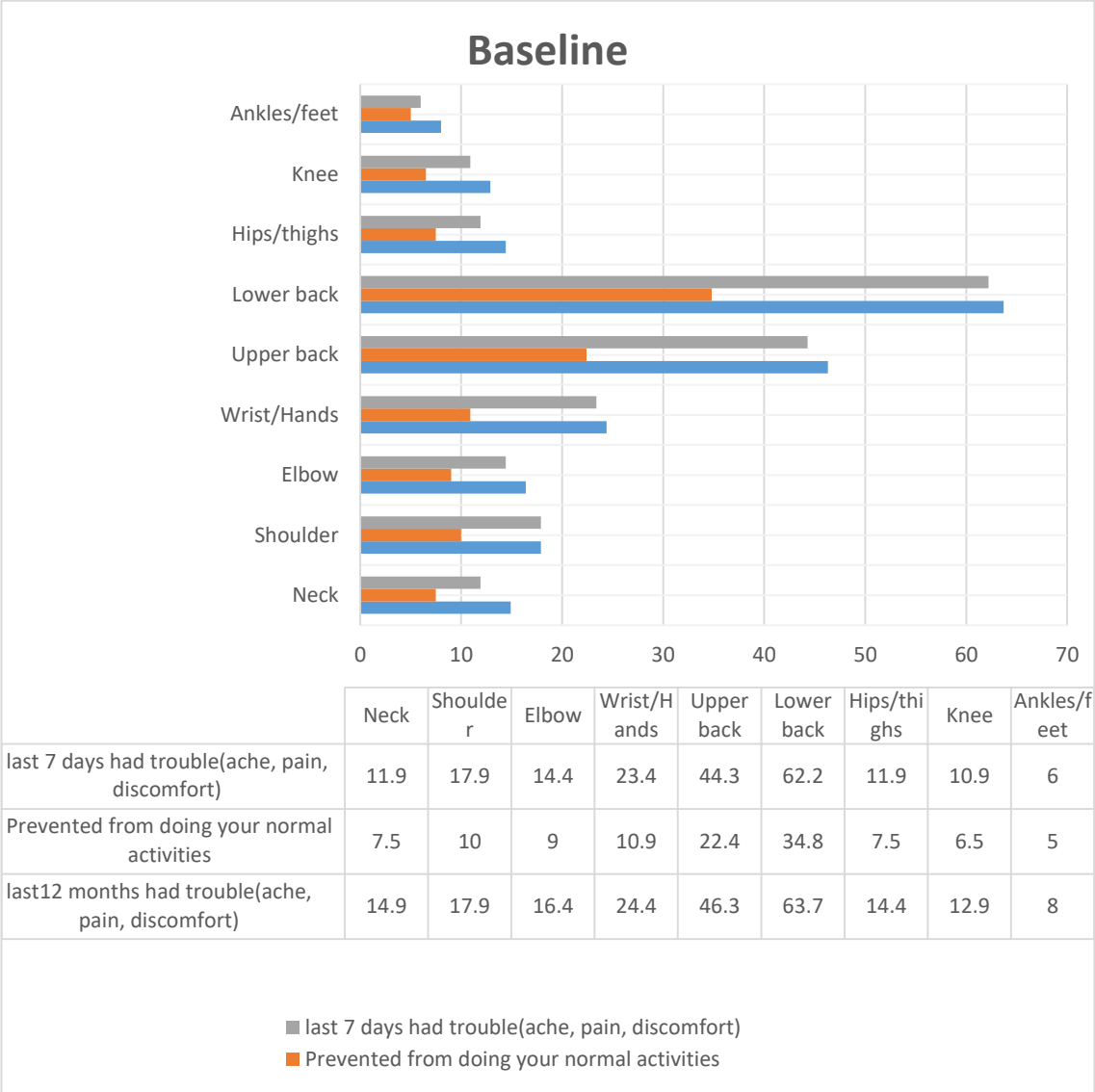
Table 17 below showed the prevalence of musculoskeletal disorders by body parts among the respondents at the baseline and post-intervention or pre-test and post-test revealed the regional prevalence based on 12 months and 7-days. The following prevalence was recorded from the baseline study (n=201) at 12 months and 7-days for the experimental group on the worker's anatomical regions as also showed in Figure 5. Lower back pain had the highest prevalence 63.7% and 62.2% upper back pain 46.3%

and 44.3%, wrist/hands 24.3% and 23.4%, shoulder 17.9% and 17.9%, elbow 16.4% and 14.4%, Neck 14.9% and 11.9%, hips/thigh 14.4% and 11.9%, Knee 12.9% and 10.9, with the ankle/Feet with the lowest prevalence at 12 months and 7-days 8.0% and 6.0%. The following prevalence was recorded from post-intervention (n=146) at 12 months and 7-days for the experimental group with lower back pain had the highest prevalence 24% and 38.4%, hips/thigh 15.8% and 15.1%, shoulder 15.1%, and 16.4%, Neck 15.1% and 13%, upper back pain 13.7% and 28.8%, wrist/hands 13% and 19.9, Knee 12.3% and 10.3%, elbow 11.6%, and 15.1%, with the ankle/Feet with the lowest prevalence at 12 months and 7-days 8.9% and 7.5%.

During the last 12 months' respondents were prevented from doing their normal activities (at work, home, or Leisure) because of the trouble in the anatomical region represented in prevalence from baseline data (n=201) and post-intervention (n=146) for the experimental group. Lower back pain had the highest prevalence 34.8% and 9.6%, upper back pain 22.4% and 5.5%, wrist/hands 10.9% and 4.1%, shoulder 10.0% and 8.2%, elbow 9.0% and 3.4%, Neck 7.5% and 4.1%, hips/thigh 7.5% and 4.1%, Knee 6.5% and 3.4, with the ankle/Feet with the lowest prevalence 5.0% and 2.7of the respondents were not affected during both phases of data collection.

Table 17: Prevalence of Work-related Musculoskeletal Disorders among the experimental group.

Percentage of body Part affected	Have you at any time during the last12 months had trouble(ache, pain, discomfort)				During the last 12 m have you been prevented from doing your normal activities (at work, home, or Leisure) because of the trouble.				Have you had trouble at any time during the last 7 days because of the pain			
	Baseline (N=201)		Post-intervention (N=146)		Baseline (N=201)		Post-intervention (N=146)		Baseline (N=201)		Post-intervention (N=146)	
	Yes	NO	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
1. Neck	30 (14.9%)	171 (89.6%)	22 (15.1%)	124 (84.9%)	15 (7.5%)	186 (92.5%)	6 (4.1%)	140 (95.9%)	24 (11.9%	177 (88.1%)	19 (13%)	127 (87%)
2. Shoulder	36 (17.9%)	165 (82.1%)	22 (15.1%)	124 (84.9%)	20 (10%)	181 (90%)	12 (8.2%)	134 (91.8%)	36 (17.9%)	165 (82.1%)	24 (16.4%)	122 (83.6%)
3. Elbow	33 (16.4%)	168 (83.6%)	17 (11.6%)	129 (88.4%)	18 (9.0%)	183 (91.0%)	5 (3.4%)	141 (96.6%)	29 (14.4%)	172 (85.6%)	22 (15.1%)	124 (84.9%)
4. Wrist (s)/ Hands (s)	49 (24.4%)	152 (75.6%)	19 (13%)	127 (87%)	22 (10.9%)	179 (89.1%)	6 (4.1%)	140 (95.9%)	47 (23.4%)	154 (76.6%)	29 (19.9%)	117 (80.1%)
5. Upper Back	93 (46.3%)	108 (53.7%)	20 (13.7%)	126 (86.3%)	45 (22.4%)	156 (77.6%)	8 (5.5%)	138 (94.5%)	89 (44.3%)	112 (55.7%)	42 (28.8%)	104 (71.2%)
6. Lower Back	128 (63.7%)	73 (36.3%)	35 (24%)	111 (76%)	70 (34.8%)	131 (65.2%)	14 (9.6%)	132 (90.4%)	125 (62.2%)	76 (37.8%)	56 (38.4%)	90 (61.6%)
7. Hip(s)/Thigh (s)	29 (14.4%)	172 (85.6%)	23 (15.8%)	123 (84.2%)	15 (7.5%)	186 (92.5%)	6 (4.1%)	140 (95.9%)	24 (11.9%)	177 (88.1%)	22 (15.1%)	124 (84.9%)
8. Knee (s)	26 (12.9%)	175 (87.1%)	18 (12.3%)	128 (87.7%)	13 (6.5%)	188 (93.5%)	5 (3.4%)	141 (96.6%)	22 (10.9%)	179 (89.1%)	15 (10.3%)	131 (89.7%)
9. Ankle (s) Foot or Feet	16 (8%)	185 (92%)	13 (8.9%)	133 (91.1%)	10 (5%)	191 (95%)	4 (2.7%)	142 (97.3%)	12 (6%)	189 (94%)	11 (7.5%)	135 (92.5%)



	Neck	Shoulder	Elbow	Wrist/Hands	Upper back	Lower back	Hips/thighs	Knee	Ankles/feet
last 7 days had trouble(ache, pain, discomfort)	11.9	17.9	14.4	23.4	44.3	62.2	11.9	10.9	6
Prevented from doing your normal activities	7.5	10	9	10.9	22.4	34.8	7.5	6.5	5
last12 months had trouble(ache, pain, discomfort)	14.9	17.9	16.4	24.4	46.3	63.7	14.4	12.9	8

Figure 5: Prevalence of WRMSDs among the experimental group in Factory A. On analysis of Standardized Musculoskeletal Questionnaire

4.1.8 Prevalence of Work-related Musculoskeletal Disorders among the Control group in Factory B.

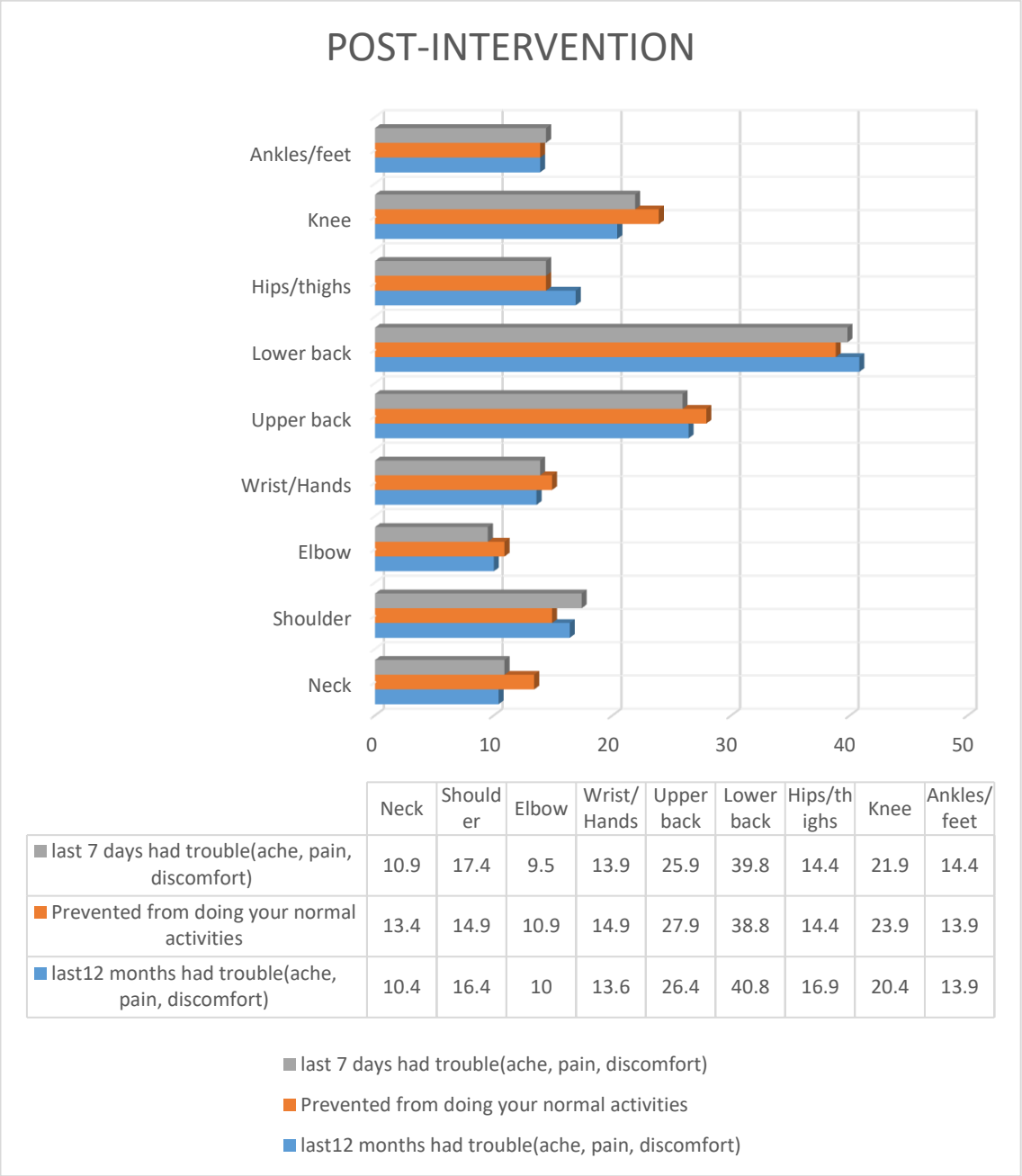
Table 18 below shows the prevalence of musculoskeletal disorders by body parts among the Control group respondents at the baseline (n=201) and the post-intervention (n=175). The majority of the respondents had the highest prevalence of 41% and 46% at the baseline and post-intervention for lower back ache/pain/discomfort during the last

12 months. However, 39% (78/201) from the baseline reported having been prevented from doing their normal activities (at work, home, or Leisure) because of the trouble of lower back pain. While 40% (80/201) of the total 201 respondents from the baseline reporting to have had had a problem of lower back pain during the last 7-days because of the pain. The lowest prevalence was reported at the elbow 10.9% and 10.3% at neck and ankles at post-intervention

Table 18: Prevalence of Work-related Musculoskeletal Disorders among control group in Factory B

	Percentage of body Part affect **Before N=201, After N=175**	Have you at any time during the last12 months had trouble(ache, pain, discomfort)				During the last 12m have you been prevented from doing your normal activities (at work, home or Leisure) because of the trouble.				Have you had trouble at any time during last 7 days because of the pain			
		Baseline (N=201)		**Post-intervention (N=146)**		**Baseline (N=201)**		**Post-intervention (N=146)**		**Baseline (N=201)**		**Post-intervention(N=146)**	
		Yes	NO	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
	Neck	21 (10.4%)	180 (89.6%)	37 (21.1%)	138 (78.9%)	27 (13.4%)	174 (86.6%)	18 (10.3%)	157 (89.7%)	22 (10.9%	179 (89.1%)	26 (14.9%)	149 (85.1%)
1	Shoulder	33 (16.4%)	168 (83.6%)	45 (25.7%)	137 (78.3%)	30 (14.9%)	171 (85.1%)	21 (12.0%)	154 (88.0%)	35 (17.4%)	166 (82.6%)	38 (21.7%)	137 (78.3%)
2	Elbow	20 (10%)	181 (90%)	36 (20.6%)	139 (79.4%)	22(10.9%)	179 (89.1%)	12 (6.9%)	163 (93.1%)	19 (9.5%)	182 (90.5%)	27 (15.4%)	148 (84.6%)
3.	Wrist (s)/ Hands (s)	28 (13.9%)	173 (86.1%)	47 (26.9%)	128 (73.1%)	30 (14.9%)	171 (85.1%)	19 (10.9%)	156 (89.1%)	28 (13.9%)	173 (86.1%)	31 (17.7%)	144 (82.3%)
4.	Upper Back	53 (26.4%)	148 (73.6%)	38 (21.7%)	137 (78.3%)	56 (27.9%)	145 (72.1%)	19 (10.9%)	156 (89.1%)	52 (25.9%)	149 (74.1%)	29 (16.6%)	144 (83.4%)
5.	Lower Back	82 (40.8%)	119 (59.2%)	81 (46.3%)	94 (53.7%)	78 (38.8%)	123 (61.2%)	32 (18.3%)	143 (81.7%)	80 (39.8%)	121 (60.2%)	46 (26.3%)	129 (73.7%)
1	Hip(s)/Thigh (s)	34 (16.9%)	167 (83.1%)	31 (17.7%)	144 (82.3%)	29 (14.4%)	172 (85.6%)	21 (12.0%)	154 (88.0%)	29 (14.4%)	172 (85.6%)	23 (13.1%)	152 (86.9%)
1	Knee (s)	41 (20.4%)	160 (79.6%)	37 (21.1%)	138 (78.9%)	48 (23.9%)	153 (76.1%)	19 (10.9%)	156 (89.1%)	44 (21.9%)	157 (78.1%)	25 (14.3%)	150 (85.7%)

1 Ankle (s) Foot or Feet	28 (13.9%)	173 (86.1%)	25 (14.3%)	150 (85.7%)	28 (13.9%)	173 (86.1%)	18 (10.3%)	157 (89.7%)	29 (14.4%)	172 (85.6%)	16 (9.1%)	159 (90.9%)



	Neck	Shoulder	Elbow	Wrist/ Hands	Upper back	Lower back	Hips/thighs	Knee	Ankles/ feet
last 7 days had trouble(ache, pain, discomfort)	10.9	17.4	9.5	13.9	25.9	39.8	14.4	21.9	14.4
Prevented from doing your normal activities	13.4	14.9	10.9	14.9	27.9	38.8	14.4	23.9	13.9
last12 months had trouble(ache, pain, discomfort)	10.4	16.4	10	13.6	26.4	40.8	16.9	20.4	13.9

Figure 6: Prevalence of WRMSDs among control group in Factory B On analysis of Standardized Musculoskeletal Questionnaire.

4.1.9 Considering the effect of musculoskeletal disorders on the workers

Based on workers' responses during the interview, it was established that the effect of WRMSDs was related to workers' level of pain they sustain as a result of WRMSDs in the body region. This was also confirmed by findings from quantitative studies, the

highest lower back pain as the most affected and most prevalent of the anatomical region among the respondent. Other subthemes were associated with the effect of WRMSDs, such as the lack of adequate rest among the workers.

Quotation from the respondents on the effect of WRMSDs

A1: *''we feel headache, low-back pain a lot of time''*

A17: ''Now for like last week, I left here when I have chest pain, and I couldn't even rest on the bed. I slept on the floor, and that is when I felt some peace''.

4.1.10 WRMSDs treatments among the workers

The majority of the workers use painkillers to reduce the pain, and it shows a direct linkage from the networking diagram. Workers also believe if they have adequate shifting, it will reduce the WRMSDs among them. Most workers were forced to look for treatment as the difficulty rose, eventually preventing them from doing their routine work.

Quotation from the respondents on the treatment of WRMSDs

A4: ''*I remain doing the work, except that I go to the clinic and they give me some medicine, then i return to work''*

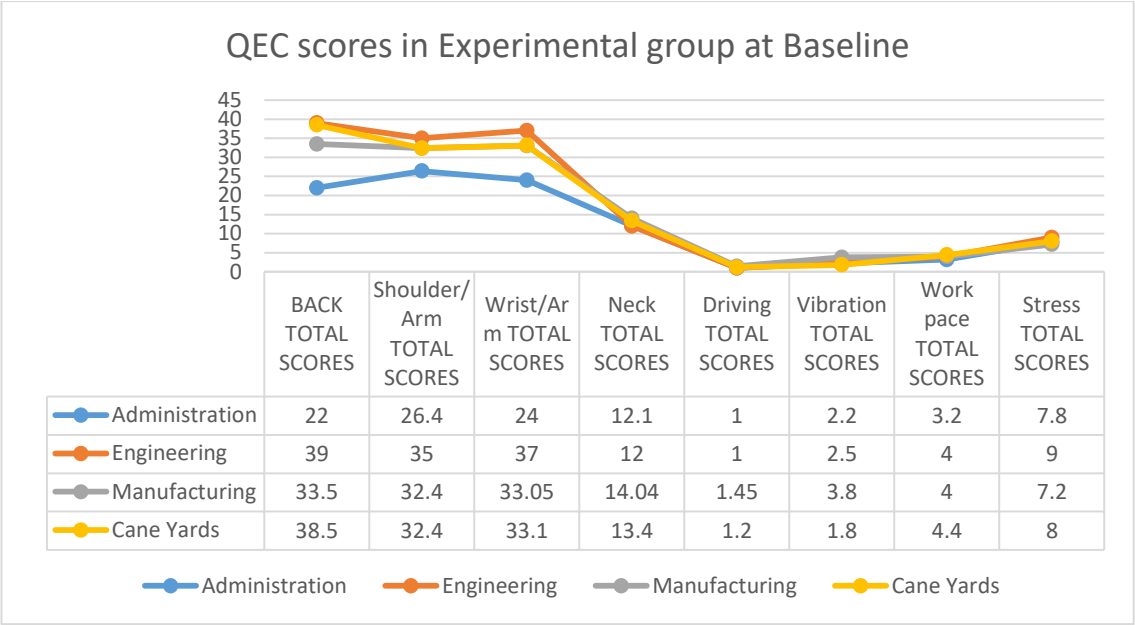
4.1.11: Assessment of the Risk of WRMSDs using Quick exposure checks scores for respondents in the Experimental group in all the departments/Units

Table 19 below displayed the descriptive statistic of the total QEC scores in the form of mean and standard deviation across each unit and department, and it was observed that during the baseline and post-intervention, respectively, respondents from the engineering unit had the highest mean score for total back score (39.0 and 29.2), shoulder/arm score (35.0 and 29.0), wrist/arm score (37.0 and 29.4) and stress total score (9.0 and 3.4). While respondents from the manufacturing department displayed

the highest mean score for neck total score (14.0 and 11.7), driving total score (1.45 and 1.1), and total vibration score (3.8 and 3.4), whereas for work pace, respondents from the cane yards during the baseline demonstrated the highest mean score with a total score of 4.4. At the post-intervention stage, all respondents displayed a mean score of 4.0 for work pace constantly across all departments. The figures below 3 and 4 also buttressed the graphical representation of QEC scores among the experimental groups in Factory A at baseline and post-intervention.

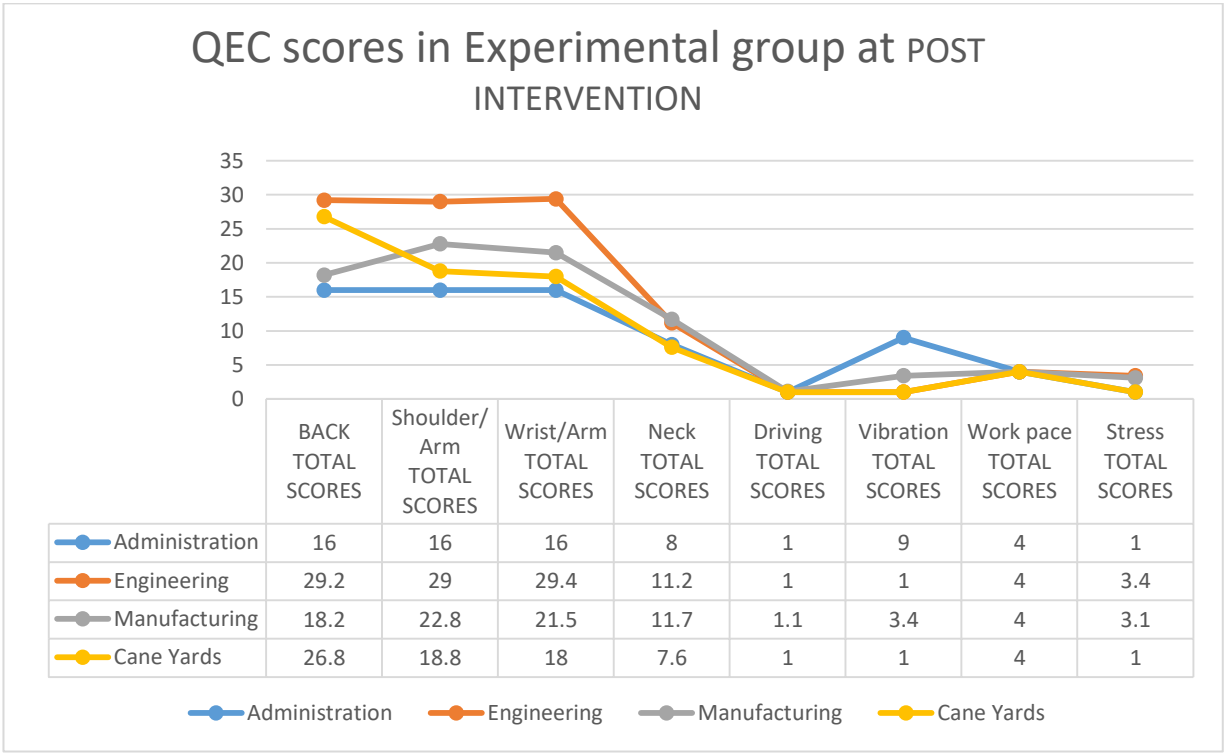
Table 19: Assessment of Risk of WRMSDs using Quick exposure checks scores for respondents in Experimental group in all the departments/Units

Departments	BASELINE (N=201)							
	OBSERVERS ASSESSMENT SCORE				WORKERS ASSESSMENT SCORE			
	BACK TOTAL SCORES	Shoulder/ Arm TOTAL SCORES	Wrist/ Arm TOTAL SCORES	Neck TOTAL SCORES	Driving TOTAL SCORES	Vibration TOTAL SCORES	Work pace TOTAL SCORES	Stress TOTAL SCORES
	Mean/(SD)	Mean/(SD)	Mean/(SD)	Mean/(SD)	Mean/(SD)	Mean/(SD)	Mean/(SD)	Mean/(SD)
Administration	22.0/4.34	26.4/7.26	24.0/7.37	12.1/0.92	1.0/0.00	2.20/1.55	3.2/1.37	7.8/4.49
Engineering	39.0/11.60	35.0/5.27	37.0/3.16	12.0/2.11	1.0/0.00	2.5/1.58	4.0/0.00	9.0/0.00
Manufacturing	33.5/10.51	32.4/9.25	33.05/7.67	14.04/2.98	1.45/1.07	3.8/3.60	4.0/1.90	7.2/4.48
Cane Yards	38.5/5.40	32.4/5.74	33.1/5.08	13.4/1.88	1.2/0.75	1.8/1.97	4.4/2.02	8.0/2.59
POST-INTERVENTION (N=146)								
Administration	16.0/0.00	16.0/0.00	16.0/0.00	8.0/0.00	1.0/0.00	9.0/0.00	4.0/0.00	1.0/0.00
Engineering	29.2/1.93	29.0/4.38	29.4/8.69	11.2/1.93	1.0/0.00	1.0/0.00	4.0/0.00	3.4/3.86
Manufacturing	18.2/6.74	22.8/5.25	21.5/7.23	11.7/20.06	1.1/0.57	3.4/3.68	4.0/0.00	3.1/1.70
Cane Yards	26.8/0.99	18.8/5.95	18.0/4.95	7.6/1.98	1.0/0.00	1.0/0.00	4.0/0.00	1.0/0.00



	BACK TOTAL SCORES	Shoulder/ Arm TOTAL SCORES	Wrist/Arm TOTAL SCORES	Neck TOTAL SCORES	Driving TOTAL SCORES	Vibration TOTAL SCORES	Work pace TOTAL SCORES	Stress TOTAL SCORES
Administration	22	26.4	24	12.1	1	2.2	3.2	7.8
Engineering	39	35	37	12	1	2.5	4	9
Manufacturing	33.5	32.4	33.05	14.04	1.45	3.8	4	7.2
Cane Yards	38.5	32.4	33.1	13.4	1.2	1.8	4.4	8

Figure 7: Assessment of the Risk of WRMSDs using Quick exposure checks scores for respondents in Experimental group in all the departments/Units at baseline.



	BACK TOTAL SCORES	Shoulder/ Arm TOTAL SCORES	Wrist/Arm TOTAL SCORES	Neck TOTAL SCORES	Driving TOTAL SCORES	Vibration TOTAL SCORES	Work pace TOTAL SCORES	Stress TOTAL SCORES
Administration	16	16	16	8	1	9	4	1
Engineering	29.2	29	29.4	11.2	1	1	4	3.4
Manufacturing	18.2	22.8	21.5	11.7	1.1	3.4	4	3.1
Cane Yards	26.8	18.8	18	7.6	1	1	4	1

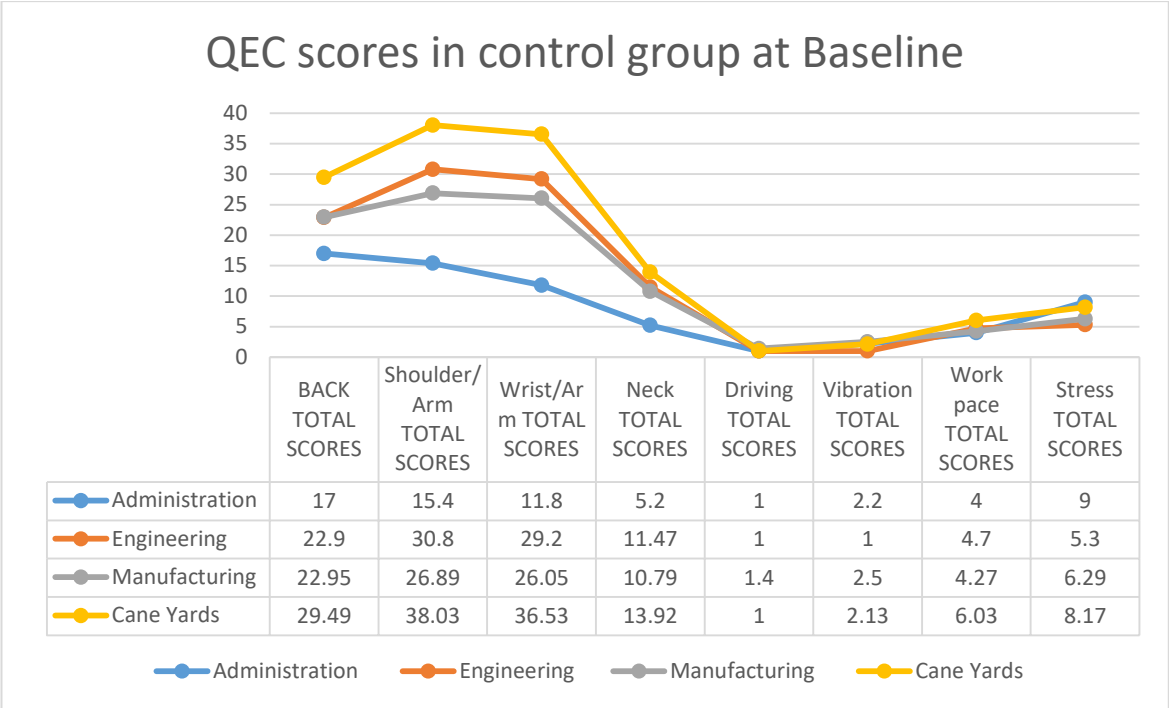
Figure 8: Assessment of the Risk of WRMSDs using Quick exposure checks scores for respondents in Experimental group in all the departments/Units at post-intervention.

