INTERDEPENDENCE OF PROLONGED COMPUTER USAGE AND MUSCULOSKELETAL PAIN AMONG UNIVERSITY OF BENIN ENGINEERING STUDENTS

BY

OSUNDE, OSAYIWENSE GORGEOUS

(BMS2001289)

A PROJECT PROPOSAL SUBMITTED TO THE DEPARTMENT OF PHYSIOTHERAPY, SCHOOL OF BASIC MEDICAL SCIENCES, COLLEGE OF MEDICAL SCIENCES, UNIVERSITY OF BENIN IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF PHYSIOTHERAPY (B.PT) DEGREE

OCTOBER, 2025

CERTIFICATION

This dissertation by Osunde Gorgeous Osayiwense 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.

SUPERVISOR **SIGNATURE AND DATE**

DR. ADEBISI HAMMED **……………………………..**

EXTERNAL EXAMINER

(NAME) **……………………………..**

APPROVED

………………………………..

DR. MRS C. O. OBASEKI

HEAD

DEPARTMENT OF PHYSIOTHERAPY

COLLEGE OF MEDICAL SCIENCES

UNIVERSITY OF BENIN

DEDICATION

This dissertation is dedicated to God Almighty, the very reason I am alive and to my parents, Mr. and Mrs. Osunde who made this work a reality through their constant support.

ABSTRACTS

Background: Musculoskeletal pain is a major health concern worldwide. In modern universities, students rely heavily on technology for their studies, which leads to long hours spent on computers. This extended use, especially when combined with bad posture, contributes to MSK pain. Engineering students face an even greater risk as they often need to use specialized software for long hours. However, research on how this issue affects university students in Nigeria is still limited. The aim of this study was to determine the interdependence of prolonged computer usage and musculoskeletal pain among University of Benin Engineering students.

Methods: A cross-sectional study involving 378 undergraduate students from the Faculty of Engineering at the University of Benin was conducted. Data was collected using adapted versions of the NMQ and SLUMP Questionnaire. Descriptive of frequency and percentage were used to summarize the socio-demographic characteristics of the respondents while inferential statistics of Spearman’s rank correlation, Kruskal–Wallis test and Chi square were used to test the hypotheses. Alpha level was set at 0.05.

Results: The findings showed that there was a high level of MSK pain among engineering undergraduates. Most symptoms were reported in the neck and lower back, with severe pain being most common in the lower back.

Conclusion: MSK pain is very common among engineering students at the University of Benin, primarily affecting their necks and lower backs. The importance of taking breaks indicates that behavioral habits play a crucial role in managing this issue among this population.

Keywords: Musculoskeletal pain, prolonged computer usage, ergonomics

ACKNOWLEDEMENTS

My sincere gratitude goes to Jehovah for the successful completion of this dissertation and His guidance and provision throughout the duration of my studies.

I want to appreciate my supervisor, Dr. Hammed Adebisi, for his ever-ready guidance, advice, and assistance during the course of this research study. I also want to appreciate the Head of Department, Dr. (Mrs.) C. O. Obaseki, for her dedication to this department and all the esteemed lecturers and adjunct lecturers of the Department of Physiotherapy, University of Benin, for their instruction in knowledge and steering me towards a better path during my stay in the department. Special thanks to the members of the Department of Physiotherapy, University of Benin Teaching Hospital, Benin City, Dr. Taiwo Oyewumi the Head of Department, the directors, the chiefs, interns, and other clinicians. I appreciate the skills and knowledge they imparted in me during my days of posting as a student. I also appreciate the non-academic staff of the Department of Physiotherapy, University of Benin.

My heartfelt gratitude goes to my parents, Mr. Ernest Osunde and Mrs. Jennifer Osunde, for their unending love and commitment to my well-being, my brothers Nosa and Obosa for their constant presence, banter and support, and my relatives especially my aunties, Aunt Osas and Aunt Osaya for their words of encouragement, prayers, and financial support throughout my stay on campus. I would also like to appreciate my friends Joan, Ifem, Titilopemi, Elvis and all CEC members (old and new) for their encouragement and tangible support, and special thanks to Nelson, Treasure, TJ, and Osama for their assistance during the period of my data collection. My appreciation goes to all my classmates and all the respondents of my study, members of Heritage Campus Fellowship, and others which the confines of this period will not allow me to state.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Pain as defined by the International Association for the Study of Pain (IASP, 2020) is an unpleasant sensory and emotional experience associated with, or resembling that associated with actual or potential tissue damage. Musculoskeletal (MSK) pain is defined as acute or chronic pain that affects bones, muscles, ligaments, tendons, and even nerves, and the pain associated with MSK disorders is a medical and socioeconomic problem (Smith et al., 2013). Acute MSK pain can be severe, lasts for a short period of time and is predominantly due to local causes such as fractures, sprains, dislocations and infections. In contrast, chronic musculoskeletal pain persists over a long period of time and is likely to be associated with underlying conditions. According to the World Health Organization (2019), 20-33% of the world population has some form of chronic MSK pain, translating to 1.75 billion people globally. MSK pain comprises of a number of different pain syndromes, which range from localized pain to neuropathic pain. MSK pain increases difficulty in carrying out daily activities, results in significantly diminished quality of life and increases the burden on the healthcare system.

