PREDICTORS OF WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG PRIMARY SCHOOL TEACHERS IN MACHAKOS COUNTY, KENYA

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Q22/CTY/PT/30529/2015

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN OCCUPATIONAL SAFETY AND HEALTH IN THE SCHOOL OF PUBLIC HEALTH OF KENYATTA UNIVERSITY

(OCTOBER, 2019)

DECLARATION

This thesis is my original work and has not been presented for a degree in any other university

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Supervisors' Approval

This thesis has been submitted with our approval as university supervisors.

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DEDICATION

Dedicated to my parents for giving me the love and support throughout this process.

ACKNOWLEDGEMENT

I am also sincerely thankful to my supervisors Dr. Jackim Nyamari and Dr. Anthony Ireri for their advice and support throughout this study. I would also like to acknowledge the School of Public Health, Kenyatta University for their support throughout the thesis writing process.

I would also like to thank the County Government of Machakos for their support during the data collection process. I also acknowledge the head teachers for the welcome and support they gave me during the data collection process, and the teachers for their willingness to assist in filling the questionnaires.

I also acknowledge my classmates for their support and encouragement throughout this entire process.

Finally, I acknowledge my family for their immeasurable support throughout the study period.

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ABBREVIATIONS AND ACCRONYMS

BMI:	Body Mass Index
CDC:	Centers for Disease Control and Prevention.
KENPRO:	Kenya Projects Organization
LBP:	Low Back Pain
MP:	Musculoskeletal Pain
MSDs:	Musculoskeletal Disorders
MSP:	Musculoskeletal Pain
NACOSTI:	National Commission for Science, Technology and Innovation
NSP:	Neck and Shoulder Pain.
OSHA:	Occupational Health and Safety Act
PTR:	Pupil-Teacher Ratio
TSC:	Teachers Service Commission
UNESCO:	United Nations Educational, Scientific and Cultural Organization
WMSDS:	Work-related Musculoskeletal Disorders

OPERATIONAL DEFINITION OF TERMS

Biomechanical factors: Factors that influence the structure and functioning of biological systems in teachers in particular, and humans in general

Kinematic imbalance: The motion of bodies or systems of bodies in an unbalanced manner in the course of conducting a task.

Kinetic imbalance: Imbalances in the course of work of a teacher that are attributable to motion.

Morphological factors: The shape, and structure of a person, specifically a teacher in this case.

Musculoskeletal Disorders: Injuries, damages or disorders that affect the joints, the back, or lower/upper limbs.

Predictor: That which increases the chances that a certain thing; for example, back pain will occur in the future as a consequence of its presence.

Work Related Predictor: An attribute of the work environment that is likely to affect the occurrence of musculoskeletal disorder.

Person-related predictor: a factor within a person, for example age or gender that is likely to influence the prevalence of musculoskeletal disorder.

Posture: A position that one holds their body, either while sitting, standing, or lying down.

Awkward Postures: Body positions that significantly deviate from the normal positions while performing activities.

Sleep disturbance: Challenges in the initiation and maintenance of the normal sleeping patterns. A teacher was classified as having sleep disturbance if they could not initiate and maintain the normal sleeping patterns of light sleep and deep sleep.

Free Primary Education: Education that is free of any charge.

ABSTRACT

Musculoskeletal disorders refer to a broad range degenerative and inflammatory conditions that affect the joints, muscles, ligaments, tendons, bones, nerves, and the localized blood circulation system. Despite there being significant literature about musculoskeletal disorders among teachers in other parts of the world, Kenya lags behind in research this area. The current studies point out to high workloads and stress levels among primary school teachers following an increase in the teacher-pupil ratio. These are among the correlates of musculoskeletal disorders, suggesting an underlying problem worth exploring. The objective of this study is to determine the prevalence and person and work-related predictors of musculoskeletal disorders among Kenyan primary school teachers in Machakos County. The specific objectives of the study were: to determine the prevalence of Musculoskeletal Disorders among primary school teachers in Machakos County, to explore the person related predictors of musculoskeletal disorders and to explore the work-related predictors of musculoskeletal disorders. A cross-sectional design was used to collect data from 302 randomly selected teachers. The data was collected using a questionnaire and an observation checklist. It was analyzed using chi-square and logistic regression analysis and expressed as odds ratio. The prevalence of musculoskeletal disorders at any site of the body was 85.10% with lower back, knees, neck, and ankles being the most affected body sites at 58.60%, 57.6%, 53.3%, and 53% respectively. The least affected body part was the elbows at 25.2%. Neck musculoskeletal disorders were associated with being between 40 and 45 years (p=0.02) and over 50 years (p=0.01), and teaching while standing (p=0.01). Shoulder musculoskeletal disorders were associated with being between 45and 49 years and being over 50 years (p<0.01 for each), teaching while standing for 2-3 hours and for over 4 hours (p=0.03 and 0.01 respectively). Elbow musculoskeletal disorders were associated with being over 50 years (p=0.01). Musculoskeletal disorders of the knees were associated with lack of back support on chairs (p<0.01). Wrists/hands musculoskeletal disorders were associated with being over 50 years and teaching while standing (p=0.01 for both). Low back musculoskeletal disorders were significantly associated with being between 30-34 years (p=0.01), 35-39 years (p=0.01), 40-44 years (p<0.01) and being over 50 years (p<0.01). Musculoskeletal disorders of the ankles were significantly associated with working on a head-down posture (p=0.01). MSDs interfered with teachers' ability their normal activities with lower back MSDs being the most prominent at 23.8%. This study reveals that musculoskeletal disorders are very common among primary school teachers in Machakos County, Kenya. The nature of the risk factors is diverse, calling for measures to reduce the notably high prevalence of MSDs, their progression, and burden.

CHAPTER 1: INTRODUCTION

1.1. Background of Study

Musculoskeletal disorders (MSDs) refer to a broad range degenerative and inflammatory conditions that affect the joints, muscles, ligaments, tendons, bones, nerves, and localized blood circulation systems, and may be attributed to or intensified by one's immediate environment (Erick & Smith, 2011). MSDs are among the most prominent reasons for decrease in work productivity because of absenteeism, sick leave, and early retirement from the profession (Erick & Smith, 2015). The work of a teacher entails not just instructing, but preparation of lesson plans, assessing the students and participation in extracurricular activities such as games. School teachers are more likely to suffer from MSDs of the neck, upper limbs, and back because of the nature of their work. School teachers have been found to be more likely to report high rates of musculoskeletal diosrders than other professionals (between 40 and 95%) (Erick & Smith, 2011).

Globally, there have been numerous studies exploring musculokeletal diosrders among teachers. The prevalence of musculoskeletal diosrders among school teachers in Brazil was 55%. The prevalence of musculoskeletal disorders was associated with working for more than 5 years, having no other paid activity apart from teaching, heat in the classrooms, and high levels of physical exertion (Cardoso et al., 2009). Among Saudi Arabian female teachers, musculoskeletal pain was prevalent in 79.17% of the teachers. The significantly associated risks factors were shoe type, school type, years in teaching, and daily working hours (Darwish & Al-Zuhair, 2013).

MSDs have also received the attention of researchers in the African continent. Beyen, Mengestu, and Zele, (2013) reported a prevalence rate of 57.50% among teachers in Ethiopia. The significant risk factors included age, sex, working experience, smoking habits, monthly salary, irregular physical exercise, sleep disturbance, prolonged sitting, lifting heavy metals, office provisions, work environment, and support structures at work (Beyen, Mengestu, & Zele, 2013). Among teachers in Botswana, the prevalence of MSD in any body part was 83.3%. The significantly associated risk factors were previous back injury and female gender had a positive correlation with low back pain were awkward position of the arm, the task's high psychological demands, Lack of physical exercise, body mass index, and education level (Erick & Smith, 2014).

The Occupational Health and Safety Act (OSHA), 2007 provides for the safety, health, and welfare of persons lawfully present at workplaces (Republic of Kenya, 2007). Specifically, as per the TSC'S safety, Health and Environment Policy (2006), teachers, being TSC employees are entitled to a "safe and health working environment" (Teachers Service Commission, 2006). The KNUT and KUPPET have been vocal in advocating for better work environment for teachers. The 2011 UNESCO report on improving the conditions of teachers in rural areas reveals that teachers experience infrastructural challenges in trying to instruct students/pupils, which can subject them to higher risk of developing musculoskeletal disorders (Adedeji & Olaniyan, 2011). In Machakos County, the introduction of Free Primary Education resulted to increase in the teacher-student ratio from 46:1 in 2001 to 52:1 in 2011 (Kaloki et al., 2015).

MSDs among teachers remain a topic that has been under looked, but numerous studies have been conducted about the issue among nurses. Muga Juliet analyzed musculoskeletal disorders among nurses in Kenyatta National Hospital, and recorded a prevalence rate of 74.2% (2015). Chebet Tanui assessed work-related musculoskeletal disorders among nurses working in Mombasa County, Kenya and recorded prevalence of 70.80% (2016).

1.2.Statement of the Problem

Musculoskeletal disorders are common among professions in which most tasks are performed while standing, sitting, or bending (Erick & Smith, 2015). The nature of a teacher's work, which involves not just teaching, but lesson preparation, assessment, and participation in extra curricular activities exposes teachers to important predictors for MSDs. The prevalence of MSDs among teachers ranges between 40 and 95% (Erick & Smith, 2015). Despite there being significant literature about MSDs among teachers and other workers in other parts of the world (Erick & Smith, 2011; Beyen et al. 2013) Ganiyu et al. 2015; Solis-Soto et al. 2017), little has been done in Kenya. There have, however, been numerous local studies exploring MSDs among nurses, showing prevalence rates of over 70% (Mugga, 2015; Tanui, 2016).

Numerous studies reveal the predominance of factors that would be termed predictors of MSDs (Kaloki et al. 2015), but none have explored MSDs among teachers in Kenya, and Machakos County in particular. Primary school teachers have been documented to experience lots of stress and burn out, which are risk factors to MSDS. Njoroge (2015), in study involving primary school teachers in Nairobi County, recorded stress levels of above 53.9%. Ng'eno (2007) documented high burn out rates among teachers in Kericho. A study

by Wangeri and Okello, (2014) in Kasarani, Nairobi County, revealed that 50.83% of the teachers experienced work overload while 61.67% experienced burn out.

In Machakos County, the introduction of Free Primary Education resulted into an increase in the teacher student ratio from 46:1 in 2001 to 52:1 in 2011. The workloads among teachers are also of concern with 29.2% of schools having teachers with workloads of above 35 lessons per week; one lesson takes 40 minutes (Kaloki et al., 2015). The predominance of these risk factors probably associated with MSDs among teachers, alongside high prevalence in related groups made it essential to conduct a study exploring MSDs among primary school teachers in Machakos County.

1.3. Justification

MSDs result into major losses through missed work days, financial losses due to medical costs, and poor work ethics related to discomfort while at work (Erick & Smith, 2015). According to Jaiswal and Mesaria, (2015) the costs associated to MSDS range between and 13 and 54 billion US Dollars per year. In Kenya, studies on MSDs have focused on nurses, overlooking teachers, and making it important to look into the group as it also ranks among the most of affected (Erick & Smith, 2011). Most studies on the health of teachers in Kenya health have focused on workloads, stress, work-conditions, and pupil teacher ratios (Chacha & Zani, 2015; Kaloki et al. 2015; Ng'eno, 2007; Njoroge, 2015; Wang'eri & Okello, 2014). These factors are known predictors of musculoskeletal disorders and make this study essential as it will fully concentrate on the topic of MSDs. This study will address the health and safety of one of the largest groups of workers in Kenya, and therefore very essential.

1.4.Research Questions

i. What is the prevalence of MSDs among primary school teachers in Machakos County, Kenya?

ii. What person related-factors are associated with the prevalence MSDs among teachers in Machakos County, Kenya?

iii. What work-related factors are associated with the prevalence MSDs among primary school teachers in Machakos County, Kenya?

1.5. Objectives of the Study

1.5.1. Broad Objective

To determine the prevalence and predictors of work-related musculoskeletal disorders among primary school teachers in Machakos county, Kenya.

1.5.2. Specific Objectives

i. To determine the prevalence of MSDs among primary school teachers

ii. To explore the person related factors associated with the prevalence of musculoskeletal disorders among teachers in Machakos County, Kenya.

iii. To explore the work-related factors associated with the prevalence of musculoskeletal disorders among teachers in Machakos County, Kenya.

1.6.Significance of the Study

MSDs are among the leading causes of suffering, pain, and disabilities in the workplace (The United States Department of labor, 2014). The findings from this study may inform changes in the work environment of primary school teachers. The study may inform research as this remains one of the underexplored areas, especially among the Kenyan

teachers. It may also form an important basis as regards how to assist teachers against the risk of developing MSDs. As considerable time and finances are lost in the management of these conditions, this study may form a platform upon which to assess the most appropriate controls that can be put in place.

The findings on significantly associated factors such as sitting for long, standing for long, and lack of seats for teachers may help the management of schools implement the relevant health policies such as the TSC's safety and health policy to cater for the emerging problem of MSDs, and improve the productivity as well as quality of life among teachers. The ministry and other stakeholders may refine policies to factor training about how to prevent predisposition to the health risks of musculoskeletal disorders. Such may also include regulation on the number of lessons for teachers.

1.7. Limitations and Delimitations

As regards limitations, this study adopted a cross-sectional whereby preceding conditions could have been overlooked. This was minimized by developing a tool that would gather as much information as possible about the conditions. The choice of an additional tool also helped with the complementarity. The choice of Machakos County was another limitation as it would bring up questions regarding the generalizability of the results.