4.1.11: Assessment of the Risk of WRMSDs using Quick exposure checks scores for respondents in the control group in all the departments/Units at baseline in Factory B.

Table 20 below displays the descriptive statistic of the total QEC scores in the form of mean and standard deviation across each unit and department. it was observed that during the baseline and post-intervention, respectively respondents from the Cane yards boasted the highest mean score for total back score (29.49 and 26.27), shoulder/arm score (38.03 and 33.76), wrist/arm score (36.53 and 32.79), total neck score (13.92 and 13.88), work pace total score (6.03 and 5.61) and stress total score among respondents from post-intervention (7.65). In contrast, respondents from the administration department at the baseline had the highest mean score for stress (9.0). From baseline and post-intervention, the respondents from the manufacturing department displayed the highest mean score for driving (1.40 and 1.17). Some concerns in the format of reporting.

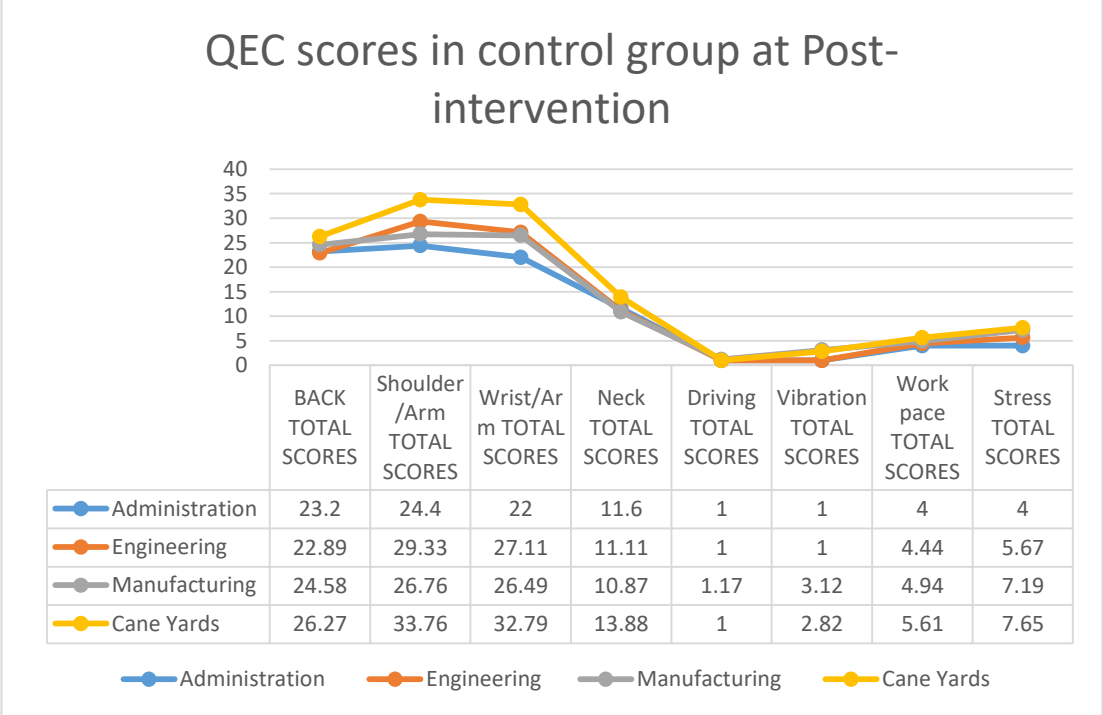
Table 20: Assessment of the Risk of WRMSDs using Quick exposure checks scores for respondents in control group in all the departments/Units at baseline.

Departments	BEFORE (N=201)							
	OBSERVERS ASSESSMENT SCORE				WORKERS ASSESSMENT SCORE			
	BACK TOTAL SCORES	Shoulder/Arm TOTAL SCORES	Wrist/Arm TOTAL SCORES	Neck TOTAL SCORES	Driving TOTAL SCORES	Vibration TOTAL SCORES	Work pace TOTAL SCORES	Stress TOTAL SCORES
	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD	Mean/SD
Administration	17.0/9.35	15.4/8.69	11.80/2.90	5.20/1.93	1.0/0.00	2.20/1.55	4.0/0.00	9.0/0.00
Engineering	22.9/7.74	30.8/8.24	29.2/5.17	11.47/2.56	1.0/0.00	1.0/0.00	4.7/2.92	5.3/2.29
Manufacturing	22.95/9.09	26.89/12.20	26.05/9.62	10.79/2.84	1.40/1.74	2.50/3.01	4.27/1.80	6.29/3.33
Cane Yards	29.49/8.57	38.03/10.82	36.53/6.92	13.92/1.87	1.0/0.00	2.13/2.54	6.03/2.84	8.17/3.70
	AFTER (N=175)							
Administration	23.20/2.53	24.40/4.09	22.0/0.00	11.60/5.72	1.0/0.00	1.0/0.00	4.0/0.00	4.0/0.00
Engineering	22.89/8.31	29.33/8.30	27.11/6.64	11.11/2.85	1.0/0.00	1.0/0.00	4.44/2.88	5.67/2.50
Manufacturing	24.58/9.22	26.76/10.84	26.49/8.07	10.87/3.20	1.17/0.69	3.12/3.23	4.94/1.97	7.19/3.39
Cane Yards	26.27/8.08	33.76/10.50	32.79/6.63	13.88/1.67	1.0/0.00	2.82/3.39	5.61/2.91	7.65/2.98



	BACK TOTAL SCORES	Shoulder/ Arm TOTAL SCORES	Wrist/Arm TOTAL SCORES	Neck TOTAL SCORES	Driving TOTAL SCORES	Vibration TOTAL SCORES	Work pace TOTAL SCORES	Stress TOTAL SCORES
Administration	17	15.4	11.8	5.2	1	2.2	4	9
Engineering	22.9	30.8	29.2	11.47	1	1	4.7	5.3
Manufacturing	22.95	26.89	26.05	10.79	1.4	2.5	4.27	6.29
Cane Yards	29.49	38.03	36.53	13.92	1	2.13	6.03	8.17

Figure 9: Assessment of the Risk of WRMSDs using Quick exposure checks scores for respondents in control group in all the departments/Units at baseline.



	BACK TOTAL SCORES	Shoulder /Arm TOTAL SCORES	Wrist/Arm TOTAL SCORES	Neck TOTAL SCORES	Driving TOTAL SCORES	Vibration TOTAL SCORES	Work pace TOTAL SCORES	Stress TOTAL SCORES
Administration	23.2	24.4	22	11.6	1	1	4	4
Engineering	22.89	29.33	27.11	11.11	1	1	4.44	5.67
Manufacturing	24.58	26.76	26.49	10.87	1.17	3.12	4.94	7.19
Cane Yards	26.27	33.76	32.79	13.88	1	2.82	5.61	7.65

Figure 10: Assessment of the Risk of WRMSDs using Quick exposure checks scores for respondents in control group in all the departments/Units at post-intervention

4.1.12: Assessment of exposure level to WRMDs risk using QEC scores for respondents in the Experimental group in all the departments/Units in Factory A at baseline.

Table 11 below shows actual exposure scores from QEC and the exposure rating between the observer and the workers' assessment score sheet. The highest exposure level was found on the back region (51.2%) and the wrist region (63.2%) among workers. The lowest exposure score was recorded on the shoulder (5.5%) and Neck region (1%). On the worker's assessment, workers have lower exposure to driving risk, and the highest exposure was on stress (90%) among the workers, and work pace was found moderate (78.1%) and might pose no potential harm to workers.

Table 21: Assessment of exposure level to WRMDs risk using QEC scores for respondents in the Experimental group in all the departments/Units in Factory A at baseline.

Risk Rating Score (RR)	Exposure level			
	Low	Moderate	High	Very High
Back total	11.9	19.4	51.2	17.4
Shoulder/arm	5.5	48.3	30.8	15.4
Wrist/Hand	7.0	23.9	63.2	6.0
Neck	1.0	11.9	31.7	35.3
Driving	90.0	10.0		
Vibration	70.1	12.4	17.4	
Workplace	12.9	78.1	9.0	
Stress	7.0	27.9	55.7	9.5

4.1.13: Assessment of exposure level to the risk of WRMSDs using QEC Cumulative scores for respondents in the Experimental group in all the departments/units post-intervention.

This table shows the QEC calculated exposure scores level at baseline among the respondents. This was generated by exposure scores from the QEC assessments score, majority of the respondent in different departments have the highest level of risk (n=131) 65.5%, almost one-third of the respondents' exposure score was n=54 (26.9%), and the only negligible number was at low-risk level n=1 (0.5%).

Table 22: Assessment of exposure level to the risk of MWRMDs using QEC Cumulative scores for respondents in Experimental group in all the departments/Units at post-intervention at baseline.

Total QEC Score (%)	N	No. (%)	Action level	Risk level	Action
0-40	1	0.5%	1	Low	Acceptable
41-50	15	7.7%	2	Moderate	Investigate further
51-70	54	26.9%	3	High	Investigate further and change soon
>70	131	65.5%	4	Very high	Investigate further and change immediately
Total		100%			

4.1.14: Assessment of exposure level to the risk of MWRMDs using QEC Cumulative scores for respondents in the Experimental group in all the departments/Units at post-intervention

The results from these tables show the QEC calculated exposure scores data from post-intervention among the respondents, majority of the risk level decreased n=80 (54.8%), only a few respondents fall into the category of the high and very high-risk level after the intervention n=22 (15.1%) and n=5 (3.4%).

Table 23: Assessment of exposure level to the risk of WRMSDs using QEC Cumulative scores for respondents in the Experimental group in all the departments/Units at post-intervention

Total QEC Score (%)	N	No. (%)	Action level	Risk level	Action
0-40	80	54.8%	1	Low	Acceptable
41-50	39	26.7%	2	Moderate	Investigate further
51-70	22	15.1%	3	High	Investigate further and change soon
>70	5	3.4%	4	Very high	Investigate further and change immediately
Total		100%			

4.1.15: Showing Independent t-test baseline characteristics of the study sample in both factories

able 14 below presents baseline characteristics of the two study groups showing their mean, standard deviations. An independent t-test was run to see statistical differences between variables at baseline for the two study groups. Variables such as; Age of the respondent (p=0.000), BMI (p=0.000), Duration of work in the field per day (p=0.033), systolic (p=0.000), and Diastolic (p=0.000) were all statistical significant between the two factories. There are no statistical differences in the average work duration in the field per week and work experience per year of the respondent from the two factories. Considering the mean BMI, it shows a normal BMI range (18.50 – 24.90) for the two study groups, the average mean of the systolic and diastolic (126.17/78.9) also conforms with the normal body systolic and diastolic pressure range (120/80). Table 14: Showing Independent t-test baseline characteristics of the study sample in both factories

Table 24: Showing Independent t-test baseline characteristics of the study sample in both factories

	The experimental group n (201)		Control group n (201)		
Variables	Mean	SD	Mean	SD	P value
Age of the group	1.49	0.79	2.13	0.93	0.000**
BMI	22.97	3.18	24.52	3.73	0.000**
Experience	1.27	0.54	2.07	0.93	0.076
Duration of work in field per week	1.80	0.55	1.70	0.57	0.056
Duration of work in field per day	2.19	0.784	2.36	0.81	0.033*
Systolic (mmHg)	121.45	10.72	130.89	14.82	0.000**
Diastolic (mmHg)	76.65	10.32	80.72	9.17	0.000**
QEC TOTAL	130.5	27.6	112.1	36.3	0.000**

4.1.16: Factors associated with the prevalence of WRMSDs in the different body regions and sociodemographic factors among the experimental group (n=201)

The table below shows the association between sociodemographic factors and the prevalence of WWRMSDs in different body regions among the workers in The experimental group at baseline for 12-month/7-days. The following variables were significant statistically, considering the 12-month prevalence of WRMSDs in different body regions. The chi-square values (χ^2) and P-value (p) respectively were indicated; Age was associated with Musculoskeletal disorders in the following anatomical structures: at the elbow (χ^2=11.049, p=0.011). Education level was associated with disorders in the following anatomical structures: at Upper back region (χ^2=8.360, p=0.039. Alcohol consumption was associated with Musculoskeletal disorders in the following anatomical structures. At the elbow (χ^2=7.162, p=0.014), the remaining

variables on sociodemographic factors are not statistically significant at P<0.005 in remaining different body regions. The following sociodemographic variables were statistically significant on considering the 7-days prevalence of WRMSDs in different body regions. The chi-square values (χ^2) and P-value (p) respectively were indicated their; Age was associated with Musculoskeletal disorders in the following anatomical structures: at the elbow (χ^2 =8.031, p=(0.045), the educational level was associated with Musculoskeletal disorders in the following anatomical structures: at 8.980 (0.030), and Upper back region (χ^2=10.555, p=0.014), smoking was associated with Musculoskeletal disorders in the following anatomical structures:: at Upper back region (χ^2= 3.817, p=0.050), and Alcohol consumption was associated with Musculoskeletal disorders in the following anatomical structures: at the elbow (χ^2=6.051, p=0.023), the remaining variables on sociodemographic factors shows no statistical significance at P=0.005 in remaining different body regions.

Table 25: Factors associated with the prevalence of WRMSDs in the different body regions and sociodemographic factors, among the experimental group (n=201)

Characteristics		neck	Shoulders	Elbow	Wrist (s)/ Hands (s)	Upper Back	Lower Back	Hip(s) /Thigh (s)	Knee(s)	Ankles/Feet
		χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)
Age										
20-29	**12-month**	5.167	5.743 (0.125)	11.049	2.768 (0.429)	0.214 (0.971)	1.776 (0.620)	1.443	1.310	3.247
30-39		(0.160)		(0.011)*				(0.696)	(0.727)	(0.355)
40-49	**7-days**	6.240	6.953 (0.073)	8.031 (0.045)*	4.327 (0.228)	0.086 (0.994)	1.946 (0.584)	2.849	1.843	2.896
50 and above		(0.100)						(0.416)	(0.606)	(0.408)
Gender										
Male	**12-month**	0.000	0.008 (0.555)	1.845 (0.138)	1.357 (0.176)	1.069 (0.205)	0.007 (0.547)	0.004	0.863	0.013
Female		(0.625)						(0.572)	(0.256)	(0.634)
	7-days	0.245	0.008 (0.555)	1.245 (0.211)	0.679 (0.274)	0.663 (0.274)	0.008 (0.554)	0.020	1.835	0.115
		(0.407)						(0.593)	(0.152)	(0.498)
Marital Status										
Married	**12-month**	0.017	0.005 (0.545)	1.108 (0.195)	0.213 (0.384)	0.937 (0.204)	0.002 (0.542)	2.395	0.060	0.502
Single		(0.528)						(0.088)	(0.485)	(0.327)
Others	**7-days**	0.448	0.0193 (0.400)	0.117 (0.445)	1.323 (0.163)	0.508 (0.284)	0.923 (0.208)	3.777	0.465	0.026
		(0.325)						(0.041)	(0.326)	(0.553)
Educational Status										
Non-formal	**12-month**	0.928	2.185 (0.535)	7.402 (0.060)	5.673 (0.129)	**8.360 (0.039)***	4.660 (0.198)	3.643	4.872	3.370
Primary/Basic		(0.819)						(0.303)	(0.181)	(0.338)
Certificate/Diploma	**7-days**	1.512	2.102 (0.552)	8.980 (0.030)*	5.832 (0.120)	**10.555**	3.541 (0.315)	4.252	6.526	5.100
Degree		(0.679)				**(0.014)***		(0.236)	(0.089)	(0.165)
Masters										
Smoking										
Yes	**12-month**	2.042	0.616 (0.381)	0.026 (0.566)	0.242 (0.471)	3.277 (0.067)	1.655 (0.168)	0.268	0.284	1.006
No		(0.161)						(0.510)	(0.429)	(0.392)
	7-days	1.578	0.616 (0.381)	0.133 (0.490)	1.327 (0.225)	3.817 (0.050)*	1.907 (0.144)	0.090	0.041	0.739
		(0.238)						(0.613)	(0.656)	(0.499)
Alcoholism										
Yes	**12-month**	0.032	3.250 (0.072)	7.162 (0.014)*	1.925 (0.132)	0.285 (0.381)	1.973 (0.119)	0.282	0.604	1.084
No		(0.577)						(0.395)	(0.311)	(0.248)
	7-days	0.915	3.250 (0.072)	6.051 (0.023)*	2.323 (0.107)	0.114 (0.459)	2.390 (0.092)	0.915	1.327	0.429

		(0.257)						(0.257)	(0.206)	(0.387)
Experience (yrs)										
< 5 years	**12-month**	0.159	0.733 (0.693)	0.240 (0.887)	0.482 (0.786)	1.771 (0.413)	5.138 (0.077)	0.517	2,467	0.785
5-9 years		(0.923)						(0.772)	(0.291)	(0.675)
10 years and above	**7-days**	0.038	0.733 (0.693)	0.707 (0.702)	0.819 (0.664)	1.083 0.582	0.858 (0.651)	0.566	0.089	0.446
		(0.981)						(0.753)	(0.449)	(0.800)
Working hours (Wks)										
< 40 hours	**12-month**	1.192	5.322 (0.070)	4.895 (0.087)	5.203 (0.074)	3.457 (0.178)	1.005 (0.605)	0.965	2.107	1.332
40-60 hours		(0.551)						(0.617)	(0.349)	(0.514)
60 hours and above	**7-days**	0.473	4.302 (0.116)	3.811 (0.149)	4.792 (0.091)	2.688 (0.261)	0.030 (0.985)	3.079	0.502	1.084
		(0.790)						(0.215)	(0.778)	(0.582)
Working hours (day)										
< 1 hour	**12-month**	3.830	0.131 (0.936)	4.361 (0.113)	1.665 (0.435)	1.704 (0.427)	0.702 (0.704)	0.589	2.471	2.166
2-4 hours		(0.147)						(0.745)	(0.291)	(0.339)
5 hours and above	**7-days**	0.830	0.385 (0.825)	3.194 (0.202)	2.474 (0.290)	3.016 (0.221)	1.632 (0.442)	1.399	1.121	0.039
		(0.660)						(0.497)	(0.571)	(0.981)

4.1.17: Factors associated with the prevalence of WRMSDs in different body region and occupational factors, among the experimental group (n=201)

The table above shows the association between Biomechanical factors which is also the work posture factors and 12-month and 7-days prevalence of WWRMSDs in different body region among the workers in The experimental group. The following variables were significant statistically, considering the 12-month prevalence of WRMDs in different body regions, The chi-square values (χ^2) and P-value (p) respectively were indicated; Awkward posture was associated with Musculoskeletal disorders in the following anatomical structures: at elbow (χ^2=6.205, p=0.008) and upper back (χ^2 =4.940, p=0.019), overstretching was associated with Musculoskeletal disorders in the following anatomical structures: at Shoulder (χ^2=7.791, p=0.003), at the elbow (χ^2 =8.313, p=0.002), Upper back (χ^2=9.786, p=0.001) and at Hips/thigh (χ^2=4.166, p=0.030), Carrying of heavy load during work was associated with Musculoskeletal disorders in the following anatomical structures: at shoulder (χ^2=8.281, p=0.003), at elbow (χ^2=6.124, p=0.010), at Wrist/hands (χ^2=3.260, p=0.050), at Upper back (χ^2 =9.337, p=0.002) and at lower back (χ^2=3.188, p=0.050), Standing for long was associated with Musculoskeletal disorders in the following anatomical structures: at wrist/hands (χ^2=4.289, p=0.026) and at Knees at (χ^2=3.958, p=0.033), Repetitive movements was associated with Musculoskeletal disorders in the following anatomical structures: at shoulders (χ^2=3.501, p=0.045), elbow at (χ^2=5.354, p=0.010), and at wrists/hands (χ^2=3.806, p=0.037), same posture for an extended period was associated with Musculoskeletal disorders in the following anatomical structures: at upper back (

χ^2=9.086, p=0.002) and at lower back (χ^2=5.654, p=0.015). The remaining variables on biomechanical factors are not statistically significant at P<0.005 in the remaining different body regions. The following variables were significant statistically, considering the 7-days prevalence of WRMDs in different body regions, The chi-square values (χ^2) and P-value (p) respectively were indicated Awkward posture was associated with Musculoskeletal disorders in the following anatomical structures: at elbow (χ^2=6.415, p=0.007), at wrist/hands (χ^2=3.640, p=0.039) and at upper back (χ^2 =4.688, p=0.022), Overstretching was associated with Musculoskeletal disorders in the following anatomical structures: at shoulders (χ^2=10.12, p=0.001), at elbow (χ^2 =8.351, p=0.002), at wrist/hands (χ^2=4.319, p=0.026), at upper back (χ^2=7.475, p=0.005), and at Hips/thigh (χ^2=3.587, p=0.043), Carrying heavy load was associated with Musculoskeletal disorders in the following anatomical structures: at shoulders (χ^2 =10.553, p=0.001), at elbow (χ^2=5.313, p=0.016) and at wrist/hands (χ^2=3.503, p=0.043), Standing for long was associated with Musculoskeletal disorders in the following anatomical structures: at elbow (χ^2=3.337, p=0.049), at wrist/hands (χ^2 =3.586, p=0.041) and at hips/thigh (χ^2=5.171, p=0.015), Repetitive movements was associated with Musculoskeletal disorders in the following anatomical structures: at shoulders (χ^2=3.501, p=0.045), at elbow (χ^2=4.595, p=0.018) and at wrists/hands (χ^2 =3.446, p=0.047), Same posture for long was associated with Musculoskeletal disorders in the following anatomical structures: at wrist/hands (χ^2=3.301, p=0.049) and at upper

back (χ^2=9.600, p=0.001). The remaining variables on biomechanical factors show no statistical significance at P=0.005 in the remaining different body regions.

Table 26: Factors associated with the prevalence of WRMSDs in the different body regions and occupational factors, among the experimental group (n=201)

Characteristics		neck	shoulders	Elbow	Wrist (s)/ Hands (s)	Upper Back	Lower Back	Hip(s)/Thigh (s)	Knee(s)	Ankles/Feet
		χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)
Awkward posture										
Yes	**12-month**	0.821 (0.249)	1.370 (0.166)	6.205 (0.008)*	1.913 (0.113)	4.940 (0.019)*	1.505 (0.143)	2.754 (0.071)	0.930 (0.228)	1.106 (0.226)
No	**7-days**	0.369 (0.364)	2.467 (0.082)	6.415 (0.007)*	3.640 (0.039)*	4.688 (0.022)*	0.113 (0.431)	2.413 (0.090)	1.303 (0.184)	0.173 (0.479)
Overstretching										
Yes	**12-month**	3.013 (0.060)	7.791 (0.003)*	8.313 (0.002)*	5.215 (0.016)*	9.786 (0.001)*	1.780 (0.119)	4.166 (0.030)*	1.543 (0.154)	0.052 (0.529)
No	**7-days**	0.949 (0.231)	10.12 (0.001)*	8.351 (0.002)*	4.319 (0.026)*	7.475 (0.005)*	0.495 (0.290)	3.587 (0.043)*	1.361 (0.178)	0.445 (0.374)
Monotonous Task										
Yes	**12-month**	0.012 (0.564)	0.778 (0.300)	0.006 (0.619)	0.126 (0.487)	1.821 (0.134)	1.108 (0.210)	0.032 (0.538)	0.108 (0.542)	1.756 (0.181)
No	**7-days**	0.040 (0.598)	2.283 (0.109)	1.428 (0.203)	0.064 (0.530)	0.470 (0.322)	0.165 (0.431)	0.890 (0.305)	0.695 (0.355)	0.019 (0.684)
Carrying Heavy load										
Yes	**12-month**	0.205 (0.402)	8.281 (0.003)*	6.124 (0.010)*	3.260 (0.050)*	9.337 (0.002)*	3.188 (0.050)*	0.079 (0.471)	0.068 (0.478)	0.279 (0.399)
No	**7-days**	0.437 (0.332)	10.553 (0.001)*	5.313 (0.016)*	3.503 (0.043)*	6.585 (0.008)	0.636 (0.257)	1.209 (0.190)	0.028 (0.521)	0.566 (0.330)
Standing for long										
Yes	**12-month**	1.084 (0.208)	2.734 (0.070)	3.173 (0.054)	4.289 (0.026)*	0.363 (0.329)	1.435 (0.151)	1.901 (0.122)	3.958 (0.033)*	2.041 (0.125)
No	**7-days**	0.670 (0.289)	1.546 (0.149)	3.337 (0.049)*	3.586 (0.041)*	0.784 (0.234)	0.841 (0.225)	5.171 (0.015)*	2.487 (0.088)	0.796 (0.300)
Sitting for long										

Yes	**12-**	0.583 (0.293)	0.339 (0.351)	0.915 (0.239)	0.037 (0.511)	0.145 (0.417)	1.464 (0.151)	0.152 (0.430)	0.050 (0.498)	0.818 (0.292)
No	**month**									
	7-days	0.979 (0.229)	0.018 (0.525)	2.460 (0.087)	0.697 (0.268)	0.111 (0.435)	0.381 (0.328)	0.362 (0.382)	0.026 (0.528)	0.170 (0.506)
Repetitive hand movement										
Yes	**12-**	0.126 (0.503)	3.501 (0.045)*	5.354	3.806 (0.037)*	1.834 (0.128)	1.067 (0.208)	0.082 (0.532)	0.513 (0.369)	0.535 (0.404)
No	**month**			(0.010)*						
	7-days	0.579 (0.316)	3.501 (0.045)*	4.595	3.446 (0.047)*	1.323 (0.176)	0.746 (0.259)	0.008 (0.571)	1.285 (0.226)	0.158 (0.568)
				(0.018)*						
Same postures for long periods										
Yes	**12-**	0.231 (0.421)	0.288 (0.391)	1.499 (0.162)	2.382 (0.087)	9.086	5.654	2.636 (0.089)	2.213 (0.113)	0.014 (0.602)
No	**month**					(0.002)*	(0.015)*			
	7-days	0.179 (0.457)	0.288 (0.391)	1.941 (0.124)	3.301 (0.049)*	9.600	3.155 (0.057)	0.015 (0.543)	0.124 (0.455)	0.084 (0.560)
						(0.001)*				

4.1.18: Factors associated with the prevalence of WRMSDs in different body region and Psychosocial Factors, among the experimental group, The (n=201/146)

The table above shows the association between Psychosocial Factors and 12-month and 7-days prevalence of WWRMSDs in different body regions among the workers in The experimental group at baseline. The following variables were significant statistically, considering the 12-month prevalence of WRMDs in different body regions, The chi-square values (χ^2) and P-value (p) respectively were indicated; Hospital Visitations was associated with Musculoskeletal disorders in the following anatomical structures: at shoulders (χ^2=5.800, p=0.013), at wrists/hands (χ^2=9.962. p=0.001), at Upper back (χ^2=21.772, p=0.000), at lower back (χ^2=32.661, p=0.000) and at knee (χ^2=8.871, p=0.003), Relieved from pain was associated with Musculoskeletal disorders in the following anatomical structures: at shoulder (χ^2=16.351, p=0.001), at elbow (χ^2=11.623, p=0.009), wrists/Hands (χ^2=14.337, p=0.002), upper back (χ^2=28.862, p=0.000), lower back (χ^2=46.381, p=0.000), Hips/thigh (χ^2=7.748, p=0.050), Work Absenteeism/sick leave was associated with Musculoskeletal disorders in the following anatomical structures: at Neck (χ^2=8.323, p=0.008), at shoulder (χ^2=14.936, p=0.000), at elbow (χ^2=14.936, p=0.000), at lower back (χ^2=6.236, p=0.009), at hips/thigh (χ^2=5.838, p=0.023), at ankles/feet (χ^2=8.659, p=0.010), Feel tense during work was associated with Musculoskeletal disorders in the following anatomical structures: at Neck (χ^2=7.066, p=0.007), at shoulder (χ^2=7.105, p=0.007), at elbow (χ^2=8.130, p=0.004), at wrists/hands (χ^2=15.412, p=0.000), at upper back (χ^2=9.270, p=0.002), at lower back (χ^2=11.020, p=0.001), at hips/thigh (χ^2=13.539, p=0.000), at knees (χ^2

=7.150, p=0.007), Feeling Tired after work was associated with Musculoskeletal disorders in the following anatomical structures: at shoulders (χ^2=8.163, p=0.017), at elbows (χ^2=6.479, p=0.039), at wrists/hands (χ^2=14.059 p=0.001), at upper back (χ^2 =10.974, p=0.004), at lower back (χ^2=8.692, p=0.013), hips/thigh (χ^2=6.367, p=0.041), feeling tiredness in the morning was associated with Musculoskeletal disorders in the following anatomical structures: at shoulders (χ^2=15.028, p=0.000), at elbow (χ^2=7.771, p=0.003), at wrists/hands (χ^2=11.396 p=0.000), upper back (χ^2 =12.373, p=0.000), lower back (χ^2=17.625, p=0.000), the remaining variables on Psychosocial Factors are not statistically significant at P<0.005 in remaining different body regions. The following variables were significant statistically, considering the 7-days prevalence of WRMDs in different body regions, The chi-square values (χ^2) and P-value (p) respectively were indicated; Hospital Visitations was associated with Musculoskeletal disorders in the following anatomical structures: at neck (χ^2=3.073, p=0.063), at shoulders (χ^2=5.800, p=0.013), at wrists/hands (χ^2=6.272, p=0.010), at Upper back (χ^2=16.528, p=0.000), at lower back (χ^2=26.966, p=0.000) and at knee (χ^2 =9.877, p=0.002), Relieved from pain was associated with Musculoskeletal disorders in the following anatomical structures: at shoulder (χ^2=16.357, p=0.001), at elbow (χ^2 =11.455, p=0.010), wrists/Hands (χ^2=18.787, p=0.000), upper back (χ^2=24.136, p=0.000), lower back (χ^2=47.053, p=0.000), Hips/thigh (χ^2=9.847, p=0.020), at knee (χ^2=12.036, p=0.007) Work Absenteeism/sick leave was associated with Musculoskeletal disorders in the following anatomical structures: at Neck (χ^2=3.947,

p=0.053), at shoulder (χ^2=10.785, p=0.002), at elbow (χ^2=9.438, p=0.005), at lower back 6.236 (0.009), at hips/thigh (χ^2=3.947, p=0.050) and at knee (χ^2=8.305, p=0.009), at ankles/feet (χ^2=6.738, p=0.023), Feel tense during was associated with Musculoskeletal disorders in the following anatomical structures: at Neck (χ^2=3.264, p=0.057), at shoulder (χ^2=9.236, p=0.002), at elbow (χ^2=8.203, p=0.004), at wrists/hands (χ^2=10.540, p=0.001), at upper back (χ^2=12.480, p=0.000), at lower back (χ^2 11.309, p=0.001), at hips/thigh (χ^2=16.126, p=0.000), at knees (χ^2=7.368, p=0.007), at ankles/feet (χ^2=9.304, p=0.003), Feeling Tired after work was associated with Musculoskeletal disorders in the following anatomical structures: at shoulders (χ^2 =8.163, p=0.017), at elbows (χ^2=6.367, p=0.041), at wrists/hands (χ^2=12.692, p=0.002), at upper back 10.305 (0.006), at lower back (χ^2=8.692, p=0.013), hips/thigh (χ^2=8.562, p=0.014), feeling tiredness in the morning was associated with Musculoskeletal disorders in the following anatomical structures: at shoulders (χ^2 =15.028, p=0.000), at wrists/hands (χ^2=6.143, p=0.009), upper back (χ^2=13.615 p=0.000), lower back (χ^2=17.087, p=0.000), at ankles/feet (χ^2=4.370, p=0.030) the remaining variables on Psychosocial Factors shows no statistical significance at P=0.005 in remaining different body regions.