In the technology-saturated era we find ourselves in, the academic landscape has taken on a new shape for both academicians and students due to the numerous transformations it has experienced. Particularly at the university level, there is an increasing reliance on technology-based learning systems and tools to assist in completing academic tasks such as conducting research, completing assignments, and accessing learning materials (Al-Fraihat et al., 2020;

Adarkwah, 2021). This increasing reliance on technology leads to periods of prolonged usage of technological devices such as phones, tablets, and computers. The reliance on the computer system is of more importance in academic work as it provides an array of services that are not easily accessible on other technological devices. The availability of computers has made varieties of work faster, easier and less frustrating to the users. Computers (also called video display terminals) have become increasingly common in both workplaces and homes over the past years.

Beyond the increased screen exposure that prolonged computer usage will inevitably cause, there is the concern of associated MSK pain, which has not been sufficiently explored, especially in Nigerian universities, to the best of the researchers' knowledge. Students in higher institutions often engage in extended periods of reading, writing, and research with the computer (Halim & Aziz, 2022), which places them at a higher risk for developing MSK pain. This is more so the case among engineering students who often spend many hours on specialized software. Engineering coursework routinely involves specialized software tools like AutoCAD, SolidWorks and simulation platforms that are resource-intensive and typically require a personal laptop for running for prolonged periods. From health, economic, and academic perspectives, recurring MSK pain can have harmful consequences for both the students and the society. Such pain is commonly associated with discomfort, can interfere with daily and recreational activities, increase psychological stress, and lead to higher financial burdens due to the frequent need for rehabilitative healthcare services.

Unlike the working class adults in a formal setting, university students may not have access to ergonomically designed workspaces, nor do they often receive training or orientation on healthy computing practices. As a result, they become vulnerable to cumulative trauma disorders that can persist beyond their academic years and negatively affects their lives.

According to a study done by Pattath & Webb (2022), MSK pain was found to be prominent in various body regions like the neck and lower back. The study found that the development of MSK pain is usually associated with the improper posture usually employed while using the computer.

Despite the growing importance of this topic, research within the Nigerian university context remains limited. There is a pressing need to investigate these health challenges more thoroughly, especially given the rapid advance of technological integration in tertiary education. Such research can inform policies that support healthier study practices and environments, ultimately contributing to the academic success and long-term health of the student population. Thus, this study seeks to investigate the prevalence, patterns, and contributing factors of MSK pain among Nigerian university undergraduates. The findings will provide valuable insights for the development of effective preventive strategies, ergonomic interventions, and health education programs tailored to the needs of the student population.

1.2 Statement of the Problem

MSK pain which can be acute or chronic affects the patient's quality of life and ability to be fully functional. Prolonged computer usage and its associated variables such as improper posture, poor ergonomics and insufficient breaks has been identified as a major contributor to MSK pain affecting areas such as the neck, back, shoulders, and wrists (Blumenberg et al., 2021). In light of these issues, there is a lack of sufficient awareness and preventive measures among university students, many of whom trivialize or overlook physical pain until it becomes chronic or debilitating.

Although some studies have been conducted to determine the relationship between prolonged computer usage and MSK pain (Biruk et al., 2024; Nur Aqila Nor et al., 2022) it remains unclear to what extent prolonged computer usage directly contributes to the incidence and severity of MSK pain among undergraduates, and how other variables such as posture, ergonomics, or break frequency moderate this relationship.

This study seeks to address this gap by examining the extent of the interdependence between MSK pain and prolonged computer usage among university of Benin engineering students, with the goal of informing future awareness campaigns, ergonomic interventions, and student health policies.

1.3 Research Questions

This study was aimed to answer the following questions:

1. What is the prevalence of MSK pain among university of Benin engineering students who use their computer for prolonged periods?
2. What specific areas of the body are most affected by MSK pain in students who use computers for prolonged periods?
3. Is there a relationship between the duration of daily computer usage and the severity of MSK pain?
4. How do posture, break duration and frequency affect the occurrence of MSK pain among students?
5. What demographic or academic factors (e.g., age, gender, department, year level) influence the interdependence between computer usage and MSK pain?

1.4 Aim of the study

The aim of this study was to determine the interdependence of prolonged computer usage and musculoskeletal pain among University of Benin Engineering students.

1.4.1 Specific Objectives

1. To determine the prevalence of MSK pain among university of Benin engineering students who use computers for prolonged periods.
2. To identify the specific body parts most affected by MSK pain among these students.
3. To examine the relationship between the duration of daily computer use and the severity of MSK pain.
4. To assess the influence of posture and break habits on the occurrence of MSK pain.
5. To investigate the influence of demographic and academic factors (e.g., age, gender, course, year level) on the occurrence and severity of MSK pain.

1.5 Hypotheses

1.5.1 Main Hypothesis

1. There is no significant relationship between prolonged computer use and the prevalence of musculoskeletal pain among the University of Benin, engineering students.