With respect to delimitations, the choice of closed-ended questions meant that a number of responses could not be mapped out exactly. This option was made in order to make more respondents interested in the study. Another delimitation was the number of years working. This choice was made based on review of literature about the development of musculoskeletal disorders. The nature of objectives was another delimitation. This is the

case as there could have been other factors outside the ones considered that had an effect on the relationship being studied.

1.8.Theoretical Framework

The study is based on two theories that explain the development of musculoskeletal injuries. The differential fatigue theory explains the asymmetric and unbalanced occupational activities that created fatigue, thereby a kinematic and kinetic imbalance that result into the development of injuries (Kumar, 2001). The second theory is the multivariate interaction theory, which posits that the genetic composition, occupational biomechanical hazards, and morphological characteristics are associated with musculoskeletal injuries (Kumar, 2001). In this theory, the genetic composition and morphological are the person-related factors, while the occupational biomechanical factors are the work-related factors.

1.9.Conceptual Framework

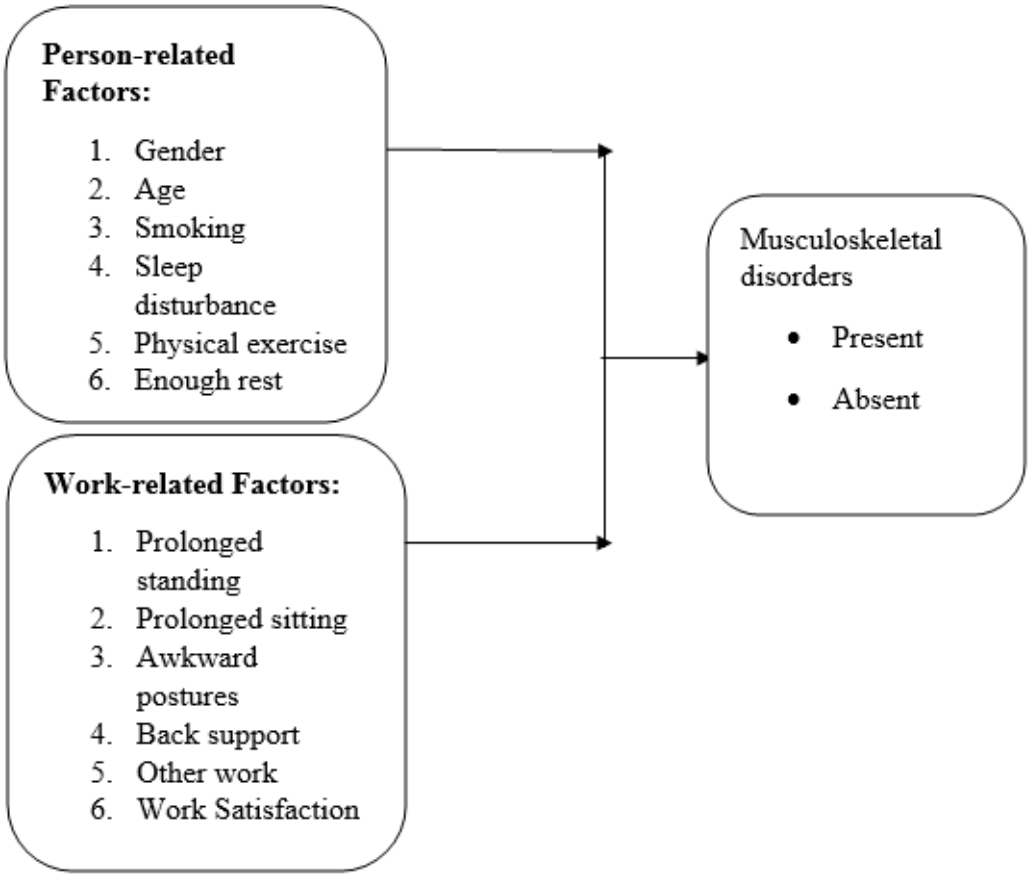

Figure 1. Conceptual framework (Source: Literature Review)

In this framework, the independent variables are categorized in person-related and work-related factors. Regarding personal factors, female gender has been shown to predict higher prevalence of MSDs. MSDs are likely to increase with age, sleep disturbance, and with smoking. With work-related factors, prolonged sitting, standing, awkward postures, lack of back support, having other profession, lack of work satisfaction, lack of physical exercise, and lacking enough rest were associated with increased prevalence of musculoskeletal disorders (Cardoso et al. 2009; Anuar et al. 2016; Beyen et al. 2013;

Damayanti et al. 2017; Ebtesam, 2015; Eggers et al. 2018; Ganiyu et al. 2015; Jaiswal & Mesaria, 2015). The dependent variable is the presence of MSDs on various body parts.

CHAPTER 2: LITERATURE REVIEW

2.1.Introduction

This chapter presents a review of existing literature about MSDs among teachers. Firstly, MSDs are defined, followed by the prevalence of MSDs. Literature on risk factors of MSDs is then reviewed Finally, the Kenyan scenario is explored with MSDs among nurses and the health of teachers.

2.2.Definition of Musculoskeletal Disorders

According to Erick and Smith (2015), MSDs refer to a broad range of degenerative and inflammatory conditions that affect the joints, muscles, ligaments, tendons, bones, nerves, and the localized blood circulation systems, and may be attributed to or intensified by tasks one does at work and their immediate environment. Globally, MSDs account for 33% of all work related occupational ilnnesses, thus the largest single cause of work related health conditions (Bodhare et al. 2011). The affected parts include tendons, muscles, ligaments, discs, nerves, and blood vessels (Middleswort, 2016). Centers for Disease Control and Prevention defines MSDs as disorders affecting muscles, tendons, nerves, and the supporting structures of lower back, lower and upper limbs, and neck caused or aggravated by exertion or extended exposure to physical factors such as vibration, force, repetition, or awkward postures (Centers for Disease Control and Prevention, 2012).

2.3.The Prevalence of Musculoskeletal Disorders

2.3.1. Prevalence among Teachers in Brazil

Cardoso, et al., (2009), explored the prevalence of musculoskeletal pain (MP) among teachers in El Savdor Brazil. Their findings reveal a high prevalence of MP in the upper limbs (23.7%), lower limbs (41.1%), and the back (41.1%). The overall prevalance of musculoskeletal pain in any body part was 55%, further affirming the risk in this profession (Cardoso et al., 2009).

2.3.2. Prevalence of MSDs among Teachers in Saudi Arabia

Darwish and Al-Zuhair (2013) reveal musculoskeletal pain was prevalent in 79.17% of the respondents. Back pain was reported by 63.8%, followed by shoulder pain at 45.5%, neck at 42%, leg at 40%, wist at 16.2%, and elbow joint at 10%. These are again numbers that call for consideration, more so upon reflecting on the consequences. In the same study, age was an important predictor of prevalence with a p-value of 0.0002, demonstrating strong evidence for the alternative hypothesis. This predictor explains the differing prevalence rates between government and private schools as most government school teachers are over 40 years of age (Darwish & Al-Zuhair, 2013).

2.3.3. Prevalence of MSDs among Teachers in Malaysia and Turkey

Samad et al., (2010) investigated the prevalence of low back pain among primary level teachers in Klang Valley, Malaysia. Nine schools included in the study were picked from a list provided by the Ministry Education. 272 participants volunteered to take part in the study. Back pain was prevalent in 40% of the respondents.

Anuar et al. (2016), in a study exploring the predictors of low back pain among teachers in Malaysia, revealed that LBP wa prevalent in 72.9% of the respondents. This figure falls within the numbers that Erick and Smith give in their literature review. Korkmaz at al. (2011) record high prevance rate in their study involving Turkish school teachers. Their findings report a prevalence rate of 51.4%.

2.3.4. Prevalence of MSDs among Teachers in China

Yue et al. (2014) used the Nordic Questionnaire and Copenhangen questionnaire to assess the physchological risk factors and prevalence of MSDs among teachers and miners in China. This study adopted a cross-sectional design, and involved 500 teachers and 500 miners. The mean age was 38.5±9.0 for teachers and 37.5±10.7 for miners. Among the miners, 93% were males, while 76% among the teachers were female. Logistic regressions were done to measure the association between psycho-social factors and Work related musculoskeletal disorders (WRMSDS). The results revealed that the prevalence was high in both groups, 72% for teachers, and 78% for miners, confiming that MSDs occur highly among teachers and miners in China. The researchers recommended for higher emphasis of psyhcological factors among teachers. The researcher only used questionnaires to gather information, creating a gap as regards additional information about the exposures that can be gathered using observational checklist.

2.3.5. Prevalence of MSDs among Teachers in the Developing World

In a literature review about musculoskeletal disorders among teachers in the developing world, Eric and Smith give information about the prevalence of the condition. According

to the review, relative to other groups, school teachers report higher rates of between 40% and 95%. The higher incidence is explained by the nature of a teacher's work, which involves not just teaching students, but also the preparation of lesson plans, assessment of students, and participation in extra-curricular activities. The exploration further revealed that teachers mostly appeared to suffer from MSD of the upper limbs, necks, and the back (Erick & Smith, 2015).

2.3.6. Prevalence of MSDs among Teachers in Egypt and Botswana

High rates were prevalent in a study involving primary school teachers in Cairo, Egypt. Lower back pain was the most prevalent musculoskeletal pain 41%, followed by neck pain at 20%, and shoulder pain at 15%. An astounding rate of 84% reported that musculoskeletal pain affected their profession (Ebtesam, 2015).

Erick and Smith's (2014) study involving Botswana's teachers also gives vital statistics about the prevalence of MSDs among African teachers. The MSD prevalence any body part was 83.3% among the respondents. The prevalence was higher for upper back, 52.6%, followed by shoulders (52.5%), and then neck at 50.8 percent. The prevalence was least reported in thighs (18.2%0, and elbows (13.3%) (Erick & Smith, 2014).

2.3.7. Prevalence of MSDs among Teachers in Ethiopia

Beyen et al., (2013) conducted a cross-sectional study exploring risk factors and prevalence of LBP among teachers school, colleges, and university lecturers in Gondar, Ethiopia. This study involved teachers with at least one year of experience. Data was collected from 411 male and 191 female teachers. Out of 602 respondents, 57.5% (346) reported to have had

a back-pain experience in their career. The 12-month low back prevalence was 53.8% among the teachers. 60.55 percent of the respondents knew about what caused their low back pain (Beyen et al. 2013). From the respondents with back pain, 33.5% felt pain in the course of instruction. A significant portion (59%) of the respondents reported to experience sub-acute low back pain. The prevalence was higher among the female teachers (75.9%) than the male (48.9%). The prevalence was also higher among teachers above the age of 40 years. The prevalence was higher in smokers than non-smokers, with a p-value of 0.028 (Beyen et al. 2013).

2.3.8. Prevalence of MSDs among Teachers in Nigeria

Odole et al. (2013) investigated 12-month prevalence, patterns, and socio-demographic as well as socioeconomic factors among 679 teachers, 538 females, and 141 males, from 54 private and public schools in Ibadan. This study adopted a cross-sectional design. The Standardized Nordic and self-developed validated questionnaires were used in data collection. In the analysis, data was summed using mean and standard deviation, percentages and frequencies. The researcher used Chi-square to determine the existence of association between variables. The 12-month prevalence of MP was 78.8% in female teachers, and 21.2% in males. The most commonly reported pain work related musculoskeletal pain was Neck pain (36.1%), followed by low back pain (34.9%), knee (34.9%), and shoulder (32.8%) (Odole, et al., 2013). As regards gaps, the researchers only used a questionnaire for data collection, calling for an additional tool such as an observation checklist in this study, to gather additional information.

2.4.The Risk Factors of Musculoskeletal Disorders

In a literature review on MSDs among teachers, Erick and Smith (2015) reveal that the teaching environment is characterised by various risk factors that predipose teachers. These include psychological attributes such as high workloads, percieved levels of stress, low job control, low social support, monotonous work, and low job satisfaction. Regular exercise and job satisfaction are said to have positive effects against musculoskeletal disorders among teachers. Literature converges on positive association between gender, smoking habits, sleep disturbance, school level, prolonged sitting, standing, and awkward postures and the development of musculoskeletal disorders (Erick & Smith, 2015). Among the recommendations was the need for greater awareness on MSDS to put in place efforts to reduce the prevalence. The author mentions gaps as regards use of observational strategies, a gap that this study will filll by adopting an observation checklist among the data collection tools.

2.4.1. Risk Factors of MSDs in Brazil

Teaching ranks among the top professions in terms of higher risk of musculoskeletal disorders. Various studies have been conducted which isolate the factors that predispose teachers to higher risk of musculoskeletal disorders. In a study involving pre-school, and elementary school level I and II teachers in Brazil, the prevalence of MP among teachers had an association with working for more than 5 years, having no other paid activity apart from teaching, heat in the classrooms, and high levels of physical expertion (Cardoso et al., 2009). Ninety two percent of the subjects in this study were women, and its mean age was 40 years ± 9.4 years. This was a cross sectional study whose objective was to explore

the prevalence of musculoskeletal pain in relation to occupation and demographic factors. A questionnaire was used to gather the study data, and a descriptive analysis was used to understand the prevalence. Among the recommendations was the development of policies to prevent diseases and promote well-being of teachers. As regards gaps, this study relied on just a questionnaire to gather information, creating the need for further inquiry using an observational questionnaire that this study will adopt.

2.4.2. The Risk factors to MSDS in China

In another cross-sectional study involving Chinese teachers, the female gender came out as an influential risk factor in the development of shoulder/neck pain and LBP. Other risk factors as per this study included prolonged sitting, standing, uncomfortable back support, static posture, and twisting posture. The study objective was to examine the risk factors and prevalence of LBP, and Neck and shoulder pain among primary, secondary school, and high school teachers. A questionnaire was used for data collection. The analysis of quantitative data was done using T-test, while for categorical was done using chi square (Yue et al. 2012). The recommendations were that further studies are essential in the development of interventional models against these problems. This study only adopted a questionnaire for data collection, creating the need for other methods such as an observation checklist to gather additional information.

