PREVALENCE OF WORK RELATED MUSCULOSKELETAL DISORDERS AMONG INTRA CAMPUS COMMERCIAL DRIVERS IN UNIVERSITY OF BENIN

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CERTIFICATION

This dissertation by Onimowo, Paul Avujebe is accepted in its present form as satisfying the dissertation requirement of the degree of Bachelor of Physiotherapy of the School of Basic Medical Sciences, College of Medical Sciences of the University of Benin.

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UNIVERSITY OF BENIN

DEDICATION

This dissertation is dedicated to God and my father, Mr Joseph Onimowo, my mother, Mrs Helen Onimowo, my brother, Mr Daniel Onimowo, my sister, Miss Joy Onimowo and my aunt Miss Mary Sanni

ABSTRACTS

Background of study: Musculoskeletal disorders can affect different parts of the body, upper and lower back, neck, shoulders and extremities. Driving involves routine muscular efforts, awkward sitting postures, long distance driving and exposure to whole body vibrations which are recognized as factors that can lead to musculoskeletal disorders.

Aim: To determine the prevalence of work related musculoskeletal disorders among intra campus commercial drivers in University of Benin

Methods: A cross-sectional study was conducted among 80 male intra campus commercial drivers. Nordic Musculoskeletal Questionnaire (NMQ) was used to assess lifetime, 12 months and 7 days prevalence of low back pain, neck pain and shoulder pain. Descriptive statistics was used to describe the obtain data. Chi square and spearman rho correlation test were used to assess the association and correlation between driving hours, age, BMI, driving duration with prevalence of low back pain, neck pain and shoulder with p value set at 0.05.

Results: The overall lifetime prevalence of low back pain, neck pain, shoulder pain were 50%, 15% and 33.8%. BMI and driving hours were associated with lifetime prevalence of low back pain ($p<0.05$) while driving duration was associated with 12 month prevalence of neck pain ($p=0.03$). Driving hours was also associated with life time prevalence of shoulder pain ($p=0.04$)

Conclusion: The Intra-campus commercial drivers in University of Benin have high prevalence of work related musculoskeletal disorders with low back pain taking the highest percentage, but low prevalence of shoulder pain and lastly neck pain in this study. It was also established from the findings of this study that BMI, driving hours, duration of driving contributes to the risk of experiencing MSDs.

Keywords: Intracampus commercial drivers, musculoskeletal disorders, Low back pain, Neck pain, Shoulder pain

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CHAPTER ONE

INTRODUCTION

Background of Study

Musculoskeletal disorders (MSDs) also called repetitive motion, ergonomic or overuse injuries are clusters of problems involving works- and non-work-related stressors (Tiemessen et al., 2008). Musculoskeletal disorders are injuries or pain in the human musculoskeletal system including the joints, ligament, muscles, nerves, tendons, and structures that support limbs, neck and back (NIOSH, 2016). A disorder becomes work-related, when work procedure, equipment, equipment handling, or environment contributes significantly to its cause. Work-related musculoskeletal disorders (WRMSDs) are therefore musculoskeletal injuries sustained at workplace (Collins et al.,2011). Reports show that worldwide, WRMSDs account for 42%–58% of all work-related illnesses (Abledu and Abledu 2012; Magnavita et al., 2011) and 40% of all work-related health costs (Abledu and Abledu 2014).

Musculoskeletal pain (MSP) is the most common cause of disability globally and is most frequently managed in primary health care (Babatunde *et al.,* 2017). Approximately 10% of the general population report such complaint, clearly indicating chronic widespread musculoskeletal pain as a major health problem in the Western world. Chronic musculoskeletal pain remains a major challenge for clinicians and researchers (Smith *et al., 2002)*. Chronic musculoskeletal pain adversely affect daily life and both physical and mental health (Nakamura *et al.,* 2011). They include conditions that arise suddenly and are short lived as well as conditions associated with ongoing pain and disability (World Health Organization, 2019). Several factors such as participation in strenuous activities, maintenance of poor body posture while resting or performing an activity and poor work or environmental ergonomics, all predispose an individual

to developing Musculoskeletal disorders (Farzan et al, 2017). Musculoskeletal disorders are a common problem in the world with the global burden estimated as 21.3%, (March et al, 2013). In the general population, 15% have been reported to experience chronic neck pain (more than 3 months) at some point in their lives; and 11-14% of the working population annually experience activity limitation due to neck pain (Haldeman,*et al*.,2008). In addition, Swedish Work Environment Authority (SWEA, 2008) reported the prevalence of pain in upper parts of the back or neck at least 1 day per week was to be 41% among females and 27% among males, the corresponding prevalence of pain in the shoulders or arms was 37% among women and 26% among men, even among young adults (16-29 years old), among young women, the prevalence of pain in the upper parts of the back or neck was reported to be 41% and among young men 26%. The prevalence of pain in the shoulders or arms was reported to be 33% among young women and 23% among young men. Pain and injuries resulting from acute, traumatic events like motor accident or falls are not considered as musculoskeletal disorders (WRMSD, 2015). Musculoskeletal disorders can affect different parts of the body, upper and lower back, neck, shoulders and extremities (arms, legs, feet, and hands) (Kuorinka et al., 1987). Musculoskeletal conditions include conditions that affect joints such as osteoarthritis, rheumatoid arthritis, psoriatic arthritis, gout, ankylosing spondylitis; bones, such as osteoporosis, osteopenia and associated fragility fractures; muscles, such as sarcopenia; the spine, such as back and neck pain; multiple body areas or systems, such as regional and widespread pain disorders and inflammatory diseases such as connective tissue diseases and vasculitis that have musculoskeletal manifestations, for example systemic lupus erythematosus. (Cieza et.al., 2019). Musculoskeletal disorders often present as pain (e.g.low back pain, shoulder pain and neck pain), inflammation and reduced range of motion in the spine and extremities (e.g.,

scoliosis, lordosis, kyphosis, genu valgus, genu varus) (Punnett & Wegman, 2004; Olayinka et al, 2009; World Health Organisation, 2019). Low back pain is one of the classical examples of musculoskeletal disorders and it is described as pain and discomfort below the 12th costal margin and above the inferior gluteal fold, with or without radiating symptoms to the lower limbs. (Global burden for disease study, 2015). The global prevalence of low back pain is estimated to be 38.9% (mean lifetime prevalence) and is reported to be more prevalent among females and individuals between the ages of 40 to 80 (Hoy et al, 2012). The point prevalence of low back pain is estimated to be 18.3% (±11.7%) globally and the global one-month prevalence is estimated to be 30.8% (±12.7%) (Hoy et al, 2012). The prevalence of low back pain in Africa is estimated to be 47% (lifetime prevalence), a one-month prevalence of 57% and point prevalence of 39% (Morris et al, 2018). In Nigeria, the 12-month prevalence of low back pain is estimated to be between 32.5% to 73.5% with a mean prevalence of 55.39% (Bello et al, 2017). Driving as a profession involves routine muscular effort (e.g.; steering), awkward sitting postures, and exposure to whole-body vibration. Commercial or occupational drivers are further exposed to biomechanically strenuous activities (such as manual load handling and lifting, bending, and twisting.) and pollution (air and noise) from the macro-environment. Thus, the work tasks and environment put drivers at risk for WRMSDs. A driver-motor vehicle system is a complex system that involves the interaction of human, technological systems and their environment. Poor design of driver's workplace has been identified as a major risk factor responsible for the uncomfortable conditions which operators of motor vehicles are exposed to while driving especially for a long period (Okuribido et al., 2007; Natasia et al., 2008). The workspace of a driver includes areas covered by the locations of the various control and display points which should be arranged in such a way as to accommodate the required controls within his reach and

to allow a compromise among competing priorities while seated in a fixed position. The design of automobile seat can affect the posture of drivers and posture in turn also can influence both comfort and physical conditions of a driver (Bryns et al., 2002;Farzana et al., 2006). The prevalence of WRMSDs among drivers has been shown to be high and varies between 53% and 91% in different parts of the world (Gkikas, 2012;Raanaas et al 2008; Abledu and Abledu 2014). Significant risk factors that have been empirically linked with WRMSDs among drivers include seat discomfort (Robb and Mansfield, 2007;
Alperovitch-Najenson et al., 2010), exposure to whole-body vibration (Magnusson et al., 1996; Bonvenzi et al., 2006), long driving time (Chen et al., 2004;Abledu and Abledu 2014), non-neutral postures (Albert et al.,2014) heavy lifting (Magnusson et al., 1996), manual materials handling (Robb and Mansfield, 2007; Bonvenzi et al., 2006).

Occupational driving has been associated with high prevalence of MSP and the prevalence for professional truck drivers in the United Kingdom has been reported to be 81% (Robb and Mansfield, 2007). High prevalence of MSP and spinal disorders has also been reported in other developed countries for urban bus drivers (Okunribido et al, 2008), car drivers (Porter and Gyi, 2002) and police officers who were drivers (Gyi and Porter, 1998). The prevalence of MSDs has also been reported to be high among occupational drivers in developing countries, such as Malaysia (Tamrin et al, 2007) and Brazil (Andrusaitis et al, 2006). Many studies on MSDs among occupational groups in Nigeria are available (Omokhodion et al, 2000; Omokhodion and Sanya, 2003; Fabunmi et al, 2005; Sanya and Ogwumike, 2005). Onawumi, 2012 reported a high prevalence of work related musculoskeletal disorders among taxi cab in Nigeria. Akinbo et al (2008) found the prevalence of MSP to be higher among occupational drivers than occupational

motorcyclists in Lagos, Nigeria. Akinpelu et al., 2012 found a high prevalence of musculoskeletal pain among occupational drivers.

1.2 Statement of the Problem

Musculoskeletal disorders are prevalent conditions among individuals of different age, demographics and occupation. Individuals of different occupation are exposed to varying factors that can result in the development of MSDs depending on the task being carried out at work and the manner in which the tasks are performed. Studies have been carried out on the prevalence of MSDs among individuals of different occupations including Drivers, Taxi-cab drivers, Truck drivers and other occupations (Madagwu et al.,2020; Akinpelu et al., 2012; Vahedian, 2015; Onawumi, 2012). However, to the best of the researchers'' knowledge, there is a paucity of literature on the prevalence of WRMSDs among Intra-campus drivers, in the University of Benin, Benin city, Edo state, Nigeria and the possible associated sociodemographic factors. This study will therefore aim to determine the prevalence of WRMSDS among Intra-campus drivers.

This study therefore aimed to answer the following questions;

i. What is the prevalence of musculoskeletal disorders among Intra-campus drivers in University of Benin, Benin city, Edo state, Nigeria?

ii. What is the association between years of driving and musculoskeletal disorders among Intra-campus drivers in University of Benin, Benin city, Edo state, Nigeria?

iii. What is the most prevalent musculoskeletal disorder among Intra-campus drivers, in the University of Benin, Benin city, Edo state, Nigeria?

1.3 Aims of study

i. To determine the prevalence of musculoskeletal disorders among Intra-campus drivers in University of Benin, Benin city, Edo state, Nigeria.

ii. To determine the pattern of musculoskeletal disorders by anatomical body site among Intra-campus drivers in University of Benin, Benin city, Edo state, Nigeria.

iii. To determine the factors that predispose Intra-campus drivers in University of Benin, Benin city, Edo state, Nigeria.

iv. To explore the association between prevalence of musculoskeletal disorders and years of driving experience.

1.4 Hypotheses

i. There will be no significant relationship between the prevalence of musculoskeletal disorders and the working hours.

ii. There will be no significant relationship between prevalence of musculoskeletal pain and the type of vehicle.

iii. There will be no significant relationship between prevalence of musculoskeletal disorders and years of driving experience.

1.4.2 Motivation of the study

Preliminary studies suggest that many Intra-campus commercial drivers are at a high risk of having musculoskeletal disorder (Onawumi, 2012; Akinpelu et al., 2012; Vahedian, 2015; Madagwu et al.,2020). Due to awkward postures, bending, twisting or stooping, prolonged sitting or standing, repetitive motions that take place in their course of driving and bouts of resting periods which can predispose them to musculoskeletal disorders. There seems to be a

dearth of studies on work related musculoskeletal disorders among Intra-campus drivers in the University of Benin, Benin City. Therefore, the desire to investigate into work related musculoskeletal pain among Intra-campus drivers in the University of Benin, Benin City.

1.5 Scope of the Study

This study was delimited to Intra-campus drivers;

i. In University of Benin, Benin City, Nigeria.
ii. With not less than twelve (12) months driving experience.
iii. Who work for a least five (5) hours per day.
iv. Of ages between 18 and above.

Instruments: The study was delimited to the use of the Standardized Nordic Musculoskeletal Questionnaire in assessment of the prevalence.