1.5.2 Sub Hypothesis

1. There is no significant relationship between the duration of daily computer use and the severity of MSK pain.
2. There is no significant relationship between gender and the occurrence of MSK pain.
3. There is no significant relationship between age and the occurrence of MSK pain.
4. There is no significant relationship between posture and the occurrence of MSK pain.
5. There is no significant relationship between break duration and the occurrence of MSK pain.
6. There is no significant relationship between break frequency and the occurrence of MSK pain.
7. There is no significant relationship between academic level and the occurrence of MSK pain.
8. There is no significant relationship between department and the occurrence of MSK pain.

1.6 Significance of the Study

This study could benefit university students, health care professionals, educators and institutional policy makers.

This study provides several important benefits for students. It serves to increase awareness about the connection between prolonged computer use and the occurrence of musculoskeletal issues, like pain in the neck, shoulders, and back. The study pointed out specific risk factors—like bad posture, poor workstation setup, and not taking enough movement breaks—that students might not notice otherwise. By recognizing these changeable habits, the research could encourage students to take steps to prevent problems by improving their study routines, arranging their workspaces better, and increasing physical activity. Moreover, the results could be used to push for healthier campus spaces, such as better seating in libraries and computer labs, along with including ergonomic education in student wellness programs.

The study could also offer important advantages for healthcare workers, especially those in physiotherapy, occupational health, and ergonomics. By showing the relationship between prolonged computer use and musculoskeletal pain in students, the study gives helpful information about new health trends among young people. This information could help healthcare workers identify, assess, and prevent computer-related musculoskeletal issues earlier. The results could assist practitioners in creating focused intervention programs that include ergonomic education, correcting posture, prescribing exercises, and changing behaviors. Additionally, the study could encourage the use of evidence-based ergonomics in student health services and helps shape preventive public health policies in schools. Overall, it may improve clinical decision-making and allows healthcare providers to offer more proactive and customized care for a generation that relies heavily on technology and spends more time sitting.

It could also provide valuable insights for both educators and institutional policymakers by highlighting the health risks associated with extended computer use in academic settings by emphasizing how digital learning and academic pressure can contribute to musculoskeletal pain due to poor posture and prolonged screen time. For teachers, the findings could support promoting healthy study habits—such as regular breaks, posture awareness, and ergonomic practices—while also encouraging the integration of health and ergonomics education into the curriculum. For policymakers, the study could offer evidence to support ergonomic improvements in classrooms and labs, the inclusion of wellness programs, and the development of guidelines that prioritize student well-being. Overall, this research could support creating healthier learning environments that enhance both academic performance and physical health.

1.7 Scope of the study

This study was delimited to students aged 18 years and above, comprising both male and female undergraduate students currently enrolled in the Faculty of Engineering at the University of Benin during the 2024–2025 academic session. This study examined the interplay of duration of computer usage and pattern of computer use on the presence, intensity and distribution of MSK pain.

1.8 Limitations of the study

The limitations of this study include:

i. The prevalence of musculoskeletal pain was self-reported, hence there may be disparity between the prevalence rate in this study and actual overall prevalence among engineering students.

1.9 Definition of Terms

i. Interdependence**:** The state of being dependent upon one another (Merriem Webster Dictionary).

ii. Prolonged**:** Continuing for a notably long time or extended in duration (Merriem Webster Dictionary).

iii. Computer**:** A programmable usually electronic device that can store, retrieve, and process data (Merriem Webster Dictionary).

iv. Musculoskeletal pain**:** This refers to pain in the muscles, bones, joints, ligaments, tendons, and/or nerves that can range from mild to severe and may be acute or chronic (Cleveland Clinic).

v. Neck pain**:** Is the pain or discomfort felt in the neck area (the transitional area between the base of the skull and the clavicles inferiorly).

vi. Back pain**:** This is pain experienced at the posterior part of the body in any of its regions (upper or lower back).

vii. Shoulder pain**:** Is the pain or discomfort felt in the region of the glenohumeral joint or region.

viii. Engineering: Is the creative application of science, mathematical methods, and empirical evidence to the innovation, design, construction and maintenance of structures, machines, materials, devices, systems, processes and organizations.

1.10 List of Abbreviations

IASP	International Association for the study of Pain
LBP	Low Back Pain
MSK	Musculoskeletal
NDI	Neck Disability Index
NMQ	Nordic Musculoskeletal Questionnaire
NPRS	Numeric Pain Rating Scale
ODI	Oswestry Disability Index
RSI	Repetitive Stress Injury

SLUMP	Student Laptop Use and Musculoskeletal Posture
WHO	World Health Organization

CHAPTER 2

LITERATURE REVIEW

2.1 Conceptual Framework

This study is hinged on the biophyschosocial model of pain which reveals the interconnection of different factors in the occurrence of musculoskeletal pain. The biopsychosocial model of pain recognizes that individuals experiences of pain result from a complex interaction of biological, psychological, and social factors, and it has received broad support (Keith M. Smart, 2023). The biopsychosocial model offers a complete way to understand musculoskeletal pain. The biopsychosocial model of pain suggests that pain is a multi-dimensional, dynamic, complex interaction among physiological, psychological and social factors that influence one another (Nicholas, 2022; Gornitzky & Diab, 2024). According to Smart (2023), the experience of pain arises from the intricate interplay between biological, psychological, and social influences, reflecting a widely accepted perspective within contemporary pain management.