2.4.3. The Risk factors to MSDs in Saudi Arabia

In another study involving Saudi Arabian female teachers, Darwish and Al-Zuhair (2013), give their insight about the risk factors predisposing teachers to musculoskeletal disorders.

This was a cross-sectional study involving a sample of government and private schools. 240 teachers, with a mean age of 35.5± 7.8 years were involved in this study. The researcher used chi square to test significant risk factors to musculoskeletal pain. These included shoe type, school type, years in teaching, and daily working hours. Darwish and Al-Zuhair (2013) recommend futher studies further studies using different interventional strategies to reduce the risk of MSDs among teachers helping justify why this study is essential as it lays the foundation for these efforts. Darwish and Al-Zuhair only deal with female teachers, creating a gap because MSDs are not gender specific, and thus this study will fill this gap.

2.4.4. The Risk Factors of MSDs in Malaysia

Samad et al., (2010) also explored the risk factors associated with low back pain among teachers. Data collection was done using a questionnaire, while OR was used in testing the association between variables. From the results, lifting of loads ranked as the significant risk exposure to the development of back pain. Other factors included prolonged standing, sitting, and poor mental health. Gender was also another risk factor with 39.6% prevelance in males and 48.1% in females. The location of school was another influence with 47.8 percent for rural areas, 40.2 percent for urban areas, and 40.2% for industrial areas. This study relied only on a questionnaire to gather data, further supporting the need to use other tools, such as observational checklist in this study to fill the gap.

Anuar et al., (2016) explored work task and satisfaction as predictors for LBP, and the influence of LBP on job satisfaction. This study adopts a cross sectional study design, and

involved 120 Malaysian teachers. Data abouut LBP was collected using the standardized Nordic Questionnaire, and Teachers satisfaction scale for satisfaction levels. Analysis was done using SPSS. Chi-square and correlation test were specifically used for statistical analysis. From the findings, 90% of the respondents were female. Odds Ratio was used to test for significant association between risk factors and development of lower back pain. Gender, prolonged sitting, walking down and up stairs, and lifting loads were significantly mentioned as risk factors. Age was also mentioned as a risk factor in this study. The recommendation was that future studies needed to explore the issue among larger sample of teachers, and randomly selected ones to increase the power of the study. As regards gaps, observational data was not considered, and this study will aim at filling this gap.

2.4.5. The Risk Factors of MSDs among Turkish Teachers

In a study exploring musculoskeletal pain, risk factors, and strategies for coping among Turkish school teachers, Korkmaz et al., (2011) mentioned age, sex, and working in an improper position as important risk factors. A questionnaire was the main tool for data collection. SPSS was used in the analysis of data. Independent t-tests and chi-square to examine the relationship between variables. The study involved 269 females, and 194 males, with mean of 3 36.12±8.34 and 40.80±9.50 respectively. 329 out of the 463 teachers involved in the study stated that standing for long increases the occurrence of pain. The prevalence in females was higher at 59.4%, further supporting the other findings on gender as a predisposing factor (Korkmaz et al., 2011). The researchers recommended longitudinal study designs as well as repeated measures in order to fully understand the the roles that

various factors play in the development of MSDS. The only tool used to gather data was a questionnaire, creating a gap as regards the need for other tools.

2.4.6. Risk Factors among Teachers in Egypt

In a qualitative study involving four randomly selected government primary schools in Cairo, musculoskeletal pain was associated with various personal factors including age, BMI, education, and smoking (Ebtesam, 2015). The aim of this study was to assess the work related factors associated with musculoskeletal pain (MP), and recommend preventive strategies. Long standing hours were also mentioned as riks factors for musculskeletal pain.

33% reported to not take any precaution to help alleviate the symptoms. Awkward postures, and school furniture were also among the heavily mentioned risk factors in this study (Ebtesam, 2015). This study adopted a cross-sectional design, and data was collected using a questionnaire. SPSS was used in the data analysis, with t-test and chi-square testing the correlation between variables. Among the recommendations was the need for increased awareness on the prevention and management of MP, and further research to investigate the relationship between MP and psychosocial factors among teachers in other levels of schools. The study involved only 4 schools, creating a question as regards the representativenss, and making this study warranted to cover a bigger sample. The researcher did not also observe the work conditions, that could have given leading information on the issue of MSDs.

2.4.7. Risk Factors among Teachers in Botswana

Eric and Smith (2014) conducted an extensive study about the risk factors and prevalance of low back pain (LBP) among teachers in Botswana. The objective of the study conduct an epidemioological investigation for LBP among randomly selected Botswana teachers. This study adopted a cross-sectional design, and a self administed questionnaire was used in the collection of data. Logistic regression models and chi-square were used in the analysis of collected data. The study involved 1747 teachers, with a 56.3% response rate. According to the results, previous back injury and female gender had a positive correlation with low back pain.

Other significantly reflected risk factors within the profession were awkward position of the arm, and the task's high psychological demands. Lack of physical exercise was stated as a significant risk factor among this group. Body mass index and education level were also among the risk factors for low back pain and disability (Erick & Smith, 2014). Among the recommendations was the need for concerted efforts to reduce the prevalence of low back pain. These include regular physical education, ergonomics education, and management of stress. The use of a questionnaire alone created a methodological gap as more tools would have helped gather more information. This study will include observational checklist to gather additional information.

2.4.8. Risk Factors among Teachers in Ethiopia

Standing posture in the course of teaching was heavily linked with the development of low back pain. As per the findings, 97.8% of the teachers reported to having instructed while

standing while 25.4% of the teachers reported having been exposed to prolonged sitting in the course of their work. The mean time that the teachers were exposed because of their work was 4.8 hours in a day with a standard deviation (SD) of 2.1 hours (Beyen et al. 2013). Lifting heavy materials was reported by 27.4% of the respondents. 18.8% reported to have lifted teaching aid devices. Following bivariate and multivariate analysis, low back pain was significantly linked with age, sex, working experience, smoking habits, monthly salary, irregular physical exercise, sleep disturbance, prolonged sitting, lifting heavy metals, office provisions, work environment, and support structures at work (Beyen et al. 2013). Among the study recommendations was the need to consider specific variables such as alcohol taken per day and cigarettes one smokes in a day. This study involved teachers from primary, secondary, and tertiary institutions, creating a gap as regards the exact impact on each group, and justifying why a study involving primary school teachers alone is important. Only a self-administered questionnaire was used in data collection, creating the need for other complementary method such as observations that can provide additional information and provide possible explanations for the trends.

2.4.9. Risk Factors of MSDs among Teachers in Nigeria

In a cross sectional study involving staff in a Nigerian Teaching and Referral Hospital, Ganiyu et al (2015) shed light on important risk factors that can be of significance in understanding MSDs among teachers. A self-reporting questionnaire adapted from the Dutch Musculoskeletal and Nordic Musculoskeletal Questionnaire was used for data collection. This study involved 90 male and 61 female health care professionals in the teaching hospital, with a mean age of 35.99 years. T-test was used in the analysis of

continous variables such as age, working hours, and working experience, whereas Chi-square was used in distinguishing the differences between participants with or without MSDs in self reported ergonomic hazards. The common ergonomic risk factors in this study were prolonged sitting or standing, and working in an awkward posture. More than 50% of the respondents mentioned working in the same posture for long as an ergonomic risk factor (Ganiyu et al., 2015). The study adopted combination of standardized and validated questionnaire, but did not use any other tool to complement, creating gap that this study will attempt to fill.

2.5.MSDs in the Kenyan Context

2.5.1. MSDs in the Nursing Profession

Kenyan studies exploring musculoskeletal disorders have dedicated their efforts towards the nursing profession, but can provide an important entry point in that nursing and teaching are among the most affected professions by MSDs. In line with this, Tanui (2016) conducted a study to assess work-related MSDs among nurses in the coastal county of Mombasa, Kenya. The study was premised on the assertion that the nature of the working environment predisposed nurses to musculoskeletal disorders. The main aim was to explore WRMSDs among nurses in both private and public hospitals in Mombasa County. This study was cross-sectional and involved 130 nurses from a sample of 169 nurses; 76.9 female and 23.1 males.

The prevalence of MSDs at any part of the body was 70.8% with low back being the most affected body part at 76.9%. The top most risk factor for MSD was lack of training on prevention of injury (93.1%), followed by maintaining the same position while working,

lifting and carrying or moving bulky materials at work. The level of awareness ranked between moderate and high. A strong association existed between the prevalence of WRMSDs and productivity of the nurses. The findings would have formed an important basis for interventions geared towards prevention and coping with MSDs, and eventual improvement in patient care. Considering that this study involved nurses, it would be important to explore the issue among other professions listed as most-affected, making this study very essential.

Mugga (2015) also conducted another study assessing MSDs among nurses in Kenyatta National Hospital. The objective of the study was to identify risk factors, the prevalence, and characterize MSDs in respect to frequently occurring ones. This study was also cross-sectional and involved 314 randomly selected nurses, with a response rate of 78%. The findings revealed that overall prevalence of MSDs among nurses was 74.2%. It was further revealed that physical factors such as poor postures, use of excessive force, and lifting heavy objects were the most prominent risk factors for MSDs. Other significant ergonomic factors included work organization, structural laying out of workplace. The most affected body parts were back (32.5%), feet (21.5%), and shoulders (20.4). Age was found to be significant as regards causation in females, but was not among the males. The age bracket that was the most affected was between 35 and 44 years. Fifty two percent of nurses who suffered from musculoskeletal disorders sought medical assistance. Sick leave seeking was significantly associated with age and experience. One of the recommendations was the need for early detection, incorporation of ergonomics training, and proper designing of work environments.

2.5.2. The introduction of Free Primary Education

Several changes within the Kenyan education sector can serve as predictors for higher risk of musculoskeletal disorders. The Kenyan government introduced free primary education in 2003 which saw dramatic increase in the enrollment rates. The enrollment rose by 30%, and saw teacher student ratio rise from 1:42 in 1998 to 1:53 in 2003, and 1:60 in 2008 (Chacha & Zani, 2015). The enlarged class sizes affect the movement of teachers in classes, making it difficult to monitor the students. The implementation of free primary education also creates a burden for teachers in terms of work they have to partake with the larger classes. Teachers have to give assignments, supervise, and mark for all the students (KENPRO, 2010). The KENPRO report also points out about the lack of physical infrastructure. This situation creates a knowledge gap as there lacks any substantial studies exploring the effect of free primary education of the risk of MSDs among primary school teachers.

Kaloki at el., (2015) conducted a descriptive survey to explore the role of increasing pupil-teacher ratio on academic performance in Machakos County. The study was conduced in 24 schools, with questionnaires forming the tools for data collection. Data analysis was done using simple regression. To determine the assocation between pupil teacher ratio and academic perfomance the Pearsons correlation co-efficient was used. The calculated R was -0.323, suggesting that PTR increase resulted into decrease in perfomance. Among the study recommendations was the need to pay attention to PTR because it affects educational perfomance of pupils. The gap in this study is the concentration of academic perfomance

among pupils, while there could be other outcomes, such as stress, and poor health among the teachers.

2.5.3. Studies on the Health of Kenyan Teachers

There have been numerous studies among Kenyan teachers, with stress among the most studied variables. These studies will have an informative role on this because stress is among the predictors of higher risk of MSDs among primary schools.

Njoroge (2015) examined the risk factors and prevalence of stress among Public primary school teachers in Nairobi County, Kenya. The study's objective was to determine socio-demographic factors that influence the experience of stress among Nairobi County primary school teacher. The study adopted a cross sectional design approach. A systematically selected random sample of 267 teachers was involved in the study. A structured demographic questionnaire and Teacher Stress Inventory were used in data collection. Data was the analyzed using SPPS version 20. All the study respondents recorded stress levels of above 53.9%. Females were more likely to experience stress than the male teachers. Among the study recommendations was the need to recruit more teachers, offer counseling services to relieve the stress, and the need for TSC to keep up to date data about teachers. The gap in this study is the decision to simply deal with stress and not try to correlate it with other issues. The study was also done in an urban center, and would make more sense of rolled out to other areas.

In another study, Ng'eno (2007) explored the cause of exhaustion among teachers in primary schools in Kericho, Kenya. The study adopted a survey design, and involved 120 teachers drawn from 300 teachers through stratified and simple random sampling. A self-

reporting questionnaire was used to obtain data for the study. Descriptive statistics were then used for data analysis. The study associated low salaries, heavy work load, lack of consideration in making decisions, and lack of promotion opportunities with high stress levels (Ng'eno, 2007). The use of questionnaire alone also creates a gap as regards the need for a complementary tool.

Wangeri and Okello, (2014) conducted a study in Kasarani, Nairobi County, to examine the correlation of work to burn out and stress among primary school teachers. The study paid particular attention to the influence of school type, overload in terms of workload and class sizes, gender, and teaching experience on stress. Data was collected using a questionnaire. 50.83% of the teachers reported to have experienced work overload, 61.67% reported burn out. The ANOVA results show that the type of school and burn out rates had a significant relationship, with an F ratio of 440.96. The study recommendation was the need for structures to make teachers' jobs manageable, need for training on stress management, and need for teachers to seek support from family and school administration.