Table 27: Factors associated with the prevalence of WRMSDs in the different body regions and Psychosocial Factors, among the experimental group, The (n=201/146)

Characteristics		neck	shoulders	Elbow	Wrist (s)/ Hands (s)	Upper Back	Lower Back	Hip(s) /Thigh (s)	Knee(s)	Ankles/Feet
		χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)
Ever visit a Doctor/ Therapist										
Yes	**12-month**	0.812 (0.241)	5.800 (0.013)*	0.525 (0.296)	9.962 (0.001)*	21.772 (0.000)*	32.661 (0.000)*	2.254 (0.097)	8.871 (0.003)*	0.769 (0.268)
No	**7-days**	3.073 (0.063)*	5.800 (0.013)*	0.484 (0.310)	6.272 (0.010)*	16.528 (0.000)*	26.966 (0.000)*	3.073 (0.063)	9.877 (0.002)*	0.087 (0.505)
Relieved from WRMSDs										
Painkillers	**12-month**	5.752 (0.124)	16.351 (0.001)*	11.623 (0.009)*	14.337 (0.002)*	28.862 (0.000)*	46.381 (0.000)*	7.748 (0.050)*	7.113 (0.068)	3.719 (0.293)
Local herbs										
Exercise	**7-days**	4.411 (0.220)	16.357 (0.001)*	11.455 (0.010)*	18.787 (0.000)*	24.136 (0.000)*	47.053 (0.000)*	9.847 (0.020)*	12.036 (0.007)*	2.279 (0.516)
others										
Sick leave										
1-3 days	**12-month**	8.323 (0.008)*	14.936 (0.000)*	13.446 (0.001)*	1.357 (0.176)	2.117 (0.106)	6.236 (0.009)*	5.838 (0.023)*	2.389 (0.111)	8.659 (0.010)*
4-7 days										
8-12 days	**7-days**	3.947 (0.053)*	10.785 (0.002)*	9.438 (0.005)*	0.653 (0.276)	2.823 (0.069)	1.201 (0.186)	3.947 (0.050)*	8.305 (0.009)*	6.738 (0.023)*
>14 days										
Not applicable										
Break time										
Once a day	**12-month**	1.802 (0.582)	0.737 (0.692)	1.594 (0.451)	0.812 (0.666)	0.772 (0.680)	0.176 (0.916)	0.621 (0.733)	2.189 (0.335)	2.084 (0.353)
Twice a day Not all										
	7-days	2.530 (0.282)	0.491 (0.782)	1.465 (0.481)	0.417 (0.812)	1.357 (0.507)	0.714 (0.700)	0.396 (0.820)	1.167 (0.558)	0.923 (0.630)
Feel tense during work										
Yes	**12-month**	7.066 (0.007)*	7.105 (0.007)*	8.130 (0.004)*	15.412 (0.000)*	9.270 (0.002)*	11.020 (0.001)*	13.539 (0.000)*	7.150 (0.007)*	8.147 (0.005)
No										
	7-days	3.264	9.236 (0.002)*	8.203 (0.004)*	10.540	12.480	11.309	16.126	7.368 (0.007)*	9.304

		(0.057)*			(0.001)*	(0.000)*	(0.001)*	(0.000)*		(0.003)*
Often very tired after work										
Yes	**12-month**	1.970 (0.373)	8.163 (0.017)*	6.479 (0.039)*	14.059 (0.001)*	10.974 (0.004)*	8.692 (0.013)*	6.367 (0.041)*	1.745 (0.418)	1.898 (0.387)
No	**7-days**	0.421 (0.810)	8.163 (0.017)*	6.367 (0.041)*	12.692 (0.002)*	10.305 (0.006)*	8.562 (0.014)*	5.779 (0.056)	2.892 (0.236)	1.781 (0.410)
Regularly feeling tired										
Yes	**12-month**	2.640 (0.075)	15.028 (0.000)*	7.771 (0.003)*	11.396 (0.000)*	12.373 (0.000)*	17.625 (0.000)*	1.858 (0.124)	1.183 (0.194)	2.364 (0.100)
No	**7-days**	0.633 (0.289)	15.028 (0.000)*	7.545 (0.004)	6.143 (0.009)*	13.615 (0.000)*	17.087 (0.000)*	2.443 (0.089)	2.023 (0.116)	4.370 (0.030)*

Significant at P=0.005

4.1.19: Factors associated with the prevalence of WRMSDs in the different body regions and sociodemographic factors among the Control group (n=201/176)

The table below shows the association between sociodemographic factors and 12-month and 7-days prevalence of WWRMSDs in different body regions among the workers in the Control group at baseline. The following variables were significant statistically, considering the 12-month prevalence of WRMDs in different body regions, The chi-square values (χ^2) and P-value (p) respectively were indicated; Age was associated with Musculoskeletal disorders in the following anatomical structures: at Hips/thigh (χ^2 =8.212, p=0.042), Alcohol consumption was associated with Musculoskeletal disorders in the following anatomical structures: at Neck (χ^2=6.029, p=0.019), Experience in years was associated with Musculoskeletal disorders in the following anatomical structures: at elbow (χ^2=6.904, p=0.032), working hours in the field per week was associated with Musculoskeletal disorders in the following anatomical structures: at shoulder (χ^2=9.039, p=0.011), at wrists/hands (χ^2=9.898, p=0.007), at upper back (χ^2 =7.447, p=0.024), and at lower back (χ^2=9.133, p=0.010), working hours in the field per day was associated with Musculoskeletal disorders in the following anatomical structures: at neck (χ^2=6.353, p=0.042), the remaining variables on sociodemographic factors are not statistically significant at P<0.005 in remaining different body regions. The following variables were significant statistically, considering the 7-days prevalence of WRMDs in different body regions, The chi-square values (χ^2) and P-value (p) respectively were indicated; Age was associated with Musculoskeletal disorders in the following anatomical structures: at lower back (χ^2=8.317, p=0.040), at ankles/feet (χ^2

=11.817, p=0.008), smoking was associated with Musculoskeletal disorders in the following anatomical structures: at ankles/feet (χ^2=5.226, p=0.027), Alcohol consumption was associated with Musculoskeletal disorders in the following anatomical structures: at Neck (χ^2=3.808, p=0.046), working hours in the field per week was associated with Musculoskeletal disorders in the following anatomical structures: at neck (χ^2=6.958, p=0.031), at elbows (χ^2=7.633, p=0.022), at wrists/hands (χ^2=8.866, p=0.012), at upper back (χ^2=10.603, p=0.005), the remaining variables on sociodemographic factors shows no statistical significance at P=0.005 in remaining different body region.

Table 28: Table 28: Factors associated with the prevalence of WRMSDs in the different body regions and sociodemographic factors, among the Control group (n=201/175)

Characteristics		neck	shoulders	Elbow	Wrist(s)/Hand(s)	Upper Back	Lower Back	Hip(s)/Thigh(s)	Knee(s)	Ankles/Feet
		χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)
Age										
20-29	**12-month**	1.945 0.584)	5.784 (0.123)	7.382 (0.061)	1.843 (0.606)	0.111 (0.991)	7.390 (0.060)	8.21 (0.042)*	6.03 (0.110)	5.73 (0.125)
30-39										
40-49	**7-days**	1.724 (0.632)	2.768 (0.429)	6.383 (0.094)	1.065 (0.786)	0.278 (0.964)	8.317 (0.040)*	5.63 (0.131)	4.36 (0.225)	11.81 (0.008)*
50 and above										
Gender										
Male	**12-month**	0.920 (0.298)	0.139 (0.495)	0.375 (0.378)	0.483 (0.379)	0.169 (0.451)	0.866 (0.240)	0.59 (0.305)	0.08 (0.521)	1.59 (0.172)
Female										
	7-days	1.038 (0.272)	0.245 (0.442)	0.505 (0.345)	0.483 (0.379)	0.127 (0.474)	0.362 (0.360)	0.28 (0.395)	0.20 (0.448)	1.378 (0.192)
Marital Status										
Married	**12-month**	0.701 (0.701)	0.840 (0.657)	0.163 (0.922)	0.985 (0.611)	1.182 (0.554)	3.219 (0.200)	2.77 (0.250)	0.43 (0.807)	3.75 (0.154)

Single	**7-days**	1.518 (0.468)	2.418 (0.298)	0.579 (0.749)	0.334 (0.846)	0.720 (0.698)	2.909 (0.233)	5.21 (0.074)	0.30 (0.861)	0.79 (0.674)
Others										
Educational Status										
Non-formal	**12-month**	3.369 (0.498)	1.867 (0.760)	5.306 (0.257)	3.437 (0.488)	0.650 (0.957)	4.529 (0.339)	5.07 (0.281)	7.95 (0.093)	4.75 (0.314)
Primary/Basic										
Certificate/	**7-days**	4.038 (0.401)	1.713 (0.788)	6.204 (0.184)	5.296 (0.258)	1.881 (0.758)	5.107 (0.277)	1.97 (0.741)	7.62 (0.106)	4.68 (0.322)
Diploma										
Degree										
Masters										
Smoking										
Yes	**12-month**	0.972 (0.407)	0.093 (0.611)	2.106 (0.183)	3.860 (0.084)	2.397 (0.129)	0.292 (0.424)	2.51 (0.136)	4.49 (0.056)	3.86 (0.084)
No										
	7-days	1.024 (0.389)	0.140 (0.580)	3.860 (0.084)	2.524 (0.122)	0.362 (0.400)	3.952 (0.092)	3.85 (0.071)	3.59 (0.092)	5.23(0.027)*
Alcoholism										
Yes	**12-month**	6.029 (0.019)*	0.669 (0.272)	0.126 (0.455)	0.184 (0.415)	0.024 (0.509)	0.133 (0.422)	0.50 (0.308)	0.19 (0.403)	0.18 (0.415)
No										
	7-days	3.808	0.240 (0.405)	0.849 (0.244)	1.985 (0.114)	0.029 (0.499)	0.643 (0.281)	0.32 (0.353)	0.03 (0.542)	1.55 (0.462)

		(0.046)*								
Experience (yrs)										
< 5 years	**12-month**	2.159 (0.340)	0.103 (0.950)	6.904 (0.032)*	4.092 (0.129)	2.473 (0.290)	4.929 (0.085)	2.23 (0.327)	0.23 (0.890)	4.12 (0.127)
5-9 years										
10 years and above	**7-days**	0.033 (0.983)	6.427 (0.040)	4.092 (0.129)	3.670 (0.160)	4.946 (0.084)	2.071 (0.355)	1.53 (0.467)	3.43 (0.180)	5.35 (0.069)
Working hours (Wks)										
< 40 hours	**12-month**	4.400 (0.111)	9.039 (0.011)*	2.120 (0.360)	9.898 (0.007)*	7.447 (0.024)*	9.133 (0.010)*	1.65 (0.439)	3.22 (0.200)	1.82 (0.403)
40-60 hours										
60 hours and above	**7-days**	6.958 (0.031)*	1.360 (0.507)	7.633 (0.022)*	8.866 (0.012)*	10.603 0.005)*	2.547 (0.280)	3.29 (0.193)	0.70 (0.705)	4.62 (0.099)
Working hours (day)										
< 1 hour	**12-month**	6.353 (0.042)*	2.038 (0.381)	2.553 (0.279)	3.411 (0.182)	2.392 (0.302)	0.576 (0.750)	2.00 (0.367)	1.42 (0.492)	1.08 (0.582)
2-4 hours										
5 hours and above	**7-days**	4.619 (0.099)	2.515 (0.284)	1.407 (0.495)	4.663 (0.097)	3.327 (0.190)	0.688 (0.709)	3.45 (0.178)	2.02 (0.365)	1.27 (0.529)

4.1.20: Factors associated with the prevalence of WRMSDs in different body region and occupational factors, among Control group (n=201/175)

The table below shows the association between Biomechanical factors which is also the work posture factors and 12-month and 7-days prevalence of WRMSDs in different body region among the workers in Control group at baseline. The following variables were significant statistically, considering the 12-month prevalence of WRMDs in different body regions, The chi-square values (χ^2) and P-value (p) respectively were indicated y; Awkward posture was associated with Musculoskeletal disorders in the following anatomical structures: at elbow (χ^2=4.350, p=0.027), at wrists/hands (χ^2 =5.933, p=0.010), and at lower back (χ^2=4.620, p=0.022), overstretching was associated with Musculoskeletal disorders in the following anatomical structures: at p=Shoulder (χ^2=3.394, p=0.047), at Upper back (χ^2=4.076, p=0.030), at lower back (χ^2=3.543, p=0.041), and at knees (χ^2=7.027, p=0.005), Carrying of heavy load during work was associated with Musculoskeletal disorders in the following anatomical structures: at Upper back (χ^2=8.252, p=0.003), and at lower back (χ^2=9.751, p=0.001), Standing for long was associated with Musculoskeletal disorders in the following anatomical structures: at lower back (χ^2=5.859, p=0.011) and at knees (χ^2=6.161, p=0.011), Sitting for long was associated with Musculoskeletal disorders in the following anatomical structures: at wrists/hands (χ^2=3.811, p=0.039), Repetitive movements was associated with Musculoskeletal disorders in the following anatomical structures: at lower back (χ^2=8.986 p=0.002), and at knees (χ^2=6.278, p=0.007), Same posture for a long was associated with Musculoskeletal disorders in the following

anatomical structures: period at neck (χ^2=26.106, p=0.000), at shoulders (χ^2=16.014, p=0.000), upper back (χ^2=14.959, p=0.001), at lower back (χ^2=7.701, p=0.021), at knees (χ^2=11.691, p=0.003), and at ankles/feet (χ^2=20.248, p=0.000). The remaining variables on biomechanical factors are not statistically significant at P<0.005 in the remaining different body regions. The following variables were significant statistically, considering the 7-days prevalence of WRMDs in different body regions, The chi-square values (χ^2) and P-value (p) respectively were indicated; Awkward posture was associated with Musculoskeletal disorders in the following anatomical structures: at elbow (χ^2=3.900, p=0.036), at wrist/hands (χ^2=3.971, p=0.033), and at lower back (χ^2 =6.732, p=0.007), Overstretching was associated with Musculoskeletal disorders in the following anatomical structures: at lower back (χ^2=5.343, p=0.015), and at knees (χ^2 =3.365, p=0.047), Monotonous Task was associated with Musculoskeletal disorders in the following anatomical structures: at hips/thighs (χ^2=5.582, p=0.013), Carrying heavy load was associated with Musculoskeletal disorders in the following anatomical structures: at upper back (χ^2=11.245, p=0.001), and at lower back (χ^2=11.421, p=0.001), Standing for long was associated with Musculoskeletal disorders in the following anatomical structures: at wrist/hands (χ^2=3.347, p=0.050), at upper back (χ^2 =4.954, p=0.019), at lower back (χ^2=5.858, p=0.011), and at hips/thigh (χ^2=13.086, p=0.000), Sitting for long was associated with Musculoskeletal disorders in the following anatomical structures: at wrists/hands (χ^2=[3.811, p=0.039), Repetitive movements was associated with Musculoskeletal disorders in the following anatomical

structures: at lower back (χ^2=6.255, p=0.009) and at Knees (χ^2=5.036, p=0.016), Same posture for long was associated with Musculoskeletal disorders in the following anatomical structures: at neck (χ^2=24.840, p=0.000), at shoulders (χ^2=15.443, p=0.000), at upper back (χ^2=11.828, p=0.003), at lower back (χ^2=6.264, p=0.044), at knees (χ^2=9.445, p=0.009), and at ankles/feet (χ^2=18.327, p=0.000). The remaining variables on biomechanical factors show no statistical significance at P=0.005 in the remaining different body regions.

Table 29: Factors associated with the prevalence of WRMSDs in the different body regions and occupational factors, among the Control group (n=201/175)

Characteristics		neck	shoulders	Elbow	Wrist(s)/Hand(s)	Upper Back	Lower Back	Hip(s)/Thigh (s)	Knee(s)	Ankles/Feet
		χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)	χ^2 (p)
Awkward posture										
Yes No	**12-month**	0.099 (0.464)	1.559 (0.148)	4.350 (0.027)*	5.933 (0.010)*	2.022 (0.105)	4.620 (0.022)*	0.900 (0.231)	1.718 (0.130)	0.440 (0.336)
	7-days	0.025 (0.524)	0.063 (0.487)	3.900 (0.036)*	3.971 (0.033)*	0.949 (0.213)	6.732 (0.007)*	0.618 (0.290)	0.762 (0.248)	0.618 (0.290)
Overstretching										
Yes No	**12-month**	0.115 (0.473)	3.394 (0.047)*	0.479 (0.338)	0.701 (0.272)	4.076 (0.030)*	3.543 (0.041)*	2.388 (0.087)	7.027 (0.005)*	0.146 (0.436)
	7-days	0.238 (0.412)	2.738 (0.070)	0.295 (0.398)	0.160 (0.436)	2.483 (0.079)	5.343 (0.015)*	1.942 (0.118)	3.365 (0.047)*	0.010 (0.553)
Monotonous Task										
Yes	**12-**	1.177	0.534	0.031	0.085 (0.462)	0.244	1.554	1.883	0.108	0.951

No	**month**	(0.198)	(0.294)	(0.534)		(0.369)	(0.136)	(0.118)	(0.438)	(0.224)
	7-days	0.793 (0.253)	0.185 (0.402)	0.000 (0.591)	0.085 (0.462)	0.909 (0.215)	1.770 (0.119)	5.582 (0.013)*	0.406 (0.320)	0.079 (0.476)
Carrying Heavy load										
Yes No	**12-month**	1.081 (0.209)	1.535 (0.148)	1.593 (0.153)	3.152 (0.059)	8.252 (0.003)*	9.751 (0.001)*	1.134 (0.191)	2.982 (0.061)	1.856 (0.124)
	7-days	1.652 (0.146)	0.268 (0.369)	1.014 (0.222)	1.856 (0.124)	11.245 (0.001)*	11.421 (0.001)*	2.495 (0.085)	0.816 (0.232)	2.495 (0.085)
Standing for long										
Yes No	**12-month**	0.160 (0.432)	0.625 (0.274)	2.493 (0.089)	2.021 (0.112)	3.018 (0.057)	5.859 (0.011)*	6.161 (0.011)*	0.601 (0.274)	0.380 (0.341)
	7-days	0.391 (0.345)	1.340 (0.166)	1.865 (0.130)	3.347 (0.050)*	4.954 (0.019)*	5.858 (0.011)*	13.086 (0.000)*	0.068 (0.463)	0.642 (0.275)
Sitting for long										
Yes No	**12-month**	2.374 (0.094)	1.536 (0.147)	0.005 (0.565)	3.811 (0.039)*	0.988 (0.202)	0.470 (0.294)	0.719 (0.255)	0.590 (0.277)	0.533 (0.300)
	7-days	1.642	0.694	0.030	3.811 (0.039)*	0.708	0.013	0.475	0.831	0.841

		(0.146)	(0.259)	(0.528)		(0.248)	(0.511)	(0.313)	(0.230)	(0.237)
Repetitive hand movement										
Yes	**12-month**	0.090 (0.204)	0.207 (0.404)	2.658 (0.083)	0.360 (0.380)	1.296 (0.176)	8.986 (0.002)*	1.202 (0.199)	6.278 (0.007)*	0.198 (0.413)
No	**7-days**	1.293 (0.195)	0.072 (0.476)	2.414 (0.099)	0.007 (0.587)	0.427 (0.335)	6.255 (0.009)*	2.990 (0.062)	5.036 (0.016)*	0.741 (0.266)
Same postures for long periods										
Yes	**12-month**	26.106 (0.000)*	16.014 (0.000)*	2.293 (0.319)	0.680 (0.712)	14.959 (0.001)*	7.701 (0.021)*	2.354 (0.308)	11.691 (0.003)*	20.248 (0.000)*
No	**7-days**	24.840 (0.000)*	15.443 (0.000)*	1.844 (0.398)	0.680 (0.712)	11.828 (0.003)*	6.264 (0.044)*	3.867 (0.145)	9.445 (0.009)*	18.327 (0.000)*

Significant at P=0.005

4.1.21: Factors associated with the prevalence of WRMSDs in the different body regions and Psychosocial Factors among the Control group (n=201/175)

The table below shows the association between Psychosocial Factors and 12-month and 7-days prevalence of WRMSDs in different body regions among the workers in the Control group at baseline. The following variables were significant statistically, considering the 12-month prevalence of WRMDs in different body regions, The chi-square values (χ^2) and P-value (p) respectively were indicated; Hospital Visitations was associated with Musculoskeletal disorders in the following anatomical structures: at the elbow (χ^2=4.422, p=0.033), at wrists/hands (χ^2=9.289, p=0.003), at the lower back (χ^2=16.090, p=0.000), and at hips/thighs (χ^2=3.708 p=0.043). Relieved from pain was associated with Musculoskeletal disorders in the following anatomical structures: at the neck (χ^2=12.355, p=0.006), at the lower back (χ^2=13.410, p=0.004), at ankles/feet (χ^2=22.552, p=0.000), feeling tiredness in the morning at hips/thigh (χ^2=3.922, p=0.038), the remaining variables on Psychosocial Factors are not statistically significant at P<0.005 in remaining different body regions. The following variables were significant statistically, considering the 7-days prevalence of WRMDs in different body regions, The chi-square values (χ^2) and P-value (p) respectively were indicated; Hospital Visitations was associated with Musculoskeletal disorders in the following anatomical structures: at the elbow (χ^2=5.843, p=0.019), at wrists/hands (χ^2=6.911, p=0.008), at Upper back (χ^2=4.057, p=0.033), at the lower back (χ^2=11.325, p=0.001), and at the knee (χ^2=12.670, p=0.000), Relieved from pain was associated with Musculoskeletal disorders in the following anatomical structures: at the neck (χ^2=12.230, p=0.007),

lower back (χ^2=13.071, p=0.004), at ankles/feet (χ^2=21.679, p=0.000), Feel tense during at upper back (χ^2=4.994, p=0.020), at the lower back (χ^2=5.447, p=0.015), Tired after work was associated with Musculoskeletal disorders in the following anatomical structures: at ankles/feet (χ^2=7.706, p=0.021). The remaining variables on Psychosocial Factors show no statistical significance at P=0.005 in remaining different body regions.