Biological factors include the body's structure and functions, like inflammation, tissue harm, joint wear, muscle tightness, or increased sensitivity of nerves. While traditional medical approaches often focus on these aspects, they do not fully explain the complexities of long-lasting MSK pain. Psychological factors such as pain perception, stress, anxiety, depression, and coping mechanisms greatly affect how someone feels and deals with pain. Negative thinking patterns like catastrophizing can make the feeling of pain worse and slow down recovery. Additionally, ongoing pain can cause emotional issues that create a cycle that is hard to break. Social factors also impact the experience of pain. This includes things like the work environment, family support systems, cultural views on pain, financial status, and access to healthcare services

2.2 Definition

‘Musculoskeletal pain refers to either acute or chronic pain involving the bones, muscles, ligaments, tendons, or even nerves. It is a widespread issue linked to musculoskeletal disorders and represents a significant global challenge both medically and socioeconomically’ (Simth et al., 2013). It includes various types of pain syndromes, ranging from localized pain to neuropathic pain (World Health Organization, 2020). The most common forms of MSK pain include chronic low back pain, neck pain, and pain related to conditions. It also encompasses other types such as muscle sprains, pain from fractures, shoulder pain, and others (Tallawy et al., 2021). A significant number of individuals experience ongoing or recurring symptoms, which intensifies the physical, emotional, and socio-economic effects of MSK pain (World Health Organization, 2020; Babatunde et al., 2017).

2.3 Epidemiology

Global data reveals a significant issue with musculoskeletal pain. The World Health Organization (WHO, 2022) estimates that around 1.71 billion people around the world suffer from an MSK condition, making these disorders the leading cause of disability globally, accounting for about 17% of all years lived with disability. Specifically, low back pain impacts roughly 570 million individuals, representing about 7.4% of global years lived with disability. A GBD recent analysis found that in 2020, approximately 494 million people had other musculoskeletal disorders, which is more than double the number reported in 1990, and this figure is expected to surpass one billion by 2050 (GBD 2021 Other Musculoskeletal

Disorders Collaborators, 2023). The prevalence of these conditions increases sharply with age and is notably higher among women, highlighting demographic patterns of MSK pain.

Musculoskeletal pain is also very common throughout Africa. A recent review of studies in Africa (Martinez-Calderon et al., 2024) indicated that about 39% of individuals experience low back pain at any given time, while around 47% will face it at some point in their lives. Other types of pain are similarly frequent, with annual reports showing knee or leg pain affecting about 25% and shoulder pain around 19% (Martinez-Calderon et al., 2024). Additionally, an occupational survey by Atalay et al. (2024) shows a similar trend of about 55% of working adults in sub-Saharan Africa experiencing low back pain within the past year. The World Health Organization predicts that due to rapid population growth and aging, the burden of MSK pain will increase especially quickly in low-income areas like Africa (WHO, 2022).

A study done in Nigeria, in a semi-urban area of Jos, North-Central Nigeria found that around 33% of adults had a MSK condition (Uhunmwangho et al., 2017). Similarly, a community-based survey in Lagos, South-West Nigeria) reported that 58% of people experienced MSK pain, with women affected more often with 62.8% of females versus 37.2% of males(Adelowo et al., 2022). The most frequent diagnoses in these studies were osteoarthritis and chronic low back pain (Uhunmwangho et al., 2017; Adelowo et al., 2022). Young adults in Nigeria seem to have particularly high rates of MSK pain. A study conducted by Afolabi et al. (2025) among university students indicated that about 66% - 76% have experienced musculoskeletal disorders in the past year. A study at a private university showed that 76% of undergraduates reported MSK symptoms within the last year, with neck pain being the most common complaint at 47%. Another study from the University of Nigeria, Enugu found that 66% of students had at least one MSK issue, with female students (75%) being more affected than male students (Ikenna et al., 2020). These high rates are partly due to sedentary lifestyles, academic stress, and poor ergonomics such as sitting for long periods and carrying heavy backpacks.

In Nigeria, there is limited information about the South-South states, to the best of researcher's knowledge. A study conducted in Edo State found that 20% of patients at a rheumatology clinic experienced low back pain, with an average age of around 60 years (Emorinken et al., 2023). This suggests that low back pain is quite common in that area. Another study from the Niger Delta showed about 89% of workers in the oil industry report experiencing work-related musculoskeletal (MSK) pain, primarily low back pain (Oluwagbejami et al., 2022). These results indicate that young adults in South-South Nigeria likely face significant MSK pain issues.

Musculoskeletal pain is highly prevalent among university students who engage in prolonged computer use, particularly due to poor posture and extended screen time. Recent studies show that over half of students report MSK symptoms, especially in the neck, lower back, and shoulders. A meta-analysis of university students during the shift to online learning found that 51.4% experienced neck pain and 50.9% had lower back pain, while 35.6% reported shoulder pain (Gotum et al., 2025).