2.6.Summary of Literature and Gaps to be filled

This chapter started with the definition of MSDs, the proceeds to explore the prevalence and risk factors of MSDs from global, to regional, and then to local. The prevalence rates have been noted to be particularly high, and in the range of between 40 and 95% as revealed by Erick and Smith (2011) in a review of literature on MSDs among teachers. The risk factors notably mentioned in the review include: age, gender, smoking habits, sleep disturbance, stress, lack of back support on chairs, school level, prolonged sitting, standing, satisfaction with the work environment, having another job apart from teaching, lack of

regular physical exercise, inadequate rest after work, office provisions, work environment, stress, and awkward postures while working. Little has been done locally as regards musculoskeletal disorders among primary school teachers. Studies on MSDs among nurses, a commonly mentioned group alongside teachers when it comes to groups MSDs are prevalent, and the rates are also high. However, local studies about teachers reveal risk factors that show the possibility of MSDs among teachers and spell the gaps that this study intends to fill in terms of exploring this issue. The factors that have been mentioned and can be used to form the basis of the need for this study include stress, exhaustion, high workloads, burnout, changing PTR ratio, understaffing, and exhaustion.

CHAPTER 3: MATERIALS AND METHODS

3.1.Introduction

This chapter entails the methodology of the study. It covers the study design, variables, location, study population, sampling techniques, sample size determination, construction of research instruments, pretest, validity and reliability, data collection techniques, data analysis, and ethical and logistical considerations.

3.2. Research Design

A descriptive cross-sectional design was used for this study. This design was because of its relative inexpensiveness, capacity to be conducted within a short span of time, and the capacity to allow the collection of data on a personal level, allowing the control of possible confounders (Thiese, 2014).

3.3.Variables

3.3.1. Independent Variables

The independent variables were categorized into personal factors which included age, gender, smoking, physical exercise, enough rest, and sleep disturbance-characterized by challenges in maintaining the normal patterns of light and deep sleep-which were categorical. With work-related risk factors, sitting for long, provision of chair with adequate support, satisfaction with work environment, having other work apart from teaching, working with neck above the shoulder, hours taught while standing, hours taught while sitting, and hours taught in head down posture were also categorical.

3.3.2. Dependent Variable

The dependent variable was the prevalence of musculoskeletal disorders among teachers, was categorical.

3.4. Study Area

The study was conducted in selected public primary schools in Machakos County. The county is located in the lower eastern region of Kenya, and covers 6,208km^2. The county is divided into eight sub counties (Infotrak Research, 2015). The county has 1,038 public

primary schools (Ministry of Education, 2015). Machakos was chosen in this study because of its representative capability for the national teacher population; it had urban, peri-urban, and rural areas helped paint a clearer picture of musculoskeletal disorders among Kenyan primary school teachers. There may not have been studies on MSDs among primary school teachers, but studies among nurses showed very high rates that would trigger an insight into the issue among teachers in Machakos. The choice of Machakos County was backed by numerous studies that have pointed out the existence of risk factors for MSDs among teachers. According to Kaloki et al., (2015) the introduction of Free Primary Education resulted into an increase in the teacher student ratio from 46:1 in 2001 to 52:1 in 2011. The workloads also increased with 29.2% of schools having teachers with workloads of above 35 lessons per week (Kaloki, et al., 2015). This is a clear suggestion of the possibility of existence of musculoskeletal disorders among primary school teachers in Machakos County, Kenya.

3.5. Study Population

The study population was public primary school teachers in Machakos County. The total number of primary school teachers in Machakos county was 9, 136 (Ministry of Education, 2015). The total number of teachers in the three sub-counties selected for this study was 3687. The introduction of free primary education influenced the choice of primary school teachers.

3.6.Sample Size Determination and Sampling

3.6.1. Sample Size Determination

The population of teachers in the selected sub-counties was below 10, 000; 3687 to be precise, this was classified as a small population. To determine the sample size for the study Yamane's formula was used (Singh & Masuku, 2014).

$$n = \frac{N}{1+N\,(e)^2}$$

In the formula, *n* was the desired sample size, *N* was the study population, and *e* was a constant equal to 0.05. Thus, as per the formula,

$$n = \frac{3687}{1+3687\,(0.05)^2}$$

$$n = 361$$

To cater for non-response, 5% of the questionnaires (19) were added to the sample size, resulting into a total of 380 questionnaires.

3.6.2. Sampling Technique

Multistage sampling was chosen for this study. Stratified random sampling was used to select the sub-counties to conduct the study. It ensured that schools from urban, peri-urban and rual subcounties were included. These sub-counties were Machakos, Matungulu, and Mwala. To ensure equal representation, proportionate sampling was used to select teachers from each sub-county to participate in the study. Simple random sampling was then used to select the schools in randomly selected divisions and zones. The divisions and zones were as follows: Central Division, Mumbuni and Muvuti Zones for Machakos Sub-County;

Matungulu division, Matungulu and Tala Zones for Matungulu Sub-County, and Masii Division, Masii Zone, and Mwala Division, Mbiuni Zone for Mwala Sub-County. Proportionate sampling was used to determine the number of teachers per school. Simple random sampling was then used to determine the specific teachers in the schools to administer the study to. Table 3.1 below shows the breakdown of the numbers per the sub-counties.

Table 3.1: Proportionate sampling of teachers per sub-county

Sub-County	Total Number of teachers	Proportionate Number
Machakos	1360	100
Matungulu	932	95
Mwala	1395	107
Total	**3687**	**302**

Note. Proportionate numbers were arrived at by factoring the proportion of the teachers in the Sub-County to the total sample size. The proportionate number was the number of questionnaires that were returned per Sub-county.

3.7. Inclusion and Exclusion Criteria

3.7.1. Inclusion Criteria

To be included in this study the participants had to have to have worked for more than one year, be actively involved in teaching, and consenting to take part in the study.

3.7.2. Exclusion Criteria

Teachers with a history of fractures, working part time, and with history of symptoms related to falls and road accidents, and conditions such as pregnancy were excluded from the study.

3.8. Contruction of Research Instruments

This study majorly relied on a self-administered questionnaire. Most of its parts were adopted from the Standardized Nordic Musculoskeletal Questionnaire (Crawford, 2007; Wilson & Corlett, 2005). The questionnaire had the following sections: Demographic factors, risk factors, and prevalence of MSDs. The respondents were expected to pick the most appropriate choice as the questions were closed-ended. An observation checklist was constructed based on literature on conditions that would predispose teachers to MSDs.

3.9. Pretest of the Tools

A pretest of the tools was done at Uamani Primary School, Matungulu zone, Matungulu Sub-County. Questionnaires were issued to a group of teachers who were requested to fill and express any challenges they experienced. Research assistants were requested to fill the check-list and compare their impressions. The objective of this pretest was to validate the tools, and their application procedure. From the pre-test, the researcher adjusted the tools and procedures for the study to run smoothly.

3.10. Validity

To ensure content validity all the items related to musculoskeletal disorders were included in the questionnaire to ensure that the attribute of interest was comprehensively measured. The choice to also include specifically affected body parts was also a measure of validity to ensure that every aspect of the construct was assessed. Various studies had also been

conducted with the objective of assessing the validity of the Nordic questionnaire, and it was expected to be suitable for this study (Crawford, 2007; Kuorinka, et al., 1987).

3.11. Reliability

Raters were asked to share their rating about the tool in order to determine its consistency to measure what it was expected to. Research assistants were also trained to enhance reliability in data collection. Questionnaires were checked for completeness at all times.

3.12. Data Collection techniques

Data was collected through the administration of the questionnaires to the respondents who fit within the study criteria and were ready to participate. Research assistants administered the questionnaires to the respondents. The research assistants were tasked with noting down their observations on the check list as the teachers filled the questionnaires.

3.13. Data Analysis

The collected information was analyzed using SPSS version 22. Descriptive statistics were used to summarize socio-demographic variables, and the prevalence of musculoskeletal disorders. For both hypotheses, Chi Square and logistic regression were used.

Chi-square was initially done to determine the statistical associations between the independent and dependent study variables. The independent variables with significant associations with the dependent variables ($p<0.05$) were then evaluated through logistical regression, and then expressed using Odds Ratios with a confidence level of 95%.

3.14. Ethical and Logistical Considerations

3.14.1. Ethical Considerations

Ethical approval from Kenyatta University Ethical Review Committee (KUERC); reference number PKU/760/1828. The researcher sought written informed consent from each participant. The participants were made aware of the type of study, and the risks and benefits that would accrue. They were also informed about their right to abandon the study at any point in case of any discomfort in the course of the study without any prejudice. Additionally, they were informed that all the information they gave would be handled with confidentiality, and was to be used for the purpose of the study only. The participants had the right to not respond to questions that would create any discomfort. The study was done in safe environments for the sake of the respondents. The results participants were assured that the results would be shared with them upon the completion of the study.

3.14.2. Logistical Considerations

To undertake the study, authorization was granted by Kenyatta University Graduate School, NACOSTI, Ministry of Education, County education authorities, Machakos County administration, and school head teachers. The reference number for the authorization from NACOSTI was NACOSTI/P/18/71539/21197. All the authorizations are appended in the document.

CHAPTER 4: RESULTS

4.1.Introduction

This chapter presents the results of the study. Tables are used to present the results. The chapter starts with the demographic characteristics of the respondents, followed by results on the prevalence of MSDs, results on risk factors, results on the relationship between risk factors and prevalence, results on the effect of MSDs on carrying out normal activities, and then results on the findings as per the observation checklist.

4.2.Demographic Characteristics

Table 4.1 below presents the distribution of respondents across demographic factors. Three hundred and two questionnaires were returned, a response rate of 79.47%. The results show the majority of the respondents were female (61.59%).

The mean weight was 68.91 kilograms with most respondents falling between 69 and 75 kilograms. Regarding age, 18.87% of the teachers, the largest proportion, were between 45 and 49 years. The mean height of the respondents was 167.75 with most respondents ranging between 170 and 179 centimeters. Over 99% of the respondents were right-handed.

Table 4.1: Distribution of Respondents across Demographic Factors (n=302)

Attribute	Frequency	Percent
Gender		
Male	116	38.41
Female	186	61.59
Age (years)		
20-24	18	5.96
25-29	25	8.28
30-34	48	15.89
35-39	50	16.56
40-44	55	18.21
45-49	57	18.87
>50	49	16.22
Weight(kilograms)		
48-54	23	7.60
55-61	65	21.52
62-68	64	21.19
69-75	70	23.18
76-82	45	14.90
83-90	35	11.59
Height (Centimeters)		
140-149	3	0.99

150-159	76	25.17
160-169	74	24.50
170-179	103	34.11
180-190	46	15.23
Right/Left-Handed		
Right-handed	296	98.01
Left-handed	6	1.99

4.3.Prevalence of Musculoskeletal Disorders

Table 4.2 presents the 12-month and 7-day prevalence of musculoskeletal disorders among primary school teachers. The results show that the 12-month prevalence in any body part was 85.10%. The body parts that were most affected included the lower back at 58.60%, knees at 57.60%, neck at 53.30% and ankles at 53.00%.

Table 4.2: Prevalence of MSDs

Body Region	**Prevalence (%) (Past 12 months)**	**Prevalence (%) (Past 7 days)**
Anybody region	85.10	
Neck	53.30	30.13
Shoulders	46.70	28.10
Elbows	25.20	19.50
Wrists/Hands	42.40	22.19
Upper back	42.40	28.50
Lower back	58.60	46.00
Thighs and buttocks	25.80	14.90
One or both knees	57.60	30.10
One or both ankles	53.00	28.10

The least affected body parts were thighs and buttocks at 25.8% and elbows at 25.2%. Lower back trouble (46 %) was the most prevalent MSD over the past 7 days, followed by neck trouble (30.1%). Thigh/buttocks MSDs were the least prevalent over the past 7 days (14.9%).

4.4.Predictors of MSDs

Table 4.3 shows the distribution of risk factors across gender. From the results, 28.8% of the respondents had experienced sleep disturbance. In addition, 8.3% were smokers. 64.6% of the teachers taught for 6 or more hours, 28.5% 3 to 5 hours, 3.6% for 1to 2 hours, and 3.4% for less than hour. With sitting for long, 87.7% did not sit for long at work while 12.3% sat for long. Concerning provision of chairs with adequate back support, 50.3% of the respondents stated that their seats did not have adequate support. Teaching on a head-down posture was also a variable of concern, and the findings revealed 61.3% worked on a head-down posture. 57.9% were satisfied with their work environment while 42.1% were not.

Table 4.3: Risk Factors across Gender

Characteristic	Male	Female	Total (%)	*P* Value
Sleep Disturbance				**0.01**
No	83	132	215(71.20%)	
Yes	33	54	87(28.80%)	
Smoking				**<0.01**
Smoke	21	4	25(8.30%)	
Don't Smoke	95	182	277(91.70%	
Hours Teaching While Standing				**0.01**
Less than 1 hours	8	2	10(3.30%)	
1-2 Hours	7	4	11(3.60%)	
3-5 hours	31	55	86(28.50%)	
6 hours and above	70	125	195(64.60%)	
Sitting for Long				0.52
No	100	165	265(87.70%)	
Yes	16	21	37(12.30%)	
Hours sitting				**<0.01**
Less than 1 hour	67	98	165(54.60%)	
1-2 hours	30	49	79(26.20%)	
3-5 hours	2	24	26(8.60%)	
6 hours above	17	15	32(10.60%)	
Chair with adequate back support				0.39
No	62	90	152(50.30%)	
Yes	54	96	150(49.70%)	
Hours in head-down posture				**<0.01**

1-2 Hours	47	103	150(49.70%)	
3-4 hours	24	43	67(22.20%)	
4 hours and above	45	40	85(28.10%)	
Satisfied with work environment				0.96
No	49	78	127(42.10%)	
Yes	67	108	175(57.90%)	
Other work apart from teaching				**0.04**
No	71	135	206(68.20%)	
Yes	45	51	96(31.80%)	
Regular physical exercise				<0.01
No	53	89	142(47.00%)	
Yes	63	97	160(53.00%)	
Enough rest				**0.01**
No	42	96	138(45.70%)	
Yes	74	90	164(54.30%)	
Work with neck above shoulder				**<0.01**
No	37	61	98(32.5%)	
Yes	79	125	204(67.5%)	

Note. P values were calculated using chi-square. Significant risk factors are bolded.