1.6 Limitations of the Study

The limitations of this study include:

i. Getting the participants to corporate with the research process
ii. The possibility of a recall bias due to the subjective method of data collection with questionnaire

1.7 Significance of the Study

The information obtained from this research may give an insight into the prevalence of work related musculoskeletal disorders among Intra-campus drivers in University of Benin, Benin City. This knowledge may assist health care practitioners in planning effective prevention strategies for musculoskeletal disorders to promote efficiency in patient care. Results from this study will

assist School authorities on policies to alleviate the prevalence of work related musculoskeletal disorders among Intra-campus drivers in the University of Benin, Benin City. It will also provide some information on the association of musculoskeletal disorders with age, type of vehicle, hours spent during work and years of working experience. The outcome may also contribute to the existing body of knowledge on the prevalence of musculoskeletal disorders among different occupations.

1.8 Definition of Terms

i. **Prevalence:** the percentage of a population that is affected with a particular medical condition (disease) at a particular point in time (Vahedian, 2015)

ii. **Musculoskeletal Disorders**: Musculoskeletal disorders are injuries or pain in the human musculoskeletal system including the joints, ligament, muscles, nerves, tendons, and structures that support limbs, neck and back (World Health Organization, 2019).

iii. **Work Related Musculoskeletal Disorders:** Work related musculoskeletal disorders are defined as musculoskeletal disorders that result from work related events (World Health Organization, 2019).

iv. **Intra-Campus Driver**: A driver that moves clients and goods within a school or campus with a vehicle (Madagwu et al.,2020)

1.9 List of Abbreviations

WRMSDs	Work Related Musculoskeletal Disorders
MSDs	Musculoskeletal Disorders
BMI	Body Mass Index
MSP	Musculoskeletal Pain

PSSR	Pattern Specific Scoliosis Rehabilitation
PSSE	Physiotherapeutic Specific-Scoliosis Exercises
ODI	Oswestry Disability Index
NDI	Neck Disability Index
SPADI	Shoulder Pain and Disability Index
SRS-22	Scoliosis Research Society Questionnaire
LBP	Low Back Pain

CHAPTER TWO

LITERATURE REVIEW

2.1 Definition

Musculoskeletal disorders are defined as health problems of the locomotor apparatus (muscles, tendons, skeleton, cartilage, and ligaments), they include conditions that arise suddenly and are short lived and also conditions associated with ongoing pain and disability" (World Health Organization, 2019). Musculoskeletal symptoms involve inflammatory and degenerative conditions that affect various structures in the muscular and skeletal system: tendons, ligaments, joints and peripheral nerves, this results in a wide range of conditions that involve the upper limbs, lower limbs and also the back (Punnett & Wegman, 2004). Musculoskeletal symptoms include conditions such as low back pain, genu valgum, dropped shoulder, scoliosis, lordosis, kyphosis, pes planus and other regional pain syndromes (Punnett & Wegman, 2004; Olayinka et al, 2009).

Among the various musculoskeletal disorders, low back pain is a very common condition, affecting approximately 38.9% of the global population (Hoy et al, 2012). Low back pain is defined as pain below the 12^{th} costal margin and above the inferior gluteal fold, with or without radiating symptoms to the lower limbs (World Health Organization, 2013). Depending on the duration of the pain, low back pain can be classified into acute (pain lasting for less than 6 weeks), subacute (pain lasting between 7 and 12 weeks) and chronic low back pain, (more than 3 months), (Koes et al, 2010). Other common among musculoskeletal symptoms specific to the back, include scoliosis, kyphosis and lordosis.

Neck Pain can either be non-specific neck pain or as a result of whiplash injury, common during road traffic accidents. Non-specific neck pain is described as neck pain that occurs as a result of

postural or mechanical complications (Binder, 2008). Factors associated with neck pain include trauma to the cervical region (whiplash injury), cervical spondylosis, posture maintained while sitting or in the workplace, anxiety, depression, neck strain and sporting injuries (Ming et al, 2004; Binder, 2008). A study Yeun and Han (2017) reported that neck pain is more prevalent among women as compared to men and associated this as a result of the difference in muscle mass around the neck area between the male and female population.

Shoulder Pain is another common musculoskeletal symptom, it describes pain around the glenohumeral, acromioclavicular and sternoclavicular joints and also within the associated soft tissues (Murphy & Carr, 2010). Shoulder pain can occur as a result of pathologies such as frozen shoulder, instability of the glenohumeral and acromioclavicular joints, trauma to the associated soft tissues as well as poor posture and muscle imbalance (Ming et al, 2004; Murphy & Carr, 2010).

2.2 Epidemiology

Musculoskeletal symptoms are a common problem worldwide; they affect individuals of all ages across various populations. The global burden of musculoskeletal symptoms is estimated to be 21.3% (March et al, 2013). Joseph et al (2020) have reported a global prevalence of musculoskeletal disorders among drivers to be estimated at 51-93%. Studies in various countries have shown that there is a high prevalence of musculoskeletal symptoms among the various populations. In a study by Delp and Wang (2013), among clerical workers in Los Angeles, the 12-months prevalence of musculoskeletal symptoms was 92%, with respondents reporting discomfort in more than one body region. In Australia, between 2014 and 2015, 30% of the population were reported to have developed at least one musculoskeletal condition, with the back

being the most affected body region with a prevalence of 16% among the population (Australian Institute of Health and Welfare, 2019).

Musculoskeletal symptoms were most prevalent among members of the population aged 75 – 84 years (72%) and least prevalent among those aged 0 – 14 years (1.0%) (Australian Institute of Health and Welfare, 2019). Hongyun et al (2019) reported a high 12-months prevalence of musculoskeletal symptoms (91.2%) among Chinese healthcare professionals, with the lower back (12-months prevalence of 72.8%) being the region most affected by musculoskeletal symptoms. Data from the Health and Safety Executive, Great Britain (2019) showed that musculoskeletal symptoms account for 37% of work-related diseases and 27% of working days missed due to work-related illnesses. In a study by Davis et al, the prevalence of musculoskeletal pain among nurses in Africa was estimated to be 64% yearly (low back pain) and 41% for neck pain (Davis et al, 2015). Ayanniyi and Udofia (2016).

In a similar study among Nigerian sonographers the estimated prevalence of work related musculoskeletal symptoms was 88% with back pain being most prevalent (45%) (Oke & Adeyekun, 2013). The prevalence of WRMSDs among drivers has been shown to be high and varies between 53% and 91% in different parts of the world (Gkikas, 2012;Raanaas et al 2008; Abledu and Abledu 2014). Occupational driving has been associated with high prevalence of MSP and the prevalence for professional truck drivers in the United Kingdom has been reported to be 81% (Robb and Mansfield, 2007). High prevalence of MSP and spinal disorders has also been reported in other developed countries for urban bus drivers to be 55.7% (Okunribido et al, 2008), car drivers to be 54% (Porter and Gyi, 2002) and police officers who were drivers to be 65% (Gyi and Porter, 1998).The prevalence of work-related musculoskeletal disorders among the bus drivers in Tricity was found to be as high as 53% (Lalit et al., 2015). Onawumi in 2012

reported a high prevalence of work related musculoskeletal disorders among taxi cab in Nigeria. Akinbo et al (2008) found the prevalence of MSP to be higher among occupational drivers (64.5%) than occupational motorcyclists (60%) in Lagos, Nigeria. Akinpelu et al., 2012 found a high prevalence of musculoskeletal pain among occupational drivers to be 89.3%. Tamrin et al in 2014 reported prolonged sorting and uncomfortable seats to be major causes for musculoskeletal disorders among driver. Ojoawo et al in 2014 reported that prolonged driving was a major (61.2%) cause of musculoskeletal pain among occupational drivers.

2.3 Anatomy of the Back

The back is the posterior part of the trunk, it lies between the neck inferiorly and superiorly to the buttocks (Moore et al, 2013). The back includes the following structures;

i. **The skin and subcutaneous tissue**
ii. **Muscles:** these comprise of two layers
    - A superficial layer, which is primarily concerned with positioning and movement of the upper limbs, and
    - Deeper layers, also called the true muscles of the back, which are more concerned with maintaining the body posture.
iii. **The vertebral column:** this comprises of the vertebral bodies, the intervertebral discs and the associated ligaments
iv. **The ribs** (located in the thoracic region)
v. **Spinal cord and the associated meninges**
vi. **And various segmental nerves and blood vessels.** (Moore et al, 2013; Modes & Fahrioglu, 2020)

2.3.1 The Vertebral Column

The vertebral column (spine) is made up of the vertebrae and the intervertebral discs. It extends from the cranium to the apex of the coccyx. The vertebral column consists of 33 vertebrae, is approximately 71 to 75cm long in adults and the intervertebral discs form one quarter of its length. The vertebral column serves the following function;

i. It protects the spinal cord and the spinal nerves
ii. It supports the weight and physical structures of the body (above the level of the pelvis)
iii. It provides an axis for the movement of the body, and a base for the head.
iv. It is important for the posture and locomotion of the body. (Valovska, 2011; Moore et al, 2013; DeSai et al, 2020)

2.3.1.1. The Vertebrae

The vertebrae and the intervertebral discs make up the vertebral column. There are 33 vertebrae in the vertebral column of an adult. These vertebrae are arranged in five regions;

i. The cervical region, made up of the first 7 vertebrae
ii. The thoracic region made up of 12 vertebrae
iii. The lumbar region, made up of 5 vertebrae
iv. The sacral region made up of 5 vertebrae
v. And the coccygeal region, which is made up of the inferior 4 vertebrae.

Significant motion occurs only between the first 25 vertebrae (cervical to lumbar region), the sacral region fuses to from a rigid sacrum and the coccygeal region fuses to form the coccyx. The junction between the lumbar vertebrae and the sacrum is described as the lumbosacral region. (Valovska, 2011; Moore et al, 2013)

The vertebrae gradually increase in size down the vertebral column up to the sacral region, from where it gradually decreases towards the apex of the coccyx. The vertebrae are largest just immediate to the superior part of the sacrum, where weight is transferred to the pelvic girdle at the sacroiliac joints. The reason for the gradual variation in size of the vertebrae down the vertebral column is due to the fact the amount of body weight born by each vertebrae gradually increases down the vertebral column. (Moore et al, 2013). Each vertebra is separated from the other superiorly and inferiorly by the intervertebral disc. The intervertebral discs are cartilaginous structures that consist of an outer avascular layer (annulus fibrosus) surrounding a soft nucleus pulposus (Valovska, 2011; DeSai et al, 2020). Zygapophyseal joints also exist between the cervical, thoracic, lumbar and first sacral vertebrae, these joints allow for more flexibility in these regions of the vertebral column. (Moore et al, 2013)

The size and characteristics of each vertebra vary from one vertebrae to another and also from one region of the vertebral column to another. However, all the vertebrae still possess a similar basic structure. The structure of a typical vertebrae consists of

i. A vertebral body
ii. A vertebral arch and
iii. 7 spinous processes.

The vertebral body is the anterior part of the vertebrae, it is the massive and roughly cylindrical part of the vertebrae. It serves to strengthen the vertebral column and support the weight of the body. It consists of two layers of bones, a thin external layer of compact bone, surrounding a vascular inner layer of cancellous bone. The trabeculae have spaces that are occupied by red marrow, this makes the vertebrae to be one of the major hematopoietic tissues in the adult

individual. The superior and inferior ends of each vertebra are covered by hyaline cartilages, in the living organism, these cartilages are, however, dried up post-mortem (Moore et al, 2013)

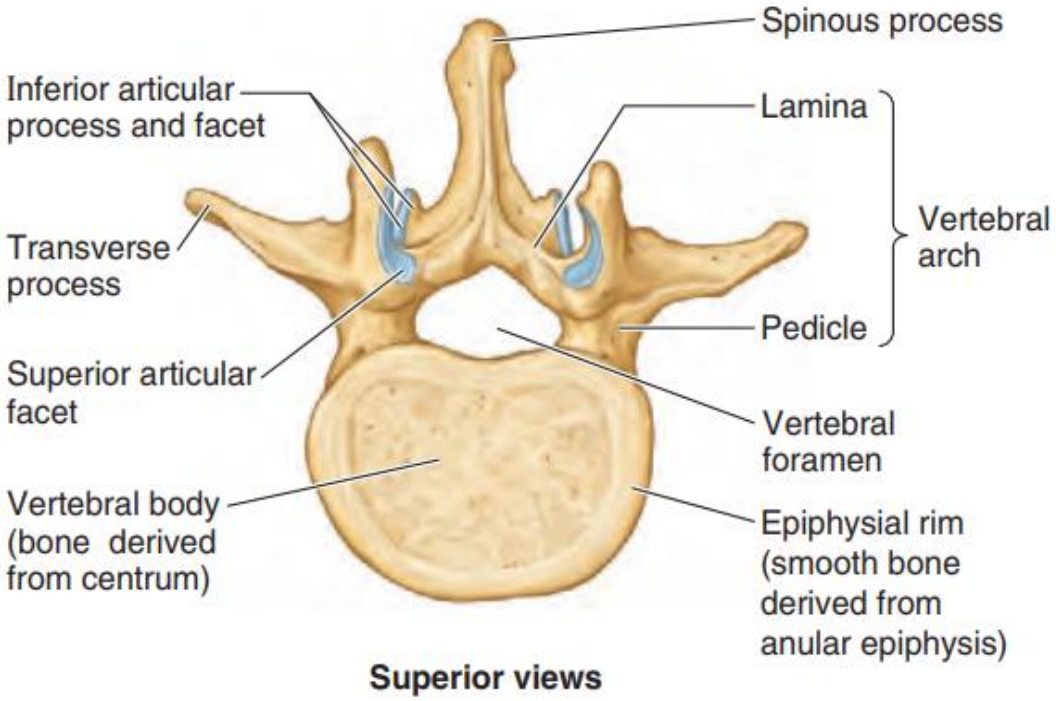

Figure 1 Superior view of the 2nd lumbar vertebrae, representing a typical vertebra

Image source: Moore, Clinically Oriented Anatomy. 7th Edition. Pg. 442.