2.4 Anatomy of Relevant Areas

2.4.1 Neck

The neck is a complex region that links the head to the trunk. It consists of various interconnected components, including bones, muscles, nerves, blood vessels, lymphatic structures, and other connective tissues(Jung et al., 2025).

1. Bones

The cervical spine and the hyoid bone constitute the bones of the neck. The function of the cervical spine is to stabilize and maintain the head in a position that allows our eyes to be parallel to the ground. The hyoid bone is a U-shaped structure located at the front of the neck, roughly at the level of the third cervical vertebra (C3). Uniquely, it does not form joints with any other bones. Instead, it serves as an anchoring point for various muscles and ligaments. Most of these structures attach to the greater horns of the hyoid, while the stylohyoid ligament connects to the lesser horns. The two sets of horns join at the center to form the body of the hyoid bone. The cervical spine consists of 7 vertebrae (C1–C7):

i. C1 (Atlas): Supports the skull; allows nodding motion.
ii. C2 (Axis): Pivot point for head rotation.
iii. C3–C7: Typical vertebrae that support the neck and house spinal nerves

The bones of the vertebral column are separated by intervertebral discs. Typical cervical vertebrae connect to each other through symphyses, which are joints separated by fibrocartilaginous intervertebral discs. Their vertebral arches form synovial joints at the articular facets. These vertebrae are stabilized by the common spinal ligaments and additionally by the nuchal ligament, which is a thickened extension of the supraspinous ligament.

2. Muscles

Neck muscles are categorized as superficial, intermediate, and deep. The key neck muscles include-

i. Sternocleidomastoid (SCM): Turns and tilts the head.
ii. Trapezius: Elevates and retracts the scapula.

iii. Scalene muscles (anterior, middle, posterior): Assist in breathing and neck flexion.

iv. Levator scapulae: Elevates the shoulder blade.

v. Suboccipital muscles: Fine control of head position.

vi. Longus capitis & longus colli: Deep flexors that stabilize the cervical spine.

3. Nerves

Cervical spinal nerves (C1–C8): Emerge from the cervical spine; control motor and sensory functions of the neck, shoulders, and upper limbs. The cervical plexus is a nerve network formed by the anterior rami of spinal nerves C1 to C4, located within the prevertebral fascia in the posterior triangle of the neck. It exists on both sides of the neck (bilaterally) and gives rise to both sensory and motor branches.

Sensory Branches: The major sensory nerves include

i. The greater auricular nerve, which supplies the external ear and the skin over the parotid gland.

ii. The transverse cervical nerve, responsible for sensation in the anterolateral neck and upper sternum.

iii. The lesser occipital nerve, which serves the posterosuperior scalp.

iv. The supraclavicular nerves, which innervate the skin over the supraclavicular fossa, sternoclavicular joint, and parts of the upper thorax.

These sensory nerves emerge from the posterior border of the sternocleidomastoid muscle, a point known as Erb’s point.

Motor Branches: The motor components primarily supply muscles in the neck and upper back. A key motor branch is the ansa cervicalis, a loop formed from C1–C3 fibers, which innervates most of the infrahyoid muscles.

Phrenic Nerve: A critical branch of the cervical plexus is the phrenic nerve, composed of fibers from C3, C4, and C5, and formed along the posterior border of the anterior scalene muscle. Each phrenic nerve descends through the mediastinum, passing in front of the lung root, and ends at the diaphragm. It provides motor innervation to the diaphragm on the same side and carries sensory fibers from the mediastinal pleura, pericardium, central diaphragm, and adjacent pleura and peritoneum.

4. Blood Vessels

Carotid arteries (common, internal, and external arteries) supply oxygen-rich blood to the brain and face. Jugular veins (internal and external) drain blood from the brain and face.

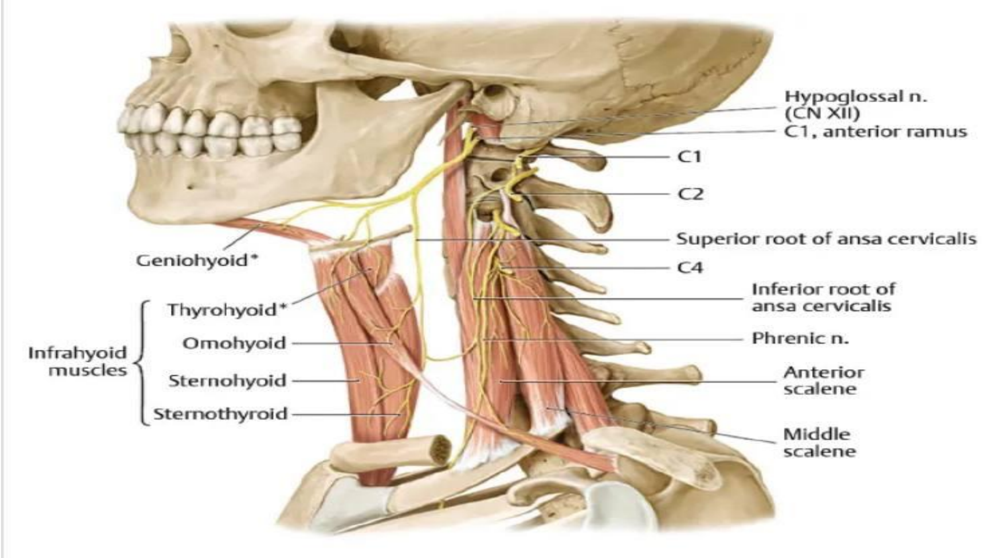


Figure 1 : Anatomy of the neck.