68.2% of the teachers did not have any work apart from teaching while 31.8% had other occupations. From the findings, 53% were involved in physical exercise, 54% had adequate rest while 67.5% worked with their neck above the shoulder.

As presented, a Chi squared test of association established that sleep disturbance was significantly associated with gender (p<0.01). Other factors that were statistically significant across gender included smoking (p=0.01), hours sitting while at work (p<0.01), hours working on a head-down posture (p<0.01), having other work apart from teaching (p=0.04), and having enough rest (p=0.01).

4.5.Person-Related Factors associated with MSDS

Table 4.4 shows the prevalence of MSDs in specific body parts across personal factors. In order to determine the relationship between risk factors and the prevalence of musculoskeletal disorders across different body parts, a chi square test of association was

conducted. The prevalence was higher among the female teachers for neck, shoulder, elbows, wrists, upper back, lower back, and knees MSDs. The prevalence among male teachers was only higher for MSDs affecting the ankles. The difference was significant for shoulders, elbows, and lower back with *p* values 0.01, 0.02, and 0.02respectively.

Table 4.4: Prevalence of MSDs in various regions across personal factors

Variable	**% Neck**	**% Shoulder**	**% Elbows**	**% Wrists**	**% Upper back**	**% Lower back**	**% Thigh/ Buttocks**	**% Knees**	**% Ankles**
Gender									
Male	51.70	17.20	8.90	29.00	43.90	50.00	30.20	44.00	45.70
Female	54.30	28.50	15.60	31.20	45.20	66.00	29.10	41.40	42.40
P Value	0.66	**0.02**	**0.03**	0.66	0.22	**0.02**	0.17	0.66	0.46
Age									
20-24	52.60	25.00	4.40	25.00	10.50	15.80	0.00	15.80	15.80
25-29	44.00				16.00	56.00	4.00	20.00	32.00
30-34	40.80	20.20	11.10	27.30	42.90	63.30	0.30	36.70	38.80
35-39	40.00				36.00	50.00	34.70	44.00	40.00
40-44	56.60	26.40	19.50	30.80	45.30	73.60	14.00	37.70	37.70
45-49	83.60				65.50	87.30	26.40	56.40	56.40
>50	53.30				45.10	33.30	40.00	56.90	56.90
P Value	<**0.01**	**0.01**	**0.01**	**0.04**	<**0.01**	<**0.01**	<**0.01**	<**0.01**	**0.01**
Sleep Disturbance									
No	47.00	21.40	14.00	27.90	37.20	55.30	22.30	34.00	35.80
Yes	69.00	31.00	16.10	31.00	55.20	66.70	34.50	63.20	60.90
P-Value	<**0.01**	**0.01**	0.83	0.17	<**0.01**	0.07	**0.02**	<**0.01**	<**0.01**
Smoke									
Yes	55.00	32.00	16.00	10.00	64.00	44.00	20.00	76.00	76.00

No	52.00	29.50	14.40	28.90	40.40	59.90	23.40	39.40	40.10
	0.82	0.83	0.88	**0.01**	**0.01**	0.12	0.49	**<0.01**	**<0.01**
Regular physical exercise									
No	61.30	24.60	10.60	31.00	47.20	59.30	29.60	45.10	48.60
Yes	46.30	13.80	18.10	26.90	38.10	56.30	24.50	40.00	45.10
P Value	**0.01**	**0.01**	0.27	0.38	0.11	0.38	0.06	0.37	0.07
Enough Rest									
No	62.30	34.10	15.20	13.60	59.40	71.70	32.60	51.40	48.60
Yes	45.70	15.90	14.00	28.00	28.00	47.60	20.10	34.80	47.40
	<0.01	**<0.01**	0.95	**0.01**	**<0.01**	**<0.01**	**0.01**	**<0.01**	0.78

Note. P values were calculated using chi-square. Significant risk factors are bolded. Some age groups were merged to fit within the criteria for application of chi-squared test.

The age group that had the highest prevalence was between 45 and 49 years, followed by 50 years and above. There were differences across all age groups for all types of MSDs: $p<0.01$ for neck, $p=0.01$ for shoulder, $p=0.01$ for elbows, $p=0.04$ for wrists, $p<0.01$ for upper and lower back and thighs/buttocks, $p<0.01$ for knees and $p<0.01$for ankles.

Sleep disturbance was associated with elevated prevalence of various forms of musculoskeletal disorders except for elbows, wrists, and lower back ($p<0.01$ for neck, shoulder, upper back, buttocks, knees and ankles). Smoking was associated with higher prevalence of MSDs affecting the wrists, upper back, $p=0.01$, and knees and ankles ($p<0.01$ for both). Lack of regular physical exercise was associated with a higher prevalence of MSD of the neck and the lower back. There was significant difference in relation to lack of physical exercise for neck ($p=0.01$) and shoulder ($p=0.01$) MSDs. There was higher prevalence in relation to lack of enough rest for neck, shoulder, elbow, upper back, lower back, thighs/buttocks, knees, and ankles. The differences were significant for neck, shoulder, wrists, upper back, lower back, thighs/buttocks and knees.

4.6.Relationship between work-related Factors and Prevalence of MSDs

Table 4.5 shows the prevalence of MSDs across body regions in relation to work-related factors. Sitting for long was associated with increased prevalence of wrists and upper back MSD (p=0.01 for both). The differences were significant across the groups as regards hours that teachers sat for MSDs affecting the shoulder (p<0.01), lower back and knees (p=0.01 each), and ankles (p<0.01).

Table 4.5: Prevalence across Body Regions in Relation to Work-Related Factors

Variable	Neck (%)	Shoulder (%)	Elbows (%)	Wrists (%)	U back (%)	L Back (%)	Thighs/Buttocks	Knees (%)	Ankles (%)
Sitting for long									
No	59.10	23.80	19.60	26.40	39.60	49.05	30.20	48.10	43.80
Yes	62.20	27.00	21.60	45.90	62.20	44.95	37.80	51.40	39.80
P value	0.25	0.45	0.36	**0.01**	**0.01**	0.66	0.06	0.24	0.50
Hours sitting									
<1	52.70	27.90	12.10	25.50	43.00	27.80	27.30	40.60	17.60
1-2	57.00	19.00	12.70	34.20	38.00	48.10	20.30	39.20	45.60
3-5	34.60	23.10	11.50	19.20	34.60	74.60	19.20	30.80	30.80
>6	16.50	18.80	34.40	40.60	56.30	62.50	37.50	68.80	75.00
P value	0.16	**<0.01**	0.05	0.15	0.28	**0.01**	0.23	**0.01**	**<0.01**
Chair with adequate back support									
No	59.20	27.00	18.40	37.50	43.40	63.20	34.20	34.90	42.80
Yes	47.30	25.30	10.70	20.00	41.30	59.00	17.30	50.00	43.30
P Value	**0.01**	0.78	**0.04**	**0.03**	0.71	0.10	**<0.01**	**0.01**	0.92
Working in head-down posture									
No	48.60	35.90	13.50	29.50	36.80	51.90	18.90	46.50	47.00
Yes	60.70	21.40	16.20	32.50	51.30	69.20	36.80	43.90	46.80
P Value	**0.01**	**<0.01**	0.10	0.71	**0.01**	**<0.01**	**<0.01**	0.57	0.98
Hours in head-down posture									
1-2	52.00	26.00	4.00	30.00	38.00	54.70	43.60	48.00	50.00
3-4	53.70	29.90	16.00	26.90	40.30	61.20	11.90	22.40	14.90
>4	58.80	6.50	20.00	30.60	51.80	63.50	42.40	48.20	52.90
P value	0.43	**0.01**	**<0.01**	0.13	0.11	0.369	**<0.01**	**<0.01**	**<0.01**
Satisfied with work environment									

No	64.60	37.80	17.30	33.90	62.80	68.50	36.20	50.40	48.60
Yes	45.10	14.30	15.60	35.10	41.90	51.40	18.30	36.60	49.30
P value	**<0.01**	**<0.01**	0.51	0.14	**0.01**	**<0.01**	**<0.01**	**0.02**	0.05
Standing for long									
No	51.10	36.00	13.50	36.40	59.50	47.05	30.00	47.10	44.50
Yes	63.20	47.00	18.50	55.60	65.20	45.95	35.80	50.30	42.80
P value	**0.03**	**0.02**	0.36	**0.01**	0.07	0.66	0.06	0.24	0.50
Hours standing									
<1	42.70	28.90	12.00	35.50	40.00	50.80	28.40	40.60	47.60
1-2	47.00	20.00	12.00	24.20	34.00	47.00	20.30	30.00	45.60
3-5	34.60	22.10	11.10	19.20	36.60	50.00	20.20	32.50	40.80
>6	26.40	18.80	35.30	40.00	46.40	57.50	33.50	38.50	48.30
P value	0.26	0.34	**0.03**	0.15	0.28	0.14	0.23	0.06	0.07
Having Other work apart from teaching									
No	51.00	24.80	15.00	28.60	48.30	57.30	24.80	39.90	49.80
Yes	53.30	22.90	13.50	28.80	49.00	33.30	28.10	52.10	50.00
P value	0.23	0.13	**0.05**	0.73	0.10	0.49	0.53	**0.01**	0.096
Work with neck above shoulder									
No	51.00	22.40	9.20	33.70	44.90	57.10	20.40	43.90	50.00
Yes	54.40	25.00	17.20	16.50	41.20	59.30	28.40	41.70	45.70
P Value	0.58	0.10	0.34	**0.01**	0.54	0.72	0.14	0.72	0.09

Note. P values were calculated using chi-square. Significant risk factors are bolded

The prevalence of MSDs was higher for neck, elbows, wrist, and buttocks/thighs in respect to the provision of chairs with adequate back support.

There was higher prevalence of MSDs of the neck (p=0.01), shoulder (p<0.01), upper back (p=0.01), lower back (p=0.01), and buttocks/thighs (p<0.01) in relation to working in a head down posture. Working for on a head down posture was associated with higher prevalence for MSDs of the neck, elbow, wrists, upper back, lower back, knees, and ankles. The differences across the various types of MSDs were significant for shoulder, ankles, thighs/buttocks, knees and ankles.

Dissatisfaction with work environment was associated with higher prevalence MSDs on all the body parts except ankles. The differences were significant for neck (p<0.01), shoulder (p<0.01), upper back (p<0.01), lower back (p<0.01), thighs/buttocks (p<0.01), and Knees (p<0.01).

Regarding having other work apart from teaching, the prevalence was higher for MSDs affecting the neck, wrists, upper back, thighs/buttocks, and knees, and the difference in the categories were significant. Working with neck above shoulder was associated with higher prevalence of MSDs affecting the neck, shoulder, elbows, lower back, and thighs and buttocks.

4.7.Significant Predictors

Table 4.6 shows the predictors that remained significant after the logistic regression, and expressed using odds ratios. Initial chi-square tests helped to isolate the individual factors that had significant association with the occurrence of different forms of MSDs. The p-value was 0.05. The independent variables that had significant associations with the occurrence of MSDs on various body parts are presented in tables 4.4 and 4.5 above. To validate the predictive power and relative contribution of the significantly associated independent variables, a logistic regression model was used. The results show that not all the variables that were initially associated with the MSDs remained significant. Age was shown to significantly predict the prevalence of neck MSDs specifically being between 45-49 years and over 50 years. The same age groups were also shown to significantly predict the occurrence of shoulder MSDs.

Being over 50 years was shown to predict higher prevalence of MSDs of the elbows, wrists/hands, and of lower back MSDs. Another significant predictor of MSDs was teaching while standing. In this respect, teaching for over four hours while standing was associated with higher prevalence of MSDs affecting the neck, shoulder, and wrists/hand.

Table 4.6: Predictors that Remained Significant in Respect to Body Regions

Body region	Significant risk factors	Odds ratio	95% CI	*P*-Value
Neck	Age 45-50	3.12	1.22-8.01	0.02
	Age >50 years	7.46	2.72-20.45	<0.01
	Teaching for >4 hours while standing	2.37	1.26-4.45	0.01
Shoulders	45.50 years	9.61	3.14-29.38	<0.01
	>50 year	7.58	2.70-21.34	<0.01
	2-3 hours While standing	6.01	1.23-29.43	0.03
	>4 while standing	2.83	1.38-5.800	0.01
Elbows	Over 50 years	3.63	1.51-8.70	<0.01
Wrists/hands	Age>50 years	2.99	1.30-6.85	0.01

	Teaching while standing >4 hours	2.46	1.40-4.34	<0.01
Lower back	30-35 years	4.89	1.59-15.03	<0.01
	35-40 years	4.96	1.94-12.67	<0.01
	40-45	4.00	1.52-10.54	<0.01
	45-50	10.62	3.79-29.75	<0.01
	Over 50	23.29	7.49-72.43	<0.01
	Hours sitting >4	4.47	1.005-19-91	0.05
Knees	Chair with adequate back support	5.27	2.46-11.29	<0.01
Ankles	Work in head-down posture	2.06	1.17-3.63	0.01

Note. Logistic regression was applied on the significant factors from the chi-squared tests

Sitting for long predicted the prevalence of musculoskeletal disorders affecting the lower back. In particular sitting for over four hours was a significant predictor for lower back MSDs. Another significant predictor following the logistic regression was adequate back support. Lack of back support remained a significant predictor for MSDs affecting the knees. Working on a head down-posture was shown to significantly predict ankle MSDs.

4.8.Prevention from Carrying out Normal Activities

Table 4.7 shows the frequencies according to body regions as regards prevention from carrying out normal activities. The upper and lower back MSDs ranked highest in preventing teachers from carrying out their normal activities at 20.2 and 23.8% respectively.