Table 30: Factors associated with the prevalence of WRMSDs in the different body regions and Psychosocial Factors, among the Control group (n=201/175)

Characteristics		**neck**	**shoulders**	**Elbow**	**Wrist (s)/ Hands (s)**	**Upper Back**	**Lower Back**	**Hip(s) /Thigh (s)**	**Knee(s)**	**Ankles/Feet**
		χ^2 **(p)**	χ^2 **(p)**	χ^2 **(p)**	χ^2 **(p)**	χ^2 **(p)**	χ^2 **(p)**	χ^2 **(p)**	χ^2 **(p)**	χ^2 **(p)**
Ever visit a Doctor/ Therapist										
Yes	**12-month**	0.205 (0.409)	2.914 (0.067)	4.422 (0.033)*	9.289 (0.003)*	2.392 (0.084)	16.090 (0.000)*	3.708 (0.043)*	8.918 (0.003)*	1.882 (0.123)
No	**7-days**	0.071 (0.481)	0.984 (0.211)	5.843 (0.019)*	6.911 (0.008)*	4.057 (0.033)*	11.325 (0.001)*	2.581 (0.082)	12.670 (0.000)*	1.425 (0.162)
Relieved from WRMSDs										
Painkillers	**12-**	12.355	5.972	3.217	1.038	4.749	13.410	3.191	1.667	22.552

Local herbs	**month**	(0.006)*	(0.118)	(0.359)	(0.792)	(0.191)	(0.004)*	(0.363)	(0.644)	(0.000)*
Exercise	**7-days**	12.230	6.066	4.062	1.038	4.581	13.071	1.845	4.466	21.679
Not applicable		(0.007)*	(0.108)	(0.255)	(0.792)	(0.205)	(0.004)*	(0.605)	(0.215)	(0.000)*
Sick leave										
1-3 days	**12-**	0.030	0.075	0.002	0.787	0.326	1.110	0.352	0.934	0.267
4-7 days	**month**	(0.550)	(0.468)	(0.604)	(0.252)	(0.345)	(0.187)	(0.346)	(0.225)	(0.399)
8-12 days	**7-days**	0.091	0.003	0.010	0.176	0.089	1.502	0.574	0.208	0.393
>14 days		(0.497)	(0.555)	(0.556)	(0.416)	(0.449)	(0.145)	(0.293)	(0.404)	(0.355)
Not applicable										
Break time										
Once a day	**12-**	2.786	0.986	1.004	0.494	1.027	1.654	2.049	0.139	0.512
Twice a day	**month**	(0.248)	(0.611)	(0.605)	(0.781)	(0.598)	(0.437)	(0.359)	(0.933)	(0.774)
Not all	**7-days**	2.949	0.081	0.505	0.089	0.212	0.666	2.642	0.279	0.409
		(0.229)	(0.960)	(0.777)	(0.956)	(0.899)	(0.717)	(0.267)	(0.870)	(0.815)

Feel tense during										
Yes	**12-**	1.552	2.994	2.094	3.064	3.125	5.821	1.404	0.850	0.224
No	**month**	(0.157)	(0.065)	(0.116)	(0.064)	(0.056)	(0.012)	(0.162)	(0.229)	(0.392)
	7-days	1.110	2.003	2.752	3.067	4.994	5.447	0.888	0.271	0.101
		(0.205)	(0.112)	(0.082)	(0.064)	(0.020)*	(0.015)*	(0.234)	(0.363)	(0.451)
Often very tired after work										
Yes	**12-**	0.124	0.882	0.560	1.467	0.680	1.804	0.280	3.927	7.421
No	**month**	(0.940)	(0.643)	(0.756)	(0.480)	(0.712)	(0.406)	(0.869)	(0.140)	(0.024)
	7-days	0.254	0.967	1.045	1.467	0.850	2.386	0.281	4.038	7.706
		(0.885)	(0.617)	(0.593)	(0.480)	(0.654)	(0.303)	(0.869)	(0.133)	(0.021)*
Regularly feeling tired										
Yes	**12-**	0.000	0.653	2.776	1.328	0.320	0.659	0.018	3.922	0.332

No	**month**	(0.588)	(0.269)	(0.081)	(0.174)	(0.349)	(0.254)	(0.532)	(0.038)*	(0.366)
	7-days	0.026	0.277	3.517	1.328	0.013	0.509	0.020	2.459	0.504
		(0.540)	(0.366)	(0.055)	(0.174)	(0.526)	(0.287)	(0.521)	(0.084)	(0.315)

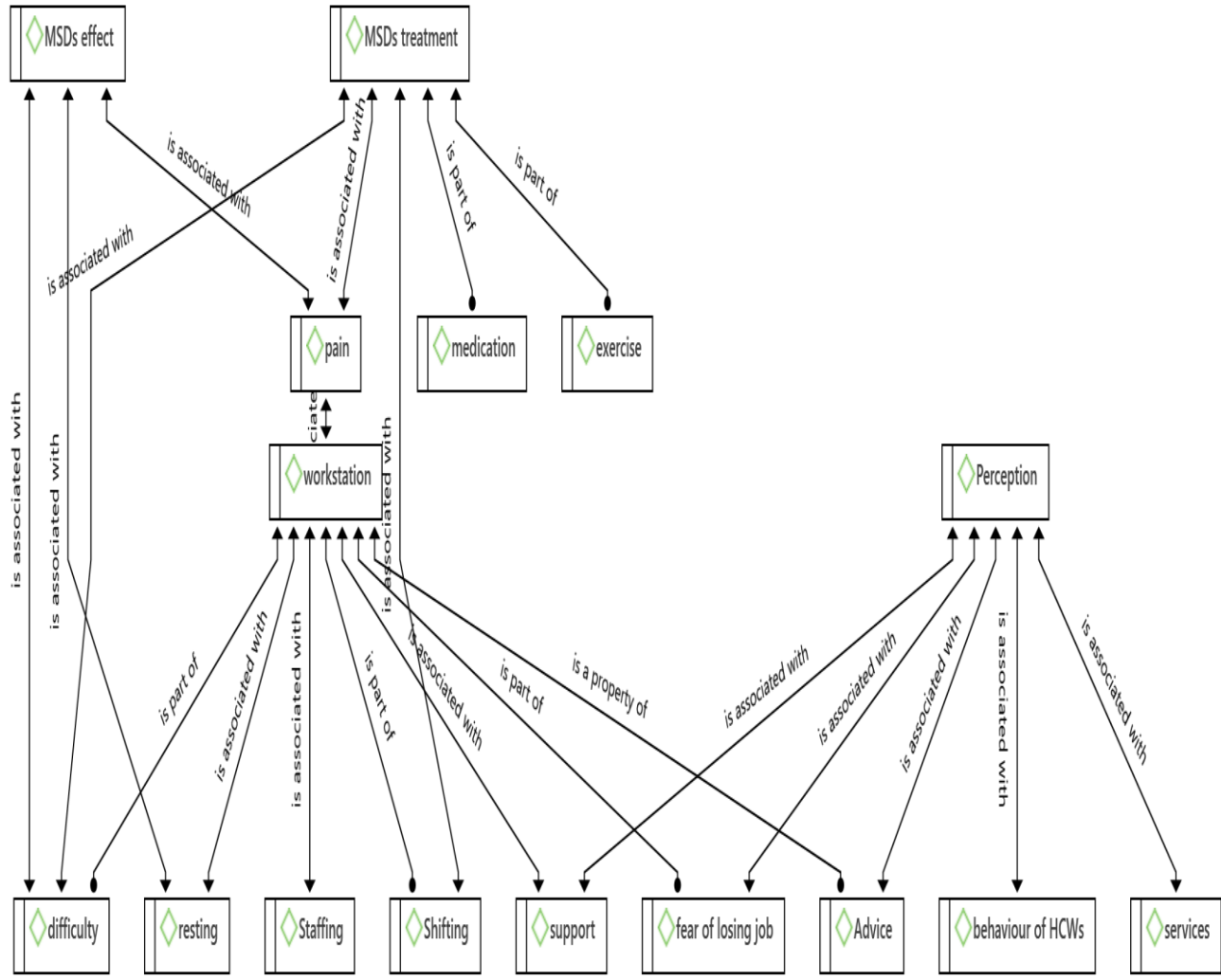


Figure 11: Show the network diagram codes generated from the themes in Atlas.ti

The following themes were in the form of networking, showing how the codes are directly linking to one another. As the diagram above shows, a cause-effect relationship between the themes and the codes was seen as most of the themes have multiple networks with many codes.

4.1.22: Workers perception of WRMSDs

Many codes were linked to workers' perception of WRMSDs, such as lack of psychosocial support from the management of the factory. Some of the workers complain of the behavior of health care workers as disgusting to them as they showed them some bad attitude while seeking care on their pains and general body assessment.

Most workers were working under fear of losing their jobs; even if they had what is wrong within the factories they rather keep quiet due to the nature of services they received.

Quotation from the respondents on perceptions of WRMSDs

A7: ‘’*You can be with your issue, and you would like to meet him secretly because we as people have our issues, and we would like to tell them to health workers because they know. But some, even the way they treat you on money, you be like can't he see my situation? He presses you to the extent that you go to even get a loan. Why is it like that?’’*

4.1.22: Workstation modifications

Many issues arise from the respondent during the interview on the workplace, Lack of support on PPE, use, Shortage of staff, inadequate shifting time, Minimal resting time. All this were found to have a relationship with the development of the body among the respondent. However, workers advise their management to improve on the work environment modification.

Quotation from the respondents on workplace modification

A11: ‘*’Even if it's two days. If he is on permanent, he can even ask for a week. So the day he attends is the one he is paid for, and it’s up to him to select the number of days to rest.’’*

A6: *‘’The issue you have brought is that they bring machines. Ok, fine, but little technology has helped our children to get jobs. So if they bring in technology, most of them will be cut off. And suffering, theft will increase. This is also why many hearts of Ugandans have got spoilt because they lack jobs and there is an increase in technology.*

For example, we have a company like Textile industry in Jinja, when technology increased in it, they chased away some workers and they depressed.''

A9: *''What I understood from his point is that they should add them, people, because this is manual work and it damages the body, and by the time they reach 2030 from now, it would have affected their back.''*

A20: *''My opinion is this, lying is bad, and we want the job, but you reach a situation when they throw sugar cane, and it pierces you, and the company doesn't buy us gumboots as other companies do, we buy them on our money. There are no gloves, and we just steal them. Other companies provide you with everything. If you can get like ten pairs of gloves and use them after they left with the supervisor, it can meanwhile as you get other equipment to use.''*

A14: *''There is also some other issue, if you have just offloaded a truck and feel some back pain, then the supervisor says go and offload another truck when some people haven't even offloaded anything. So by the time you finish offloading that truck, you have back pain, and you got nothing to do.''*

A19: ''The supervisor has no problem, it's the old people who come and put us under pressure and tell us to get up on the truck and offload sugarcane, and if we don't work, they chase us away.''

4.1.23: Showing code-co-occurrence coefficient. (COC)

The tables show below a strong relationship between some of the codes while some are not related. The relationship in this table is like the correlation coefficient in the table. The c-coefficient ranges from 0 to 1, where the higher the c-coefficient the stronger the association between two codes. As shown in the table, there is an association between WRMSDs effect and the musculoskeletal pain in the body of the respondents 4 (0.33),

WRMSDs effect, and facing difficulty at work among workers 4 (0.44). Therefore, this also confirms an association stating that the difficulty the workers face results from pain 3 (0.25). It was also shown that other factors such as musculoskeletal treatments 2 (0.20), workplace modification 2 (0.11), lack of resting 2 (0.18), and lack of shifting 2 (0.13) have an association with the pain of WWRMSDs that workers are experiencing during their work.

Table 31: Showing code-co-occurrence coefficient. (COC) :

	Work difficulty	**Exercise**	**Medication**	**WRMSDs effect**	**WRMSDs treatment**	**WRMSDs Pain**	**Workers Perception**	**Clinic Service**	**Shifting**	**Staffing**	**Support**	**workstation**
Work difficulty				4(0.44)		3 (0.25)		1 (0.11)				
Exercise			1 (0.20)	1 (0.11)	1 (0.22)	2 (0.22)			1 (0.10)	1 (0.13)		1 (0.07)
Medication		1 (0.20			2 (0.50)	1 (0.09)	1 (0.20)	1 (0.17)				
WRMSDs effect	4(0.44)	1 (0.11)			1 (0.11)	4(0.33)		1 (0.10)				
WRMSDs treatment		1 (0.20)	2 (0.50)	1 (0.11)		2 (0.20)						
WRMSDs Pain	3 (0.25)	2 (0.20)	1 (0.09)	4(0.33)	2 (0.20)		1 (0.09)	1 (0.08)	2 (0.13)	2 (0.15)		2 (0.11)
Workers Perception			1 (0.20)			1 (0.09)		2 (0.40)				

Resting					2 (0.18)			4(0.50)	2 (0.25)	1 (0.17)	2 (0.14)
Clinic Service	1 (0.11)		1 (0.17)	1 (0.10)	1 (0.08)	2 (0.40)			1 (0.11)		1 (0.07)
Shifting		1 (0.10)			2 (0.13)				4(0.40)	1 (0.10)	6 (0.43)
Support								1 (0.10)			2 (0.15)
Workstation		1 (0.07)			2 (0.11)		1 (0.07)	6 (0.43)	6 (0.50)	2 (0.15)	

4.1.24: Showing an independent t-test of Assessment of the Risk of WRMSDs using Quick exposure checks scores for the evaluation of the intervention between the two groups

The table below shows the t-test results for the Assessment of the Risk of WRMSDs using Quick exposure checks scores to evaluate the intervention between the experimental and control groups. Considering the mean differences for different exposures regions for WRMSDs risk both groups, the experimental and control groups, at baseline. The following regions scores were statistically significant; the back region (p=0.000), wrist/hand region (p=0.000) and Neck region (p=0.000). while at post-intervention the followings were statistically significant for the two groups; back region (p=0.000), shoulder/arm region, wrist/hand region (p=0.000), work pace (p=0.000) and stress total (p=0.000).

Table 32: Showing an independent t-test of Assessment of the Risk of WRMSDs using Quick exposure checks scores for the evaluation of the intervention between the two groups

Variables		Experimental Mean (SD)	Control Mean (SD)	P-value
BACK region total	Before	34.75 (9.61)	25.10 (9.48)	0.000**
	After	21.45 (6.83)	25.05 (8.51)	0.000**
SHOULDER/ARM region TOTAL	Before	32.09 (7.92)	30.77 (12.85)	0.216
	After	21.51 (6.04)	29.39 (10.84)	0.000**
WRIST/HAND TOTAL	Before	32.6 (7.07)	29.49 (10.32)	0.000**
	After	20.60 (7.10)	28.64 (7.96)	0.000**
NECK region TOTAL	Before	13.57 (2.53)	11.73 (3.22)	0.000**
	After	10.14 (15.07)	12.06 (3.23)	0.102
DRIVING exposure	Before	1.30 (0.90)	1.20 (1.24)	0.355
	After	1.06 (0.47)	1.09 (0.50)	0.0545
VIBRATION TOTAL	Before	2.77 (3.03)	2.23 (2.68)	0.059
	After	2.86 (3.39)	2.78 (3.16)	0.827
WORKPACE TOTAL	Before	4.85 (1.88)	4.95 (2.681)	0.665
	After	4.00 (0.01)	5.11 (2.40)	0.000**
	Before	7.65 (3.77)	7.06 (3.50)	0.105
STRESS TOTAL	After	2.34 (1.90)	7.10 (3.20)	0.000**
cumulative exposure QEC TOTAL	Before	130.5 (27.6)	112.1 (36.3)	0.000**
	After	79.4 (20.2) n=146	110.0 (28.5) n=175	0.703

The table below displayed the paired sample tests for the study respondents from the experimental group; all the QECs parameters were statistically significant except the vibrations (p=0.215) and work pace (p=0.734). The mean differences were shown to be very high between the baseline and post-intervention of all the statistically significant parameters

Table 33: Showing a paired t-test of Assessment of the Risk of WRMSDs using Quick exposure checks scores for the evaluation of the intervention in the experimental group

			Paired Differences					T	df	Sig. (2-tailed)
	baseline	post-intervention	Mean	Std. Dev	SE Mean	95% CI of the Difference				
						Lower	Upper			
Backtotal	Backtotal 1 -	BACKTOTAL2	11.69863	12.30944	1.01874	9.68514	13.71212	11.483	145	0.000**
Shouldertotal	Shouldertotal 1 -	ShoulderArmtotal2	10.65068	9.82017	.81272	9.04437	12.25700	13.105	145	0.000**
Wristhandtotal	Wristhandtotal 1 -	WRISTHANDTOTAL2	11.49315	10.50665	.86954	9.77455	13.21175	13.218	145	0.000**
Necktotal	Necktotal 1 -	NECKTOTAL2	3.39726	15.48547	1.28159	.86426	5.93026	2.651	145	0.009**
Drivingtotal	Drivingtotal 1 -	DRIVINGTOTAL2	.34932	1.14225	.09453	.16247	.53616	3.695	145	0.000**
Vibrationtotal	Vibrationtotal 1 -	VIBRATIONTOTAL2	.46575	4.52147	.37420	-.27384	1.20534	1.245	145	0.215
Workplacetotal	Workplacetotal 1-	Workpacetotal2	-.04795	1.70327	.14096	-.32655	.23066	-.340	145	0.734
Stresstotal	Stress 1 -	Stresstotal2	5.17808	4.58737	.37965	4.42771	5.92845	13.639	145	0.000**

From the table below, the paired sample test for the demographic characteristics of the respondents is reported where no significant difference is found in the mean of the base and post-intervention for respondents' age, BMI, systolic, and diastolic blood pressures with p-values (**>0.05**)

Table 34: Showing a paired t-test of the sociodemographic factors in an experimental group

		Paired Differences					T	df	Sig. (2-tailed)
		Mean	Std. Dev.	SE Mean	95% CI of the Difference Lower	Upper			
Pair 1	Age of the respondent - Age of the respondent (post)	.02740	1.05664	.08745	-.14544	.20023	.313	145	0.755
Pair 2	BMI of the respondent - BMI of the respondent (post)	.148	4.462	.369	-.582	.878	.401	145	0.689
Pair 3	systolic of the respondent - systolic of the respondent (post)	.322	16.427	1.360	-2.365	3.009	.237	145	0.813
Pair 4	Diastolic of the respondent - Diastolic of the respondent (post)	.603	15.500	1.283	-1.933	3.138	.470	145	0.639

4.1.25: Showing a paired t-test of the sociodemographic factors in an experimental group

The above-paired sample t-test between the intervention and the control group showed no significant difference in the mean of QEC for back total (p=0.105), shoulder/arm total (p=0.445), wrist total (p=0.324), driving total (p=0.192), vibration total (p=0.151), workplace total (p=0.068) and stress total (p=0.065). A significant mean difference was

recorded for QEC of neck total among the intervention and control groups with a p-value of (**0.018**).

Table 35: Showing a paired t-test of Assessment of the Risk of WRMSDs using Quick exposure checks scores for the control group

		Paired Differences					T	df	Sig. (2-tailed)
		Mean	Std. Dev.	SE Mean	95% CI of the Difference Lower	Upper			
Pair 1	BACKTOTAL2 – BackTotal	1.65714	13.43598	1.01566	-.34747	3.66175	1.632	174	0.105
Pair 2	SHOULDERARMTOTAL2 – ShoulderArmtotal	1.01714	17.56285	1.32763	-1.60318	3.63747	.766	174	0.445
Pair 3	WRISTTOTAL2 – WristHandtotal	.96571	12.92280	.97687	-.96233	2.89376	.989	174	0.324
Pair 4	NECKTOTAL2 – Necktotal	.84571	4.67989	.35377	.14749	1.54394	2.391	174	0.018*
Pair 5	DRIVINGTOTAL2 – DrivingTotal	-.14286	1.44124	.10895	-.35789	.07217	-1.311	174	0.192
Pair 6	VIBRATIONTOTAL2 – VibrationTotal	.48000	4.40198	.33276	-.17676	1.13676	1.442	174	0.151
Pair 7	WORKPACETOTAL2 – Workpacetotal	.48571	3.49360	.26409	-.03552	1.00695	1.839	174	0.068
Pair 8	STRESSTOTAL2 – StressTotal	.61143	4.36126	.32968	-.03926	1.26212	1.855	174	0.065

4.10.22: From the table above, the paired sample test for the demographic characteristics between the intervention and control group among the respondents demonstrated no significant difference in the mean of the respondents' age (p=0.909), BMI (p=0.982), systolic (p=0.387) and diastolic blood pressure (0.505) (p>**0.05**).

Table 36: Showing a paired t-test of the sociodemographic factors for the control

		Paired Differences					T	df	Sig. (2-tailed)
		Mean	Std. Dev.	SE Mean	95% CI of the Difference				
					Lower	Upper			
Pair 1	Age of the respondent - Age of the respondent	-.01143	1.31738	.09958	-.20798	.18512	-.115	174	0.909
Pair 2	BMI of the respondent - BMI of the respondent	-.009	5.097	.385	-.769	.752	-.022	174	0.982
Pair 3	systolic of the respondent - systolic of the respondent	-1.680	25.650	1.939	-5.507	2.147	-.866	174	0.387
Pair 4	Diastolic of the respondent - Diastolic of the respondent	-.766	15.161	1.146	-3.028	1.496	-.668	174	0.505

Table 37 above shows the results of the multiple logistic regression. Some factors were established as a predictor for annual WRMSDs development among the study respondents in the experimental group. However, a significant relationship was established from the study between educational attainment among the respondents and the development of WRMSDs in the previous 12 months. Respondents who had non-formal education are 53% more likely to develop WMSD in the last 12 months than their counterparts (p=0.006, CI=0.339-0.838). Primary/basic education poses a 73% likelihood of having MSD in the previous 12 months (p=0.028, CI=0.547-0.967). Respondents at certificate/diploma level of education are 0.74 times more likely to have MSD in the last 12 months before the study than their counterparts (p=0.034, CI=0.560-0.978). There was no association between MSD during the previous 12 months and having (degree/masters). Other predictors of MSD in the last 12 months before this study are the department/unit of work and the working experience of the respondents. It was established from the results that respondents from the manufacturing department were 1.2 times more likely to have WMSD in the previous 12 months than other

respondents from other departments (p=0.011, CI=1.040-1.356). Respondents with work experience are 1.16 times more likely to be affected with MSD than those without experience (p=0.011, CI=1.035-1.301). Age, gender, marital status, smoking, alcohol status, weekly hours per work, among others, are not significantly associated with annual WMSD among the study respondents.

Table 37: Showing Multiple logistic regression predictors of WRMSDSs for sociodemographic factors, psychosocial and occupational factors in the control group

Parameter	Sig.	Exp(B)	95% Wald Confidence Interval for Exp(B)	
			Lower	Upper
(Intercept)	0.027	2.865	1.129	7.269
[Gender=1.00]	0.824	1.021	.849	1.228
[Gender=2.00]	.	1	.	.
[Marital=1.00]	0.880	.990	.867	1.130
[Marital=2.00]	.	1	.	.
[Educational=1.00]	**0.006***	.533	.339	0.838
[Educational=2.00]	**0.028***	.727	.547	0.967
[Educational=3.00]	**0.034***	.740	.560	0.978
[Educational=4.00]	.	1	.	.
[Age=1.00]	0.895	.978	.702	1.362
[Age=2.00]	0.594	.913	.655	1.274
[Age=3.00]	0.771	.947	.658	1.363
[Age=4.00]	.	1	.	.
[Department=1.00]	0.064	.774	.590	1.016
[Department=2.00]	0.577	1.082	.820	1.427
[Department=3.00]	**0.011***	1.187	1.040	1.356
[Department=4.00]	.	1	.	.
Smoking	0.978	1.004	.770	1.309
Alcohol	0.127	1.172	.956	1.437
Experience	**0.011***	1.161	1.035	1.301
Hours_wks	0.370	.949	.847	1.064
Awkward bending	0.523	.955	.828	1.101
overstretching	0.301	1.085	.929	1.267
Monotonous task	0.205	.880	.723	1.072
Heavy load	0.354	1.070	.927	1.234
Standing long	0.406	1.065	.918	1.235
Sitting long	0.732	.972	.824	1.146
Hand movement	0.374	1.089	.903	1.314
Same posture	0.936	1.006	.868	1.167
Job time	**.001****	.950	.876	1.030

***significant association at *p≤0.005, **p≤0.01, and ***p≤0.001**

Dependent Variable: Have you had any form of work-related injury in the past 12 months

Model: (Intercept), Gender, Marital, Educational, Age, Department, Smoking, Alcohol, Experience, Hours_wks, Awkward_bending, overstretching, Monotonous_task, Heavy_load, Standing_long, Sitting_long, Hand_movement, Same_posture, Job_time

a. Set to zero because this parameter is redundant.

b. maximum likelihood estimate.

The predictors of MSD among the study respondents in the control group were displayed above; the only significant predictor found out was job time. The respondent's daily hours per work, denoted as their job time, predicted MSD development in 12 months. Respondents with the specified daily job time are 1.142 times more likely to have MSD (p=0.001, CI= 1.058-1.232). Factors such as age, gender, educational attainment, department, weekly working hours, awkward bending, and overstretching were not significantly associated with MSD, as shown in table 37.

Table 38: Showing Multiple logistic regression predictors of WRMSDSs for sociodemographic factors, psychosocial and occupational factors in the control group

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
			Lower	Upper	Wald Chi-Square	df	Sig.		Lower	Upper
(Intercept)	1.789	.6674	.481	3.097	7.182	1	0.007	5.981	1.617	22.124
[Gender=1.00]	-.064	.1037	-.267	.139	.378	1	0.539	.938	.766	1.150
[Gender=2.00]	0[a]	.	.	.	.	.	.	1	.	.
[Marital=1.00]	-.202	.4455	-1.075	.671	.205	1	0.650	.817	.341	1.957
[Marital=2.00]	.009	.4524	-.878	.895	.000	1	0.985	1.009	.416	2.448
[Marital=3.00]	0[a]	.	.	.	.	.	.	1	.	.
[Educational=1.00]	-.517	.3241	-1.152	.118	2.544	1	0.111	.596	.316	1.126
[Educational=2.00]	-.351	.3129	-.964	.262	1.260	1	0.262	.704	.381	1.299
[Educational=3.00]	-.367	.3114	-.978	.243	1.393	1	0.238	.692	.376	1.275
[Educational=4.00]	-.410	.3201	-1.038	.217	1.644	1	0.200	.663	.354	1.242
[Educational=5.00]	0[a]	.	.	.	.	.	.	1	.	.
[Age=1.00]	-.069	.1269	-.318	.180	.294	1	0.588	.933	.728	1.197
[Age=2.00]	.065	.1063	-.143	.273	.374	1	0.541	1.067	.866	1.314
[Age=3.00]	.096	.1183	-.136	.328	.660	1	0.417	1.101	.873	1.388
[Age=4.00]	0[a]	.	.	.	.	.	.	1	.	.
[Department=1.00]	.137	.1515	-.160	.434	.814	1	0.367	1.146	.852	1.543
[Department=2.00]	.056	.1252	-.189	.302	.202	1	0.653	1.058	.828	1.352

[Department=3.00]	.033	.0689	-.102	.168	.234	1	0.628	1.034	.903	1.183
[Department=4.00]	0[a]	.	.	.	.	.	.	1	.	.
Smoking	-.233	.1543	-.535	.070	2.272	1	0.132	.792	.586	1.072
Alcohol	.010	.0778	-.143	.162	.016	1	0.899	1.010	.867	1.176
Experince	-.027	.0377	-.101	.047	.517	1	0.472	.973	.904	1.048
Hours_wks	.041	.0593	-.075	.157	.475	1	0.490	1.042	.927	1.170
Awkward_bending	-.014	.0793	-.169	.141	.031	1	0.860	.986	.844	1.152
overstrecting	.107	.0806	-.051	.265	1.753	1	0.186	1.113	.950	1.303
Monotonous_task	-.035	.0685	-.169	.099	.265	1	0.606	.965	.844	1.104
Heavy_load	.071	.0664	-.059	.201	1.142	1	0.285	1.074	.943	1.223
Standing_long	.139	.0661	.010	.269	4.437	1	**0.035***	1.149	1.010	1.309
Sitting_long	.032	.0670	-.100	.163	.224	1	0.636	1.032	.905	1.177
Hand_movement	.152	.0880	-.021	.324	2.978	1	0.084	1.164	.980	1.383
Same_posture	-.034	.0686	-.169	.100	.248	1	0.618	.966	.845	1.106
Job_time	.132	.0389	.056	.209	11.581	1	**.001****	1.142	1.058	1.232
(Scale)	.164[b]	.0164	.135	.199						

Dependent Variable: Have you had any form of work related injury in the past 12 months

del: (Intercept), Gender, Marital, Educational, Age, Department, Smoking, Alcohol, Experience, Hours_wks, Awkward_bending, overstrecting, Monotonous_task, Heavy_load, Standing_long, Sitting_long, Hand_movement, Same_posture, Job_time

a. Set to zero because this parameter is redundant.

b. Maximum likelihood estimate.

4.2: Discussion

This section presents the discussions of the findings based on the study objectives.

4.2.1: Prevalence of Work-related musculoskeletal disorders among the sugar factory workers.

One of the most common signs and symptoms of work-related musculoskeletal disorders is excruciating pain among the workers affected by the WRMSDs regions during their working time (Wahl et al., 2018).

This study reported the prevalence of WRMSDs in both factories as 77.1% and 28.4% for the experimental and control groups during the last 12 months. The high prevalence in the experimental group was as a result of manual work activities, which are less mechanized as compared to the control group. This also predisposes workers in the experimental group to musculoskeletal disorders more than the Control group. Several studies conducted in various occupational settings having similar work situations have been explored for a detailed discussion of this study. The extremely high prevalence of this study was comparable to multiple studies conducted by Phajan, et al (2014), who reported a very high prevalence of 82.96% and 88.70 for 12-months and 7-days among sugarcane farmers on work-related musculoskeletal disorders in North-eastern Thailand. In their study lower back region has the highest 58.7% and ankles/feet region on the anatomical region among the respondents. A very high prevalence of 96.6% during the last 12 months was also reported by Mousavibaghi, et al., (2019) among Technicians of Surgery who reported pain and discomfort in at least one of the anatomical regions, they also reported lower back region with the prevalence of 71.5% and the least on the anatomical region was ankles with 16.2% similar to finding from this study. Hosseini et al., (2019) reported a very high prevalence of 91.9% among dentists in Iran, during the

last 12 months, Mekonnen, et al., (2020) among hairdressers on the prevalence of work-related musculoskeletal disorders in Ethiopia reported a similar high prevalence of 70.2% (N=458). A similar study by Udom et al., 2018 in a rubber plantation in Pakistan, also revealed that the prevalence of WRMSDs in the last year was 87.7% and the previous week to be 65.11%. A Nigeria study by Okeuze O, et al., (2020) on work-related musculoskeletal disorders among office workers in Higher Education institutions also reported a very similar prevalence to this current study of 71.9%. Considering the different anatomical regions, the study showed a higher prevalence on the lower back region of 58.1% and the lowest to be 20.7%, similar to the same result from this current study among factories workers. Another comparable prevalence rate from two studies among Turkish office workers by Celik et al., (2018) and Ardham H, (2016) reported a similar prevalence of 68.1% and 69.7%, with both studies showing severe WRMSDs symptoms, which triggers difficulties among workers during their work schedule and physical discomfort. Lagerstrom et al., (2019) conducted an interventional study on professional loggers on Active surveillance on WRMSDs symptoms in the development of safety intervention, reported a year prevalence of 60% among the conventional harvester and 50% among Mechanized harvesters. They further attribute this varying in prevalence between the two factories due to the machine used among mechanized harvesters, which reduces their chance of being exposed to ergonomic hazards compared to the conventional harvester. Also, the one-year prevalence of lower back is 24.8% in Conventional and 22.7% in Mechanized harvesters. Furthermore, many other studies have supported this high prevalence among factory workers, which is not only limited to the Agricultural industry, this includes work done by Quemelo et al,.2015 among Brazilians population reported a very high prevalence of 74%, also a study by Drako, (2018).

On work-related Musculoskeletal disorders among Automobile spare workers also revealed a prevalence of 71.6% and low back being the most affected of the body region having 38.1%, which is similar to findings from this current study with a prevalence of 63.7% at 12 months and 62.2% at 7-days. A study by Madadizadeh et al., (2016) shows a high prevalence of 85% in all the nine anatomical regions over the last year among Administrative Employees of Kerman University in Iran, with a higher prevalence of 41% on lower back region among the anatomical body region. A similar study among Sri Lanka rubber tapper plantations revealed a high prevalence of 66% in the last 12 months; they reported a similar prevalence on the anatomy region, with the lower back having 43% (Stankevitz, et al., 2016).

There was a decline in the prevalence rate due to the ergonomic intervention, which caused a drop in the prevalence rates in the different anatomical regions among the experimental group respondents. The following notable prevalence was recorded from the experimental group at baseline and post-intervention for 12 months, with the lower back having the highest (63.7% & 24.0%), upper back region (46.3% & 13.7%), and the lowest being the Ankle/feet (8.0% & 8.9%).