Image Source: https://entokey.com/surgical-anatomy-of-the-neck/

2.4.2 Upper Limb and Shoulder

The upper limb comprises many muscles which are organized into anatomical compartments. These muscles act on the various joints of the hand, arm, and shoulder, maintaining tone, providing stability and allowing precise fluid movement (Javed et al., 2023). The muscles of the shoulder and upper limb are specifically adapted for tasks involving force application and object manipulation. Skeletal muscle is composed of myofibers, which are packed with numerous myofibrils—each made up of repeating units called sarcomeres, the basic contractile elements. As a result, skeletal muscle fibers are primarily designed to produce force. In addition to movement, skeletal muscle also plays key roles in voluntary motion, protecting internal organs, generating body heat, and maintaining posture. (Ojima K 2019; Schmidt et al., 2019).

1. Bones

   The bones of the upper limb are organized into four primary regions: the shoulder girdle, arm, forearm, and hand. Unlike the lower limb, which is primarily responsible for bearing weight and enabling movement, the upper limb's primary function is to position the hand precisely in space, allowing for the manipulation of objects.

   At the top of the limb is the shoulder girdle, made up of the clavicle and scapula. The scapula is a flat, triangular bone that serves as a major attachment site for muscles. The clavicle connects to the sternum at the front of the body, providing a structural link between the upper limb and the axial skeleton.

   The humerus forms the skeletal framework of the arm. It connects with the scapula at the shoulder (glenohumeral joint) and with the radius and ulna at the elbow joint.

   In the forearm, two bones are present: the ulna, located medially, and the radius, located laterally. The radius rotates around the ulna, allowing movement at both the proximal and distal radio-ulnar joints. The ulna serves primarily to stabilize the forearm.

The hand consists of the carpal bones, metacarpals, and phalanges. The carpals are eight small bones arranged in two rows in the wrist region. These articulate with five metacarpal bones, each corresponding to a finger. Each finger contains three phalanges (proximal, middle, and distal), except for the thumb, which has only two.

2. Muscles

The muscles of the upper limb are organized into six key regions: the pectoral region, shoulder, upper arm, anterior forearm, posterior forearm, and the hand. Each group plays a specific role in facilitating movement and maintaining stability throughout the limb.

The pectoral region contains four primary muscles: the pectoralis major, pectoralis minor, serratus anterior, and subclavius. These muscles work together to stabilize the scapula and assist in various upper limb movements, particularly those involving the shoulder. Muscles associated with the shoulder joint are classified into extrinsic and intrinsic groups. The extrinsic muscles originate from the trunk and attach to the bones of the shoulder, contributing to gross movements of the upper limb. In contrast, the intrinsic muscles originate from within the shoulder girdle—such as the scapula or clavicle—and insert on the humerus, playing a key role in moving the upper arm and stabilizing the shoulder joint. Between the shoulder and elbow lies the upper arm, which is divided into anterior and posterior compartments. Muscles in the anterior compartment, such as the biceps brachii, are primarily involved in flexing the elbow and shoulder. The posterior compartment contains the triceps brachii, which functions to extend the arm at the elbow joint.

The muscles of the forearm are grouped into anterior and posterior compartments. The anterior compartment consists of three layers—superficial, intermediate, and deep—and is innervated by the median and ulnar nerves. These muscles collectively enable wrist and finger flexion and also allow for pronation of the forearm. The posterior compartment includes superficial and deep layers as well, and its muscles are innervated by the radial nerve. These are commonly referred to as the extensor muscles, as they are mainly responsible for extending the wrist and fingers.

Lastly, the muscles of the hand are divided into extrinsic and intrinsic groups. The extrinsic muscles originate in the forearm and attach to the hand bones, contributing to more powerful, less precise movements. The intrinsic muscles, on the other hand, originate and insert within the hand itself and are crucial for fine, delicate motor functions. Both muscle groups receive innervation from the median and ulnar nerves.

3. Nerves

The nerves of the upper limb, mainly the axillary, musculocutaneous, median, radial, and ulnar nerves, arise from the brachial plexus. They provide both motor and sensory innervation to the shoulder, arm, forearm, and hand. The brachial plexus is formed by the anterior rami of the C5 to T1 spinal nerves. A detailed breakdown of the upper limb nerves:

i. Axillary Nerve: From the posterior cord (C5–C6), the axillary nerve travels through the axilla with the posterior circumflex humeral artery, supplying the deltoid and giving rise to the lateral superior cutaneous nerve, which innervates the lateral shoulder skin.

ii. Musculocutaneous Nerve: Arising from the lateral cord (C5–C7), it pierces the coracobrachialis and innervates the anterior arm muscles. It continues as the lateral antebrachial cutaneous nerve, providing sensation to the lateral forearm.