The vertebral arch lies posteriorly to the vertebral body. It consists of two pedicles and laminae (right and left). The vertebral arch along with the posterior portion of the vertebral body forms the vertebral foramen. The vertebral foramens of all the vertebrae form a central canal in the vertebral column, referred to as the vertebral canal. The vertebral canal contains the spinal cord, its meninges, the spinal nerve roots and the associated blood vessels. (Moore et al, 2013)

From a lateral view, lying superiorly and inferiorly to each pedicle of the vertebral arch, is the superior and inferior vertebral notches.

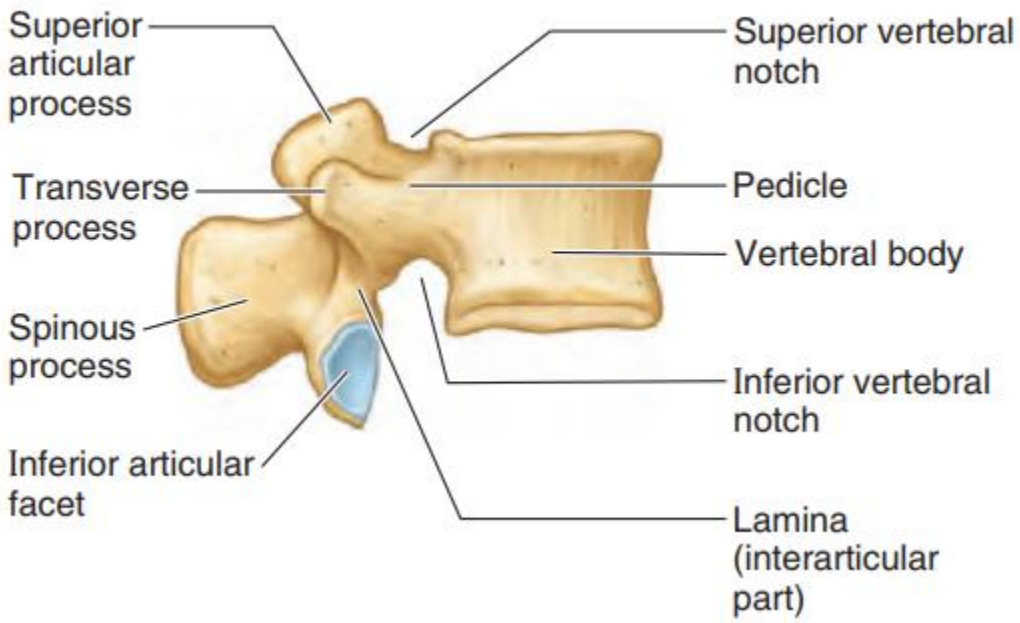

Figure 2 Lateral view of the 2nd lumbar vertebrae, showing the lateral features of a typical vertebrae

Image source: Moore, Clinically Oriented Anatomy. 7th Edition. Pg. 442.

The superior and inferior vertebral notches of adjacent vertebrae, along with the connecting intervertebral disc form the intervertebral foramina, from which the spinal nerves emerge from the vertebral column. (Valovska, 2011; Moore et al, 2013).

In a typical vertebra, there are seven spinal processes arising from the vertebral arch:

i. One median spinous process, which projects posteriorly from the junction of the laminae.
ii. Two transverse processes, that project posterolaterally from the junction of the lamina and the pedicle, and
iii. Four articular processes (2 superior and 2 inferior), arising from the junction of the lamina and the pedicle. These articular processes are also described as zygapophyses

The transverse and spinous processes serve to provide attachment for the deep muscles of the back, while the articular process along with articular processes from adjacent vertebrae, form the zygapophyseal joints, these joints determine the types of movements that are permitted between each vertebrae. (Valovska, 2011; Moore et al, 2013). The articular processes also bear weight during certain periods of transition, when one sit ups from a flexed position and also when the cervical vertebrae are flexed laterally to end range (Moore et al, 2013).

2.3.1.2 Joints of the Vertebral Column

The vertebral column comprises of several joints which include;

i. Joints of the vertebral bodies, formed by the intervertebral discs
ii. Joints of the vertebral arches, formed between the inferior and superior articular processes of adjacent vertebrae.
iii. The craniovertebral joints, the atlanto-occipital and the atlanto-axial joints
iv. The uncovertebral joints (between each cervical vertebral body and the one immediately below it)

v. The costovertebral joints (between the vertebral columns and the ribs)

vi. The sacroiliac joints (Valovska, 2011; Moore et al, 2013)

2.3.1.3 Movement of the Vertebral Column

Movement across the vertebral column occurs at the nuclei pulposi of each intervertebral disc and the zygapophyseal joints. The range of movement across the vertebral column is permitted by the elasticity and flexibility of the intervertebral discs between each vertebra. The movement of the vertebral column is produced mainly by the muscles of the back, assisted by gravity and also by the anterior abdominal muscles. The range of motion varies across the different regions of the vertebra, and is limited by;

i. The adjoining ligaments of the vertebral column (the ligamentum flava, the posterior and anterior longitudinal ligaments.

ii. The shape and orientation of the zygapophyseal joints

iii. Resistance provided by the back muscles and surrounding tissues

iv. The rib cage. (Moore et al, 2013)

The range of movement of the vertebral column is wider at the lumbar and the cervical regions than the remaining three regions of the vertebral column. Possible movement that can occur along the vertebral column are;

i. Flexion (greatest in the cervical region)

ii. Extension (greatest in the lumbar region)

iii. Rotation (Moore et al, 2013)

2.3.1.4 Curvatures of the Vertebral Column

The vertebral column in an adult individual, when viewed laterally has four curvatures, in the cervical, thoracic, lumbar and sacral regions. Kyphosis, a curvature where the vertebral column

is convex posteriorly and concave anteriorly, occurs in the thoracic and sacral region. Lordosis, a curvature in which the vertebral column is concave posteriorly and convex anteriorly, occurs in the cervical and lumbar region. The curvature of the vertebral column along with the flexibility and elasticity of the intervertebral discs, allows for greater degree of movement than would be allowed by the intervertebral disc alone. While the intervertebral disc provides a passive flexibility, due to the resistance of the zygapophyseal joints, the spinal curvatures provides a dynamic flexibility due to the resistance provided by the antagonist muscle groups to the movement of the curvature (thoracic kyphosis is restricted by the long extensors of the back and lumbar lordosis is restricted by the abdominal flexors). (Valovska, 2011; Moore et al, 2013).

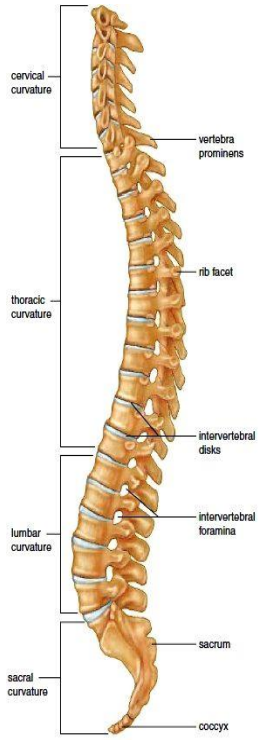

Figure 3 Lateral view of the vertebral column, showing the four spinal curvatures

Image source: www.pinterest.at

The spinal curvatures can be increased by carrying additional weights anterior to the normal gravitational axis of the body, when such weights are carried for a long duration it often results

in aching of the muscles that are antagonistic to the movement of the curvature. (Moore et al, 2013).

2.3.1.5 Vasculature of the Vertebral Column

The major **arterial supply** to the vertebral column is provided by the

i. vertebral and ascending vertebral arteries and
ii. the segmental arteries of the trunk. These include the posterior intercostal arteries (in the thoracic region), the subcostal & lumbar arteries and the iliocostal, lateral and medial sacral arteries.

The anterolateral surfaces of the vertebrae are supplied by the periosteal and equatorial branches of these arteries, while the spinal branches enter the intervertebral foramina and divide into larger branches (radicular medullary arteries) and smaller anterior and posterior vertebral canal branches. The anterior vertebral canal branches supply the vertebral bodies, while the posterior branches supply the vertebral arches. Nutrient arteries to the vertebral bodies arise as branches from the anterior vertebral canal arteries, these arteries supply the red marrow of the central vertebral body. The radicular medullary arteries supply the posterior and anterior roots of the spinal nerves along with their meninges (Moore et al, 2013).

The **venous drainage** of the vertebral column is provided by venous plexuses on the inside and outside of the vertebral canal. These plexuses, the internal and external vertebral venous plexuses are formed from the spinal veins, they communicate through the intervertebral foramina. The vertebral bodies are drained by the basivertebral veins, which drain into the anterior internal and external vertebral plexuses. Blood from the vertebral venous plexuses and also from the spinal cord are drained by the intervertebral veins into the vertebral veins of the neck and the segmental veins of the trunk, the lumbar, sacral and intercostal veins (Moore et al, 2013).

2.3.1.6 Nerve Supply of the Vertebral Column

The nerve supply to the vertebral column is provided by the recurrent meningeal branches of the spinal nerves. These nerves originate from the mixed spinal nerve, just before it bifurcates into the anterior and posterior rami, or in some variations they may originate from the anterior rami. Branches outside the vertebral canal supply the anterolateral aspect of the vertebral bodies and of the intervertebral discs and the anterior longitudinal ligament. Within the spinal canal, branches supply the periosteum of the posterior aspect of the vertebra, ligament flava, annuli fibrosis of the posterolateral aspect of the intervertebral disc, the posterior longitudinal ligament, spinal dura mater and the vasculature within the vertebral canal. The zygapophyseal joint is however supplied by the articular branches of the medial branches of the posterior rami. The nerve supply to the periosteum are mainly nociceptors, while the annuli fibrosis and the ligaments are supplied by both nociceptors and proprioceptors. (Moore et al, 2013).

2.3.2 Muscles of the Back

There are two major groups of muscles in the back.

i. The extrinsic back muscles and
ii. The intrinsic back muscles

The extrinsic back muscles include superficial and intermediate muscle groups and they both of these muscle groups serve to initiate and control respiratory movement and also movement of the limbs (Moore et al, 2013). However, Henson et al (2020), categorized muscles of the back into three groups with the superficial and intermediate muscle groups categorized separately along with the intrinsic muscle groups. The intrinsic muscle groups are attached to the vertebral column and are involved in controlling the movement of the vertebral column along with helping to maintain body posture (Moore et al, 2013; Henson et al, 2020)

2.3.2.1 Extrinsic Muscles of the Back

There are two groups of extrinsic muscles of the back, the superficial and intermediate muscles. The superficial muscle groups include the trapezius, latissimus dorsi, rhomboids and levator scapulae. These muscles connect the vertebral column to the upper appendicular skeleton (the pectoral girdle and the humerus). They act to initiate and control movement of the upper limbs. Nerve supply to this group of muscles is from the anterior rami of the cervical nerves, except for the trapezius which receives its innervation from the spinal accessory nerve (cranial nerve XI). (Moore et al, 2013, Modes & Fahrioglu, 2020)

The intermediate extrinsic back muscles are the serratus posterior muscles (superior and inferior muscle), they are responsible for respiratory movement. The serratus posterior superior lies deep to the rhomboids, while the serratus posterior inferior lies deep to the latissimus dorsi. Both muscles are innervated by the intercostal nerves (Moore et al, 2013, Modes & Fahrioglu, 2020)

2.3.2.2 Intrinsic Muscles of the Back

The intrinsic muscles of the back are the muscles that control the movement of the vertebral column and act to maintain the posture of the body. These muscles extend from the pelvis to the cranium, they are covered by the deep fascia and are innervated by the posterior rami of the spinal nerves. (Moore et al, 2013; Modes & Fahrioglu, 2020)

There are three layers of the intrinsic back muscles:

i. The superficial layer (the splenius capitis and splenius cervicis)
ii. The intermediate layer (the erector spinae muscles – the iliocostalis, longissimus and the spinalis muscles)
iii. The deep layer (the transversospinalis muscles – the semispinalis, multifidus and rotatores muscles) (Moore et al, 2013; Henson et al, 2020)

The muscles of the superficial layer, the splenius capitis and splenius cervicis, act to cover the deep neck muscles and maintain the position of the neck. The intermediate layer, the erector spinae muscles act to extend the vertebral column. The muscles of the deep layer, the transversospinalis muscles occupy the depression between the transverse and spinous processes of the vertebrae (Moore et al, 2013)