The Control group also revealed a very similar prevalence of (40.8% & 46.3%) for the lower back region, upper back region (21.7% & 26%), and elbow having the lowest prevalence of (10.4% & 21.1%). The increase in the prevalence rates accounts for no intervention in the Control group, so workers are continuously exposed to ergonomic hazards that predispose the respondents to develop WRMSDs. Despite the mechanized organization of the control group, workers are still prone to developing WRMSDs since ergonomic hazards control are not properly in place as recommended. Similarly, Gourab, *et al.,* (2016) conducted a study on Work-related musculoskeletal disorders

among male sugar factory workers who deal mainly with molasses in Nadia district of West Bengal, India. They reported an extreme prevalence of 76% for the lower back region and reported Ankle/feet 3.5%, which was exactly similar to the report of this current study in Uganda. However, this very high prevalence was consistent with different studies conducted in different occupational regions. A similar cross-sectional study conducted by Smita, Y.V. & Deepak, (2016) also revealed a very high prevalence of WMSD's among sugarcane workers. From their results, they reported that prevalence was more in the lower back (50%), knee (29%), neck (19%), hip (13%), ankle (10%), upper back (13%), shoulders (13%), elbows (10%) and wrists (14%). A Malaysian study among healthcare workers in a public hospital reported that over two-thirds of 376 nurses had complained about discomfort and pains at some of the anatomical regions for the musculoskeletal disorders sites within the last 12 months. They reported prevalence rate for different body parts was the upper lumbar (back) (40.69%) with a slightly higher prevalence as compared to the lower back region, with lower prevalence having the prevalent to be (35.28%) though slightly different from the prevalence reported in this current study (Amin *et al.* (2018). Furthermore, research was conducted by Arsalani*et al*. (2016) among Nursing staff personnel in Tehran, Iran. They reported that the majority of the nursing staff (88.0%) have complained and experienced musculoskeletal disorders in one of the anatomical regions in the last year, with the lower back having the highest prevalence rate at (65.3%) similar to findings from the experimental group prevalence at baseline.

Chaiklieng and Suggaravetsiri (2019) conducted a study on risk factors for WRMSDs among school teachers in Thailand and reported high prevalence rates of 54.5% for low back, 36.1% for the upper back, 34.5% for the neck, and 27.9% for the arm. They further showed an insignificant variation in the prevalence rate between genders and

across age groups. However, his studies' findings were not in line with some of the prevalence reported on the neck and arm from this study, with a slightly higher prevalence than what was reported in this study. Hosseini and his colleagues also reported a very high prevalence in the upper back region of 63.2%, which was similar and slightly higher to the result of this study, 46.3% among the respondents (Hosseini et al., 2019). Akodu et al., (2015), in their study from Nigeria, reported a higher prevalence of 74% in the lower back region, which is a similar report from the study.

An independent t-test analysis was done on SPSS to see if there are statistical differences between variables at baseline for the two study groups. There was a significant difference between the variables such as; Age of the respondent (p=0.000), BMI (p=0.000), Duration of work in the field per day (p=0.033), systolic (p=0.000), and Diastolic (p=0.000) in the control and experimental group at baseline. There are no statistical differences in the average work duration in the field per week and work experience per year for the control and experimental group respondent at baseline. Dehghan et al., 2016 conducted a study on the effect of a multifaceted ergonomic intervention program among dentists on reducing WRMSDs, which showed a statistical difference in similar variables like this current study on Age of the respondent (p=0.009), Average working hours per day in hours (p=0.008) and their BMI (p=0.006). However, variables such as work experience in years were statistically significant, not in line with the findings from this current study.

4.2.2: Risk Factors for the development of Work-related musculoskeletal disorders among the sugar factory workers

4.2.2.1: Socio-demographic Factors

The results from this study on demographic characteristics of the respondents in The experimental group and control group involved in the baseline and post-intervention revealed that two-thirds of respondents mean age of 30 years (30-39 years) and 35 years (30-39 years). An independent t-test shows that there were statistical differences between the age of the respondents in the two factories. Abareshi, et al., (2015), from their study, showed no significant difference among the age of the respondents in their study on Educational intervention for reducing work-related musculoskeletal disorders and promoting productivity. This age distribution from this study shows that the two Factory workers were dominated mainly by youth, and since the work activities, sugar factory required a lot of physical strength. This age group from the sugar factory is similar to ages reported from various studies in Agricultural industries and other factories that demand physical strength. A decrease in age among workers leads to a reduction in tissue elasticity. Joints may become less flexible, less mobile, and inflamed. The structural changes in the spine and load-bearing joints in human body are due to the decrease in the fluids of the joints and the wear and tear on the cartilage (Sites *et al.*, 2018).

A study by Gourab et al., (2017) among male (sugar factory) molasses workers in India on Work-related musculoskeletal disorders reported similar findings on age categories of 30-39 years were most affected by the WRMSDs with only ankles/feet showing some statistical significance among all the body region similar to findings from their study.

Generally, many components of the human body deteriorate with aging due to the working posture among the workers, possibly causing an adverse response in their musculoskeletal systems, leading to WRMSDs and weakening the tissue because of cumulative exposure (Sites *et al.,* 2018).

The univariate and multivariate analysis findings do not reflect a significant association on gender as risk factors for developing WRMSDs in all the nine anatomical regions. It was reported from this study that 8 out of every 10 respondents from the baseline and post-intervention were male. In contrast, relatively half of both respondents were married in both factories. However, this study reported that the majority of the married workers have this disease condition at a point time in their lifetime. The findings from this study were in line with results from a study among sugar industry workers in Kurad, Indian, which shows males have a higher prevalence of WRMSDs than females. However, this difference was not statistically significant among the workers from their studies (Desale, & Sagar, 2020).

Workers were also categorized based on level of education, workers with degrees (Bachelors or postgraduate), and workers without a degree (certificate such as primary/basic, certification, and diploma). The majority of the workers without a degree have the highest prevalence of WRMSDs compared to workers with a degree in both factories. Findings from the univariate analysis showed the statistical association between educational status and the lower back region as the only anatomical region affected with WRMSDs among the workers. Multivariate analysis also shows educational level as a predictor of WRMSDs prognosis among workers. These findings imply that workers with a higher level of education tend to be more compliant with work posture procedures than workers without a degree, reducing their risk of

developing WRMSDs. Gourab et al., (2017) also confirmed from their study among male (sugar factory) molasses workers in India on Work-related musculoskeletal disorders that workers above the primary level of education have no WWRMSDs risks. However, a slight deviation from this study as educations is not a predictor for WRMSDs development among the workers. Similar research by Iwan et al., (2019) on the correlation power of related factors affected musculoskeletal disorders complaints in Indonesia among rice mill unit operators showed a different result. From their findings, educational level was not statistically significant to the development of WRMSDs among the workers.

This current study showed that the respondents' mean BMI in both factories has a very close BMI of 23.1 for The experimental group and 24.5 for the Control group, which falls in the normal universal BMI range of 18.50-24.99 (WHO, 2019). Another factor similar to BMI was the Blood pressure rate in both factories. The average mean of the systolic and diastolic (126.17/78.9) also conforms with the average body systolic, diastolic pressure range (120/80). An independent t-test shows a statistical difference between the experimental and control group's BMI and blood pressure variables. However, a paired t-test shows no significant difference between BMI and Blood pressure of both groups at baseline and post-intervention. A study by Desale and his colleagues (2020) also found similar results showing a statistical difference in BMI among the respondents in the sugar factory. Another study by Dehghan et al., (2016) had similar findings in their interventional study among dentists on reducing WRMSDs, which showed that there is a significant difference between BMI of the control and interventions groups, also no any significant difference between BMI and Blood pressure among the participants was reported during their baseline and post-intervention data.

Similarly, Gourab et al. (2017) report among sugar factory workers also showed conformity with the blood pressure rate among the workers of (130/80) for systolic and diastolic blood pressure, although not a predictor for WRMSDs among workers. Their normal BMI and blood pressure resulted from high demanding physical activities in both groups, which makes the workers physically fit. A study by Fariba, et al., (2020) on examination of work-related musculoskeletal disorders and related factors among farmers of Asadab city in Iran also showed no significant association between the prevalence of WRMSDs and body mass index (BMI) among the farmers. Hassannejad, (2017) documented that a high basal mass index, which includes obesity and overweight, was reported as the critical, independent variable and a risk factor for WRMSDs, similar to the findings from this study.

4.2.2.2: Lifestyle factors

Regarding the lifestyle factors among the respondent that predisposed them to the development of WRMSDs, the study reported that more than one-third of the respondents were fieldworkers, and relatively half of them; worked at the manufacturing department. At the multivariate level of analysis, the work unit/departments were a predictor (p=0.011, CI=1.040-1.356) for WRMSDs among the respondents. However, this was not statistically significant at the bivariate level among the respondent in both factories. Manual job in sugar factory involves activities such as: separating the sugarcane leaves before it is crushed into the crush rollers, checking the texture of juice extracted, crystallized sugar, comparing the color crystallized sugar from raw sugar, adjusting packages into the machine for packing, loading the packed sugar into trucks to store them into the warehouse, Karkousha,., &Elhafeza, (2017). The findings from the above report suggest why most workers are predominantly field workers.

More than 90% of the respondents, both at the baseline and the post-intervention do not smoke. At the same time, more than three-quarters of both groups do not drink. The bivariate level analysis shows that smoking and drinking habits were associated with the development of WRMSDs among the workers, Especially in the following anatomical region; neck region (p=0.019), upper back region (p=0.050), elbow region (p=0.023), and ankles/feet (p=0.027) region among the respondent. However, this study also showed that the worker smoking and drinking habit was very low in both factories, the reason might be due to their busy work schedule. A similar study by Gourab et al., (2017) also reported a similar statistical significance on the ankle region as the only anatomical region among workers concerning alcoholic addiction. No statistical association on smoking among the workers was reported. Other studies on cigarette smoking and alcohol also show its association with WRMSDs development among workers; Cigarette smoking is a habit that impairs and damages the nutrition and structure of the muscular and skeletal system through hypoxia and vasoconstriction. It may favor the onset or aggravate the progression of WRMSDs (James*et et al.*, 2017). In a similar study on WRMSDs conducted among bank workers in Kuwait, smoking was shown to be a significant predictor for the occurrence of WRMSDs in the previous 12 months (Heidari, *et al.*, 2019). This study was inconsistent with Tesfaye et al., (2019), which also reported alcohol consumption is the other significant predictor of upper extremities pain among workers. The upper extremities include the neck region, the elbow region, the wrist/hands region, and the upper back region. A report from research by Emilson *et al.,* (2016) on Alcohol consumption on the physical therapist in Sweden showed an estimation that 40– 60% of all adult alcohol addicts show skeletal muscle myopathy. An imbalance in protein metabolism causes this myopathy and muscle wasting associated with chronic alcohol abuse.

Workers from the control group have more working experience in terms of the number of years spent in the factories than the experimental. The extended work experience might be due to infrastructural stability in the control group, which can also motivate workers to stay longer in the factory. WRMSDs prevalence was proportionate to this work experience in years among workers in both factories. Older workers with more experience have more exposure to WRMSDs risk than the new workers with less work experience. The work duration among the respondents, was represented in terms of hours per day and week. The majority of the workers in both groups work regular hours per week and per day in both factories due to their work schedule. Considering the work duration among the workers, only work experience in the year was a predictor for WRMSDs at the multivariate level of analysis. An independent t-test showed a statistical difference between the two groups' work duration in hours per day. There was no statistical difference between the work experience in years and work duration in hours per week in both groups.

Similarly, Abareshi et al. (2015) study on Educational intervention reduces work-related musculoskeletal disorders and promotes productivity in Iran, among workers. The respondents reported no statistical difference between the two groups' work duration in hours per day, work experience in years, and hours per week. Also, anatomical region like elbow region (p=0.032), shoulder region (p=0.0.011), wrist/hands region (p=0.007), upper back region (p=0.024), the lower back region (p=0.010) was found to be statistically significant with the duration of work in the factory, in several years, hours per week and hours per day. This implies that pain or discomfort in those anatomical regions resulted from work duration in both groups and departments. Nilvarangkul et al, (2018) reported findings similar to this current study on work-related musculoskeletal disorder risk-assessment tools among sugarcane farmers in North-Eastern Thailand. The

majority, 66.8% of the sugar factory workers, work more than five hours per day and 30% of the workers who have fewer than10-years' experience have discomfort in their anatomical regions. Another study on sugar factory workers revealed that workers spend more than two hours in their various work schedules, similar to the findings from this study Pawaret et al., (2019). They further established a statistically significant association on work experience among workers with the development of WRMSDs in their study to find the impact of work duration on the health of Sugarcane factory workers in India. In line with these study findings reported by Noroozi et al., (2015), workers with more than 10 years of working experience have a higher risk of neck and back pain as the anatomical region affected among the office workers on the prevalence of WRMSDs. Kim et al. (2019) also reported a different finding on upper extremity musculoskeletal diseases and disability prevalence from this current study. Working hours per day was a predictive factor for WRMSDs among fruit tree farmers. Another study by Sulaeiman et al. (2015) among bank workers showed no significant correlation between WRMSDs and the number of hours spent per week at work. This concretized the findings from this current study, highlighting that work duration in hours per week is not a predictor for WRMSDs among sugar factory workers.

4.2.2.3: Biomechanical factors

Regarding the biomechanical factors among the respondent that predisposed them to the development of WRMSDs, On their everyday repetitive actions while cutting sugar cane; extending or twisting the wrist, prolonged standing, stooping, exerting or twisting the torso, lifting objects among the workers. Almost all the workers (90.5%) were engaged in monotonous tasks while doing their work schedule compared to the control group, where 63% of the respondents engaged in a monotonous task. The majority of the respondents in both groups were engaged in an awkward position like bending.

Twisting posture during tasks, Two-thirds of the respondents overstretch during their jobs. Carrying of heavy load during their job was found higher among The experimental group (56.2%) than the Control group (42.2%).

In contrast, most workers in The experimental group (72.1%) do some of their work schedules while standing, which is less than the control group 48.3%. This study reported a very low prevalence among respondents who sit while working in the experimental group, 28.9%. Compared to the control group, 52.6%, this is due to the nature of the work in both Factories. However, the work situations in Experimental groups require a lot of human physical strength, such as loading and offloading sugarcane from the truck is more demanding. Both groups have the majority of their workers who engaged in repetitive movements during their tasks. The experimental group had more workers who engaged in the same postures for extended periods because they engaged in more manual work. A multivariate analysis finding from this current study showed that standing for long during the task was the only predictor (p=0.035, CI= 1.010-1.309) for musculoskeletal disorders among the respondents. A different study from the findings from this study by Tamene, et al., (2020) on Musculoskeletal disorders and associated factors among Vehicle repair workers in Ethiopia did not agree with prolonged standing as the predictor of WRMSDs. Their study reported repetitive motions as a predictor of WRMSDs at the multivariate level. Bivariate analysis showed several associations between the biomechanical factors and different anatomical body regions; Neck (p=0.000), elbow (p=0.045), wrist/hands (p=0.010), upper back (p=0.001), lower back (p=0.021), hips/thigh (p=0.000), legs (p=0.015), knees (p=0.003), and ankles/feet (p=0.000) at 12-months or 7-days prevalence of WRMSDs among the respondents respectively. Each worker took more than 4 hours to carry out this task in both factories.

A study by Fariba, et al., (2020) concluded that there was no significant relationship between musculoskeletal disorders induced by farm work and the average daily load carried by the farmers in Asadabad City in Afghanistan. Since agricultural jobs demand repetitive movements, they keep their knees bent while carrying heavy loads in their working conditions. They further concluded that regions such as; the knees, the legs, the ankles/feet, the lower back, and the waist region are prone to musculoskeletal disorders among the farmers in Agricultural settings. A similar study on sugar factory workers showed that repetitive movements resulting from conventional sugar cane cutting among the sugar factory workers, sugar cane works routine are so tedious, which raises the possibility of musculoskeletal disorders, most especially in the hand and wrist (Smita & Deepak 2016, Sakzewski and Naser-ud-Din 2015). The same study from Smita & Deepak, (2016) shows prolonged, static, and awkward postures were linked to the development of WRMSDs among Sugarcane workers. They consistently pulled branches of sugarcane repetitively, the way the workers lifted the sugarcane, and finally threw it into the trucks for transportation. While in these activities, worker continuously controls their body posture and frequently lift their hands above their heads; they always extend forward on their feet to empty them into the truck. Results from Desale, & Sagar (2020) showed that sugar industry workers have to lift heavyweight of sugarcane on their shoulder and back, which causes the WRMSDs pain. They reported a strong association with bending and lifting as the most common causes of low back pain similar to findings from this study. Gourab et al. (2017) reported from their study on sugar factory workers that workers maintain different awkward working posture types during prolonged working hours. The bent and twisted back position makes it hazardous to musculoskeletal disorders. Their study among the workers strongly associated the knee, legs, and lower back region. The Lower back pain was associated with repetitive

movements and overstretching. This is due to repetitive forward bending and twisting of back posture, which exerts a compressive pressure on the lower part of the vertebra bone and its surrounding muscles (Gourab et al., 2017, Phajan et al., 2014).

Several studies by Biswas on the occupational health status of construction workers and Singh on upper limb musculoskeletal disorders associated with computer usage in a healthcare professional have reported that working posture during work can cause WWRMSDs among the workers (Biswas, Bhattacharya, Bhattacharya. 2017, Singh, et al., 2015). Another study on dentists found an association between sitting for an extended period also predisposed the workers to WRMSDs affecting the lower back, Neck, and Shoulder region, which was also consistent with the findings from this current study (Ashu, M. A., & Kamo, H. 2016). Saputri et al., (2020) conducted a study in India on the effect of ergonomics intervention on work-related musculoskeletal disorders among tailors, showing overtime work, overuse, and prolonged adopted work position among the tailors have a strong association with the development of WRMSDs. An Iranian study on the workforce and job group's prevalence of WRMSDs also revealed similar findings. They establish that risk factors such as lifting a heavy load, repetitive movements, standing position for long, extra force exertion/overstretching are the significant causes of the high prevalence rate of WRMSDs symptoms among workers with static or monotonous job dynamics (Choobineh et al., 2016). Okello et al., (2020) show that the findings from their study concerning heavy lifting or lowering for 2 hours and above were significantly associated with reporting WRMSDs among the gold mine workers in South Kivu, Democratic Republic of Congo. Another critical study by Subramaniam and Murugesan in 2015 also reported similar findings to this current study. Studies on WRMSDs among workers show a trend similar to the conclusion from this study on the effects of the biomechanical factors on WRMSDs

among sugar factory workers. The risk factors for WRMSDs among catering workers include lifting heavy objects, awkward posture, excessive force, repetitive work, and prolonged standing.

4.2.2.4: Psychosocial factors

Many psychosocial factors are known from other research to be a positive predictor of the prevalence of WRMSDs (Bernal *et al.,* 2015), which was inconsistent with the finding from this study. Psychosocial factors among the respondents show an association with the development of WRMSDs. Factors such as health-seeking behavior among the respondents, conclusions of this study reported that a more significant number of respondents had visited a doctor or therapist due to WRMSDs. The majority also reported being hospitalized due to the WRMSDs in both factories. The Majority of the respondents use painkillers to get relief from the pain. However, the numbers were higher in The experimental group than the control group due to the prevalence rate of WRMSDs. This study also revealed that only a few respondents think of changing their current job because of the WRMSDs pain. However, the absenteeism or sick leave in the last 12 months due to discomfort or pain arising from WRMSDs was somehow high, like 20%. Workers' dissatisfaction with the mindset of changing their jobs was also similar to a finding by Mousavibaghi, et al., (2019) on prevalence and risk factors of WRMSDs among Technicians of Surgery, which showed 21.2 of the respondents also intended to change their jobs due to discomfort emanating from the pain. This was also similar to findings by Hallamn et al., (2019) as they also reported sick leave among the workers in their study to be 24%.

Most of the respondents have breaks twice a day in the control group. In contrast, the majority in The experimental group only have one break time, or sometimes they don’t

get a chance to break till they complete their daily task, and most of the respondents also work in shifts. The psychosocial factors and prevalence of WRMSDs among the respondents at 12 months and 7-days in the two factories were statistically significant at the bivariate level. The lower back region was statistically significant with all the psychosocial factors, followed by the upper back region and upper extremities region among the respondents and the development of WRMSDs . The lower extremities regions like thigh, knees, and ankles/feet were also significant but not all psychosocial factors.

Another study by Hallman, et al., (2019), when they were exploring sick leave due to musculoskeletal disorder among blue and white-collar workers, revealed that most pain characteristics among workers showed a very strong significant association with sick leave trajectories., This was in line with the finding of this study which showed sick leave has a significant association with the development of WRMSDs among workers. Another similar result on Multiple anatomical region pain was associated with a high risk of sick leave or absenteeism among workers, as reported by Feleus et al. (2016). Higher rates of sick leave due to WRMDs with workers of informal sectors and workers with high physical demands, this evidence could also be backing the findings from this study on the nature of the job of the sugar factory workers (Feleus et al. 2016; Pekkala et al. 2018). A Ugandan study by Munabi et al, 2014 on Nursing personnel also revealed variables like feeling tired after work as mental exhaustion and break time have associated risk factors for developing WRMSDs. Oluka et al. (2020) also showed poor break time during domestic gas station workers' tasks and sleeping disturbance as a predictive factor for WRMSDs, which was also similar to the complaint from workers in this current study who regularly feel tired after getting up in the morning. Another study on work-related musculoskeletal disorders among bank workers in 12 months

reported respondents who had job stress were two times more likely to develop WRMSDs than workers who had no job stress. This job stress was also similar to findings from this current study among the workers on feeling tensed at work and tired during morning time after their sleeping (Dagne et. al., 2020).

Okello et al., (2020) also reported in their study that psychosocial factors associated with WRMSDs among the workers and workers with low job demands were less to report WRMSDs. These were similar to findings from this study where workers with high job demands tend to be more stressed and ultimately develop WRMSDs in one of the body regions. The effect of psychosocial factors has been reported by various researchers across all industries in the causation of WRMSDs, Yue, et al., (2016); Taiwah et al., (2015); Shukariah et al., (2017).

4.2.3: Ergonomic based intervention

The QEC was the ergonomic assessment tool used in this current study to evaluate the effect of the intervention on the experimental group. Several interventional studies considered using QEC due to its effectiveness and its reliability. In conformity with the reasons why QEC was chosen, a study done by Stanton et al. (2018) also shows from their findings that QEC is an assessment tool to assess whether an ergonomic intervention can effectively reduce these exposure levels among the workers. The QEC data was calculated, and the respondents were categorized based on their units/departments to show the magnitude of WRMSDs and the frequency of exposure to injury in four anatomical regions. The mean score from QEC was initially high in the experimental group at baseline; after administering the ergonomic intervention, there was a reduction in mean difference from baseline and post-intervention in The experimental group. The reduction in the QEC total score for the post-intervention was

the key indication of this study. Because the prevalence of WRMSDs reduced from 77.1% to 37.0% among the experimental group. This reduction in the total QEC score was comparable with findings from other research, where a reduction in WRMSDs was also reported (Fateemah et al., 2015). The control group, which was the control group, has consistent or less significant differences in their mean score from QEC. By contrast, the experimental group has higher QEC assessment mean scores than the control group; this is also attributable to the system of works in the experimental group, which is less mechanized than the control group, although the QEC scores were also high as well. So generally, most sugar factory workers are exposed to ergonomic Hazards that predispose them to the development of MDSs. However, workers in experimental groups are more exposed to ergonomic hazards than the control group due to their work situation. Fateemah et al., (2015) also reported something contrary to this study by showing the control groups having a reduced QEC total score among respondents. They gave a reason to be possibly due to job rotations among the control group, which may subject the respondents to work with more difficulty and attributable risk factors. The engineering unit and the Cane yard unit from this study have the highest mean score for back exposure to ergonomics risk 39 and 38.5, while Admin has the lowest mean score of 22. Manufacturing units had the highest neck exposure to ergonomics risk mean score of 14.04, while the engineering unit had the lowest mean score of 12.0, similar to the Administration unit's mean score of 12.1. Vibration means score exposure to ergonomics risk was higher among workers in Manufacturing units due to the nature of sugar factory machines. The workers always work while their body is vibrating; this can be a constituting factor for the development of WRMSDs. Using the QEC tools, the back and wrist region total exposure to ergonomics risk has the highest mean difference score of 11.70 and 11.49, while work pace has the lowest mean difference score of 0.05.

The calculated QEC exposure scores from WRMSDS show a reduction in the action level (AL) of exposure score presented at baseline and post-intervention. Before intervention among the respondents, the majority of the respondent at different units had the highest level of risk (AL 4=70% and above) (n=131) 65.5%, this highest level of risk poses a threat to the workers and the action level recommended was to investigate further and change immediately at the baseline before the intervention. The higher action level was also inconsistent with findings by Hossain et al, (2018); in their study, they also concluded to investigate further and change the work situation immediately among workers. After the intervention, the action level for QEC was reduced considerably. The calculated QEC exposure scores for WRMSDs reduced to a low level (AL1=0-40%) n=80 (54.8%). The recommended action level from the QEC assessment was acceptable, although some proportion of the workers were still within the moderate action level (AL2=41-50%).

An independent t-test showed statistical differences between the back region's total exposure to ergonomics risk and the wrist/hand region's total exposure to ergonomics risk from the control and experimental groups before and after the intervention. Other QEC parameters like shoulder total, neck total, work pace, and stress total show a statistical difference before or after the intervention. In contrast, the remaining parameters show no statistical differences in both Factories as compared. This implies a significant difference between the two groups on exposure to ergonomic Hazards in regards to the QECs parameters.

The result obtained from the paired t-test shows there are statistical differences in the following QEC total scores. There were significant differences between the data collected at baseline and post-intervention only for the intervention groups but not

significant in the control category. However, Exposure scores in different body parameters show that's in The experimental group; back total, shoulder total, wrist total, Neck total, Driving total, and stress total at baseline and post-intervention. Finding from this in the Control group showed that only the Neck total only shows statistical differences from all the QEC parameters at pre and post-intervention.

In their analysis report, a study on educative interventions for reducing work-related musculoskeletal disorders and promoting productivity by Fateemah et al., 2015 revealed that QEC total scores were significant differences between the data collected prior and post-intervention in both case and control groups. This was in line with the finding of this study. Salleh et al., (2017), also supported the conclusions of this study based on their QEC exposure score evaluations. The back, shoulder, and arms regions are parts of the body that obtained higher risk scores among catering workers' preliminary study of musculoskeletal complaints and ergonomic risk factors. A similar comparison of these results among sugar factory workers and the level of exposure showed a very high exposure in this group than Seyareh hydropower plant workers. However, they have fewer workers in their study groups (Farhadi, et al., 2014). The highest frequency level of exposure to an injury in the body part of the respondents are Wrist/arm region 63.2%, lower back region 51.2%, Neck region 31.7%, and Shoulder region 30.8% high level of exposure of injury among the sugar factories workers. This was different from the study done by Mousavibaghi, et al., (2019) on surgical technicians with the highest exposure to an injury in the back 45.3%, neck 45.3%, shoulder 44.3%, and wrist 44.1% was related to moderate level of exposure. In addition, the QEC exposure score revealed that the work pace and stress-related risk factors in this study were moderate 78.1% level and very high 55.7% risk level; however, the highest frequency of risk factors of exposure to vibration was associated with a low-risk level 70.1. This exact finding was

similar to what Mousavibaghi et al. (2018) reported in their study on work-pace 67.6%, stress 60.9%, and vibration 68.2%. A study of Musculoskeletal discomfort evaluation using Quick Exposure Check (QEC) among tower crane operators also reported similar findings to this study. However, their result on the high-risk level differs from the body region reported in this study as the wrist/arm was the highest in their study. This can be due to workers using more of their hands during most of their activities than other body parts.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter presents the conclusion and recommendations from the discussions of the results and analysis in chapter four. This study aimed to conduct an ergonomic-based intervention on musculoskeletal disorders among two sugar factory workers; Uganda Farmers Crops limited as The experimental group and Sugar Corporation of Uganda Limited the Control group in Jinja, Uganda?

5.1 Summary of the findings

Work-related musculoskeletal disorders are relatively common among sugar factory workers in Uganda, although the aetiology of WRMSDs among the sugar factory workers was found to be multi-factorial. The prevalence of WWRMSDs was so alarming and high among the factory sugar workers, which predisposes the workers to the prognosis of WRMSDs in both factories. Findings from this study reveal the magnitude of WRMSDs and the predisposing factors among the sugar factory workers, which has been one of the neglected areas of research in Agricultural industries. The lower back region was the most reported anatomical region that affected WRMSDs among the workers in almost all the units. This was evident by using the Quick Exposure Check, which also revealed the Back region total to be the highest risk level in all the body regions. The Control group uses more of an engineering control hierarchy, so most of the work in the factory was done by the machine, including offloading sugar cane from the truck and loading sugar into the truck. Hence, workers face few hazards compare to the experimental. All the body regions had a statistical association with almost all the risk factors in this study. However, this high prevalence was that the experimental group's working condition was not as mechanized as in the

Control group. The majority of the experimental group cane yards unit workers permanently offload the sugar cane manually from the truck. This exposes the workers to many occupational hazards such as Award bending, prolonged twisting, and repetitive movements. Workers in the experimental group offload 30 big trucks loaded with sugarcane daily; the drivers, too, had insufficient knowledge of ergonomics because they were exposed to ergonomic Hazards like vibration and awkward posture they assumed while driving. With introducing the Ergonomic intervention in the experimental group, many modifications were put in places, such as training the workers on the best working posture, proper lifting techniques, and ergonomic stretching.

The outcome of the interventions in the experimental group is as follows;

i. Workers were adequately informed about the Hazards they might get due to not working safely, which can affect their health.
ii. Workers' morale was high as they felt the experimental group took their health seriously, so they felt motivated to work.
iii. Workers undergo ergonomic training to better their working experience and knowledge
iv. Workers were practically shown how best they can work that is free of ergonomic Hazards
v. The complaints of body pain after the intervention were reduced based on the report from the factory sickbay.
vi. Posters were attached strategically in different workstations to remind the workers of the best working conditions continuously.

vii. Workplace places modifications were done, such as office chair adjustment, Computers, and all office accessories were ergonomically arranged to avoid any form of work-related injuries.

viii. Driver's sits were modified to adjustable levels free of occupational injury.

ix. All workers in different units were taught the proper lifting and lowering techniques.