iii. Radial Nerve: From the posterior cord (C5–T1), it runs with the brachial artery through the radial groove. It gives off several cutaneous branches: the posterior brachial, lateral inferior brachial, and posterior antebrachial cutaneous nerves, supplying the arm and posterior forearm. At the elbow, it divides into the superficial and posterior interosseous nerves, with terminal branches innervating the dorsum of the hand and radial thumb.

iv. Median Nerve: Formed by the medial and lateral cords (C6–T1), it travels with the brachial artery and passes through the cubital fossa. It gives off the anterior interosseous (motor) and palmar cutaneous (sensory) branches. After crossing the carpal tunnel, it innervates the thenar muscles and provides sensation to the lateral 3½ digits.

v. Ulnar Nerve: Originating from the medial cord (C8–T1), it travels medially and passes through the cubital tunnel. Before entering the wrist, it gives off dorsal and palmar cutaneous branches for the medial hand. In the hand, it passes through the canal of Guyon and divides into a deep motor branch and a superficial sensory branch, serving the medial 1½ digits.

vi. Medial Brachial Cutaneous Nerve: A pure sensory nerve from the medial cord (C8–T1) that supplies the skin over the medial upper arm. It connects with the medial antebrachial cutaneous nerve.

vii. Medial Antebrachial Cutaneous Nerve: Also from the medial cord (C8–T1), it runs along the anteromedial arm, dividing into volar and ulnar branches. It provides sensory innervation to the medial and anterior forearm down to the wrist.

viii. Intercostobrachial Nerve: Usually derived from the second intercostal nerve, it supplies cutaneous sensation to the axilla.

ix. Supraclavicular Nerve: Originating from C3–C4 ventral rami, this nerve passes deep to the sternocleidomastoid and platysma, branching into medial, intermediate, and lateral nerves. It supplies sensation to the upper and front regions of the shoulder.

4. Blood vessels

The blood vessels supplying the upper limb consist of both arterial and venous vessels.

Arterial supply- The arterial supply of the upper limb originates from the subclavian artery, which continues as the axillary artery once it passes the lateral border of the first rib. As it travels through the axilla and enters the arm, it becomes the brachial artery.

i. Subclavian Artery: Arises from the aortic arch (left side) or the brachiocephalic trunk (right side). It supplies the shoulder and upper thoracic region.

ii. Axillary Artery: A continuation of the subclavian artery, it begins at the lateral border of the first rib and ends at the inferior border of the teres major muscle. It gives off several branches that supply the shoulder, chest wall, and upper arm.

iii. Brachial Artery: Begins at the lower margin of the teres major muscle and runs down the arm. It gives rise to the profunda brachii artery (deep artery of the arm), which accompanies the radial nerve. At the level of the cubital fossa, it divides into: Radial artery (lateral) and Ulnar artery (medial).

iv. Radial Artery: Travels along the lateral forearm, supplying the lateral wrist and hand. It contributes to the deep palmar arch in the hand.

v. Ulnar Artery: Courses medially along the forearm, supplying the medial wrist and hand. It contributes primarily to the superficial palmar arc

Venous Drainage: Venous return from the upper limb is accomplished via superficial and deep veins.

vi. Superficial Veins: Cephalic vein runs along the lateral aspect of the arm and drains into the axillary vein. Basilic vein runs medially and joins with the brachial vein to form the axillary vein. Median cubital vein connects the cephalic and basilic veins at the elbow.

vii. Deep Veins: These accompany arteries and are typically paired, including the radial, ulnar, brachial, and axillary veins.