Table 4.7: Prevention from Carrying Out Normal Activities

Body Region	Percent

Neck	12.30
Shoulder	15.60
Elbows	9.90
Wrists/hands	11.90
Upper back	20.20
Lower back	23.80
Thighs/buttocks	9.90
Knees	19.20
Ankles/feet	16.90

Note. Teachers were asked to clarify on the affected region that prevented them from carrying out normal activities.

The least disrupting forms of MSDs in relation to carrying out normal tasks were MSD affecting thighs/buttocks, elbows, and wrists/hands.

4.9.Summary of Observations

Table 4.8 summarizes the observations that were done during the study. An observation check-list was used to gather information from selected schools and teachers. From the results, the postures made by the teachers were fairly normal ones with no much straining observed for those who were teaching. The habits while teaching would vary depending on the teacher preferences and whether they taught lower or upper primary. Teachers who taught lower primary classes were more likely to teach while seated compared to those taught upper primary. This could be explained by the fact that most upper primary school teachers had to move to the staffroom and to other classes for other lessons. The shoe type varied on the basis of gender with female teachers generally wearing heeled shoes and males wearing flat though there were female teachers particularly in the schools in the rural areas who wore flat shoes.

Table 4.8: Summary of the Observations

Attribute	Percentage
Normal teaching postures	60.00
Standing while teaching	66.00
Sitting while teaching	35.00
Flat shoes	58.00
Heeled shoes	41.00
Appropriate chairs for teachers	55.00
Blackboard positioned appropriately	100
Provision of offices for teachers	40.00
Provision of well-equipped staffroom	50.00
Overcrowding in the classes	20.00

Schools that were close to the urban centers had an adequate number of chairs with back support while this trend changed with schools located in the rural areas.

The blackboards were in all schools well-positioned, 100%. The provision of offices for teachers was also a factor of the location and size of schools. In this regard, schools in urban areas and big in size provided teachers with good offices with comfortable furniture. In this respect, 40% of the schools provided offices for the teachers. This trend was also applicable as regards the provision of staffrooms. Some schools in the rural areas did not even have adequate and appropriate chairs for the teachers. In this respect, 55% of the observed schools provided seats for the teachers. The sizes of the class corresponded with the number of students. Overcrowding was observed in 20% of the schools.

CHAPTER 5: SUMMARY OF FINDINGS, DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1.Introduction

This chapter first presents a summary of the study findings. The discussion of the results then follows. The discussion is then followed by the conclusion and recommendations based on the findings of the study.

5.2. Summary

The prevalence of MSDs for any part of the body was 85.1%. The body parts that were most affected included the lower back, knees, neck, and ankles. The predictors that remained significant included age, teaching while standing, teaching while sitting, Lack of back support on chairs, and working on a head down-posture. The upper and lower back MSDs were the most common as pertained prevention from carrying out normal activities

5.3.Discussion

5.3.1. Prevalence of MSDs

This study aimed at establishing the prevalence of musculoskeletal disorders among teachers in Machakos County, Kenya over the past 12 months. The overall prevalence of musculoskeletal disorders in any body part was 85.1%. This prevalence, though a bit higher was close to the prevalence reported among nurses in Kenya (74.20% and 70.8% (Mugga, 2015; Tanui, 2016). This prevalence was around the range reported in previous studies among teachers in Botswana (83.3%) (Erick & Smith, 2014), Chiquisaca, Bolivia (86%) (Solis-Soto et al., 2017), and 76% (Yue et al., 2014) and (72%) (Yue, et al., 2012) in China. This prevalence falls within the range of between 40 and 95% reported by Erick and Smith (2011) in their systematic review of literature on MSDs in the teaching profession. The prevalence was higher than that reported among teachers in Brazil (55%) (Cardoso et al , 2009) and in Ethiopia (53.8%) (Beyen et al., 2013). These results revealed that MSD was a significant issue among kenyan teachers, with rates that are beyond those reported across the world. The differences may be a factor of methodology, for instance the choice of sample size to involve as the sample size in this study was smaller. The high prevalence may be a factor of the work conditions revealed in the results section. These conditions increase the chances of the teachers developing musculoskeletal disorders.

The most affected body parts were lower back and knees at 58.60% and 57.60% respectively. The prevalence of low back pain was within the range reported among teachers in Ethiopia (53.80%), 40.40% among teachers in India (Samad et al., 2010) and

41.00% among teachers in Cairo (Ebtesam, 2015). This rate was higher than (33.10%) reported among teachers in Bolivia. Odole et al., (2013) reported low back pain at 34.9% among teachers in Nigeria, a considerably lower percentage compared to the one for this study.

The prevalence of knee MSDs was higher than the one found among teachers in Nigeria (34.9%). A study involving Braizilian teachers recorded a 41.00% prevalence of MSD on lower limbs which was also lower than the ones reported (Cardoso et al., 2009). The rate was also higher than that recorded among teachers in Botswana (Erick & Smith, 2014). The prevalence rate was higher than that reported among teachers in Bolivia (37.5%) (Solis-Soto et al., 2017). The prevalence was above the 22.6% reported among teachers in China (Li et al., 2012). The higher prevalence could be as a consequene of the significant predictors that are pointed out in this study including standing for long while at work, sitting for long, and lack of back support on chairs.

The second category of body parts with the highest prevalence rates was the neck and ankles. The prevalence of neck MSD was 53.30%, and almost similar to that reported by teachers in Botswana (50.80%). The rate was equal to 57.9% reported among teachers in Enugu, Nigeria (Ojukwu, et al., 2018) and 53.52% reported among teachers in India (Damayanti et al., 2017). The rate for neck was around the 47% reported among teachers working in rural and urban areas in Bolivia. The prevalence rate in relation to ankles was 30.4% among teachers in Bolivia, which is lower than that recorded in this study. The prevalence on the neck was higher than 42% reported among school teachers in China (Li, Liu, & Yue, 2012). The prevalence on the ankles was higher than the reported (12.3%)

amongst female teachers in Saudi Arabia and among teacher in Botswana (37.8%). This could be a factor of the fact that this study was conducted in not just an urban setting, but rural as well.

The third category in terms of prevalence included shoulder MSDs at 46.7%, and wrists/hands and upper back both at 42.2%. The prevalence on the shoulders was lower than the 52.5% reported among teachers in Botswana (Erick & Smith, 2014). It was also lower than the rate reported among teachers in Enugu, Nigeria (62.3%) (Ojukwu, et al., 2018). The prevalence on the shoulder was higher than the one reported among teachers in Bolivia (34.6%), China (35.9%) (Yue, et al. 2012), and 20.6% among female teachers in Saudi Arabia (Darwish & Al-Zuhair, 2013). In reference to wrists, the prevalence was equal to the one reported among female teachers in Saudi Arabia (40.5%) (Abdulmonem et al., 2014). The prevalence was higher than the one among teachers in Botswana (30.7%). It was also higher than the 25.7% reported among teachers in Bolivia. With regards to the upper back, the prevalence was lower than the 52.6% among teachers in Botswana as reported by Erick and Smith (2014). It was however higher than the prevalence reported among teachers in Bolivia (35.8%) and among teachers in Saudi (17.7%) (Abdulmonem, Hanan, Elaf, Haneen, & Jenan, 2014). The prevalence of MSDs of hands/wrists was higher than the 30.7% reported by Erick and Smith (2014) among teachers in Botswana, 25.7% reported among Bolivian teachers (Solis-Soto et al., 2017), 20.7% among Chinese teachers (Li et al., 2012), and 25.2% that was reported by teachers in Northern and Eastern India (Damayanti et al., 2017). It was less than the prevalence that was reported by female

teachers in Saudi Arabia (59.5%). This can imply that gender may be a significant predictor of MSDs as only female teachers were involved in the Saudi study.

The least affected body parts on the basis of the 12-month prevalence were elbows and thighs/buttocks at 25.20% and 25.80% respectively. The prevalence of elbow trouble was higher than 12.3% reported among primary school teachers in China (Li et al., 2012), 10% reported among Saudi's female secondary school teachers (Darwish & Al-Zuhair, 2013), 13.3% among teachers in Botswana and 12.3% among teachers in Bolivia. This rate was also higher than the eight percent that was recorded in respect to elbows among Turkish teachers (Korkmaz et al., 2011). It was also lower than 42% reported among female teachers in Saudi Arabia (Abdulmonem et al., 2014). With respect to thighs/buttocks, the prevalence was lower than the one reported by teachers in Bolivia (31.9%) and higher than the one that was reported among teachers in Botswana (18.3%). Thighs and elbows were the body parts with the lowest percentage of MSDs, a finding that was consistent with the one by Eric and Smith (2014) though the rates for this study were higher.

5.3.2. MSD Significant Risk Factors

5.3.2.1. Age

From the findings of this study, increase in age had a positive relationship with neck MSDS with teachers between 45 -49 years and over 50 years. Age was also positively associated with shoulder trouble. This association also applied to MSDs affecting the elbows. Age was also associated with MSDs affecting wrists/hands. There was also a positive relationship between age and lower back trouble for the age groups 30-34 years 35-49 years

40-44 years 45-49 years and over 50 years These findings are in line with those of Erick and Smith's (2014) study among teachers in Botswana that revealed that teachers between 41 and 50 years and above 50 years more more likely to have MSDs affecting their knees; 1.91 and 1.85 times respectively. The relationship also alligns with the finding by (Ebtesam, 2015) that musculoskeletal pain was associated with age (p=0.01). Cardoso et al. (2009) also converge with the findings as regards age having noted an increase in musculoskeletal pain with age. In this study, with adjustments for age, the association between time that teachers had worked and musculoskeletal pain remained signifiicant lower limbs (p<0.05), upper limbs (p<0.01) and for back (p<0.01). In a study involving Saudi teachers, Darwish and Al-Zuhair (2013) listed age among factors that had sinificant relationships (p<0.01). It was stated that musculoskeletal disorders were likely to increase with advancing age. In a study seeking to determine the prevalence of Neck and Shoulder Pain and Low Back Pain, Eggers, Pillay, and Govender (2018) failed to establish the significance even after clearly elevated prevalence for age groups 46 to 50 and 40 to 49 years. Their argument was that the small sample size could have limited the statistical power, affecting such a comparison. This relationship can be expained by the wear and tear as a consequence of aging. It can also be a factor of the organization of work as well as the work environment. Older teachers are less likely to engage in physical exercises that may help reduce the risk.

5.3.2.2.Hours Taught while standing

Teaching for more than 4 hours while standing was associated with higher prevalence of MSDs of the neck, shoulder and wrists. This trend was consistent with the one found among

teaching staff in a Nigerian teaching and referral hospital, where staff who taught while standing were 1.10 times more likely to develop lower back trouble (Ganiyu et al, 2015). Ebtesam (2015) also found a link between MSD prevalence and job duration (p<0.01). Eggers, Pillay, and Govender (2018) also found out that prolonged standing was associated with increase in prevalence of musculoskeletal disorders (p<0.01). On the other hand, in the study involving teachers in Botswana, there was no association between the hours taught per week and the prevalence of musculoskeletal disorders (Erick & Smith, 2014). The exertion on the rest of the body while standing can explain the prominence of this predictor. One is likely to experience pain or other discomforts on other parts of the body following extended periods of standing. Teachers do spend loads of their time standing while carrying out tasks such as supervision and ensuring that students have complete understanding of the concepts.

5.3.2.3.Hours sitting

Teachers who taught while sitting for over four hours in a day were 4.47 times more likely to develop MSDs affecting the lower back. This finding was congruent with the finding by Yue, Liu, & Li (2012); Beyen, Mengestu, & Zele (2013) and Ganiyu, et al, 2015). According to Yue, Liu, & Li (2012) prolonged sitting was associated with higher occurrence of neck and shoulder trouble (OR: 1.70, 1.36-2.34) and lower back pain (OR: 1.60, 1.22-2.10). Beyen, Mengestu, and Zele (2013) associated prolonged sitting with 0.61 odds of developing lower back pain. Erick and Smith, (2011) also mentioned the relationship between sitting for long and development in their literature review. Samad et al., (2010) ranked prolonged sitting as the second most pronounced contributor to the

development of back pain among teachers(25.20%). In a study exploring job satisfaction and work tasks as predictors of LBP among teachers in Putrajaya Anuar et al. (2016) isolated sitting for long as a significant predictor (p=0.02). On the other hand, Eggers, Pillay, and Govender (2018), in a study exploring musculoskeletal pain (MP) among teachers in SouthAfrica, found no significant association between sitting for long and the development of musculoskeletal disorders (*p*=0.74). Extended hours of prolonged sitting may be explained by the fact that some tasks such as marking can only be comfortably done while sitting. The risk of MSDs is further elevated when teachers are not provided with comfortable chairs and have to strain during the tasks. This straining ends up reflecting on the lower back as the teachers have to either strecth or sit awkwardly while performing their tasks in this posture. Sitting, if done within the acceptable limits does not increase the risks of MSDs, but when prolonged becomes a significant risk factor. It is important to provide chairs with adequate back support in order to reduce the risk of MSDs following prolonged sitting.

5.3.2.4.Chair with adequate back support

The lack of back support on chairs was positively associated with the development of musculoskeletal issues affecting the knees. Lack of back support may result into muscle loading that can induce the development of some musculoskeletal disorders. Maintaining extreme postures in absence of the vital support can result into pain and discomfort associated with musculoskeletal disorders. The link with knees in this case can be explained by the fact that such a provision means that static loads shift to the lower body

parts such as knees. Without the essential back support, one may have to use their knees for bracing, predicting the likelihood of knee problems.