The transversospinalis muscles serve to collectively extend the back, the semispinalis muscle extends the head, the cervical and the thoracic region of the vertebral column, it also acts unilaterally on one side to rotate the contralateral side of these regions. The multifidus mucle serves to stabilize the vertebrae while it moves, the rotatores also stabilizes the vertebrae and assists with extension and rotatory movement (Moore et al, 2013; Modes & Fahrioglu, 2020)

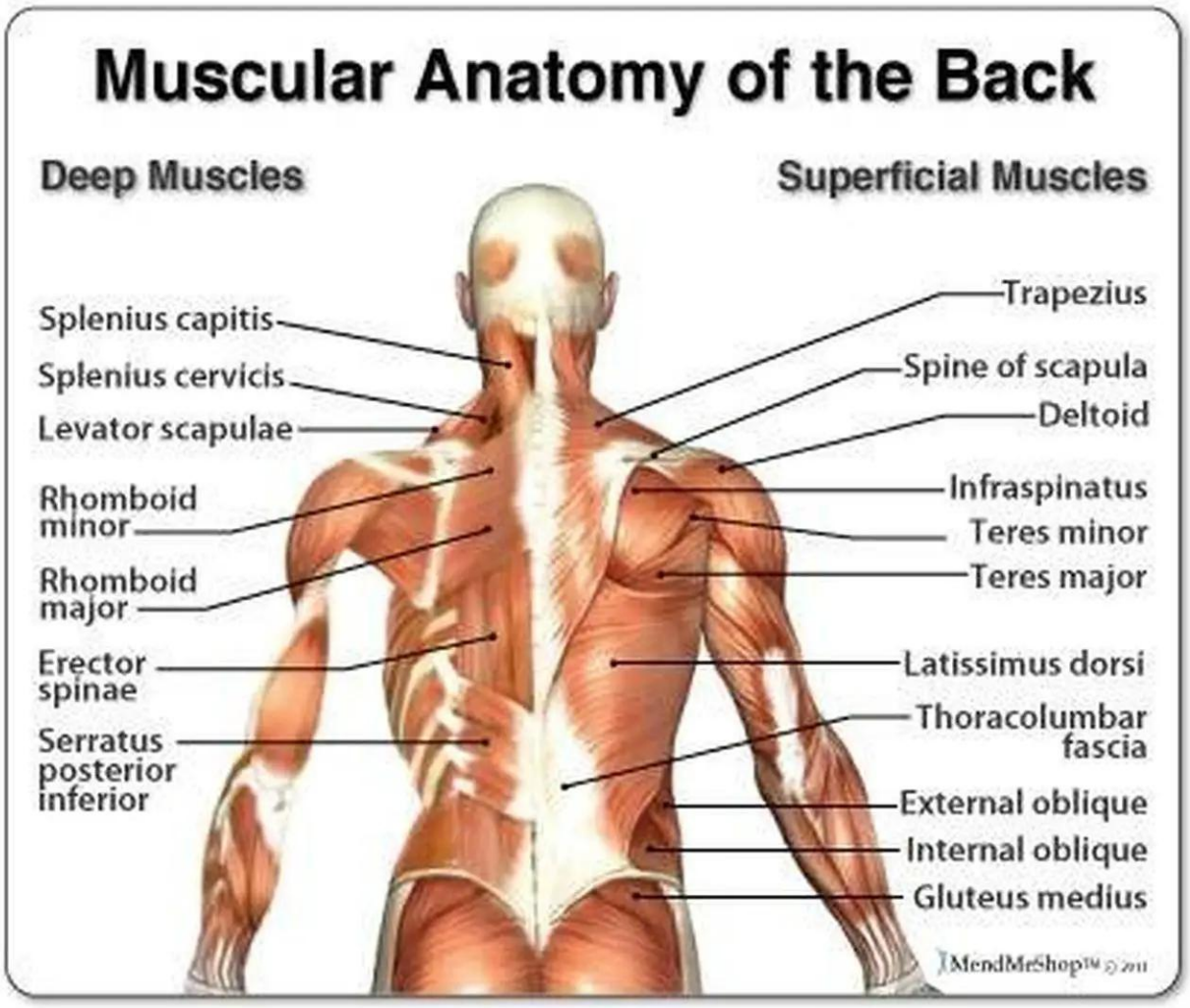

Figure 4 Muscular anatomy of the back

Image source: healthiack.com

2.3.2.3 Blood Supply and Innervation of the Back Muscles

The arterial blood supply of all the muscle groups of the back are provided by the deep cervical, posterior intercostal, subcostal or lumbar vertebral arteries (Henson et al, 2020)

The nerve supply for muscles of the back originate from the ventral and dorsal rami of the spinal nerves;

i. The anterior rami of the spinal nerves innervate the extrinsic muscles
ii. The splenius capitis muscle is innervated by lateral branches of the C2 – C3 dorsal rami
iii. The lateral branches of the lower cervical dorsal rami supply the splenius cervicis muscle
iv. The erector spinae muscles are innervated dorsal rami of the spinal nerves. The lateral branches of the dorsal rami innervate the ilocostalis muscle and the longissimus muscle is innervated by the intermediate branches.
v. The transversospinalis muscles supplied by the primary branches of the C1 – L5 dorsal rami. (Moore et al, 2013; Eovaldi & Varacallo, 2019; Henson et al, 2020).

2.4 Pathophysiology of Musculoskeletal symptoms

Musculoskeletal symptoms occur when a tissue in the musculoskeletal system is made to perform a repetitive or forceful task, which results in multiple and repeated overstretching, compression, overexertion, ischemia and/or friction to the tissue involved (Barbie & Barr, 2006). These injuries to structures of the musculoskeletal system results in inflammation, which is initially meant to repair the injured tissue. However, when the injurious task is continued, this can result in a vicious cycle of injury to the affected tissue, chronic or systemic inflammation, fibrosis of the affected tissue and may even result in breaking down of the affected tissue, these will ultimately result in pain and loss of function in the region affected (Barbe & Barr, 2006). Musculoskeletal symptoms occur when the body is exposed to heavy loads over a long period of

time, they can also occur due to maintenance of an awkward body posture for an extended period of time (Oke & Adeyekun, 2013).

2.4.1 Etiology of Musculoskeletal symptoms

2.4.1.1 Posture

Postural scoliosis usually occurs as a compensatory deformity secondary to conditions that are not associated with the spine, such as limb length discrepancy or a pelvic tilt due to hip contractures. (Solomon et al, 2010). Postural low back pain can develop when the back in sustained in a poor position for a long period of time, this causes tension in the musculature and ligaments of the back, causing minor injuries which can present symptomatically as pain in the low back (Taguchi, 2003). Postural neck pain also occurs as a result of the loading of the cervical spine and the shoulder girdle due sustained posture while working or during leisure (Edmondston et al, 2007), this pain is common among computer users, who exert strains on the musculature and ligaments of the neck due to awkward postures and forward bending of the neck adopted while working (Ming et al, 2004). Oke & Dada (2004), reported that the prevalence of neck pain is higher among computer users who spend at least 6 hours a day working on the computer.

2.4.1.2 Degenerative changes

Degenerative changes in the spine such as lumbar or cervical spondylosis can result in the development of musculoskeletal symptoms across the spine, resulting in conditions such as low back pain (Solomon et al, 2010). In spondylosis as the degeneration of the intervertebral disc progresses, there is bone growth along the edges of the vertebrae, this bony growths, termed osteophytes, along with the narrowing of the intervertebral space can impinge on the peripheral nerves that exit from the vertebral foramen resulting in

radiculopathy associated with low back pain and neck pain (Solomon et al, 2010). The formation of bony growths can also narrow the spinal canal resulting in spinal stenosis with can lead to presentation of symptoms of myelopathy.

Vertebral disc prolapse (herniation) which is the bulging out of the annulus portion of the intervertebral disc. Vertebral disc prolapse can result in the compression of the nerve structures on the side where the bulge occurs, this can result in back pain and also cause the patient to maintain a tilted posture (sciatic scoliosis) (Solomon et al, 2010).

2.4.1.3 Trauma

Traumas such as vehicle accidents, fractures, whiplash injury and micro traumas (such as occurs while lifting heavy loads) result in injuries to the musculoskeletal tissues and this can often present as musculoskeletal symptoms such as pain or complications like contractures or limb length discrepancies (Taguchi et al, 2003; Solomon et al, 2010). In a study by Amako et al (2018) among a Japanese population, exercises were the most common cause of musculoskeletal injuries (48.8%) while vehicle accidents were the cause of 14.8% of musculoskeletal injuries.

2.4.1.4 Diseases and Infections

Systemic infections and diseases such as a pyogenic infection (staphylococcus) and tuberculosis and conditions such as rheumatoid arthritis. The infective pyogenic organism travels to the spine via the blood supply and infects the intervertebral disc (resulting in reduced disk space) and the vertebral bodies, abscess may form and spread into the spinal canal and the surrounding musculatures (Solomon et al, 2010). Presenting symptoms include muscle spasm and neck stiffness. Tuberculosis affecting the spine can also result in the formation of abscesses in the vertebral and the collapse of the vertebral curve.

Tuberculosis of the cervical spine can result in the collapse of the cervical spine into a kyphosis and patients often present with neck pain. In the lumbar spine a severe tuberculosis infection can result in a collapse of the vertebral bodies and in the formation of a gibbus and kyphotic curve, the abscess formation can also lead to compression of the spinal cord (Solomon et al, 2010). Rheumatoid arthritis, an autoimmune disease, can often affect the spine, eroding the facet leading to joint instability and possible compression of the spinal nerves (Solomon et al, 2010)

2.4.2 Risk Factors for Musculoskeletal symptoms

There are several risk factors associated with the development of musculoskeletal symptoms and the occurrence of musculoskeletal symptoms is multifactorial, involving activities carried out at work and even recreational activities and activities of daily living, which result in overloading or stressing of the musculoskeletal system (Punnett & Wegman, 2004). Risk factors involve individual, physical and psychosocial factors. (Punnett & Wegman, 2004; Nunes & Bush, 2012)

Risk factors for the development of musculoskeletal symptoms include:

i. **Gender:** studies report that there are gender differences in the prevalence of musculoskeletal symptoms, with higher prevalence reported among women. These differences are associated with factors such as physiological differences, such as hormonal influence and also ergonomic factors. (Nunes & Bush, 2012). Cavallari et al (2016), reported higher prevalence of back, upper and lower extremities symptoms among females compared to males who are exposed to relatively the same kind of work, the largest discrepancy occurred in the prevalence of upper extremity symptoms. Ming et al (2004), reported that women are more predisposed to developing neck and shoulder pain because the work place is ergonomically designed to fit the male population more.

ii. **Ergonomics** : When considering the ergonomics of the driver's vehicle (Szeto and Lam, 2007) identified seat position/body mismatch in taxi and bus drivers as being associated with MSDs in drivers and also identified uncomfortable steering wheel position and steering wheel tightness in bus drivers. Alperovitch-Najenson et al in 2010 reported poor back support to cause MSDs among occupational drivers. Sa-ngiamsak in 2021 reported awkward body posture as a risk factor to MSDs.

iii. **Working duration:** Andrusaitis et al in 2006 reported that 10.22 hours of driving per day could result to the development of musculoskeletal disorders. Rufus et al in 2015 showed that 10 to 15 hours of driving a day is associated with a increased risk of developing musculoskeletal disorder among drivers. Arminian et al in 2016 then reported that driving for 48.72 hours a week is associated with an increased risk of developing musculoskeletal disorder among truck drivers.

iv. **Level of physical activity and muscle strength:** physical activity can predispose to the development of musculoskeletal symptoms as increased level of activity results in increased risk of injuries to the musculoskeletal tissues, as there is increased loading of the muscles and the frequency of repetitive movements. However, increased level of physical activity also results in the strengthening of the muscles and other tissues, improves blood flow to the musculoskeletal tissues and the oxygenation of these tissues, leading to a reduced rate of injury (as the tissues can withstand more force) and greater rate of repair from injury (Nunes & Bush, 2012; Karen & Gisela, 2017).

v. **Age**: The process of aging is associated with certain degenerative changes especially at the joints, as the body ages, the intervertebral discs begin to degenerate leading to a reduction in the space between the vertebral bodies. These degenerative changes result in

pain and reduced range of motion at the back and can also result in radiculopathy if peripheral nerves are compressed. (Ming et al, 2004; Nunes & Bush, 2012).

vi. **Posture**: maintaining a static posture while working or performing activities of daily living can result in the build of tension and overloading of the muscles associated with maintaining that posture, especially the intrinsic back muscles, this overloading can result in injury to the muscles and development of musculoskeletal symptoms. (Ming et al, 2004; Nunes & Bush, 2012). Studies have shown increased association between awkward body postures and a high prevalence of musculoskeletal symptoms (Gangopadhyay et al, 2010; Anita et al, 2014, Chen & Mu, 2018).

vii. **Psychosocial factors:** such as financial/economic status, satisfaction with work and inter-relationships at the work place. Psychosocial factors are non-biomechanical risk factors that predispose to the development of musculoskeletal symptoms. A negative perception of one's self, environment and work place can result in physiological and psychological stress which can result in physiological responses such as increase in muscle tension. Psychosocial factors on their own cannot result in injuries but in combination with the physical risk factors can result in occurrence of injuries and musculoskeletal symptoms. (European Agency for Safety and Health at Work, 2008; Nunes & Bush, 2012)

2.5 Clinical Presentations of Musculoskeletal symptoms

i. Pain: as defined by the International Association for the Study of Pain (IASP, 2020) pain is an unpleasant sensory and emotional experience associated with, or resembling that associated with actual or potential tissue damage. Pain may be experienced as aching, burning, stabbing, sharp or dull, and may vary in intensity from mild to severe.