Considering the work schedule of the sugar factory workers, which is different from other agricultural sectors, most of their activities are awkward, prolonged standing and sitting, repetitive movement, and bending.

This study thoroughly looked into some of the risk factors such as sociodemographic, occupational, lifestyle, biomechanical, and psychosocial factors predisposed workers to develop WRMSDs. This research shows most of the workers in both groups were young; the majority were male and single with a medium level of education below degree. Age plays a vital role in developing WRMSDs among the workers in both groups. Although almost all the married people reported the prevalence of WRMSDs in both groups, they also reported high discomfort during their jobs leisure at home with friends and families. It was also significantly associated with the development of WRMSDs. The majority of the workers with moderate or normal BMI and blood pressure are in the manufacturing department, which could be due to their work situations. The experimental group does most of their work while standing and maintaining unnatural anatomical postures, while workers in the Control group do most of their work while sited. Several studies have established higher BMI to sedentary lifestyle like prolonged sitting at the workplace. The reason for slight changes in the BMI of the factories was due to settings as well.

The units/department also predisposed workers to various hazards; units like cane yards, engineering, and manufacturing pose a lot of risk to workers. The QEC showed all these units high risk for WRMSDs development among workers. Workers in Cane yards are dominated by people of certificate level of education and junior field workers. It was proven from this study that education has a significant association with the development of WRMSDs, meaning they might not be aware of educational information to protect themselves from the poor working situation. However, the WRMSDs prevalence was very low among the most educated workers that predominate the Administrative units. The supervisors at every department were adequately informed of what they needed to do to protect themselves from such Hazards.

Work experience also played an essential role as a predictor of WRMSDs among the workers; most of the workers with more experience in years might have undergone some specific training on ergonomics, which can also assist them in managing this situation on their own. In contrast, workers with less experience are prone to this occupational injury. Due to their experience, they are young, and sometimes they tend to be overzealous in doing things out of proper instruction by their supervisors. Workers' lifestyle, including smoking and alcohol consumption, was low in both companies; this might be due to some restriction in the workplace. Workers who smoke and drink also reported the case of WRMSDs although some anatomical region was associated with the development of WRMSDs. Another reason for most workers not having this lifestyle of smoking and drinking might be their salary which might not allow them to leave such kind of lifestyle. Workers' job procedure involves a lot of physical strength, which makes them assume different unnatural postures. All the listed working postures on the risk factors such as bending, sitting for long, prolonged standing, repetitive hand movements, and prolonged posture were all significantly

associated with WRMSDs among the workers. With lower back pain and the upper extremities being the most affected. The Ergonomic evaluation tools also confirmed this result, showing back total at the high-risk level and all the upper extremities. This can be interpreted as working postures that workers assume also pose a lot of risk to the development of WRMSDs.

The study also presented psychosocial factors as a predictor for WRMSDs among workers. The workers getting relieved from pain, and the frequency of their visitation to hospital for treatment was also at an alarming rate. This could translate into WRMSDs having a multiplier effect on economic burdens both to the workers and the factories because the most dispensed drug at the Factory Sick Bay was the painkillers. As one-fourth of the factory workers have ever taken sick leave or been absent from work due to the pain and discomfort they sustain during their job, some workers were thinking of changing their work. Some workers complain of not having enough time during their break, while some complain that they only have time for the break when they are leaving the factories. Not having enough or adequate rest time can worsen the WRMSDs among the workers, thereby affecting their stress level. The majority of the workers feel tense at work. This might be due to lack of enough break time during their work, while workers also feel tired regularly after waking up in the morning. This indicates the body has been overused during the day at work, so lack of adequate break time can affect workers' morale. When one has stressed, it triggers pain, fatigue, and sensations in the body. The risk factors identified for WRMDs included unnatural physical posture, the duration spent carrying loads or undertaking a specific task, forceful exertion applied on both hands/wrist, working pace or speed, and worker’s mental exhaustion (stress level).

Findings from this current study have highlighted that the nature of working conditions in sugar factories was a predisposing and conducive reason for developing the work-related musculoskeletal disorder; hence this intervention was suitable and timely.

5.2 Conclusions

There are a lot of future study opportunities regarding musculoskeletal disorders among sugar factories workers. To the best of my knowledge, this study of ergonomic-based intervention of musculoskeletal disorders among the sugar factory workers is a pioneering research on the use of the Nordic Musculoskeletal Disorders Questionnaire (NMQ) and Quick Exposure Check (QEC) tool in Uganda and the entire East Africa region. As demonstrated by this current study, the prevalence of WRMSDs in the interventional group significantly reduced than in the control group after the ergonomic-based intervention in sugar the experimental group among the workers. Furthermore, when compared between the control and the intervention after the intervention, the level of WRMSDs risk decreased significantly. Therefore, findings from this study will support the conclusion that ergonomic-based intervention might affect the prevalence of WRMSDs among sugar factory workers. Therefore, incorporation of ergonomic-based intervention on-the-job training initiatives for old and new workers will assist and with continuous improvement in workplace conditions, this will consequently reduce workplace accident or injuries and work absenteeism among workers and also increase the productivity of the workers in their different units. To minimize the occupational exposure to work-related musculoskeletal disorders among sugar factory workers, an ergonomic intervention like this should be continuous and duly monitored by the safety officer of the factory. By assessing ergonomic risk factors at any given workplace at a time, the effectiveness of the workplace intervention can be assessed and evaluated

without waiting for a drop in the prevalence of the musculoskeletal to become evident by analysis, provided the total QEC score has shown a reduction in the risk level.

5.3 Recommendation for practices

This study is one of the upcoming areas of Non-communicable diseases in research. Based on the findings from this study, the following recommendations were made.

5.3.1 Recommendations to Authorities/Policymakers

1. In addition to routine occupational health and safety training to employees as speculated and required by the Uganda Health and safety Act 2005 legislation. It was also recommended that factories focus more on educational and promotional activities to improve occupational and safety awareness and create a safety culture. The outcomes of this occupational training should be documented, monitored, and reported by regular inspections to the top management.
2. In general, a very low-cost solution can also be recommended for policymakers to alleviate the risk and burden of WRMSDs. This should include a work-rest cycle and sitting chair with backrest and hand rest or position during work.
3. The Labor Union in Uganda should ensure workers in this occupational setting work within the country's occupational health and safety guidelines.
4. The ministry of health in Uganda should formulate policies that will enhance safety and prevent work-related WRMSDs among Sugar factory workers.

5.3.2 Recommendations to Sugar Factories/other stakeholders

1 Those contributing factors noted in this study should be addressed accordingly to be influential among the workers.

2 It was observed that it is necessary to be carrying out an ergonomic assessment in a factory from time to time to correct adverse work-related physical conditions among workers, thereby promoting the farmer's level of knowledge through the educational intervention of occupational health.

3 As it is prerogative to every factory or organization, employers should take practical actions on ensuring the working environment free of hazards. At the same time, employees are also advised to strictly follow the factory's standard operating procedures to prevent WRMSDs.

4 A top management commitment to Health and safety issues is very paramount.

5.3.3 Recommendations to the workers in the sugar factory

1 Findings from this current study show that workers have a higher risk of developing musculoskeletal disorders, a booklet, pamphlets, and a big poster was recommended to be prepared. This will have detailed all ergonomic postures, ergonomic hazards, and wrong posture while working to sensitize the workers on the awareness of these musculoskeletal disorders.

2 All the unit’s supervisors were tasked to monitor and see if the workers were doing the right things to avoid occupational injury at work.

3 All field workers should be equipped with personal protective equipment to reduce their exposure to ergonomic hazards due to vibration.

4 More outstanding advocacy should be to alleviate the burden of higher-risk WRMSDs among workers. This will include increased recruitment of more

workers, better working conditions, reduction in work time and improvement on job satisfaction, and adopting a new technology where resources permit to reduce the exposure risk among the workers.

5 Therefore, to prevent these complications, workers are recommended to be given more time to the existing rest time/break between shifts. They should do various ergonomic stretching/movements at the workplace like waist swing exercise, rubbing their calf muscles, sitting, and moving up continuously.

5.4 Recommended Area for further research in this field of study.

1. A minimum of 12 months would be appropriate when undertaking such an investigation so that workers can get aquatinted all the training involved and be well informed about ergonomics.
2. The economic burden of Musculoskeletal disorders should be thoroughly explored because, so far, in African settings no documented evidence on the Regional burden of WRMSDs.
3. Epidemiological surveillance systems should be further studied to ease the proper diagnosis of WRMSDs among the workers.
4. Linking the disease's co-morbidity to the prognosis of WRMSDs should also be explored.

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APPENDICES

Appendix I: Inform Consent for Study Participants

Request for Participation in a Research Project

Consent: You are being invited to participate in a research study focusing on one of the major health challenges that's mostly common to all industrial workers titled "Ergonomic based intervention for musculoskeletal disorders among Sugar Factory workers in Jinja, Uganda." My name is AREMU ABDULMUJEEB BABATUNDE, I am a student from Mount Kenya University, Kenya studying PhD in Public Health.

You were selected as a possible participant in this study Due to nature of your work situation involves some hazards that might predispose you to development of this disease condition known as Musculoskeletal disorders.

What participation involves

The whole exercise will take about 20 minutes of your time; questionnaire 5 minutes, Anthropometric measurement 5 minutes, Physical exercise 5 minutes, training 5 minutes.

Confidentiality

All information collected in this exercise will be treated with highest level of privacy and confidentiality, by using codes/identification numbers.

Benefits

There are no known any risks involves if you decide to participate in this research study. The information you provide will be useful in identifying the magnitude of the diseased condition, its impact among the workers, guiding the researchers on best approach to reducing it burdens among all other sectors involve in this work situations and also be useful for Healthcare decision makers.

Contact: for any questions or complaints, feel free to call the researcher:

Number: **+256754407054** or email: abumujaeed@gmail.com

signature of the participants…….

Date……..

Appendix II: Questionnaire

Phase 1 Questionnaire Section

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

Section A: Personal Information

1. Gender

Male	
Female	

2. Marital status a). Married b). Single c). others
3. Educational level: a). O'level/A level b). Diploma c). Degree D. Masters
4. Age a). 20-29yrs b). 30-39yrs c). 40-49yrs d). 50 yrs and above
5. Weight _____ kg
6. Height _____ m
7. Blood pressure systolic [ ] diastolic [ ]
8. Level of work a) Field workers b) Junior staff c). Middle staff d). senior management
9. Division/Department/Unit_____ ____
10. Do you smoke? a). Yes b). No
11. How many cigarettes do you smoke per day?
12. For how many years have you smoked? a). less than 1-year b). 2 – 4 yrs c). above 5 yrs
13. Do you consume alcohol? a). Yes, b). No

Section B: Occupational History

13. Is this your first job yes

No

14. If yes, have you ever experienced Any forms of Musculoskeletal disorders in any body part in your previous job Yes

No

15. How long have you been working in this sugar the experimental group). less than 5 yrs b). 5- 9 yrs c). 10 years and above

16. On average, how many hours per week do you work? a). less than 40 hours b). 40-60 hrs c). 60 hrs and above

17. Does your job involve any of the following?

Work situations	**Never**	**Seldom**	**Sometimes**	**Often**	**Always**
17.1 Bending					
17.2 Overstretching					
17.3 Monotonous Task					
17.4 Vibration					
17.5 Standing					
17.6 Sitting					
17.7 Repetitive hand movement					
17.8 Same postures for long periods					
17.9 Awkward posture					

18. On average, how much time do you spend on the above job situations a).

19. Have you had any form of work-related injury in the past 12 months? a). Yes b). No

20. Were your off from work as a result of such injury? a). Yes b). No

21. If **YES** to question 17, how many days? _____ days .

Section C: Standardized nordic questionnaire for analysis of musculoskeletal symptoms (Iti et al, 2016**)**

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

Section D: Psychosocial Factors

Answer the following questions ONLY IF YOU HAVE SUFFERED IN SOME WAY

1. Have you ever been seen by a doctor, physiotherapist, chiropractor, or other such person because of the problems? a). Yes b). No
2. Have you ever been hospitalized due to these pains or problems? a). Yes b). No
3. Have you ever had to change jobs due to these pains or problems? a). Yes b). No
4. For how many days did you have the problems in the past 12 months? (Select ONE option only)

0 days	**1 – 7 days**	**8 – 30 days**	**More than 30 days**	**Every day**

5. Has any of the above troubles caused you to reduce your activity in the following area during the last 12 months?

b. Work activity (at home or away from home) a). Yes b). No
c. Leisure activity a). Yes b). No

6. For how many days in the last year did the problems prevent you from doing your normal work? (Select ONE option only)

0 days	**Every day**	**1 – 7 days**	**8 – 30 days**	**More than 30 days**

7. How often do u have break during this job situation a). once a day b). twice a day c). Not at all

Do you feel stress in any of following:

8. During my task a). strongly disagree b) Disagree c). strongly Agree d) Agree
9. With my workmates a). strongly disagree b) Disagree c). strongly Agree d) Agree
10. Work environment a). strongly disagree b) Disagree c). strongly Agree d) Agree

11. Working over time a). strongly disagree b) Disagree c). strongly Agree d) Agree

PHASE 2: INTERVENTION

1. Has the intervention been of help to you?

A) Agree b) strongly Agree c). strongly disagree d) Disagree

2. Has your pain reduced after the training exercise?

a) Agree b) strongly Agree c). strongly disagree d) Disagree

3 Has your level of activities at work activities increase after the intervention?

a) Agree b) strongly Agree c). strongly disagree d) Disagree

4 Has your level of activities at leisure activities increase after the intervention?

a) Agree b) strongly Agree c). strongly disagree d) Disagree

5 Has your absenteeism reduce

a) Agree b) strongly Agree c). strongly disagree d) Disagree

6 Has the cost of buying painkillers reduces after the intervention?

a) Agree b) strongly Agree c). strongly disagree d) Disagree

7 In your own opinion could you recommend this kind of programme be continuous

a) Agree b) strongly Agree c). strongly disagree d) Disagree

8 For how many days did you have the problems in the past 6 months? (Select ONE option only)

0 days	**1 – 7 days**	**8 – 30 days**	**More than 30 days**	**Every day**

Thank you for participating in this study.

Appendix III: In-depth Interview Guide

1. How do you see musculoskeletal disorders in your personal life?
2. How does it affect you and your job?
3. How best do you normally treat this musculoskeletal disorder?
4. In your opinion do you believe if musculoskeletal disorders are treated it can improve your productivity at work
5. Would you suggest to the company should improve on your duty station?
6. Do you know musculoskeletal disorders can lead to disability if not treated early?
7. Is most of the sick leave related to musculoskeletal disorders
8. When was the first time in life, you first experience this pain?

Appendix IV Questioniare Translated To Luganda

Ebibuuzo Ebigenda Okubuuzibwa

Omutendera ogusooka Ogwebibuuzo

Ddamu ebibuuzo byonna ebikubuziddwa era ojjuzemu amabanga wekyetagisiza**.** Byonna byogenda okuddamu bigenda kukumibwa nga byakyama .Towandika linnya lyo ku kiwandiko kino

Ekitundu Ekisooka : Ebikukwatako ng'omuntu

1. Ekikula Kyo

Mwami	
Mukyala	

2. Oli Mufumbo **a)** ndi mufumbo **b)**Sili mufumbo **c)** Ngwa mu kiti kirala ……..

3. Omutendera gw'obuyigirize bwo **a)** Sasomako **b)**Nakoma mu pulayimale **c)** Nina Dipuloma **d)**Nina Digguli emu **e)** Nina Digguli bbiri

4. Emyaka gyo **a)** Wakati wabbiri –Nabbiri mu omwenda **b)**Assatu –Nassatu mu omwenda **c)**Anna-N'ennamu omwenda **d)**Atanno n'okudda waggulu

5. Obuzito bwo ……..Mu kilo

6. Obuwanvu bwo ……Mu mita

7. Ekika ky'entunuusi : Dayasitoliki [ ] Sitoliki [ ]

8. Omutendera gw'omulimu gwo **a)**Mukozi wa mu byalo **b)**Mukozi wa ddala elya wansi **c)**mukozi wa ddala ely'omumakati**, d)**Mukozi wa ddala ly'awagulu

9. Ekitongole Mwokolera ……

10. Onnywa sigala? a) Yee b) Nedda

11. Onnywa eminwe gy'asigala emmeka olunaku? …….

12. Sigala wakamunywera emyaka emmeka? **a)** Sinaweza mwaka **b)**wakati wemyaka ebbiri –N'enna **c)** munnyweredde emyaka ettano n'okusoba

13. Onnywa Omwenge **a)** Yee **b)** Nedda

E kitundu Ek'okubiri : Ebikwata ku mirimu gyo

14. Guno gw'emulimu gw'ogusooka? **a)** Yee **b)** Nedda

15. Bweguba gw'egusooka , wali ofunnyeko obulumi mu bitundu by'omubiri gwo nga bwekusa ku mulimu gwewasooka okoola? **a)** Yee **b)** Nedda

16. Banga ki ly'omaze ng'kola mukolero ly'asukali lino? **a)** sinaweza myaka ettano **b)** wakati w'emyaka ettano – N'omwenda **c)** Myaka kumi n'okwambuka

17. Okutwaliza awamu .Okola essawa mmeka e wiki? **a)** Wansi wessawa ammaukumi Anna **b)**Wakati w'essawa Amakumi Ana – N'enkaga **c)** Essawa nkaga n'okudda waggulu

18. Bwoba okola omulimu gwo, okola bino wammanga?

Embeera gy'emukoleramu	**Tekibangawo**	**Tekitera**	**Oluusi**	**Ebiseera ebisinga**	**Buli kiseera**
18.1 Okukutama					
18.2 Okulafubana Ennyo					
18.3 Okudigana omulimu					
18.4 Okuwulirira ebivumbeera					
18.5 Okuyimirira					
18.6 Okuttula					
18.7 Okukyusakyusa emikono buli kiseera					
18.8 Okukola mungeri yemu okumala ebbanga egwanvu					
18.9 Okukola mu ng'otudde ,oba oyimiridde n'emungeri endala zonna naye nga sizabuvunannyibwa					

19. Okutwaliza awamu, embeera eyo gy'okoleramu ogyibeeramu okumala essawa mmeka? .....

20. Wali ofunnyeko obuvune bwonna ng'abwekuusa ku mulimu mu banga ely'emyeezi ekkumi n'ebbiri egyiyise? **a)** Yee **b)** Nedda

21. Okugenda okuwumulamu kyava ku buvune bw'ewali ofunnye? **a)** Yee **b)** Nedda

22. Bwekiba kituufu nga okuwumulamu kwava ku kibuuzo namba abbiri mwemu, wawumulamu ennaku meka? ……

E kitundu E ky'okusatu.

Ebibuuzo ku mutendera ogwawaggulu ebyeyambisiddwa okusobola okwekennenya obubonero obulaga nti omuntu yakosebwa mu biyungo byomubiri ng'akola emirimu gye (**Bisigukuluddwa mu kiwandiiko kya Iti et al, 2016**)

To be answered by every one		**To be answered by those who have had trouble**		
Wali ofunnyeko obuvunne bwona mu banga ly'amyezi kumi nebbiri egyiyise gamba nga, (obulumi, obuteyagala,okuwulira amasannyalaze mu mubiri in:		Wali olemeseddwako okukola emirimu gyo mu biseera by'okola mu myezi kumi n'ebbiri emabega awaka oba ku kifo ewalala yonna		wali ofunnyeko obuzibu bwona mu nnaku omusanvu e ziyise
Ensingo		**Nedda**	**Yee**	**Nedda** **Yee**
Nedda	**Yee**			
Ebibegabega	**Yee** ekibegabega ekya ddyo	**Nedda**	**Yee**	**Nedda** **Yee**
Nedda	**Yee** ekibagabega ekya kkono			
	Yee ebibegabega byombi			
Enkokola	**Yee** olukokola olwa ddyo	**Nedda**	**Yee**	**Nedda** **Yee**
Nedda	**Yee** olukokola olwa kkono			
	Yee enkokola zombi			
Emikono		**Nedda**	**Yee**	**Nedda** **Yee**
Nedda	**Yee** omukono ogwa ddyo			
	Yee omukono ogwa kkono			
	Yee emikono gyombi			
Omugongo waggulu		**Nedda**	**Yee**	**Nedda** **Yee**
Nedda	**Yee**			
Omugongo Wansi		**Nedda**	**Yee**	**Nedda** **Yee**

Nedda **Yee**

Ku bisambi oba ku kabina **Nedda** **Yee** **Nedda** **Yee**

Ku ma vvivi gombi oba ku limu **Nedda** **Yee** **Nedda** **Yee**

Ku kakongovule oba ku bigere **Nedda** **Yee** **Nedda** **Yee**

Ddamu Ebibuuzo bino wammanga bwoba wali ofunnye obuzibu mu ngeri yona

1. Wali ogenzeko e'womusawo yenna oluvannyuma lw'okufuna obuvune bwonna **a)** Yee**b)** Nedda

2. Bali bakuwaddeko ekitanda oluvannyuma lw'okufuna obuzibu oba obulumi **a)** Yee **b)** Nedda

3. Wali okyusizako omulimu lwa nsonga ya buvunne buno bwewafuna **a)** Yee **b)** Nedda

4. Obuzibu buno wammala nabwo ennaku mmeka mu myezi ekkumi n'ebiri egyiyise (Londako kimu)

0 days 1-7 days 8-30 days more than 30 days Every day

5. Obuzibu buno bwali bukulemeseza okukola emirimu gyo ewaka oba ewalala yonna mu myezi kumi nebbiri Egyiyise **a)** Yee **b)** Nedda

b) Okugenda okwesannyusamu? **a)** Yee **b)** Nedda

6. Ennaku mekka Zewamala ng'atokola mirimu gyo gyabulijjo oluvannyuma lw'okufuna buno(Londako kimu)

0 days Every day 1 -7 days 8-30 days More than 30 days

7. Emmirundi emmeka gy’owumula oluvannyuma lw’okufuna obuvune /obuzibu nga buva ku mulimu guno? **a)** omulundi gumu olunaku **b)** Emirundi ebbiri olunaku **c)** Siwummulilako ddala

8. Owulira nga teweyagala ng’okola emirimu egyimu ku gino Wammanga? **a)** Tewali nakamu **b)** Nedda **c)** Kituufu Nnyo **d)** Yee

9. Ngoli nebakozi bano? **a)** Tewali nakamu **b)** Nedda **c)** Kituufu Nnyo **d)** Yee

10. Embeera gy’emukoleramu ku mulimu. **a)** Tewali nakamu **b)** Nedda **c)** Kituufu Nnyo **d)** Yee

11. Okukola okusuka obudde wolina okoma. . **a)** Tewali nakamu **b)** Nedda **c)** Kituufu Nnyo **d)** Yee

Omutendera ogw'okubiri: ebikoleddwa okusobola okumalawo oba okukendeza obuvune bwofuna ng'abwekuusa ku mulimu gw'okola.

1. Ensisikano eno ebadde ya mugaso gyoli?

   a) Yee b**)** kituufu nnyo **c)** Sikiririza ddala **d)** Sikiriza

2. Obulumi bukendedde oluvannyuma lw'okola duyiro

   a) Yee b**)** kituufu nnyo **c)** Sikiririza ddala **d)** Sikiriza

3. Emitendera gy'emirimu gyokola ku mulimu gwo gy'eyongeddeko oluvannyuma lw'ensisinkano eno.

   a) Yee b**)** kituufu nnyo **c)** Sikiririza ddala **d)** Sikiriza

4. Mu ndowooza yo okiliza nti obuvune bwewafuna mu bitundu by'omubirigwo bwebuba bujanjabiddwa oyinza okwongera okubeera ow'omugaso ku mulimu gwo?

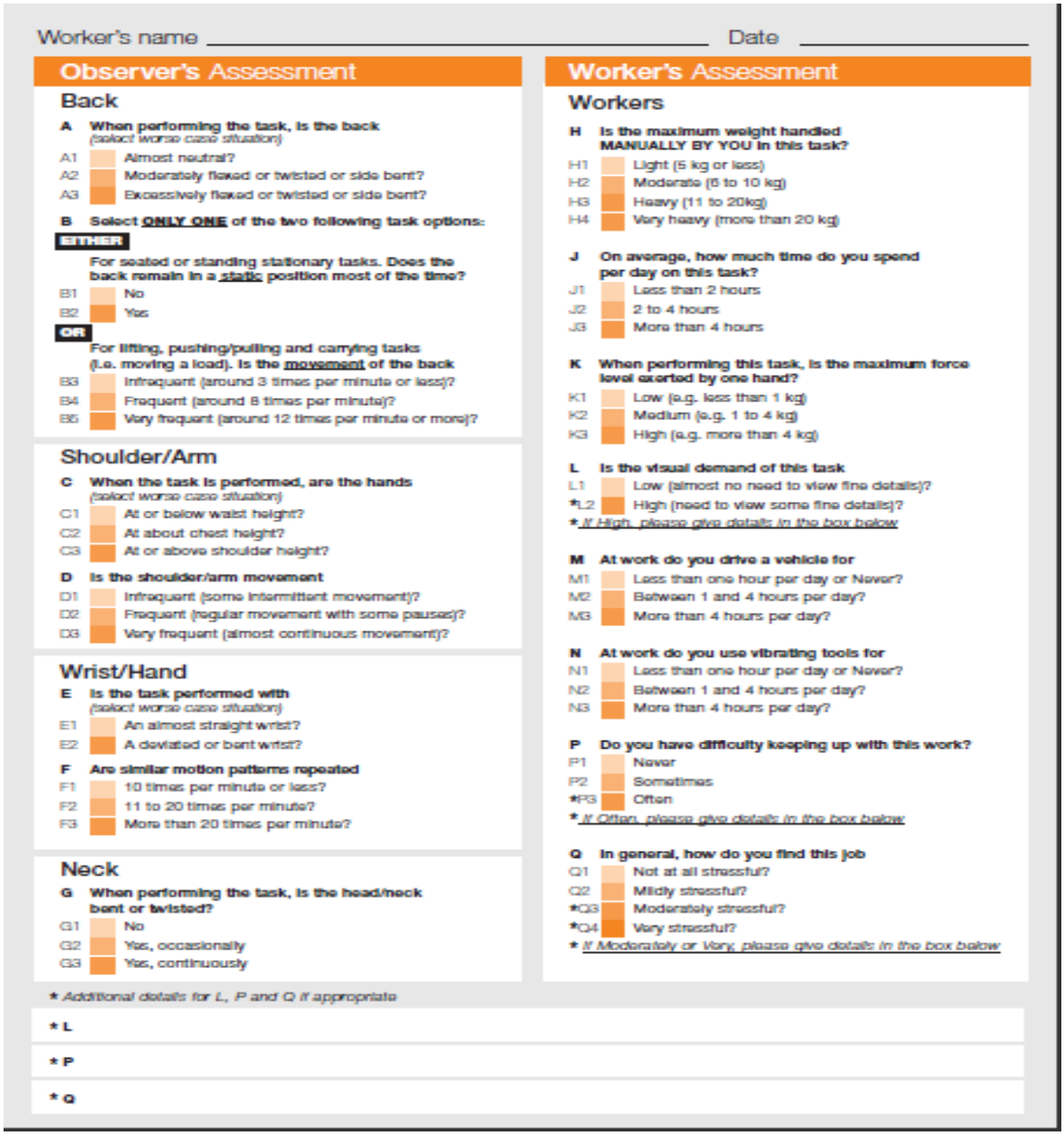
5. Oyinza okuleeta ekiteeso mu kampuni elongoose oba ekyusemu mu mbeera gy'emukoleramu?

6. Okimannyi nti bwotojanjaba buvune bwofunye mu bwangu oyita okuleeta obulemu ku mubiri gwo?

7. Buli ku wumula kwofuna okwekiseera ku mulimu gwo kwekusa ku bulemu ku bitundu by'omubiri gwo?

8. Ddi lw'ewasooka mu bulamu bwo okufuna obulumi obwekika kino?

Appendix V: Quick Eposure Check (QEC) tools



Worker's name _____ Date _____

Observer's Assessment

Back

A When performing the task, is the back *(select worse case situation)*

- A1 Almost neutral?
- A2 Moderately flexed or twisted or side bent?
- A3 Excessively flexed or twisted or side bent?

B Select ONLY ONE of the two following task options:

EITHER

For seated or standing stationary tasks. Does the back remain in a static position most of the time?

- B1 No
- B2 Yes

OR

For lifting, pushing/pulling and carrying tasks (i.e. moving a load). Is the movement of the back

- B3 Infrequent (around 3 times per minute or less)?
- B4 Frequent (around 8 times per minute)?
- B5 Very frequent (around 12 times per minute or more)?

Shoulder/Arm

C When the task is performed, are the hands *(select worse case situation)*

- C1 At or below waist height?
- C2 At about chest height?
- C3 At or above shoulder height?

D Is the shoulder/arm movement

- D1 Infrequent (some intermittent movement)?
- D2 Frequent (regular movement with some pauses)?
- D3 Very frequent (almost continuous movement)?

Wrist/Hand

E Is the task performed with *(select worse case situation)*

- E1 An almost straight wrist?
- E2 A deviated or bent wrist?

F Are similar motion patterns repeated

- F1 10 times per minute or less?
- F2 11 to 20 times per minute?
- F3 More than 20 times per minute?

Neck

G When performing the task, is the head/neck bent or twisted?