5.3.2.5.Working on a head-down posture

Teachers who worked on a head-down posture were 2.06 times more likely experienced increased prevalence of ankle/s MSDs. These findings converge with those by various researchers including Yue et al., (2012) and Ganiyu et al. (2015) as pertains the effects of postures on the development of MSDs on various body parts. According to Yue et al., (2012) prolonged static postures were strongly associated with neck and shoulder trouble (OR 2.25, 1.56-3.24, 95% CI) and hand/wrist trouble (OR 2.33, 1.46-3.71, 95% CI), and knee trouble (OR 2.14, 1.36 - 3.37, 95% CI). As Ganiyu revealed, awkward postures ranked among the most common hazards among student participants, with $p<0.01$ for working or reaching away from the body.

The possible explanation for this trend could be the fact that working on a head-down posture particularly on poor work conditions such as lack of chairs with back support is likely to result into exertion on the lower extremities such as the ankles. With most of the schools not furnishing the teachers adequately in terms of chair and desks in Machakos, it is not surprise that most teachers ended up working in this posture and reporting musculoskeletal disorders. Though not supported by this study, teachers working in this posture were also likely to develop neck trouble (Erick & Smith, 2011). Eggers et al., (2018) did not find significant statistical differences in respect to working on a bend posture for long, working on a twisted posture, and working in generally uncomfortable postures.

The possible explanation for this difference could be the small sample size that was involved in this study.

5.3.3. Prevention from Carrying out Normal Activities

Questions into whether musculoskeletal disorders prevented teachers from carrying normal activities during the past 12 months revealed that low back trouble was the top form in that respect as reported by 23.8% of the respondents. It was closely followed by upper back and knee trouble. MSDs of the back had the highest scores in preventing teachers from carrying out their normal activities by Erick and Smith (2014). On the other hand, Darwish and Al-Zuhair (2013) reported that teachers missed 1.76±2.2 days because of trouble associated with musculoskeletal disorders. Prevention from carrying normal activities may have taken numerous shapes such as entirely failing to report to work or being present at the workplace but unable to deliver as expected.

5.4.Conclusion

This study sought to establish the prevalence and risk factors to MSDs among teachers in Kenya. The study revealed that musculoskeletal disorders were very common among primary school teachers. The most affected body parts were the lower back, knees, and the neck. The least common form of MSD in respect to body parts was the elbow MSD. It was revealed that MSDs prevented a considerable number of teachers from carrying out their normal activities in the past 12 months. Lower back trouble was the most common form of MSD that prevented teachers from carrying out their normal activities. The most common person-related predictor was age. The odds of MSDs were a factor of hours taught while

standing, hours taught while sitting, lack of back support on chairs, and working on a head-down posture.

5.5.Recommendations

The high prevalence of musculoskeletal disorders alongside isolation of specific sigificant risk factors calls for action from all the relevant stakeholders.

- Teachers can engage in activities such as physical exercise to reduce the risk of MSD.
- Teachers can also avoid working in postures that can put them at increased risk of musculokeletal disorders.

5.6.Further Research

With this study having adopted a cross-sectional design, a longitudinal study would be ideal to help understand the development of conditions among teachers. Based on the great variations revealed between schools that were in urban and rural areas in terms of provisions for the teachers, comparative studies to isolate the variations between rural and urban schools are also recommended. A comparative study between public and private schools to compare the rates of MSDs between public and private schools or primary and secondary schools would also be welcome. It would also be important to explore the preventive role of physical exercise on the occurrence of work related MSDs.

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APPENDICES

Appendix 1: Informed Consent Form

INFORMED CONSENT FORM

My name is Ancent Ndonye Ndawa, a student from Kenyatta University pursuing Master of Science in Occupational Health and Safety. As partial fulfillment for the award of the degree, I am carrying out a study on the predictors of work-related musculoskeletal disorders among primary school teachers in Machakos County, Kenya. The information from this study will help determine the person related, and work-related predictors associated with the development of musculoskeletal disorders, and the prevalence of different forms of MSDs among primary school teachers. The findings from this study may inform changes in the work environment of primary school teachers

Procedures

Participation in this study will require you to respond to several questions. I will record your response to the questions in a questionnaire. Participating in this study will be voluntary; you will not be forced to take part. Your decision to not take part in the study will not influence your current or future relationship with Kenyatta University. You can

get all the details about this study as we interact. You can decline or terminate the interview if you are uncomfortable to proceed with the process.

Discomfort/ Risks

Some of the questions may sound personal, creating some discomfort. You have the freedom to not respond to any questions that you feel are arouse any uneasiness, or even stop. The interview may take a significant proportion of your time, perhaps inconveniencing you. I assure you that there are no risks in taking part in this study.

Benefits

Your voluntary participation will help me uncover the person and work-related predictors of musculoskeletal disorders, and the prevalence of different forms of MSDs among primary school teachers. The information will help create awareness about the risks, and form the basis of the necessary interventions. This study has the potential to identify issues that affect the health, and productivity of teachers, serving as a guide in setting up remedies that can eventually improve the health of teachers and improve the quality of education. You will also benefit from my advice as regards best practices to minimize the risk of developing work-related musculoskeletal disorders.

Rewards

You will not have direct benefits in the form of monetary compensation for taking part in this study.

Confidentiality

The interview will take place at a secluded section in your work environment. I will not record on the questionnaire. The completed questionnaires will be kept in a safe cabinet and everything will be handled confidentially.

Contacts

In case you need any clarification, feel free to contact me on 0726 696 927, or my supervisors Dr. Nyamari on 0722 589 335, and Dr. Ireri on 0725 365 915, or KU Ethical Review Committee on +254(20)8714388 or email chairman.kuerc@ku.ac.ke

Participant's Statement

I have been fully informed about the nature of this study and understand it fully. I have been given the opportunity to ask questions, and have been answered satisfactorily. I know the benefits and discomforts and understand that there are no risks. I know that my participation in this study is voluntary and that the information obtained will remain confidential. I hereby give my consent to any information which is required from me.

Signature of the respondents…….Date……

Investigator's Statement

I, the undersigned, have taken time to explain to the participant in a comprehensible language, particularly as regards the risks, benefits, and study procedure.

Investigator's Name……Date……...

Appendix 2: Questionnaire

QUESTIONNAIRE

INSTRUCTIONS
1. Please answer all the questions

2. Select by putting a tick (√) in the box next to the response that corresponds to your situation.

PART A: DEMOGRAPHIC FACTORS

MM DD YY

1) Today's date ☐ ☐ ☐

Male Female

2) Sex 1.☐ 2. ☐

3) How old are you?

1. ☐ 20-24 years
2. ☐ 25-29 years
3. ☐ 30-34 years

4. ☐ 35-39 years
5. ☐ 40-44 years
6. ☐ 45-49 years
7. ☐ Above 50 years

4) What is your weight? ☐ Kgs

5) What is your height? Feet ☐ Inches ☐ or ☐ cm

6) Are you right or left handed? R ☐ L ☐ Use both ☐

PART B: RISK FACTORS

7) Do you experience sleep disturbance?

	No	Yes
1. 2.	☐	☐

8) Do you smoke cigarettes?

1. ☐ Yes, Regularly. Got to question 8.a.
2. ☐ No, proceed to question 9
3. ☐ Occasionally, go to question 8.b.

a. On average, how many cigarettes do you smoke per day? ☐

b. On how many days per week do you smoke cigarettes?

1. ☐ Usually on one day or less
2. ☐ Usually on 2 to 4 days
3. ☐ Almost every day

9) . How many hours per day do you work while standing?

1. ☐ Less than 1 hours

2. ☐ 1-2 hours

3. ☐ 3-5 hours

4. ☐ 6 hours and above

10) . Do you sit for long while at work? If No, proceed to question 12.

No	Yes
1. ☐	2. ☐

11) How many hours per day do you work while sitting?

1. ☐ Less than 1 hours

2. ☐ 1-2 hours

3. ☐ 3-5 hours

4. ☐ 6 hours and above

12). Does the chair you are provided with offer adequate back support?

No	Yes
1. ☐	2. ☐

13). Do you teach students while working in head down posture? (Having neck on a forward bent down posture for long time). If No, proceed to question 14.

No	Yes
1. ☐	2. ☐

14). How many hours per day do you work in this posture?

1. ☐ 1-2 hours

2. ☐ 3-4 hours

3. ☐ 4 hours and above

15). Are you satisfied with your work environment?

	No	Yes
1.	☐	2. ☐

16). Do you have any other work apart from teaching?

	No	Yes
1.	☐	2. ☐

17). Do you have regular physical exercise throughout the week?

	No	Yes
1.	☐	2. ☐

18). Do you have enough rest time after work?

	No	Yes
1.	☐	2. ☐

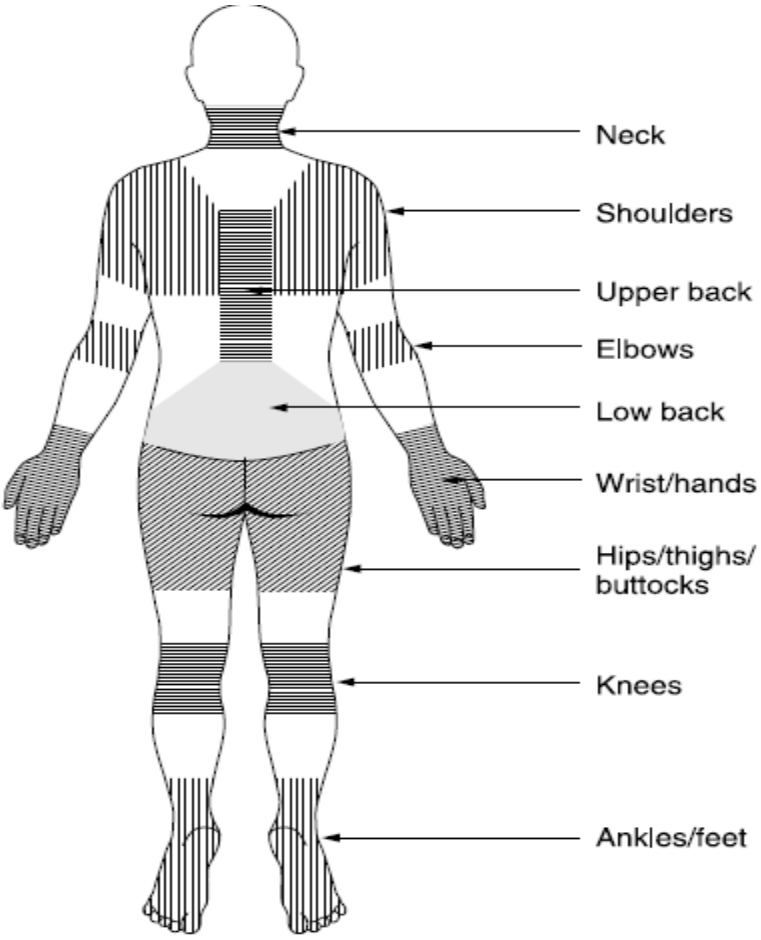
19). Do you work for long with neck above the shoulder?

	No	Yes
1.	☐	2. ☐

PART C: PREVALENCE OF MUSCULOSKELETAL DISORDERS

TROUBLE WITH LOCOMOTIVE ORGANS

The figure below presents approximate positions of the body as referred to in this questionnaire. Limits are not sharply defined, and may overlap. Answer the questions that follow by ticking the most appropriate answer. Please note that it is important to answer every part of the questionnaire even if you have never had any trouble with it.


Neck
Shoulders
Upper back
Elbows
Low back
Wrist/hands
Hips/thighs/
buttocks
Knees
Ankles/feet

Have you at any time during the past 12 months had trouble (such as ache, pain, discomfort, numbness) in:	**Have you had trouble during the last 7 days?**	**During the last 12 months have you been prevented from carrying out normal activities because of this trouble?**
1) Neck No Yes 1. ☐ 2. ☐	2) Neck No Yes 1. ☐ 2. ☐	3) Neck No Yes 1. ☐ 2. ☐
4) Shoulders No Yes 1. ☐ 2. ☐ Right 3. ☐ Left 4. ☐ Both	5) Shoulders No Yes 1. ☐ 2. ☐ Right 3. ☐ Left 4. ☐ Both	6) Shoulders (Both/either) No Yes 1. ☐ 2. ☐
7) Elbows No Yes 1. ☐ 2. ☐ Right 3. ☐ Left 4. ☐ Both	8) Elbows No Yes 1. ☐ 2. ☐ Right 3. ☐ Left 4. ☐ Both	9) Elbows (both/either) No Yes 1. ☐ 2. ☐
10) Wrists/hands No Yes 1. ☐ 2. ☐ Right 3. ☐ Left 4. ☐ Both	11) Wrists/Hands No Yes 1. ☐ 2. ☐ Right 3. ☐ Left 4. ☐ Both	12) Wrists/hands (both/either) No Yes 1. ☐ 2. ☐
13) Upper back No Yes 1. ☐ 2. ☐	14) Upper back No Yes 1. ☐ 2. ☐	15) Upper back No Yes 1. ☐ 2. ☐
16) Lower back No Yes 1. ☐ 2. ☐	17) Lower back No Yes 1. ☐ 2. ☐	18) Lower back No Yes 1. ☐ 2. ☐
19) One/both thighs/buttocks No Yes 1. ☐ 2. ☐	20) One/both No Yes 1. ☐ 2. ☐	21) One/both thighs/buttocks No Yes 1. ☐ 2. ☐
22) One or both Knees No Yes 1. ☐ 2. ☐	23) One or both knees No Yes 1. ☐ 2. ☐	24) One of both knees No Yes 1. ☐ 2. ☐
25) One or both ankles/feet No Yes 1. ☐ 2. ☐	26) One or both ankles/feet No Yes 1. ☐ 2. ☐	27) One or both ankles/feet No Yes 1. ☐ 2. ☐