Sometimes the pain may be aggravated by motion or certain postures and may vary depending on the time of the day. ((Ming et al, 2004; Beatrice, 2013).

ii. Reduced range of motion, especially in conditions such as scoliosis and hyper-kyphosis. Reduction in range of motion of a joint can occur as a result muscles stiffness, inflammation around the joint, prolonged immobilisation and also joint pain. (Kaneguchi et al. 2016).

iii. Radiculopathy: this describes a pain syndrome that is characterized by pain, weakness and numbing sensation along the course of a nerve. It is caused by compression or irritation of the nerve root (Alexander & Varacallo, 2020), which is common in degenerative conditions that affect the spine. Radicular symptoms experienced may differ depending on the level of the lumbar spine where the nerve compression occurs. In L2, L3 and L4 radiculopathy, radiating pain is felt at the anterior aspect of the thigh and may progress to the knee and the medial aspect of the lower leg (Dydyk, Khan and Das, 2021). In L5 radiculopathy radicular symptoms are felt at the lateral leg and into the foot, while S1 radiculopathy will result in radiating symptoms in the posterior leg, into the foot and the perineum (Dydyk, Khan and Das, 2021).

iv. Joint stiffness: joint stiffness can occur as a result of various musculoskeletal conditions such as, spondylosis, arthritic conditions or adhesive capsulitis, among others. It results in the loss or reduction of the range of motion that occurs at a joint. All movement at the joint may be lost or limited while in some cases only some types of movements are limited, depending on the severity and cause of the joint stiffness (Solomon et al, 2010).

2.6 Diagnosis of Musculoskeletal symptoms

2.6.1 Patient History

The first step in accurate diagnosis of a patient with musculoskeletal symptoms is taking a proper and detailed history of the patient. History taken should include period of onset of the symptoms, history of trauma or diseases, location and description of the pain, family history, patient's occupation, severity and duration of the symptoms, aggravating and relieving factors (positional and time factors), medications used and treatments received, along with past medical and surgical treatments. (Ming et al, 2004; Porter & Tidy, 2013)

2.6.2 Physical Examination:

Physical examination involves the general observation, local observation and assessment of movement and muscles strength. There are also specific physical tests for various musculoskeletal conditions which can be carried out to confirm or rule out a specific condition. (Porter & Tidy, 2013)

General observation involves observing the patient gait and posture upon entry into the examination room, while walking, standing and sitting. (Walter and Linpicott , 2013).

Local observation involves observation of the affected area for swelling, abnormal contours, muscle atrophy, asymmetry of muscles, joint malalignments and deformities. (Thompson and Walton 2017).

The range of motion is assessed with the aid of a goniometer. The muscle strength is assessed and can be graded with outcome measures such as the Oxford muscle grading scale (Walter and Linpicott , 2013).

Certain orthopedic tests can be performed to rule out or confirm certain pathologies, these tests include: Straight leg raise test, Faber's test, vertical oscillatory pressure (for low back pain), Empty can test (for shoulder pain), cervical distraction test (for neck pain) (Porter & Tidy, 2013, among others). Scoliosis can be observed using the Adam's forward bend test (Reamy & Slakey, 2001). Adam's forward bend test is performed by asking the patient to expose his/her back and then bend forward at the waist, to the point where the spine becomes parallel to the horizontal plane, with the palms held together and the arms extended at the elbow. The examiner will then observe the spine along the horizontal plane to detect any asymmetry in the contour of the back (rib hump) which will be indicative of scoliosis (Reamy & Slakey, 2001).

2.6.3 Radiographic Examination

Radiographic examination involves the use of X-rays, Computerized tomography and Magnetic resonance imaging to examine internal tissues and detect the presence or absence of abnormalities.

2.6.3.1 X-rays

X-rays are the most commonly used imaging techniques for assessing skeletal deformities, as it is readily available and relatively cheap. X-rays can be used to assess fractures, bony deformities and degenerative changes. (Lateef & Patel, 2009). In the assessment of low back pain, if patient history indicates a non-mechanical cause of pain or if degenerative changes are suspected in the lumbar spine, an X-ray is usually recommended for further diagnosis (Lateef & Patel, 2009). The anteroposterior and lateral views are the common angles from which the X-ray is taken. For suspected spondylolysis, an oblique view may be requested which will show any fracture at the pars

interarticularis. The film obtained is observed by the clinician for degenerative changes, reduced intervertebral disc, fracture of the vertebral body or any other obvious deformity (Lateef & Patel, 2009).

X-rays are also used in the assessment of scoliotic curves and kyphotic curves. In the frontal plane it is used to measure the cobb angle of all scoliotic curves along the spine, the thoracic curve, the thoracolumbar scoliotic curve and fractional curves in the lumbosacral junction. While the kyphotic and the lordotic curves can be obtained in the sagittal plane, these curves include the thoracic kyphosis (cobb angle between the superior endplate of the 4th thoracic vertebra and the inferior end plate of the 12th thoracic vertebra), the thoracolumbar kyphosis (cobb angle between the superior end plate of the 10th thoracic vertebra and the inferior end plate of the 2nd sacral vertebra) and lumbar lordosis (cobb angle between the superior end plate of the 1st lumbar vertebra and the superior end plate of the 1st sacral vertebra). (Bess et al, 2016).

Cobb angle is measured by identifying the upper and lower end vertebrae on the anteroposterior x-ray film, a perpendicular line is drawn from both the upper and lower

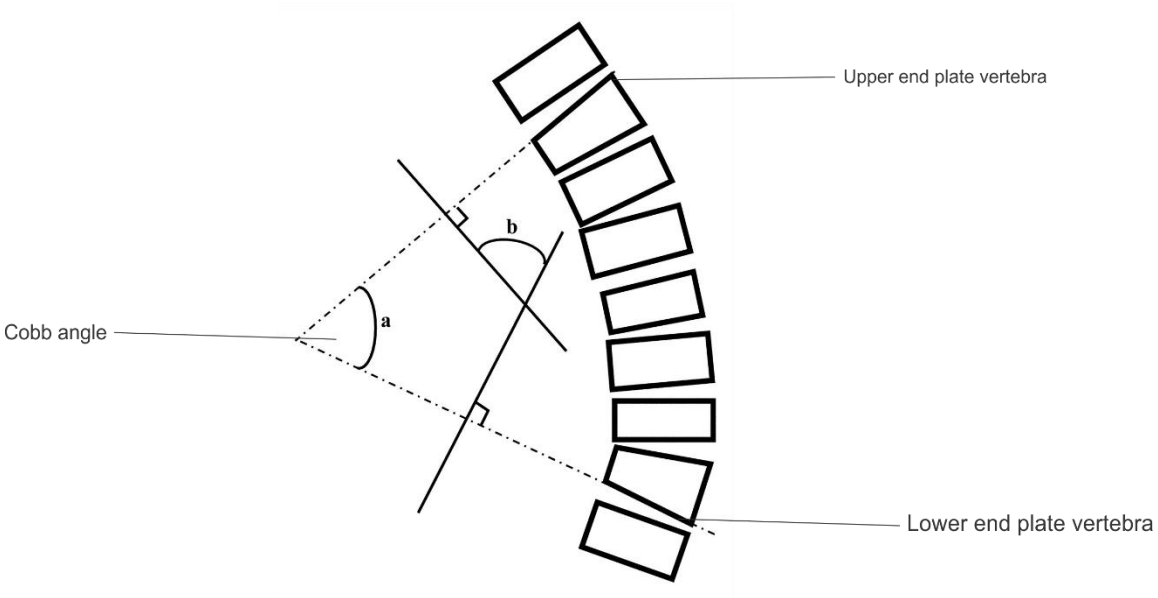

Figure 5 Measurement of Cobb angle

Image source: Adapted from https://pubs.rsna.org

vertebral endplate lines, the angle between the two vertical lines, at their point of intersection is the cobb angle of that curve. (Wang et al, 2018)

2.6.3.2. Computerized Tomography (CT) Scan

Computerized tomography is used mainly to assess the osseous structures of the spine, and the relation of the vertebrae to the neural canal in the axial plane. (Arya, 2014). In the assessment of musculoskeletal conditions, CT scan is useful in detecting the relationship of one bony structure to another, to show tumors, fractures and complete or partial dislocations (Arya 2014). In the diagnosis of low back pain, CT scan can be used to view the lumbar spine and detect abnormalities like spondylolisthesis (Arya, 2014). CT scan allows for the detection of complex bony abnormalities associated with the development of scoliosis (Wang et al, 2018).

2.6.3.3 Magnetic Resonance Imaging (MRI)

Magnetic resonance imaging involves the use of the natural magnetic properties of the body to generate detailed radiographic images (Berger, 2002). MRI is currently the standard diagnostic tool for detecting abnormalities in neurologic structures associated with low back pain (Arya, 2014). Magnetic resonance imaging provides multiaxial and multiplanar high resolution of tissues and has the advantage of having no known biohazard effects. Compared to computerized tomography, MRI is better suited at detecting the relationship between discs and nerves and locating soft tissue and non-bony structures as well as detecting conditions such as early osteomyelitis, discitis and hematomas (Arya, 2014). In the diagnosis of neck pain with symptoms including balance

and gait problems (indicative of cervical myelopathy), MRI can be used to detect disk herniations or spinal stenosis that may be causative of the symptoms (Pompan, 2011). MRI is also indicated in young and middle-aged patients with shoulder pain, following traumatic injury, reporting with persistent pain and weakness, as there may be a complete rotator cuff tear, detectable by the MRI (Pompan, 2011). MRI is used in the evaluation of patients with scoliosis presenting with unusual curve patterns or with alarming clinical and neuropathic symptoms (Wang et al, 2018).

2.7 Management of Musculoskeletal symptoms

Musculoskeletal symptoms result from variety of causes and risk factors, management of these disorders will involve approaching the causes of the disorder and correcting any associated deformity.

Management of musculoskeletal symptoms include the following

i. Patient education and self-management
ii. Exercise therapy
iii. Manual therapy
iv. Pharmacological treatment (mainly analgesics). (Babatunde et al, 2017)

Management of musculoskeletal symptoms vary depending on the type of disorder and the region affected.

For the management of low back pain, early involvement of the patient in physical activity and exercise is recommended, while bed rest, as a means of management should be discouraged (Koes et al, 2010). Analgesics as a means of management is also recommended (Koes et al, 2010; Babatunde et al, 2017), manipulative therapy in the form of lumbar traction is also recommended in the treatment of low back pain (Koes et al 2010). Specific back exercises are recommended in

the management of chronic low back pain, but patients suffering from acute low back pain are advised to maintain a general state of physical activity, as opposed to performing exercises specifically for the back (Koes et al, 2010). Lumbar braces have also reported to be effective in the management of low back pain (Arya, 2014)

In the management of spinal deformities such as scoliosis and kyphosis, braces and therapeutic exercises are often recommended, surgical interventions may as well be required depending on the degree of affectation (Bettany-Saltikov et al, 2017). Surgical procedures involved spinal fusion, vertebroplasty, kyphoplasty, vertebral body stapling and vertebral body tethering (Bettany-Saltikov et al, 2017). Surgical management is indicated for patients with spinal curves greater than 45^{o}. Therapeutic exercises prescribed include Pattern Specific Scoliosis Rehabilitation (PSSR), Physiotherapeutic Specific-Scoliosis Exercises (PSSE), positional and active stretching of the pectoralis muscles and exercises targeting the strengthening of the back muscles (Bettany-Saltikov et al, 2017).

For shoulder and neck pain, management involves postural changes, manual therapy, physical exercises, early mobilization, range of motion exercises to the neck and shoulder and the use of noon-steroidal anti-inflammatory drugs (Ming et al, 2004). If symptoms are not relieved by conservative management, surgical intervention can become necessary especially in cases of nerve root compression. (Ming et al, 2004)

2.8 Prevention of Musculoskeletal symptoms

The prevention of musculoskeletal symptoms involves avoiding the risk and causative factors that predispose to the disorders (European Agency for Safety and Health at Work, 2008). Preventive measures include:

i. **Improving the ergonomics of the work environment:** studies have shown that improving the ergonomics of the work and home environment, such as the type of chairs used, the type and size of work tables used, sitting with back and arm support and general positioning while working and at home helps to reduce the occurrence of back pain and neck pain. (Ming et al, 2004; European Agency for Safety and Health at Work, 2008).

ii. **Behavioral changes:** this involves proper positioning while sitting at a desk, performing activities of daily living, working or carrying loads. Adjustments can also be made to sleeping positions and work habits, such as taking short breaks in between work hours to promote relaxation of the muscles. (Ming et al, 2004; European Agency for Safety and Health at Work, 2008).

iii. **Wearing of protective equipment:** protective equipment such as back braces, wrist splints and neck collars can help to minimize the development of musculoskeletal symptoms. Back belts help to stabilize the trunk and increase intra-abdominal pressure and reduce the incidence of low back pain. (European Agency for Safety and Health at Work, 2008).

iv. **Physical Exercises:** Strengthening of the neck and back muscles help to increase the physical capacity of these muscles. This helps to reduce the overloading of the muscles hence reducing the development of musculoskeletal symptoms. (European Agency for Safety and Health at Work, 2008).