- G1 No
- G2 Yes, occasionally
- G3 Yes, continuously

Worker's Assessment

Workers

H Is the maximum weight handled MANUALLY BY YOU in this task?

- H1 Light (5 kg or less)
- H2 Moderate (6 to 10 kg)
- H3 Heavy (11 to 20kg)
- H4 Very heavy (more than 20 kg)

J On average, how much time do you spend per day on this task?

- J1 Less than 2 hours
- J2 2 to 4 hours
- J3 More than 4 hours

K When performing this task, is the maximum force level exerted by one hand?

- K1 Low (e.g. less than 1 kg)
- K2 Medium (e.g. 1 to 4 kg)
- K3 High (e.g. more than 4 kg)

L Is the visual demand of this task

- L1 Low (almost no need to view fine details)?
- *L2 High (need to view some fine details)?

* *If High, please give details in the box below*

M At work do you drive a vehicle for

- M1 Less than one hour per day or Never?
- M2 Between 1 and 4 hours per day?
- M3 More than 4 hours per day?

N At work do you use vibrating tools for

- N1 Less than one hour per day or Never?
- N2 Between 1 and 4 hours per day?
- N3 More than 4 hours per day?

P Do you have difficulty keeping up with this work?

- P1 Never
- P2 Sometimes
- *P3 Often

* *If Often, please give details in the box below*

Q In general, how do you find this job

- Q1 Not at all stressful?
- Q2 Mildly stressful?
- *Q3 Moderately stressful?
- *Q4 Very stressful?

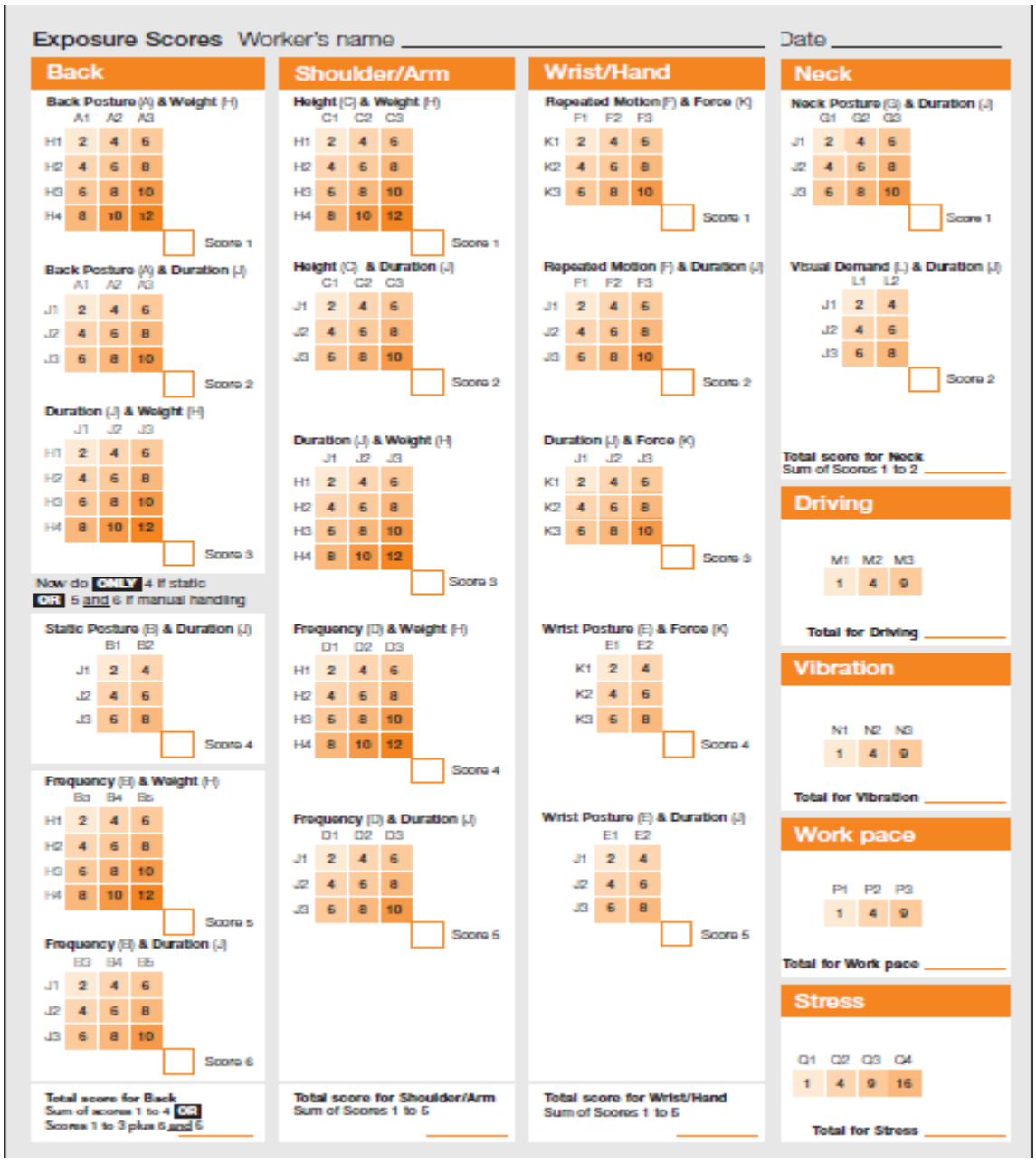
* *If Moderately or Very, please give details in the box below*

* *Additional details for L, P and Q if appropriate*

*** L**

*** P**

*** Q**



Exposure Scores

Worker's name _____ Date _____

Back

Back Posture (A) & Weight (H)

	A1	A2	A3
H1	2	4	6
H2	4	6	8
H3	6	8	10
H4	8	10	12

Score 1

Back Posture (A) & Duration (J)

	A1	A2	A3
J1	2	4	6
J2	4	6	8
J3	6	8	10

Score 2

Duration (J) & Weight (H)

	J1	J2	J3
H1	2	4	6
H2	4	6	8
H3	6	8	10
H4	8	10	12

Score 3

Now do **ONLY** 4 if static
OR 5 and 6 if manual handling

Static Posture (B) & Duration (J)

	B1	B2
J1	2	4
J2	4	6
J3	6	8

Score 4

Frequency (B) & Weight (H)

	B3	B4	B5
H1	2	4	6
H2	4	6	8
H3	6	8	10
H4	8	10	12

Score 5

Frequency (B) & Duration (J)

	B3	B4	B5
J1	2	4	6
J2	4	6	8
J3	6	8	10

Score 6

Total score for Back
Sum of scores 1 to 4 **OR**
Scores 1 to 3 plus 5 and 6 _____

Shoulder/Arm

Height (C) & Weight (H)

	C1	C2	C3
H1	2	4	6
H2	4	6	8
H3	6	8	10
H4	8	10	12

Score 1

Height (C) & Duration (J)

	C1	C2	C3
J1	2	4	6
J2	4	6	8
J3	6	8	10

Score 2

Duration (J) & Weight (H)

	J1	J2	J3
H1	2	4	6
H2	4	6	8
H3	6	8	10
H4	8	10	12

Score 3

Frequency (D) & Weight (H)

	D1	D2	D3
H1	2	4	6
H2	4	6	8
H3	6	8	10
H4	8	10	12

Score 4

Frequency (D) & Duration (J)

	D1	D2	D3
J1	2	4	6
J2	4	6	8
J3	6	8	10

Score 5

Total score for Shoulder/Arm
Sum of Scores 1 to 5 _____

Wrist/Hand

Repeated Motion (F) & Force (K)

	F1	F2	F3
K1	2	4	6
K2	4	6	8
K3	6	8	10

Score 1

Repeated Motion (F) & Duration (J)

	F1	F2	F3
J1	2	4	6
J2	4	6	8
J3	6	8	10

Score 2

Duration (J) & Force (K)

	J1	J2	J3
K1	2	4	6
K2	4	6	8
K3	6	8	10

Score 3

Wrist Posture (E) & Force (K)

	E1	E2
K1	2	4
K2	4	6
K3	6	8

Score 4

Wrist Posture (E) & Duration (J)

	E1	E2
J1	2	4
J2	4	6
J3	6	8

Score 5

Total score for Wrist/Hand
Sum of Scores 1 to 5 _____

Neck

Neck Posture (G) & Duration (J)

	G1	G2	G3
J1	2	4	6
J2	4	6	8
J3	6	8	10

Score 1

Visual Demand (L) & Duration (J)

	L1	L2
J1	2	4
J2	4	6
J3	6	8

Score 2

Total score for Neck
Sum of Scores 1 to 2 _____

Driving

M1	M2	M3
1	4	9

Total for Driving _____

Vibration

N1	N2	N3
1	4	9

Total for Vibration _____

Work pace

P1	P2	P3
1	4	9

Total for Work pace _____

Stress

Q1	Q2	Q3	Q4
1	4	9	16

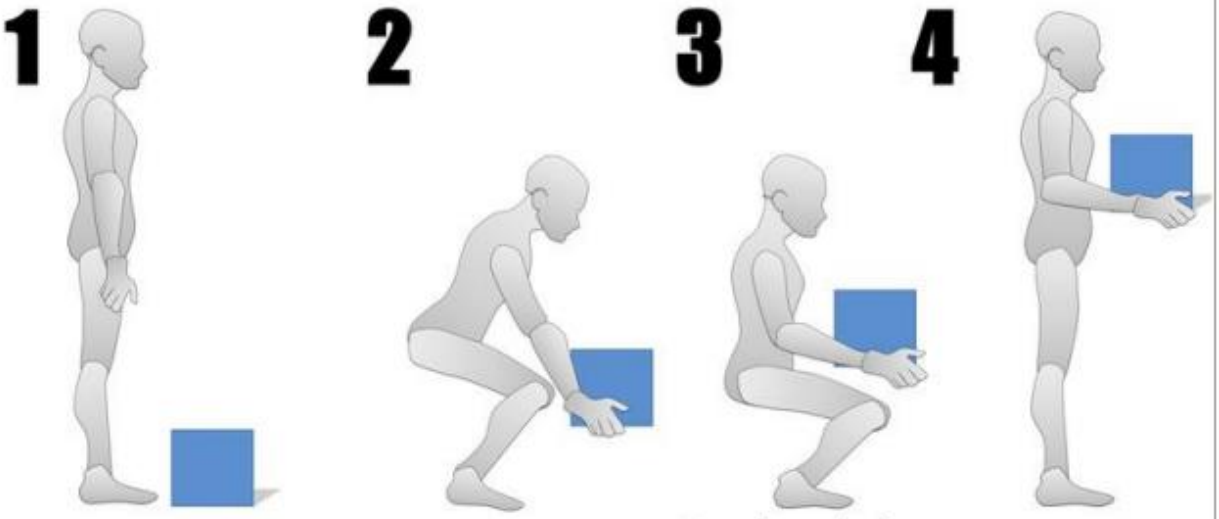
Total for Stress _____


The wrong way!
The right way!


Don't Jump...
Don't Bend...
Don't Twist...
Don't Reach...

HOW TO LIFT

UCDAVIS
OCCUPATIONAL
HEALTH SERVICES



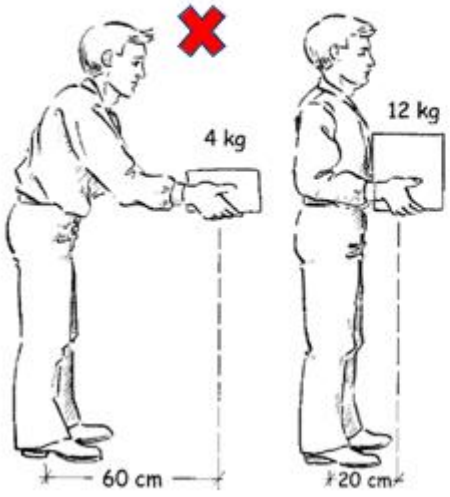
- Get close to the object
- Gloves may improve grip
- Ensure loads are lightweight
- Avoid lifting from the floor

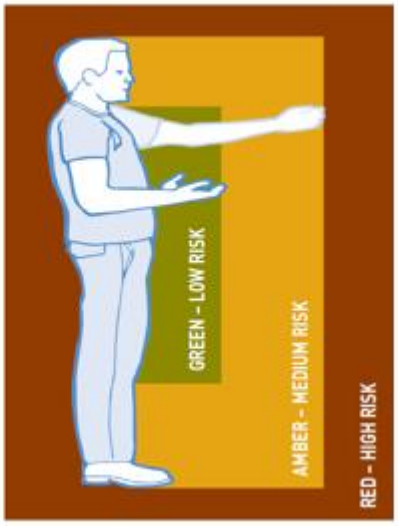
- Bend at the waist
- Use both hands
- Have a good grip

- Keep close to body
- Push up with legs
- Use forearms & thighs to rest load

- Get help, if needed
- Keep it tucked in
- Pivot with your feet, not your back

S.M.A.R.T Lifting





Musculoskeletal Disorders (MSD)

- MSD are associated with *repetitive, sustained, unnatural or forceful* movements:

The Don'ts

- Prolonged and intense keyboard or mouse use
- High demands on vision
- Sustained mental effort
- Peak demands or set work rates

The Do's:

- Change posture at frequent intervals
- Don't key all day
- Give yourself mini breaks
- Practice gentle stretching at work


MANUAL HANDLING
TOP 10 TIPS:
1 COMPLETE A MANUAL HANDLING RISK ASSESSMENT
RISK
2
CERTIFICATE
ENSURE EMPLOYEES HAVE THE CORRECT MANUAL HANDLING TRAINING
3 USE MECHANICAL AIDS WHEREVER POSSIBLE
4 PLAN YOUR ROUTE
5 WORK FROM A STABLE BASE
6 KEEP THE LOAD CLOSE TO YOUR BODY
BEND YOUR KNEES 7
8 AVOID TWISTING
PUSH 9 A LOAD RATHER THAN PULL IT
10 KNOW YOUR LIMITS

STRETCHING PROGRAM
BETTER BACKS & BODIES

work healthy AUSTRALIA

TRICEPS

- Lift both arms above your head and bend elbows so that your forearms are behind your head but not resting on it
- Gently grasp your left elbow with your right hand
- Gently reach your left hand towards the centre of your shoulder blades
- Keep your face looking forward
- Hold for 15-30 seconds
- Repeat on opposite side

CHEST

- Place your hands behind your head and point your elbows to the side
- Feel a stretch by pushing your elbows as far back as possible, squeezing your shoulder blades together
- Hold the stretch for 20 seconds
- Repeat 3-4 times

SHOULDERS

- Bring your left arm across your chest while using your right arm to pull it towards your chest
- Hold the stretch for 15-30 seconds
- Repeat on the other side

SHOULDERS & CHEST

- Standing upright, interlace your hands behind your back
- Keep your arms straight and slowly lift your hands upwards
- Hold the stretch for about 20 seconds
- Repeat stretch 3-4 times

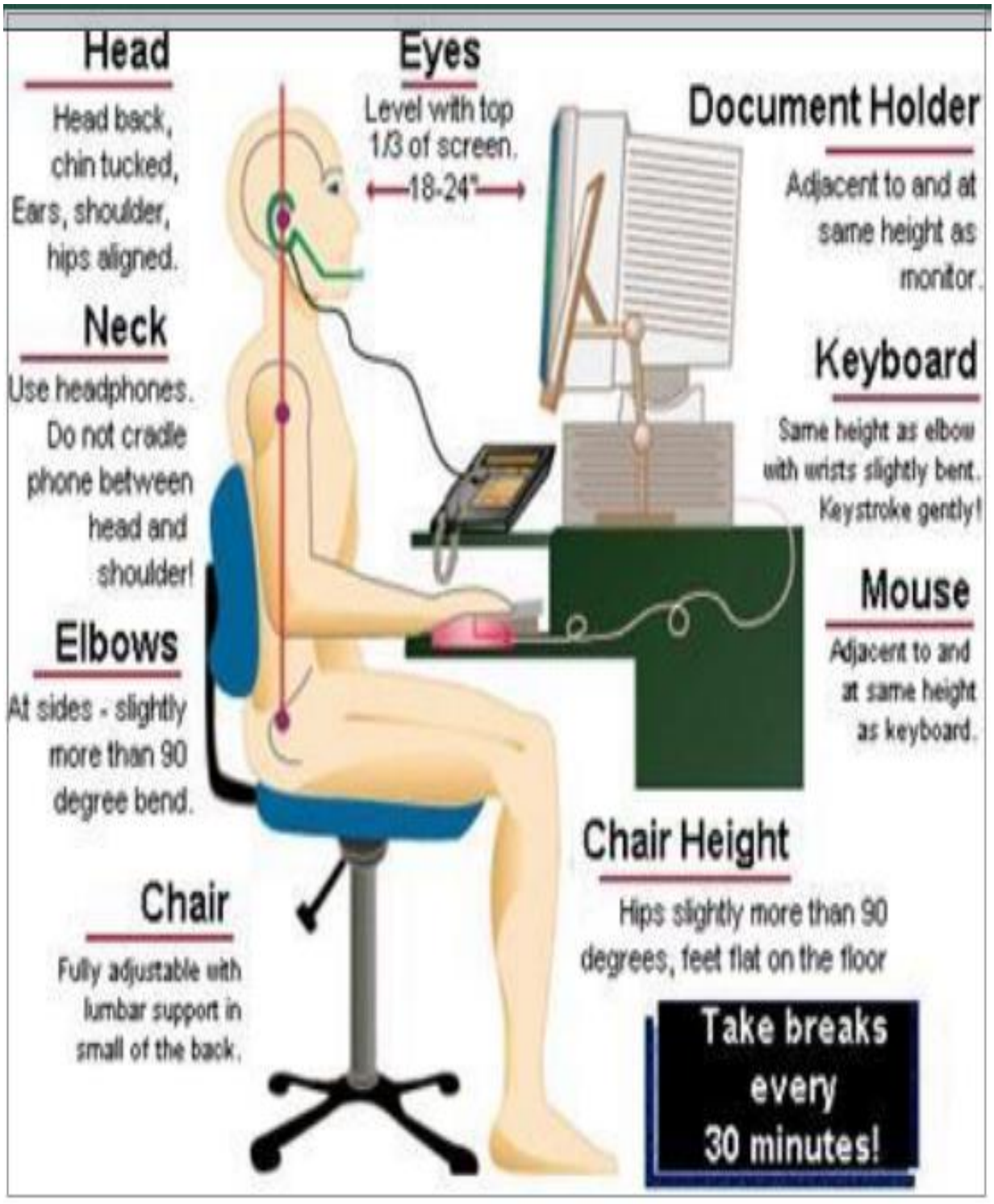
WRIST

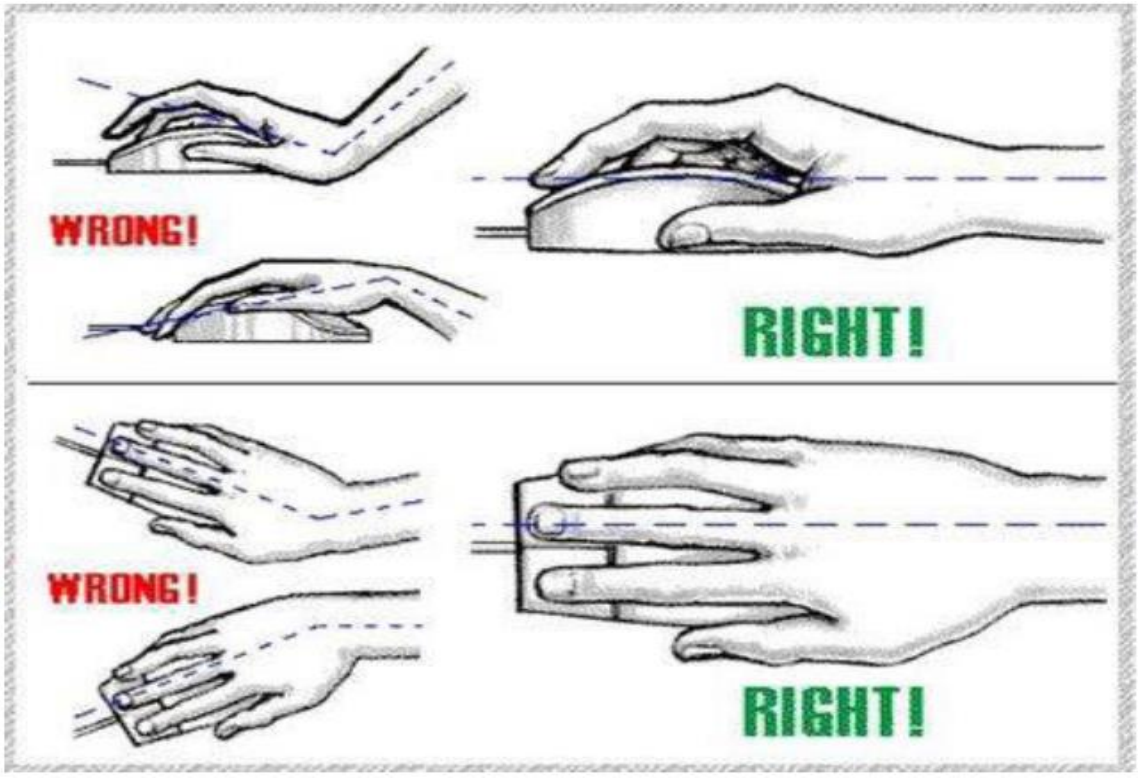
See image 1

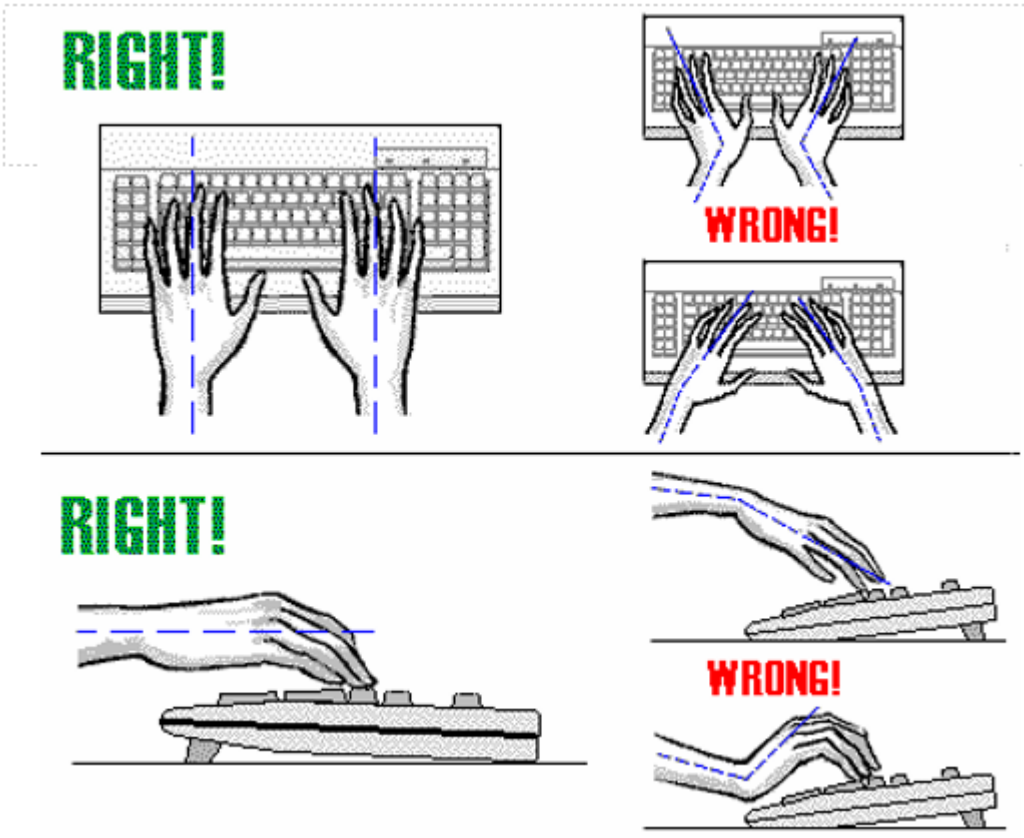
- Sit or stand with feet flat on the floor
- Extend your right arm in front of your right shoulder with your palm facing **up**
- Use your left hand to gently pull your fingers towards you
- Hold for 20 seconds
- Repeat on other side

See image 2

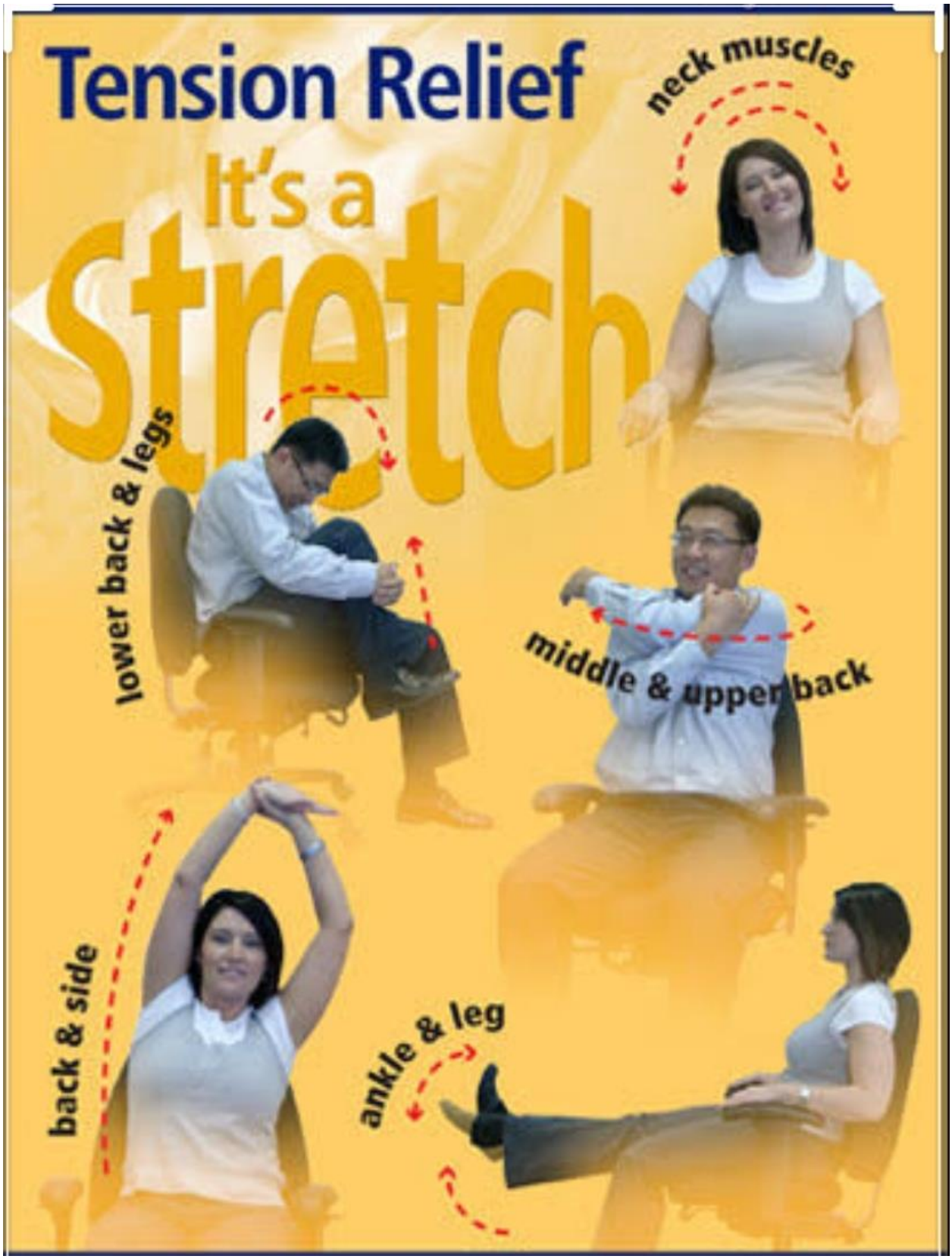
- Sit or stand with feet flat on the floor
- Extend your right arm in front of your right shoulder with your palm facing **down**
- Use your left hand to gently pull your fingers towards you
- Hold for 20 seconds
- Repeat on other side


Head
Head back, chin tucked, Ears, shoulder, hips aligned.
Neck
Use headphones. Do not cradle phone between head and shoulder!
Elbows
At sides - slightly more than 90 degree bend.
Chair
Fully adjustable with lumbar support in small of the back.
Eyes
Level with top 1/3 of screen.
18-24"
Document Holder
Adjacent to and at same height as monitor.
Keyboard
Same height as elbow with wrists slightly bent. Keystroke gently!
Mouse
Adjacent to and at same height as keyboard.
Chair Height
Hips slightly more than 90 degrees, feet flat on the floor
Take breaks every 30 minutes!


WRONG!
RIGHT!
WRONG!
RIGHT!


RIGHT!
WRONG!
RIGHT!
WRONG!


Foggy brain
Strained neck
Sore shoulders and back
Heart disease
Overproductive pancreas
Colon cancer
Disc damage
Weak abs
Tight hips
Soft glutes
Dangers of Sitting
All Day, Every Day


Tension Relief
It's a
Stretch
neck muscles
lower back & legs
middle & upper back
back & side
ankle & leg

Musculoskeletal Disorders (MSD)

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- Sustained mental effort
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ERGONOMIC BASED INTERVENTION FOR MUSCULOSKELETAL DISORDERS AMONG SUGAR FACTORY WORKERS IN UGANDA.