Appendix 3: Observation Checklist

Person-specific factors

i. Teaching posture

ii. Common teaching habit- standing on one position/moving from one point to another/teaching while seated/combining standing and sitting

iii. Type of shoe-flat versus heeled

Work-related factors

i. Provision of chairs for teachers in classrooms- type of chairs provided

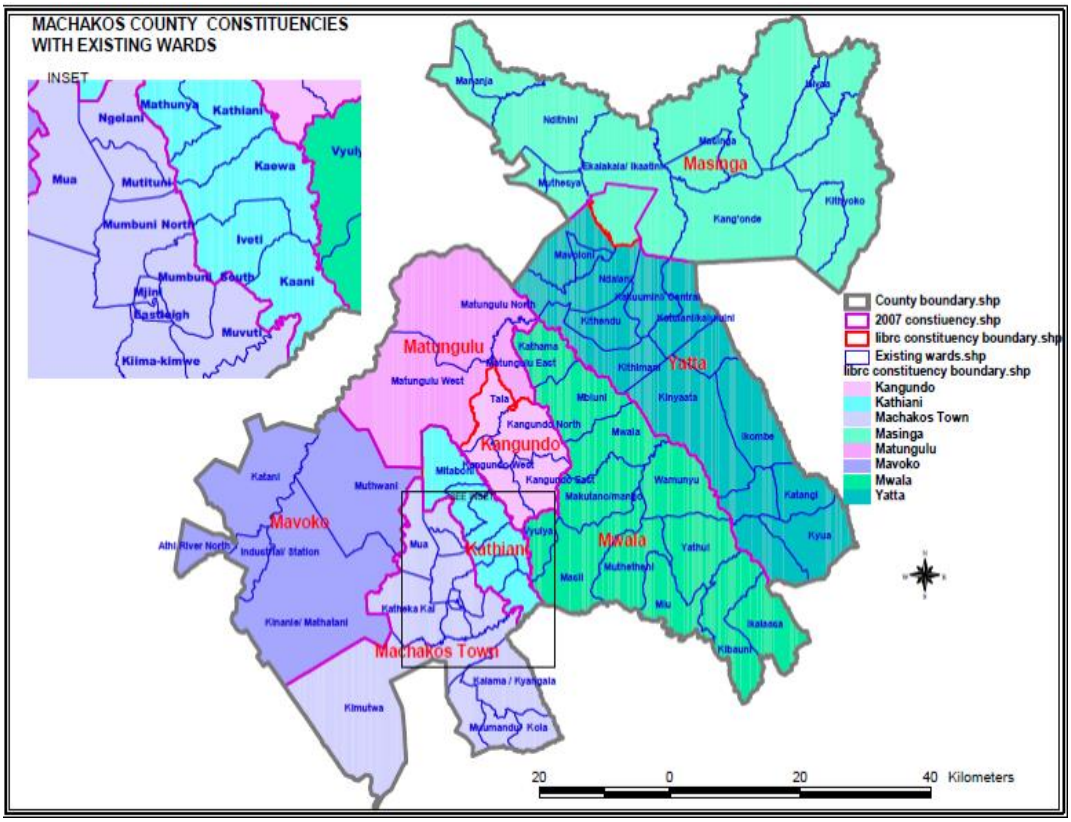
ii. Position of the blackboards

iii. Provision of offices for teachers to rest

iv. Provision of a well-equipped staff-room-right chairs and benches

v. Class sizes in relation to number of students

Appendix 4: Map of Machakos County



Machakos County Map (IEBC, 2012)

Appendix 5: Research Authorization-Kenyatta University

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 8710901 Ext. 57530

Our Ref: Q22/CTY/PT/30529/2015

DATE: 30th October, 2017

Director General,
National Commission for Science, Technology
& Innovation
P.O. Box 30623-00100,
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION FOR NDAWA ANCENT NDONYE – REG. NO. Q22/CTY/PT/30529/2015

I write to introduce Mr. Ndawa Ancent Ndonye who is a Postgraduate Student of this University. He is registered for M.Sc. degree programme in the Department of Environmental Health.

Mr. Ndonye intends to conduct research for an M.Sc. Proposal entitled, "Predictors of Work-Related Musculoskeletal Disorders among Primary School Teachers in Machakos County, Kenya".

Any assistance given will be highly appreciated.

KENYATTA UNIVERSITY
OFFICE OF DEAN
30 OCT 2017
GRADUATE SCHOOL
P.O. BOX 43844-00100 NAIROBI

Yours faithfully,

MRS. LUCY N. MBAABU
FOR: DEAN, GRADUATE SCHOOL

JL/rwm

Appendix 6: Ethical Clearance

KENYATTA UNIVERSITY
ETHICS REVIEW COMMITTEE

Fax: 8711242/8711575
Email: chairman.kuerc@ku.ac.ke
secretary.kuerc@ku.ac.ke

P. O. Box 43844-00100
Nairobi.

Tel: 8710901/12

Website: www.ku.ac.ke

Our Ref: **KU/ERC/ Re-Review Appr./VOL.1** (53) Date: 29th January 2018.

Ndawa Ancent Ndonye
Kenyatta University
P.O. Box 43844-00100
NAIROBI.

Dear Ancent,

APPLICATION NUMBER- PKU/760/I828 'PREDICTORS OF WORK-RELATED MUSCULOSKELETAL DISORDERS AMONG PRIMARY SCHOOL TEACHERS IN MACHAKOS COUNTY, KENYA."

1. **IDENTIFICATION OF PROTOCOL**

The application before the Committee is with a research topic **PKU/760/I828** 'Predictors of Work-Related Musculoskeletal Disorders among Primary School Teachers in Machakos County, Kenya" received on 2nd November, 2017 and deliberated on the 16th of January, 2018 and received on 23rd January 2018 for re review

2. **APPLICANT**

Ndawa Ancent Ndonye

3. **SITE**

Machakos County. Kenya.

4. **DECISION**

The Committee has considered the research protocol in accordance with the Kenyatta University Research Policy (Section 7.2.1.3) and the Kenyatta University Review Committee Guidelines **AND APPROVED that the research may proceed for a period of ONE year from 25th January 2018.**

ADVICE/CONDITIONS

You must include a Clinician in the Study and include an elaboration of Community benefits.

i. Progress reports are submitted to the KU-ERC every six months and a full report is submitted at the end of the study.
ii. Serious and unexpected adverse events related to the conduct of the study are reported to this committee immediately they occur.
iii. Notify the Kenyatta University Ethics Committee of any amendments to the protocol.
iv. Submit an electronic copy of the protocol to KUERC.

When replying, kindly quote the application number above.
If you accept the decision reached and advice and conditions given please sign in the space Provided below and return to KU-ERC a copy of the letter.

KENYATTA UNIVERSITY ... ETHICS REVIEW COMMITTEE ... P.O. BOX 43844 - 00100 NAIROBI

29 JAN 2018

DR. TITUS KAHIGA,
CHAIRMAN ETHICS REVIEW COMMITTEE

I ..Ndawa Anant Nanje.. accept the advice given and will fulfill the conditions therein.

Signature..... Dated this day of... 31 January .....2018.

C.c. DVC Research Innovation and Outreach

Appendix 7: NACOSTI Research Authorization

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone:+254-20-2213471,
2241349,3310571,2219420
Fax:+254-20-318245,318249
Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/18/71539/21197**

Date: **20th February, 2018**

Ancent Ndonye Ndawa
Kenyatta University
P.O. Box 43844-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Predictors of work-related musculoskeletal disorders among primary school teachers in Machakos County, Kenya,"*** I am pleased to inform you that you have been authorized to undertake research in **Mchakos County** for the period ending **20th February, 2019.**

You are advised to report to **the County Commissioner and the County Director of Education, Machakos County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

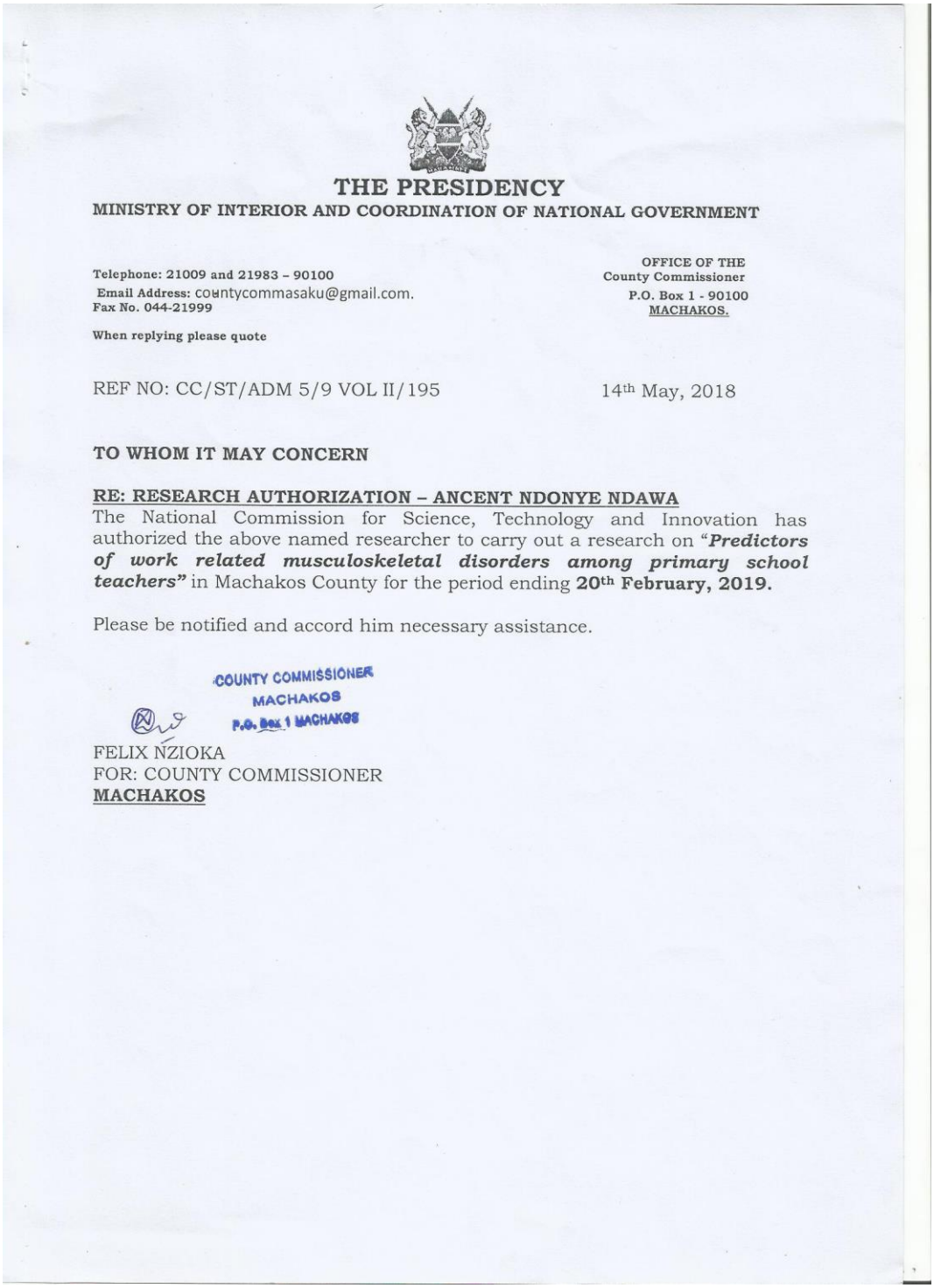
GP Kalerwa
GODFREY P. KALERWA MSc., MBA, MKIM
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Machakos County.

The County Director of Education
Machakos County.

Appendix 8: County Commissioner Authorization



THE PRESIDENCY

MINISTRY OF INTERIOR AND COORDINATION OF NATIONAL GOVERNMENT

Telephone: 21009 and 21983 – 90100
Email Address: countycommasaku@gmail.com.
Fax No. 044-21999

When replying please quote

OFFICE OF THE
County Commissioner
P.O. Box 1 - 90100
MACHAKOS.

REF NO: CC/ST/ADM 5/9 VOL II/195 — 14th May, 2018

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORIZATION – ANCENT NDONYE NDAWA

The National Commission for Science, Technology and Innovation has authorized the above named researcher to carry out a research on ***"Predictors of work related musculoskeletal disorders among primary school teachers"*** in Machakos County for the period ending **20th February, 2019.**

Please be notified and accord him necessary assistance.

COUNTY COMMISSIONER
MACHAKOS
P.O. Box 1 MACHAKOS

FELIX NZIOKA
FOR: COUNTY COMMISSIONER
MACHAKOS

Appendix 9: Authorization by the County Director of Education

MINISTRY OF EDUCATION
STATE DEPARTMENT OF EDUCATION

Telegrams: **"SCHOOLING"** Machakos
Telephone: Machakos (
Fax: Machakos
Email –cdemachakos@yahoo.com
When replying please quote

OFFICE OF THE
COUNTY DIRECTOR OF
EDUCATION
P.O. BOX 2666-90100,
MACHAKOS

MKS/ED/CDE/U/1/VOL.2/206 **Date: 14th May, 2018**

Ancent Ndonye Ndawa
Kenyatta University
P.O. Box 43844-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION.

Reference is made to the letter from National Commission for Science, Technology and Innovation Ref: **NACOSTI/P/18/71539/21197** dated **20th February, 2018.**

You are hereby authorized to carry out your research on, ***"Predictors of work-related musculoskeletal disorders among primary school teachers in Machakos County, Kenya"*** in Machakos County, for a period ending **20th February, *2019*.**

COUNTY DIRECTOR OF EDUCATION
MACHAKOS
14 MAY 2018
MINISTRY OF EDUCATION
P.O. Box 2666-90100 MACHAKOS

SAMWEL BOTO
COUNTY DIRECTOR OF EDUCATION
MACHAKOS