2.9 Outcome Measures

2.9.1 The Oswestry Disability Index (ODI)

The Oswestry disability index is one of the commonly used outcome measures to assess patients with low back pain. The questionnaire is self-administered, divided into ten sections, and it

assesses the pain intensity along with various activities of daily living (personal care, lifting, walking, sitting, standing, sleeping, sex life, social life and travelling). Each section contains 6 statements which describe scenarios in the patient's life in correlation to the pain. The first statement is scored 0 and the last statement is scored six, patients are to pick one statement from each section. The total score is calculated by dividing the sum of the scores gotten by the patient, by the total possible score (50) and then multiplying by 100 to get a percentage (Fairbank & Pynsent, 2000; Mehra et al, 2008). The total score in percentage is sued to estimate the degree of disability perceived by the patient, a higher percentage correlates to a higher perception of disability (Fairbank & Pynsent, 2000) The test retest reliability of the ODI ranges from r = 0.83 to 0.99 (Vianin, 2008), Fairbank reported a test-retest reliability of 0.99 (Fairbank and Pynsent, 2000). In a study assessing the psychometric evaluation of the cross-cultural adaptation of the Oswestry disability index among a Yoruba population, the one-week test-retest reliability of the ODI was found to be 0.80 (95% CI 0.74 – 0.84) and the convergent validity of the ODI with the Yoruba version of the visual analogue scale (VAS) was r = 0.30, p = 0.001 (Mbada et al, 2020)

2.9.2 Neck Disability Index (NDI)

The neck disability index was designed to assess neck-specific disability in patients, it consists of 10 items that involves pain intensity and patient's activities of daily living (personal care, lifting, reading, headaches, concentration, driving, work, sleeping and recreation) (Vernon & Mior, 1991). Each section has 6 statements, with the first statement scored 0 and the sixth statement scored 5, a total score is obtained and can be expressed in percentage by dividing by the total possible score (50) and multiplying by 100. Higher percentages equal a greater degree of disability. (Vernon & Mior, 1991). The test-retest reliability of the NDI is estimated to be high with an intra-class correlation value of 0.93, 95% confidence limits of 0.86 – 0.97 and an internal

consistency of 0.864 (McCarthy et al, 2007). A study by Odole and colleagues, assessed the test-retest reliability of the NDI among a Nigerian population and ascertained that the NDI is a valid instrument (content validity) for assessing neck pain among a Nigerian population and with a test-retest reliability coefficient of 0.96 (Odole et al, 2011)

2.9.3 Shoulder Pain and Disability Index (SPADI)

The shoulder pain and disability index was design to assess the level of pain and disability in patients as a result of shoulder pathologies. It is a self-administered questionnaire. It contains of 13 statements distributed across two subscales (pain and disability), there are 5 questions under the pain subscale and 8 questions under the disability subscale (Roach et al, 1991). Answering the SPADI patients were required to mark a point on line which best describes their pain or disability, at the ends of the lines are statements that describe the severity of the pain or disability as no pain/ difficulty to worst pain imaginable/so difficult required help (similar to the Visual analogue scale) (Roach et al, 1991). To score the SPADI the horizontal line is divided into 12 segments scored 0 to 11 and the point where the patient marked is assigned the score for the segment the mark falls in (Roach et al, 1991). The subscale scores are calculated by adding the scores gotten for each point the patient marks and dividing by the total possible scores for the subscales items that were applicable by the patient (the number of items for which the patient provides an answer) and the multiplying by 100. The total SPADI scored is obtained by averaging the scores for the pain and disability subscales. Total scores can vary from 0 to 100, with higher values representing greater degree of pain and disability (Roach et al, 1991). Roach et al, evaluated the test-retest reliability of the SPADI and obtained a coefficient of 0.6552, the values for the criterion validity ranged from -0.5555 to -0.8036 (Roach et al, 1991). A similar study on the validity and reliability of the SPADI among a Dutch population reported a test-

retest reliability with intra-class correlation value of 0.89 (95% CI 0.82 – 0.93) and a correlation validity between the SPADI and the shoulder disability questionnaire (SDQ) of r = 0.69 (Graaf et al, 2014).

2.9.4 Scoliosis Research Society Questionnaire (SRS-22)

The SRS question was originally designed by Haher et al (1999), to provide a patient based assessment tool for assessing surgical outcomes of patients with idiopathic scoliosis (Asher et al, 2003; Berven et al, 2003), several modifications have been made to the original question resulting in the SRS-22 which has been validated for use in the assessment of the quality of life in the patient with idiopathic scoliosis (Vavken, 2015) and also for use in the assessment of adult spinal deformities in general (Berven et al, 2003). The SRS-22 assesses the patients level of pain at various durations, their perception of their appearance, their levels of activity, the impact of their medications and how the condition affects their psychological state and social relationships. (Scoliosis Research Society, 2003). The current modification of the SRS questionnaire is the SRS-30, which encompasses the SRS-22 and also serve as an outcome measure for assessing post-surgical intervention for spinal deformities. Scoring the SRS question involves grading each answer that the patient chooses under each question. There are 22 questions with 5 answers each describing, with the answer describing the best possible outcome scored 5 and the answer describing the worst outcome scored 1. The questionnaire is divided into domains (function, pain, satisfaction with management, self-image and mental health) and the total score for the domains is calculated, the total score for the questionnaire is also calculated (with scores ranging from 22 to 110), the mean score for the questionnaire is also calculated (values ranging from 1 to 5), lower values represent greater degrees of pain and disability (Scoliosis Research Society, 2006). Studies have examined the validity and reliability of the SRS questionnaire an instrument of

clinical measurement, Asher et al evaluated the test-retest reliability of the SRS-22 questionnaire and obtained an intra-class correlation value of 0.75 for all the domains of the SRS-22, the study also evaluated the concurrent validity of the SRS-22 questionnaire with the SF-36 questionnaire (Short form-36 survey used to assess Health-Related Quality of Life) obtaining correlational values of 0.92 ($p < 0.0001$) between the pain domains of both questionnaires, and values ranging between 0.77 to 0.84 for the other domains (Asher et al, 2003).

2.10 Summary of Literature Review

Musculoskeletal symptoms are health conditions that affect the musculoskeletal system of the body, affectations involve the muscles, tendons, skeletal structures, the ligaments and the nerve and vessels that supply these structures. Symptoms of musculoskeletal symptoms may be short lived or may be chronic and associated with an ongoing disability. Musculoskeletal symptoms are a common problem globally and can be found in both the young and adult population. Common causes of musculoskeletal symptoms include trauma, awkward and static body postures, non-ergonomic nature of the home or work environment. Musculoskeletal symptoms are known to affect different parts of the body such as the neck, the back, the shoulder and regions of the upper and lower limbs, symptoms can vary depending on the nature of one's activities of daily living and the kind of work environment one is exposed to. The symptoms of musculoskeletal symptoms mainly involve pain and affectation of the range of motion. In the management of musculoskeletal symptoms early diagnosis is a crucial factor and involves a detailed history of the patient, physical examination (including orthopedic tests such as straight leg raise test, empty can test), and radiographic examination (x-ray of the spine is particularly used to diagnose degenerative processes in the spine, detect fractures in the spine and especially in the diagnosis of scoliosis in measuring the cobb angle which is used to measure the progression of the scoliotic

curve). Musculoskeletal symptoms can be prevented by improving the ergonomics of the home or work environment, postural and behavioral changes, wearing protective equipment and physical exercises. Management of musculoskeletal symptoms involve pharmaceutical, therapeutic and surgical interventions. Outcome measures can be used in the assessment of the pain and disability caused by the musculoskeletal symptoms to the patient and also to assess the patients' perception of their condition. These outcome measures include the Oswestry disability index (ODI), used to assess the degree of pain and disability in patients with low back pain, the neck disability index (NDI), the Standardized Nordic musculoskeletal questionnaire, used to assess the occurrence of musculoskeletal disorders and varies levels of limitations at home and work. the shoulder pain and disability index (SPADI) and the Scoliosis Research Society -22 questionnaire (SRS-22) which can be used to assess the level of pain and disability of patients with scoliosis and other spinal deformities and also to assess their perception of their appearance and how it impacts their psychology and social life.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Participants

3.1.1 Participant Selection

This study was conducted among Intra-campus commercial drivers in the University of Benin, Benin city, Edo state, Nigeria.

3.1.2 Inclusion Criteria

The following participants were included in this study:

i. Intra-campus commercial drivers in the University of Benin, Benin city.
ii. Intra-campus commercial drivers who are aged 21 to 65 years.
iii. Intra-campus commercial drivers who have working experience of 12 months and above.
iv. Intra-campus commercial drivers who will give consent to this research.

3.1.3 Exclusion Criteria

The following participants were excluded from this study:

i. Intra-campus commercial drivers with previous traumatic musculoskeletal injuries to the spine, neck or shoulder region and extremities.

ii. Intra-campus commercial drivers with rheumatic diseases, neurological diseases or other underlying health conditions, affecting active or unsupported ambulation.

3.2 Materials

3.2.1 Apparatus/Instruments

Proforma: This was used to obtain information on sociodemographic variables and document anthropometric characteristics of the respondents (age, marital status, religion, educational level, type of vehicle, years of driving, hours spent driving daily, height and weight).

The Standardized Nordic Musculoskeletal Questionnaire: The Standardized Nordic Musculoskeletal Questionnaire was developed by Kuorinka et al (1987) to serve as an instrument for the examination of musculoskeletal symptoms among a given population within an ergonomic context and for occupational health services. The standardization of the assessment questions is required for the analysis and detection of musculoskeletal complaints of various persons in different regions of the world utilizing indirect approaches. It would be difficult to compare the results of different investigations if this were the case. As a result, Kuorinka and his team worked with the Nordic Council of Ministers to design the NMQ (Kuorinka et al, 1987). It consists of 28 multiple-choice questions, some of which are negative, divided into two sections. The first section, referred to as "generic," relates to symptoms in nine body areas (neck, shoulders, elbows, wrists/hands, upper back, lower back, hip/thighs, knees, and ankles/feet) within the last 12 months/7 days. The second section, which is more precise, relates to symptoms in three regions of the body (neck, shoulders, and lower back) over the course of the subject's working life (7 days prior). The validity of the questionnaire showed a number of dissimilar answers varying between 0% to 20% (Kuorinka et al, 1987). The Nordic Musculoskeletal questionnaire when used to assess pain within the past 7 days has a sensitivity that ranges between 66% and 92% and a specificity that ranges between 71% and 88% (Ohlsson et al, 1994).

The sensitivity was highest at the shoulders and lowest at the neck, while the specificity was highest at the elbows and lowest at the shoulders (Ohlsson et al, 1994). The Nordic musculoskeletal questionnaire has a good reliability for assessing musculoskeletal symptoms with a kappa coefficient that varies between 0.64 and 0.71 for pain in the past one week, 0.73 and 0.82 for pain in the past year and between 0.59 and 0.78 for pain in the past year that interferes with work or leisure (Palmer et al, 1999).

3.3 Methods

3.3.1 Sampling Technique

This study was conducted in University of Benin, Benin City and Intra-campus commercial drivers will be recruited for this research. A convenience sampling technique was used for this study.

3.3.2 Sample Size Determination

Sample size was determined using the Slovin's formula

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

Where n = Sample size

N = Population size

e = Margin of error (set at 0.05)

The total record of Intra-campus commercial drivers in the University of Benin is 100 as gotten from the university of Benin Intra-campus commercial drivers union.

So therefore,

$$n = \frac{100}{1 + 100(0.05)^2}$$

n = 80

The sample size for this research is 80.

3.3.3 Research Design

A cross sectional survey research design was used in this study.

3.3.4 Procedure for Data Collection

The data for this study was collected using the Standardized Nordic Musculoskeletal Questionnaire. 80 Intra-campus commercial drivers in the University of Benin were recruited to complete the questionnaire while the researcher clarify any question and provide assistance answering when needed. The researcher recorded responses from the respondents.

3.3.5 Ethical Consideration

Ethical approval for this study was obtained (CMS/REC/2023/373) from the Ethics Research Committee of College of Medical Sciences, University of Benin, Benin City.

Informed consent was obtained from the intra campus commercial drivers. Before seeking informed consent, prospective participants were adequately informed about the aims, methods, any possible conflicts of interest, institutional affiliations of the researcher, the anticipated benefits and potential discomfort it may entail. Afterwards, participants were reserved with the right to refuse to participate without reprisal.