(MANUAL WORKERS)

By

AREMU ABDULMUJEEB BABATUNDE

Session Objectives

You will be able to:

- Understand the principles of ergonomics
- Recognize the risk factors, signs, and symptoms of musculoskeletal disorders (MSDs)
- Understand methods of identifying, reporting, and controlling MSDs
- Know how to protect yourself from MSD injuries and reduce your risk

Ergonomics Defined

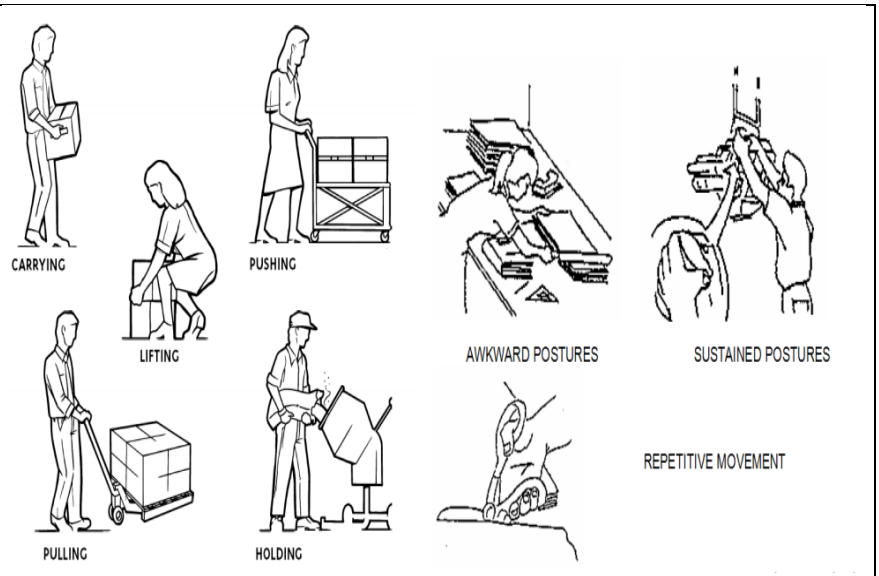
The applied science of equipment design, as for the workplace, intended to maximize productivity by reducing operator fatigue and discomfort.

- Use your brain, not your back.
- Work smarter, not harder.
- Fix the job, not the worker.

What is manual handling in Sugar factory?
Manual Handling is the transporting or supporting of a load by one or more people and by means of its characteristics or of unfavorable ergonomic conditions, involves risk, particularly of back injury.

This includes the followings:

Bending
Carrying
Holding
Lifting
Pushing
Pulling
Repetitive movements
Awkward postures
Sustained postures



- **How injuries occur from manual Handling:**

1. Gradual wear and tear
2. Sudden damage
3. Direct trauma from unexpected events

- **Cost of Manual Task Injuries**

1. 1 in every 3 lost time injuries is a result of performing manual tasks.
2. 1 in every 4 workers who suffers a manual task related lost time injury is off work for at least 3 months.

Problems of Manual Handling (TILE)

Manual Handling problems includes:

1. The task
2. The load
3. The working environment
4. Individual capacity
5. Handling aid and equipment
6. Work organization factors

THE TASK

The various task involves in manual Handling are**:**

1. Focus on what the person is doing
2. Posture
3. Reaching
4. Working height
5. Travel distance
6. Pushing and pulling
7. Sudden movement
8. Seated or team lifting

THE LOAD

The various load involves in manual Handling are:

1. Weight
2. Shape
3. Size
4. Centre of Gravity
5. Sudden movements
6. Grasping and moving the load
7. HSE Guidance

WORKING ENVIRONMENT

The Working Environment involves in manual Handling are:

1. Space constraints
2. Variation in level
3. Floor
4. Environmental factors

Individual characteristics

Individual characteristics affect the risk involved in the activity

1. Gender incl pregnancy

2. Age
3. Disability
4. Positive discrimination
5. Health issues

- **General Signs of MSDs**

1. Decreased strength for gripping
2. Decreased range of motion
3. Loss of muscle function
4. Inability to do everyday tasks

- **Common Injury Locations**

1. Back and neck— shooting pain, stiffness
2. Shoulders—pain, stiffness, loss of mobility
3. Arms and legs— shooting pains, numbness
4. Elbow and knee joints— pain, swelling, stiffness, soreness
5. Hands and wrists— swelling, numbness, loss of strength
6. Fingers—jerking movements, or loss of strength, mobility, and feeling
7. Feet and toes—numbness, tingling, stiffness, burning sensation
8. Thumbs—pain at the base

- **Risk Factors for Injury**

1. Increasing age
2. Gender (♀ > ♂)
3. Previous injury
4. Co-existing health problems
5. Stress
6. Lack of physical conditioning
7. Time constraints

- **Ergonomic Factors That Lead to MSDs**

1. Repetitive motions
2. Forceful exertions
3. Awkward postures
4. Contact stress (pressure points)
5. Vibrations

- **How to Protect Yourself**

1. Change positions often
2. Take stretch breaks
3. Maintain neutral posture
4. Stay healthy / Stay limber

5. Use material-handling aids Report MSD symptoms

- **Use Proper Lifting Techniques**

1. Use lifting devices
2. Don’t twist while lifting
3. Lift using your legs not back
4. Use a stool or stepladder
5. Don’t overdo it
6. Keep your back in shape

- **Act on the Signs of MSD**
    1. Act immediately:
    2. Report the problem to supervisor.
    3. Work with HR to seek medical attention when necessary.
    4. Seek early treatment
- **The benefits of an Ergonomic program**
    1. Decreased injuries, illnesses, and workers’ compensation costs.
    2. Increased efficiency at work.
    3. Increased physical well-being.
    4. Decreased absenteeism and turnover.
    5. Increase in employee morale.

ERGONOMIC BASED INTERVENTION FOR MUSCULOSKELETAL DISORDERS AMONG SUGAR FACTORY WORKERS IN UGANDA.

(OFFICE WORKERS)

By

AREMU ABDULMUJEEB BABATUNDE

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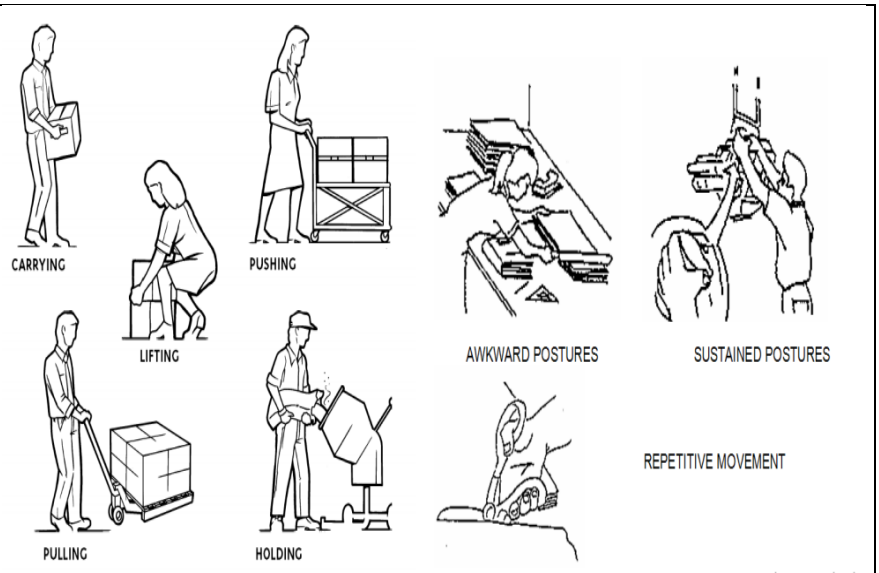

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4. 1 in every 4 workers who suffers a manual task related lost time injury is off work for at least 3 months.

To proactively provide employees with a safe work environment, here are some major office ergonomic risk factors employers should monitor:

1. Awkward sitting positions.
2. Sustained postures.
3. Repetitive motions.
4. Poor lighting.
5. Temperature extremes.
6. Insufficient breaks.
7. Heavy lifting.

- **General Signs of MSDs**

5. Decreased strength for gripping
6. Decreased range of motion
7. Loss of muscle function
8. Inability to do everyday tasks

- **Common Injury Locations**

9. Back and neck— shooting pain, stiffness
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14. Time constraints

Five Steps to Improve Ergonomics in the Office

1. Understand Office Ergonomics

2. Understand Ergonomic Injuries

3. Identify Your Ergonomic Challenges

4. Set Up Your Workstation

5. Select the Right Equipment

Ergonomic workstation items:

- **Chair** – Should offer pneumatic seat-pan height adjustment, a backrest that tilts backward and forward, backrest tension control and lumbar support.
- **Adjustable workstation** – Should offer height adjustability of work surface and have a large surface with ample room to perform tasks.
- **Keyboard/keyboard tray** – Should lie flat and offer slope adjustability to achieve up to ± 15° slope and have a low profile (approximately 1" or 30 mm).
- **Input device** – Features should include a long cord for proper placement or wireless, should move easily and be usable by left- and right-handed users.
- **Monitor** – Adjustable brightness and contrast, free from flicker and adjustable tilt.
- **Monitor arm/stand** – Should be height-adjustable 27" (69 cm) to 34" (86 cm) above the seat pan and the weight of monitor should match the weight of the stand or arm.
- **Wrist rest** – Should be constructed of compressible or soft material to reduce external pressure on the wrist and offer a non-friction surface.
- **Headset** – Should be digital, rather than analog, and offer a quick-disconnect capability.
- **Footrest** – Needs to be height adjustable from 11" (28 cm) to 18" (46 cm).
- **Task lighting** – Should offer 75 to 140-foot candles of adjustable lighting and be asymmetrical to reduce shadows and glare spots.

- **Laptops** – Use an external mouse and keyboard for extended periods of computer use and take regular breaks and change your posture when working for long periods of time.

- **How to Protect Yourself**

6. Change positions often
7. Take stretch breaks
8. Maintain neutral posture
9. Stay healthy / Stay limber
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- **Use Proper Lifting Techniques**

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7. Increased efficiency at work.
8. Increased physical well-being.
9. Decreased absenteeism and turnover.
10. Increase in employee morale.

Appendix VI: Data Collection form

Uganda Farmers Crop Industries Limited

16th September, 2020

HRD/FA/2020

Mr. Aremu Abdulmujeeb
C/o IUIU
Habib Medical School

Dear Mr. Aremu,

RE: RESEARCH

Iam glad to inform you that Management has accepted you to undertake your research in the factory on Ergonomic based interventions of the musculoskeletal disorders among sugar factory workers.

The research will commence on your reporting date.

Please note that management retains the right to terminate the research at any time depending on the circumstances prevailing at the time. Besides, the company will not be liable for any loss or injury that you may suffer as a result of your failure to observe safety requirements in place.

At the end of the research, you will be required to write a report in duplicate and submit a copy of it to the Human Resources Office.

Management wishes you a pleasant stay at Uganda Farmers Crop Industries Limited.

Yours sincerely,
FOR: UGANDA FARMERS CROP INDUSTRIES LIMITED

14/9

BETTY WASIRWA
HUMAN RESOURCES MANAGER

JAMES KISAMBIRA
GENERAL MANAGER

UGANDA FARMERS CROP INDUSTRIES LTD
1 SEP 20
P.O.BOX 261 KAKIRA (U)

Sugar Corporation of Uganda Limited

An ISO 9001 & 14001 Certified Company

P.O. BOX 1, LUGAZI, UGANDA. Tel: 256-312-55 55 00, Fax: 256-312-55 52 96

Email: scoul@mehtagroup.com Website: www.mehtagroup.com

REF: SDMHR/ADMIN/HR/TRAIN/21 Date: 25th January 2021

TO: **DR. AREMU ABDULMUJEEB BABATUNDE**
Islamic University in Uganda
P.O Box 2555
Mbale - Uganda

Dear Sir/Madam,

Re: **RESEARCH STUDY**

This is in reference to your application dated 29th December 2020 regarding the above subject.

We wish to inform you of Management's decision to allow you conduct your Research Study with this company, for a period of one (01) week.

Please note that for the period indicated above you will be attached to Works Department Environment Section, with effect from 26th January to 1st February, 2021.

Privately organize for your accommodation, meals and Management will not pay any form of salary or allowances to you.

Wish you a gainful stay.

Yours faithfully,
For and on behalf of:
SUGAR CORPORATION OF UGANDA LIMITED (SCOUL)

HEAD OF TRAINING SECTION
HUMAN RESOURCES DEPARTMENT
SCOUL
25 JAN 2021
P O BOX 1, LUGAZI (U)

OBBO VINCENT
SR. DY. MGR. HR & TRAINING & DEVELOPMENT

CC: GM EHS
CC: SR. DY. MANAGER HR FACTORY

Kampala office: 133/135, 6th Street Industrial Area, P.O. Box 1185, Kampala UGANDA. Tel: 256-414-25 50 36 Fax: 256-414-34 75 97

CLARKE INTERNATIONAL UNIVERSITY
LEAD - INNOVATE - TRANSFORM
RESEARCH ETHICS COMMITTEE

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www.rec.ciu.ac.ug

16th December, 2020

UG-REC-015

CIUREC/0234

Mr. Aremu Abdulmujeeb. B
Principal Investigator
Mt. Kenya University
P.O BOX 342-01000
Kenya.

CLARKE INTERNATIONAL UNIVERSITY
16 DEC 2021
APPROVED / VALID UNTIL
RESEARCH ETHICS COMMITTEE

Category of review
[x] Initial review
[ ] Continuing review
[ ] Amendment
[ ] Reactivation
[ ] SAEs

RE: "ERGONOMIC BASED INTERVENTION FOR MUSCULOSKELETAL DISORDERS AMONG SUGAR FACTORY WORKERS IN JINJA, UGANDA"

Reference is made to the above mentioned protocol which was submitted to Clarke International University Research Ethics Committee (CIUREC) for initial review and approval.

You have addressed all the issues earlier raised and the committee is satisfied with the responses submitted in version 2.0 dated 14th December, 2020.

I am glad to inform you that your study has been approved for a period of one year from 16th December, 2020 to 16th December, 2021.

The documents approved include the following;

Document	Language	Version	Submission Date
Protocol	English	Version 2.0	14th December, 2020
Consent forms			
Informed Consent	English	Version 2.0	14th December, 2020
Informed Consent	Luganda	Version 1.0	14th December, 2020
Data collection tools			
Semi-Structured Questionnaires	English	Version 2.0	14th December, 2020
Intervention Assessment Tool	English	Version 1.0	14th December, 2020
Risk Management Plan	English	Version 1.0	14th December, 2020

Please note that any problem of a serious nature as a result of this study to the participants should be reported to CIUREC and Uganda National Council of Science and Technology (UNCST) immediately.

Also note that annual report and request for renewal where applicable should be submitted at least one month before the expiry date of approval. In addition, you are also required to submit copies of the stamped approved documents to the Uganda National Council for Science and Technology (UNCST) before the study can commence.

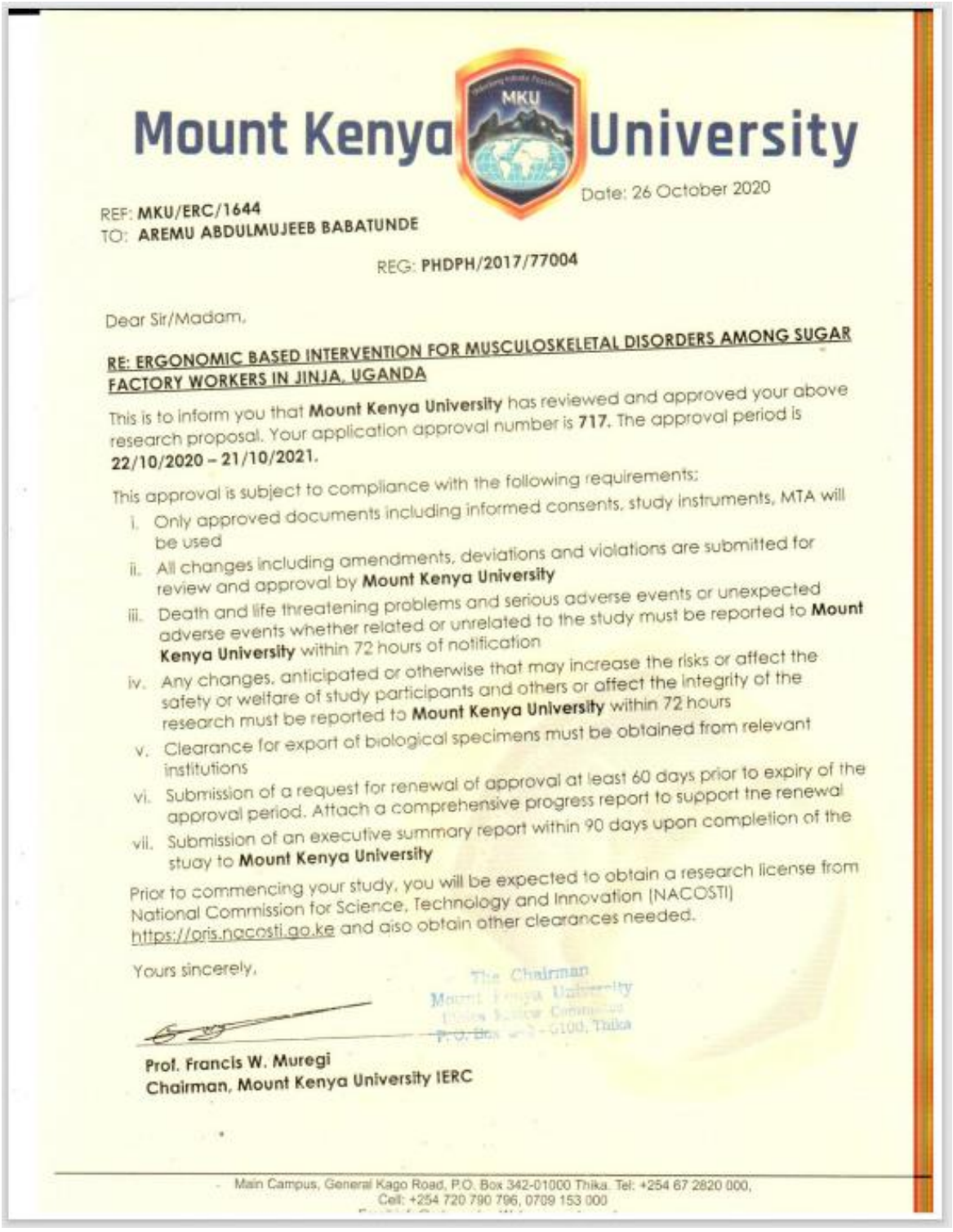
We would like to congratulate you and wish you a successful conduct of the study.

Yours Sincerely,

Dr. Samuel Kabwigu
CIUREC Chairperson

16/12/2020
Date

Appendix VII: Introductory Letter



Mount Kenya University

Date: 26 October 2020

REF: **MKU/ERC/1644**
TO: **AREMU ABDULMUJEEB BABATUNDE**

REG: **PHDPH/2017/77004**

Dear Sir/Madam,

RE: ERGONOMIC BASED INTERVENTION FOR MUSCULOSKELETAL DISORDERS AMONG SUGAR FACTORY WORKERS IN JINJA, UGANDA

This is to inform you that **Mount Kenya University** has reviewed and approved your above research proposal. Your application approval number is **717.** The approval period is **22/10/2020 – 21/10/2021.**

This approval is subject to compliance with the following requirements:

i. Only approved documents including informed consents, study instruments, MTA will be used
ii. All changes including amendments, deviations and violations are submitted for review and approval by **Mount Kenya University**
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to **Mount Kenya University** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affect the safety or welfare of study participants and others or affect the integrity of the research must be reported to **Mount Kenya University** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal
vii. Submission of an executive summary report within 90 days upon completion of the study to **Mount Kenya University**

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://oris.nacosti.go.ke and also obtain other clearances needed.

Yours sincerely,

The Chairman
Mount Kenya University
Ethics Review Committee
P.O. Box 342-01000, Thika

Prof. Francis W. Muregi
Chairman, Mount Kenya University IERC

Main Campus, General Kago Road, P.O. Box 342-01000 Thika. Tel: +254 67 2820 000,
Cell: +254 720 790 796, 0709 153 000

Mount Kenya University

DIRECTORATE OF GRADUATE STUDIES

PHDPH/2017/77004

17th December, 2020

To Whom It May Concern

Dear Sir/Madam,

RE: AREMU ABDULMUJEEB BABATUNDE
REGISTRATION NO. PHDPH/2017/77004

The purpose of this letter is to introduce the above named student who is pursuing **Doctor of Philosophy in Public Health** in the Department of **Epidemiology & Biostatistics** in the School of **Public Health.**

The title of his research is ***"Ergonomic based Intervention for Musculoskeletal Disorders among Sugar Factory Workers in Jinja, Uganda."***

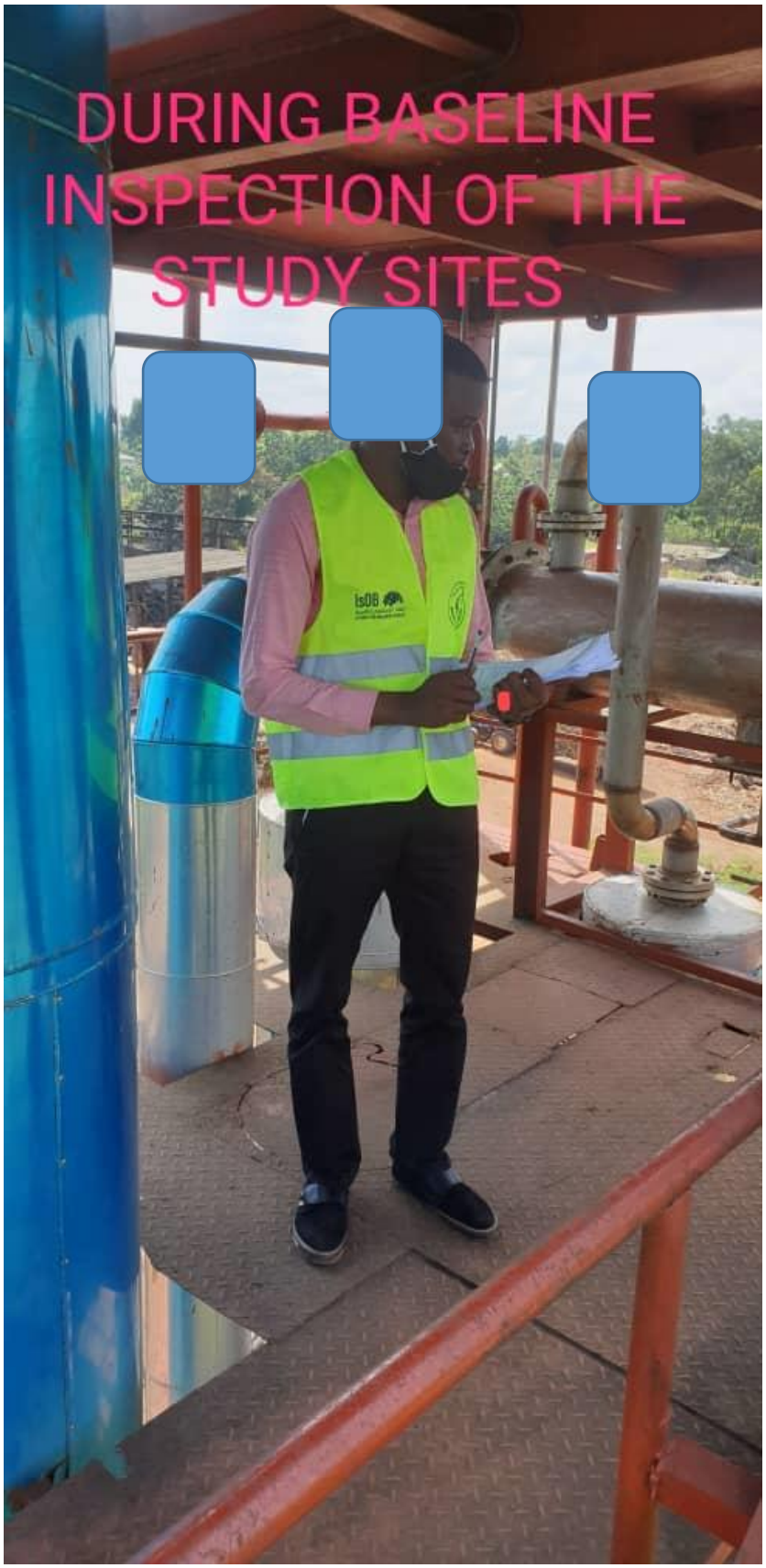
He has been cleared by the University's Ethics Review Committee (Certificate attached) and now has to proceed to the field to collect data for his research between **December 2020 and May, 2021.**

Any assistance accorded to him will be highly appreciated.

Thank you.

Mount Kenya University
P. O. Box 342 - 01000, THIKA
Office of the Director
Graduate Studies

Dr. Samuel M. Kareinga, Ph.D.
Director, Graduate Studies
Enc.


DURING BASELINE
INSPECTION OF THE
STUDY SITES


DATA COLLECTION
EXERCISE AT
CONTROL GROUP
STUDY SITE


Antropometric data: the stadiometer


Data collection
exercises

During ergonomics educative training sessions

during physical activity training among the respondents

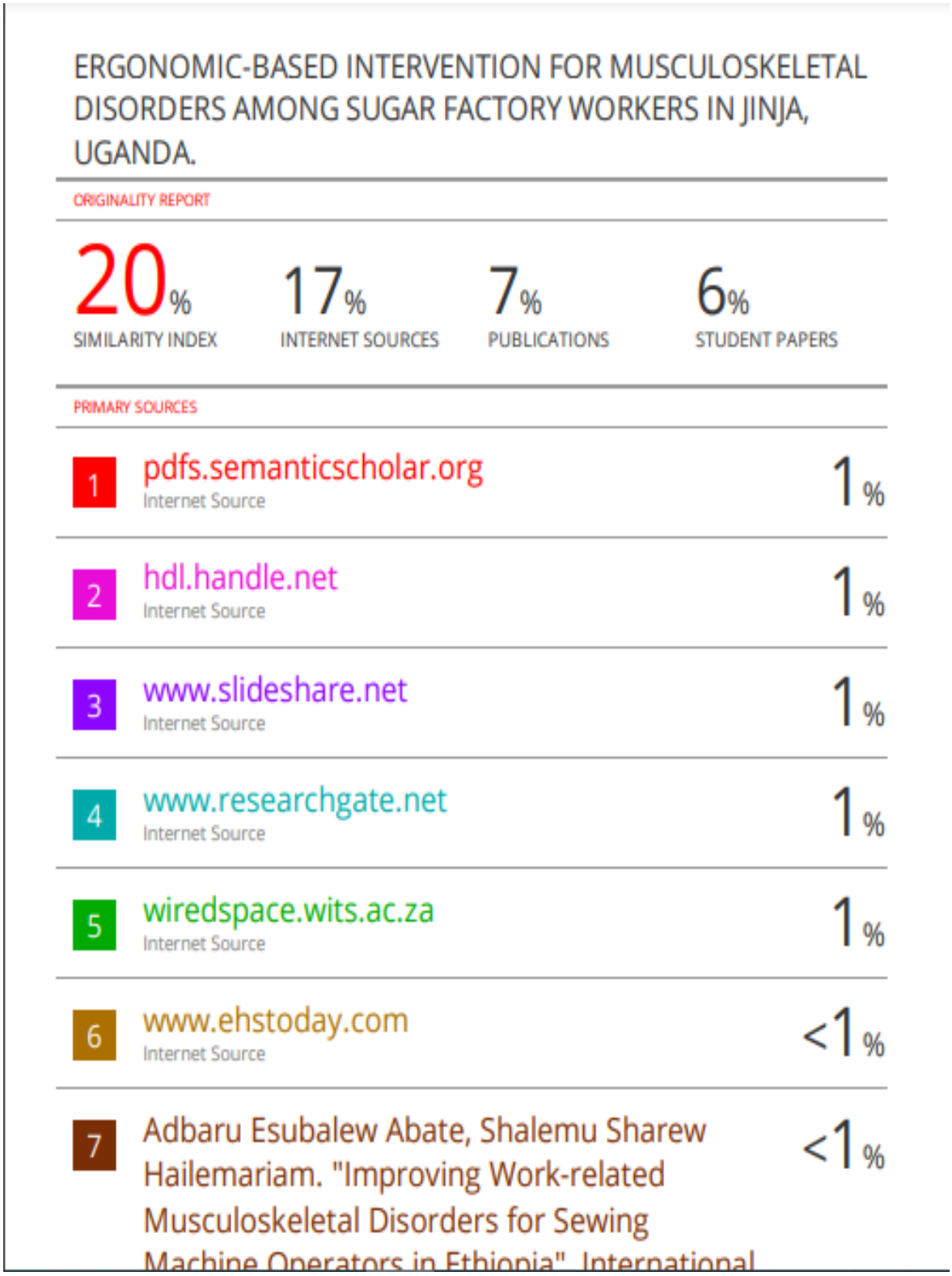
ining session on ergonom


Work actives observation
in cane unit


During some ergonomic assessments of the workers


During data collection
exercises

Appendix VIII: Similarity Index



ERGONOMIC-BASED INTERVENTION FOR MUSCULOSKELETAL DISORDERS AMONG SUGAR FACTORY WORKERS IN JINJA, UGANDA.

ORIGINALITY REPORT

20%	17%	7%	6%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	pdfs.semanticscholar.org Internet Source	1%
2	hdl.handle.net Internet Source	1%
3	www.slideshare.net Internet Source	1%
4	www.researchgate.net Internet Source	1%
5	wiredspace.wits.ac.za Internet Source	1%
6	www.ehstoday.com Internet Source	<1%
7	Adbaru Esubalew Abate, Shalemu Sharew Hailemariam. "Improving Work-related Musculoskeletal Disorders for Sewing Machine Operators in Ethiopia", International	<1%