3.3.6 Data Analysis

Data was analyzed using descriptive statistics of mean, frequency and standard deviation. Chi Square was used to determine the association between the occurrence of musculoskeletal symptoms and occupation. Data was analyzed using Statistical Package for Social Sciences (IBM SPSS) version 21. The level of significance was set at $p<0.05$.

CHAPTER FOUR

RESULTS

4.1.1 SOCIODEMOGRAPHIC DATA OF THE RESPONDENTS

80 respondents were recruited for this study. 100% of the respondents were male, with no female respondents. Majority of the respondents' ethnicity were Benin 74 (92.5%) while Benue represents the ethnic group with the least 1 (1.3%). Regarding marital status, the majority of the respondents, 67 (83.8%) were married, while only 1 (1.3%) identified as a widower. Most of the respondents were Christians 71 (88.8%). In relation to educational background, 54 respondents (67.5%) had completed secondary education, while 26 individuals (32.5%) had attained a tertiary education level. 38 (47.5%) were employed as cab drivers, whereas 42 (52.1%) respondents worked as bus drivers within the campus. The socio-demographic characteristics are shown on Table 1.

Table 1: Socio-demographic data of participants N=80

Variable	Category	Frequency	Percentage (%)
Age	25-30	8	10.1
	31-35	5	6.3
	36-40	7	8.8
	40-45	14	17.5
	>45	46	57.5
Ethnicity	Benin	74	92.5
	Delta	3	3
	Yoruba	2	2.6
	Benue	1	1.3
Marital Status	Single	9	11.3
	Married	67	83.8
	Divorce	3	3.8
	Widowed	1	1.3
Religion	Christian	71	88.8
	Muslim	1	1.3
	Others	8	10.1
Education Level	Secondary	54	67.5
	Tertiary	26	32.5
Type of Vehicle	Bus	38	47.5
	Cab	42	52.5

Table 2: Physical characteristics of respondents N=80

Variables	Minimum	Maximum	Mean ± SD
Weight (Kg)	45.80	88.60	66.36 ± 9.78
Height (m)	1.26	1.89	1.61 ± 0.12
BMI (Kg/m^2)	17.35	36.65	25.70 ± 4.32
Driving duration (years)	1	27	7.96 ± 5.18
Daily driving (hrs)	4	15	9.26 ± 2.51

Table 2 shows the weight (kg) ranged from 45.80 to 88.60kg with a mean 66.36 ± 9.78kg and the height (m) ranged from 1.26 to 1.89m with a mean of 1.61 ± 0.12. BMI (kg/m^2) of the respondents ranged between 17.35 and 36.65kg/m^2 with a mean value of 25.70 ± 4.32. The driving duration (years) of the respondents ranged between 1 and 27 years with a mean year of 7.96 ± 5.18. The daily driving hours ranged from 4 hours to 15 hours with a mean value of 9.56 ± 2.51.

4.1.3.1 PREVALENCE OF LOW BACK PAIN AMONG RESPONDENTS

Table 3: Prevalence of LBP among respondents N = 80

Variable	Frequency	Percentage (%)
Have you ever had low back pain?		
Yes	50	50.0
No	50	50.0
What is the total length of time you had low back pain in the past 12 months?		
0 days	41	51.3
1 – 7 days	18	22.5
6 – 30 days	11	13.8
More than 30 days	9	11.3
Everyday	1	1.3
Have you low back pain in the last 7 days?		
Yes	21	26.3
No	59	73.8

As shown in Table 3, it is observed that the lifetime prevalence of LBP was 50%, with 40 of respondents reporting to have ever had LBP. The 12-month prevalence of low back pain among respondents was 48.7% (39), while the point prevalence within the last 7 days of the study was 26.3% (21).

4.1.3.2 PREVALENCE OF NECK PAIN AMONG RESPONDENTS

Table 4: Prevalence of neck pain among respondents N = 80

Variable	Frequency	Percentage (%)
Have you ever had neck pain?		
Yes	12	15.0
No	68	85.0
What is the total length of time you had neck pain in the past 12 months?		
0 days	70	87.5
1 – 7 days	4	5.0
6 – 30 days	3	3.8
More than 30 days	3	3.8
Everyday	0	0
Have you neck pain in the last 7 days?		
Yes	8	10.0
No	72	90.0

As shown in Table 4, it is observed that the lifetime prevalence of neck pain was 15.0%, with 12 of respondents reporting to have ever had neck pain. When considering the 12-month prevalence, 10 respondents (12.5%) reported experiencing neck pain within the past year, specifically within a period of 1 to 7 days. 8 (10.0%) of the respondents reported to have had neck pain within the last 7 days of the study.

4.1.3.3 PREVALENCE OF SHOULDER PAIN AMONG THE RESPONDENTS

Table 5: Prevalence of shoulder pain among the respondents N = 80

Variable	Frequency	Percentage (%)
Have you ever had shoulder pain?		
Yes	27	33.8
No	53	66.3
What is the total length of time you had shoulder pain in the past 12 months?		
0 days	54	67.5
1 – 7 days	14	17.5
6 – 30 days	10	12.5
More than 30 days	2	2.5
Everyday	0	0
Have you shoulder pain in the last 7 days?		
Yes	13	16.3
No	67	83.8

As shown in Table 5, it is observed that the lifetime prevalence of shoulder pain was 33.8%, with 27 of the respondents reporting to have ever had shoulder pain. The 12-month prevalence of shoulder pain was (32.5%), with 26 of the respondents also reported to have shoulder pain in the last 12 months. The point prevalence of shoulder pain was reported to be (16.3%), 13 of the respondents reported to have had shoulder pain within the last 7 days of the study.

4.1.4 CHI-SQUARE RELATIONSHIP BETWEEN SOCIO-DEMOGRAPHICS AND PREVALENCE OF MUSCULOSKELETAL SYMPTOMS

Variable	Category	LBP		X^2	p-value
		Yes(n)	No(n)		
Age	25-30	6	2	14.402	0.013*
	31-35	1	4		
	35-40	2	5		
	>40	3	11		
Ethnicity	Benin	29	30	7.509	0.578
	Delta	2	1		
	Yoruba	2	0		
	Benue	1	0		
Marital Status	Single	8	1	7.509	0.057
	Married	30	37		
	Divorce	1	2		
	Widowed	1	0		
Religion	Christian	36	35	1.014	0.602
	Muslim	0	1		
	Others	4	2		

As shown in table 6, there was a significant relationship between age (p=0.013) and education level (p=0.017) with prevalence of LBP. Moreover, Table 7 reveals significant relationship between ethnicity and neck pain (p=0.016), as well as marital status and neck pain (p=0.028). Furthermore, Table 8 demonstrates a statistically significant relationship between religion and shoulder pain (p=0.028).

Education Level	Secondary	32	22	5.698	0.017*
	Tertiary	8	18		
Type of Vehicle	Bus	17	21	0.802	0.370
	Cab	23	19		

Variable	**Category**	**Neck pain**		**X^2**	**p-value**
		Yes(n)	**No(n)**		
Age	25-30	4	5	8.803	0.117
	31-35	0	5		
	35-40	2	5		
	40-45	0	14		
	>45	7	39		
Ethnicity	Benin	10	64	12.617	0.016*
	Delta	0	3		
	Yoruba	2	0		
	Benue	0	1		
Marital Status	Single	3	6	9.061	0.028*
	Married	8	59		
	Divorce	0	3		
	Widowed	1	0		
Religion	Christian	12	59	1.790	0.409
	Muslim	0	1		
	Others	0	8		

Table 6: Association between socio-demographics and LBP among intra campus commercial drivers N=80

Education Level	Secondary	6	48	1.971	0.160
	Tertiary	6	20		
Type of Vehicle	Bus	5	33	0.193	0.661
	Cab	7	35		

Variable	**Category**	**Shoulder pain**		**X^2**	**p-value**
		Yes(n)	**No(n)**		
Age	25-30	4	5	4.503	0.480
	31-35	1	4		
	35-40	1	6		
	40-45	3	11		
	>45	19	27		
Ethnicity	Benin	23	51	6.125	0.190
	Delta	2	1		
	Yoruba	1	1		
	Benue	1	0		
Marital Status	Single	4	5	4.333	0.228
	Married	20	47		
	Divorce	2	1		
	Widowed	1	0		
Religion	Christian	21	50	7.150	0.028*
	Muslim	0	1		
	Others	6	2		
Education Level	Secondary	21	33	1.962	0.161
	Tertiary	6	20		

Table 7: Association between socio-demographics and Neck pain among intra campus commercial drivers N=80

Type of Vehicle	Bus	13	25	0.007	0.934
	Cab	14	28		

Table 8: Association between socio-demographics and Shoulder pain among intra campus commercial drivers N=80

4.1.5 SPEARMAN RHO CORRELATION STATISTICS BETWEEN WORKING VARIABLES AND PREVALENCE OF MUSCULOSKELETAL SYMPTOMS

Table 9: Spearman rho correlation between BMI, driving hours and duration of driving with prevalence of low back pain N=80

	BMI(kg/m^2) (rs , p)	**Driving hours (rs , p)**	**Duration of driving (rs , p)**
Low back pain			
Lifetime	0.134, 0.04*	0.146, 0.031*	-0.063, 0.580
12 month	-0.078, 0.494	-0.074, 0.640	0.062, 0.585
Point	0.129, 0.356	0.036, 0.753	0.059, 0.603
Neck pain			
Lifetime	0.171, 0.129	0.040, 0.723	-0.055, 0.630
12 month	-0.122, 0.280	-0.020, 0.858	0.773, 0.033*
Point	0.134, 0.238	-0.043, 0.708	-0.055, 0.630

Shoulder pain			
Lifetime	-0.62, 0.582	0.076, 0.040*	0.169, 0.134
12 month	0.111, 0.328	0.116, 0.304	-0.124, 0.271
Point	-0.010, 0.993	-0.183, 0.104	0.068, 0.548

Spearman's rho correlation statistics was used to examine the potential relationship between driving hours, duration of driving, and the prevalence of lower back pain (LBP), neck pain, and shoulder pain. The findings indicated a significant association between the 12 month prevalence of LBP and driving hours ($rs=0.134$, $p=0.04$). Similarly, there was a significant association between lifetime prevalence of shoulder pain and driving hours ($rs=0.146$, $p=0.031$), while there was also a significant association between 12 month prevalence of neck pain and driving duration ($rs=0.773$, $p=0.033$).

4.2 HYPOTHESIS TESTING

Hypothesis 1: The hypothesis stated that there would be no significant relationship between driving hours and the lifetime prevalence of low back pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: $p < 0.05$

Since the observed p value was less than 0.05 Alpha level. The hypothesis was therefore REJECTED

Hypothesis 2: The hypothesis stated that there would be no significant relationship between driving hours and the 12 month prevalence of low back pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED.

Hypothesis 3: The hypothesis stated that there would be no significant relationship between driving hours and the 12 month prevalence of low back pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED

Hypothesis 4: The hypothesis stated that there would be no significant relationship between driving hours and the lifetime prevalence of neck pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED

Hypothesis 5: The hypothesis stated that there would be no significant relationship between driving hours and the 12 month prevalence of neck pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED

Hypothesis 6: The hypothesis stated that there would be no significant relationship between driving hours and the point prevalence of neck pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED

Hypothesis 7: The hypothesis stated that there would be no significant relationship between driving hours and the lifetime prevalence of shoulder pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: $p < 0.05$

Since the observed p value was less than 0.05 Alpha level. The hypothesis was therefore REJECTED

Hypothesis 8: The hypothesis stated that there would be no significant relationship between driving hours and the 12 month prevalence of shoulder pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: p >0.05

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED

Hypothesis 9: The hypothesis stated that there would be no significant relationship between driving hours and the point prevalence of shoulder pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: p >0.05

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED

Hypothesis 10: The hypothesis stated that there would be no significant association between type of driving vehicle and the prevalence of low back pain

Alpha level: 0.05

Test statistics: Chi square test

Observed: p >0.05

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED

Hypothesis 11: The hypothesis stated that there would be no significant association between type of driving vehicle and the prevalence of neck pain

Alpha level: 0.05

Test statistics: Chi square test

Observed: p >0.05

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED

Hypothesis 12: The hypothesis stated that there would be no significant association between type of driving vehicle and the prevalence of shoulder pain

Alpha level: 0.05

Test statistics: Chi square test

Observed: p >0.05

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED

Hypothesis 13: The hypothesis stated that there would be no significant relationship between years of driving experience and the lifetime prevalence of low back pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: p >0.05

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED

Hypothesis 14: The hypothesis stated that there would be no significant relationship between years of driving experience and the l2 month prevalence of low back pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: p >0.05

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED

Hypothesis 14: The hypothesis stated that there would be no significant relationship between years of driving experience and the 7 days prevalence of low back pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: p >0.05

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED

Hypothesis 15: The hypothesis stated that there would be no significant relationship between years of driving experience and the lifetime prevalence of neck pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: p >0.05

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED

Hypothesis 16: The hypothesis stated that there would be no significant relationship between years of driving experience and the l2 month prevalence of neck pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: $p < 0.05$

Since the observed p value was lesser than 0.05 Alpha level, I therefore FAIL TO REJECT the null hypothesis.

Hypothesis 17: The hypothesis stated that there would be no significant relationship between years of driving experience and the 7 days prevalence of neck pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED

Hypothesis 18: The hypothesis stated that there would be no significant relationship between years of driving experience and the lifetime prevalence of shoulder pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED.

Hypothesis 19: The hypothesis stated that there would be no significant relationship between years of driving experience and the 12 prevalence of neck pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED.

Hypothesis 20: The hypothesis stated that there would be no significant relationship between years of driving experience and the 7 days prevalence of neck pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED

Hypothesis 21: The hypothesis stated that there would be no significant relationship between age and the prevalence of low back pain.

Alpha level: 0.05

Test statistics: chi square test

Observed: $p < 0.05$

Since the observed p value was less than 0.05 Alpha level, I therefore reject the null hypothesis.

Hypothesis 22: The hypothesis stated that there would be no significant relationship between age and the prevalence of neck pain.

Alpha level: 0.05

Test statistics: Chi square test

Observed: p >0.05

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED

Hypothesis 23: The hypothesis stated that there would be no significant relationship between age and prevalence of shoulder pain

Alpha level: 0.05

Test statistics: Spearman's correlation

Observed: p >0.05

Since the observed p value was greater than 0.05 Alpha level. The hypothesis was therefore NOT REJECTED

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This study investigated the prevalence of work related musculoskeletal disorders among intra-campus commercial drivers in University of Benin.

5.1 Prevalence of Low Back Pain among Respondents

The findings of this study showed that the lifetime prevalence of LBP in respondents was 50%, the 12-month prevalence of low back pain among respondents was 48.7%, while the point prevalence within the last 7 days of the study was 26.3%. The finding is in agreement with reports of Joseph *et al*. (2020), where the prevalence of musculoskeletal pain (MSP) ranged between 43.1% and 93% with low back pain as the most frequently reported body region for MSP.

The study conducted in Sao Paulo, Brazil, focused on 410 drivers experienced low back pain, while 41% did not report any low back pain (Andrusaitis *et al*., 2006). This relatively high prevalence of low back pain is in contrast with the findings from the present study. In another research conducted by Fadhli *et al*. (2016) in Malaysia, it was discovered that low back pain was

the most common complaint among Malaysian bus drivers, accounting for 60.4% of musculoskeletal disorders (MSDs) reported. This indicates a significant issue with low back pain among the Malaysian bus driver population. However, Fadhli *et al*.'s (2016) study in Taipei aligns more closely with this study's results, as it revealed a prevalence of approximately 51% for low back pain among commercial bus drivers in Taipei (Fadhli *et al*., 2016).

These differing prevalence rates could be attributed to a range of factors, including variations in study methodologies, cultural differences, work-related conditions, ergonomic considerations, and healthcare access.

5.2 Prevalence of Neck Pain among Respondents

The findings of the present study showed that the lifetime prevalence of neck pain among respondents was 15.0%, When considering the 12-month prevalence, 12.5% reported experiencing neck pain within the past year, specifically within a period of 1 to 7 days while 10.0% of the respondents reported to have had neck pain within the last 7 days. This shows that there is low risk of drivers developing neck pain unlike low back pain. Relating this with the study done by Joseph *et al*. (2020) whose study reveals a 12-month mean prevalence of 37.2 % professional drivers experiencing neck pain, the present study has a lower prevalence. Another study by Bovenzi., *et al* (2014), reported that the cumulative incidence for neck pain was 31.9% which is also in contrast to the findings of this present study.

However, comparing the result of the present study to a study done among commercial drivers in Mubi, Nigeria by Maduagwu *et al* (2020) which found that the prevalence of neck pain within

12 months was 18.9%, a percentage which can be said to be in agreement with the finding from the current study. Similarly, a study by Kashif *et al*. (2015) among drivers at the University of Faisalabad found that only 18% of drivers experienced neck pain, while the remaining 82% were pain-free, which further corroborates the findings of the present study. This similarity in the prevalence of neck pain among different driver populations across different studies suggests a certain level of consistency in the experiences of drivers when it comes to neck pain. It could indicate that certain occupational and ergonomic factors in the driving profession might contribute to similar rates of neck pain across various contexts.

5.3 Prevalence of Shoulder Pain among Respondents

The findings of this study showed that lifetime prevalence of shoulder pain was 33.8% while the 12-month prevalence of shoulder pain was 32.5% and the point prevalence of shoulder pain been 16.3%. Shoulder pain is not very common among drivers, however, the annual prevalence of neck pain was reported to be 18.9% in a study conducted among Mubi drivers (Maduagwu *et al*., 2020). Prevalence rate from the present study is found to be higher than that reported by Maduagwu *et al*.. According to Joseph *et al*. (2020), the global meta-prevalence data of MSP shoulder regions was 39.2% among professional drivers which is in agreement with the result of the present study. Bovenzi (2014) conducted a study on drivers working for public utilities and found that the 12-month prevalence of shoulder pain varied between 15% and 52%, a range that is line with the findings of this present study.

5.4 Association between socio-demographics and Prevalence of LBP.

The findings of the present study showed there is a significant correlation between driving hours and prevalence of low back pain. This observations has been reported by previous similar study by Rufa'i *et al*.'s (2011) where prevalence of low back pain was associated to driving for more than 15 hours per day. This suggests a clear influence of the time spent driving on the likelihood of experiencing LBP. The prolonged duration of driving might contribute to postural strain and discomfort, potentially leading to higher chances of LBP development. Also, result of the present study shows that there is a significant correlation between 12 month prevalence of low back pain and Body mass index. The association between BMI (Body Mass Index) and the lifetime prevalence of LBP aligns with Siddiqui *et al*.'s study, which emphasized the heightened probability of individuals with higher BMI experiencing LBP. The relationship between weight gain and lumbar spine compression in the lower back contributes to this heightened risk. Moreover, the significant relationship between the duration of driving

5.5 Association between socio-demographics and Prevalence of Neck pain

The result of this study showed that the 12-month prevalence of neck pain is significantly correlated with duration of driving. This is in agreement with previous study by Bovenzi (2014) and Maduagwu *et al*., 2020 who also found a significant association between prevalence of neck pain and duration of driving. Prolonged driving can contribute to the development of neck pain due to maintaining a consistent and proper driving posture is crucial to preventing neck pain. However, during long drives, people tend to slouch, hunch forward, or extend their necks excessively, which can strain the muscles and ligaments in the neck area.

5.6 Association between socio-demographics and Prevalence of shoulder pain

The findings of the present study also showed a significant correlation between prevalence of shoulder pain and driving hours. This is in agreement with previous study by Bovenzi (2014) and Kasemsan *et al*., 2021 who also found a significant association between prevalence of neck pain and duration of driving. Driving involves being in a relatively static position for an extended period. This lack of movement can cause muscles to become tense and fatigued. As a result, the muscles supporting the shoulder may become tight and uncomfortable.

5.7 Conclusion

The Intra-campus commercial drivers in University of Benin have high prevalence of work related musculoskeletal disorders with low back pain taking the highest percentage, but low prevalence of shoulder pain and least for neck pain in this study. It has also been from the findings of this study that BMI, driving hours, duration of driving contributes to the risk of experiencing these MSDs.

5.8 Recommendations

I. To prevent drivers from musculoskeletal disorders, emphasis should be made on the benefit of strengthening and stretching of trunk muscles need to be done by the drivers.

II. Emphasis should be laid on proper work postures that are ergonomic for driving in this case the back, neck, and hand positioning, especially for those working for a long period so as to avoid WRMSDs.

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APPENDIX 1

PROFORMA

Age (in years): _____

Marital Status: Single [ ] Married [ ] Divorced [ ] widowed [ ]

Religion: Christian [ ] Muslim [ ] Others [ ]

How long have you been driving in this school: _____

How many hours do you spend driving daily: _____

What type of vehicle do you drive: _____

Educational level: _____

Ethnicity: _____

Height: _____

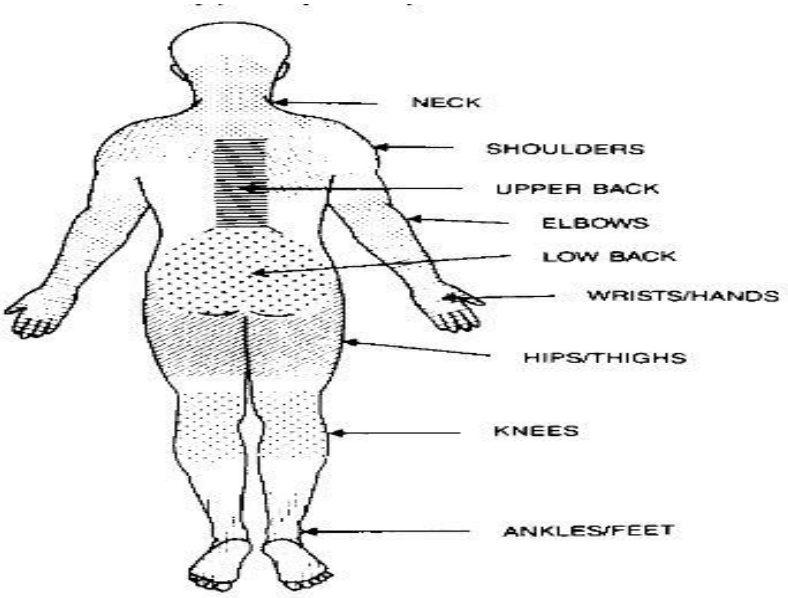
Weight: _____

Body mass index: _____

APPENDIX 2

NORDIC MUSCULOSKELETAL QUESTIONNAIRE

Please answer by marking the appropriate box – one mark for each question. You may be in doubt on how to answer but please do your best anyway. Please answer every question, even if you have never had trouble in any part of your body. In this picture, you can see the appropriate position of the parts of the body referred to in the questionnaire. Limits are not sharply defined and certain parts overlap. You should decide for yourself which part you have or have had your trouble (if any).



Questionnaire about the Low Back

S/N	QUESTIONS	No	Yes
1	Have you ever had low back trouble (ache pain or discomfort)?		
2	Have you ever been hospitalized because of low back trouble?		
3	Have you ever been absent from work because of low back trouble?		
4	What is the total length of time you had low back trouble during the last 12 months? a). 0 days b). 1 – 7 days c). 6 – 30 days d). More than 30 days, but not every day e). Every		

	day		
5	Has low back trouble caused you to reduce your activity during the last 12 months?	No	Yes
6	What is the total length of time that low back trouble has prevented you from doing your normal work during the last 12 months? a). 0 days b). 1 – 7 days c). 6 – 30 days d). More than 30 days, but not every day e). Every day		
7	Have you ever had low back trouble at any time during the last 7 days?		
8	Have you ever been seen by a doctor, physiotherapist, chiropractor or other such person because of lower back trouble during the last 12 months?		

Questionnaire about the Neck

S/N	QUESTIONS	ANSWERS No	Yes
9	Have you ever had neck, ache, pain or discomfort)?		
10	Have you ever hurt your neck in an accident?		
11	Have you ever been absent from work because of neck trouble?		
12	What is the total length of time you had neck trouble during the last 12 months? a) 0 days b) 1 – 7 days c) 6 – 30 days d) More than 30 days, but not every day e) Every day		
13	Has neck trouble caused you to reduce your activity during the last 12 months?		
14	What is the total length of time that neck trouble has prevented you from doing your normal work during the last 12 months? a) 0 days b) 1 – 7 days c) 6 – 30 days d) More than 30 days		

15	Have you ever had neck trouble during at any time during the last 7 days?		
16	Have you ever been seen by a doctor, physiotherapist, chiropractor or other such person because of neck trouble during the last 12 months?		

Questionnaire about the Shoulder

S/N	QUESTIONS	ANSWERS No	Yes
17	Have you ever had shoulder trouble (ache pain or discomfort)?		
18	Have you ever been hurt in your shoulder in an accident?		
19	Have you ever been absent from work because of shoulder trouble?		
20	Have you had shoulder trouble in the past 12 months? a) my right shoulder b) my left shoulder c) both shoulders		
21	What is the total length of time you had shoulder trouble during the last 12 months? a) 0 days b) 1 – 7 days c) 6 – 30 days d) More than 30 days, but not every day e) Every day		
22	Has shoulder trouble caused you to reduce your activity during the last 12 months?		

23	What is the total length of time that shoulder trouble has prevented you from doing your normal work during the last 12 months? a) 0 days b) 1 – 7 days c) 6 – 3 days d) More than 30 days		
24	Have you ever had shoulder trouble during at any time during the last 7 days?		
25	Have you ever been seen by a doctor, physiotherapist, chiropractor or other such person because of shoulder trouble during the last 12 months?		

APPENDIX 3

Figure 6 Measurement of the weight of the participant