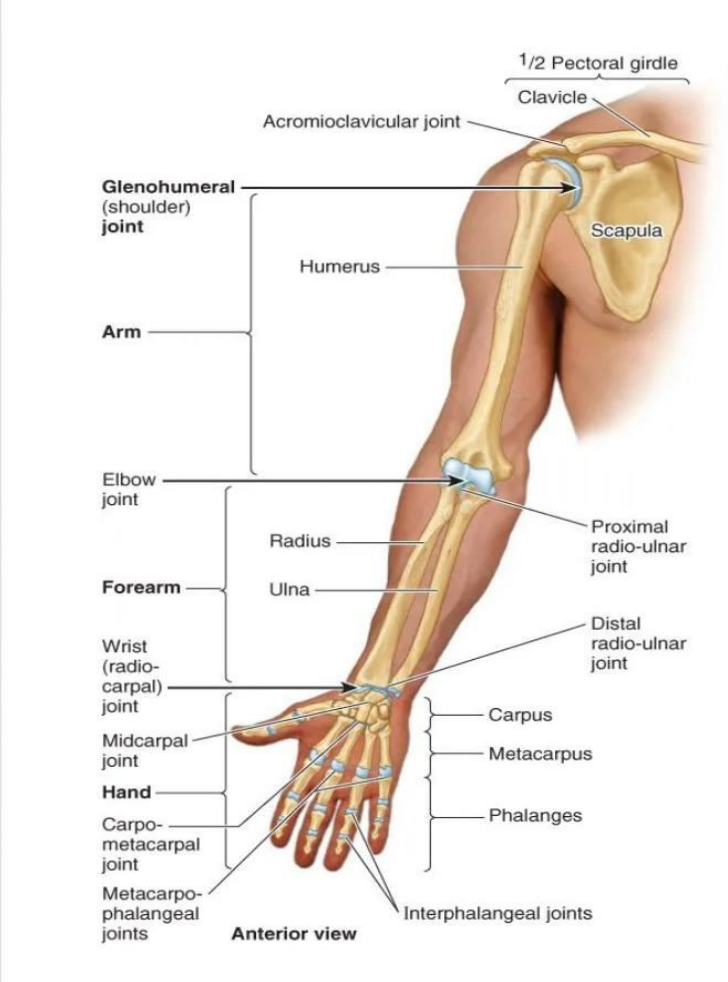


Figure 2: Segments and bones of upper limb

Image Source: https://basicmedicalkey.com/upper-limb-5/

2.4.3 Back

The back is located on the posterior side of the body and consists of the vertebral column, the spinal cord, and the muscles that support and stabilize this region.

1. Bones

   The bones of the back, together, make up the vertebral column. The vertebral column is made up of 5 sections: the cervical vertebrae, the thoracic vertebrae, the lumbar vertebrae, the sacrum and the coccyx. These sections total 33 vertebrae which function together to aid locomotion and posture as well as providing support and protection. Between each vertebra lies an intervertebral disc, which allows for shock absorption and movement. There are multiple ligaments that articulate with the bones of the back and work to prevent excessive movements and strengthen the joints. Amongst these ligaments are the ligamentum flavum, interspinous ligament, supraspinous ligament, intertransverse ligaments and the anterior and posterior longitudinal ligaments.

i. Cervical Vertebrae (7): Located in the neck region, these vertebrae are the smallest and lightest in the spine, designed for mobility and flexibility. The first cervical vertebra (C1) is called the atlas, which supports the skull and allows the head to nod. The second cervical vertebra (C2) is the axis, which contains a bony projection called the dens (odontoid process) that fits into the atlas, allowing the head to rotate side-to-side. The cervical vertebrae have transverse foramina, openings in their transverse processes that allow passage of the vertebral arteries supplying blood to the brain. This region supports the head and permits a wide range of movement, including rotation, flexion, extension, and lateral bending.

ii. Thoracic Vertebrae (12): Located in the upper and mid-back, these vertebrae are larger than cervical vertebrae and are characterized by facets for rib articulation. Each thoracic vertebra articulates with a pair of ribs, forming the posterior part of the thoracic cage, which protects the heart and lungs. Movements in this region are more limited due to the attachment of the ribs, contributing to the spine's stability. The spinous processes of thoracic vertebrae are typically long and angled downward.

iii. Lumbar Vertebrae (5): Found in the lower back, lumbar vertebrae are the largest and strongest vertebrae due to the significant load-bearing function they perform. They have large, kidney-shaped bodies to support the weight of the upper body. Unlike cervical and thoracic vertebrae, they lack foramina and rib articulation points. This region allows for flexion and extension (such as bending forward and backward) but has limited rotation.

iv. Sacral Vertebrae (5, fused): These vertebrae fuse in early adulthood to form the sacrum, a triangular-shaped bone located between the two hip bones. The sacrum forms the posterior portion of the pelvis, articulating with the ilium bones at the sacroiliac joints. It contains foramina (openings) for the sacral nerves to pass through. The sacrum plays a crucial role in transferring body weight from the spine to the lower limbs.

v. Coccygeal Vertebrae (4, fused): Commonly known as the coccyx or tailbone, these small, fused vertebrae form the terminal end of the vertebral column. Though it is a vestigial structure (remnant of a tail in evolutionary terms), the coccyx serves as an attachment site for ligaments and muscles of the pelvic floor. It helps support a person's weight while sitting, especially when leaning back.

2. Muscles

The muscles of the back are grouped into three layers based on their anatomical position: superficial, intermediate, and intrinsic. The intrinsic back muscles are so named because they originate from the back during embryonic development. In contrast, the superficial and intermediate muscles develop in other regions of the body and migrate to the back, classifying them as extrinsic muscles.

The superficial back muscles are situated underneath the skin and superficial fascia. They originate from the vertebral column and attach to the bones of the shoulder, the clavicle, scapula and humerus. All these muscles are therefore associated with movements of the upper limb. The muscles in this group are the trapezius, latissimus dorsi, levator scapulae and the rhomboids. The trapezius and the latissimus dorsi lie the most superficially, with the trapezius covering the rhomboids and levator scapulae.

i. Trapezius

- Origin: Occipital bone, nuchal ligament, and spinous processes of C7–T12
- Insertion: Clavicle, acromion, and spine of the scapula
- Action: Elevates, retracts, depresses, and rotates the scapula
- Innervation: Spinal accessory nerve (cranial nerve XI)

ii. Latissimus Dorsi

- Origin: Spinous processes of T7–T12, thoracolumbar fascia, iliac crest, and lower ribs
- Insertion: Intertubercular groove of the humerus
- Action: Extends, adducts, and medially rotates the arm
- Innervation: Thoracodorsal nerve

iii. Levator Scapulae

- Origin: Transverse processes of C1–C4

- Insertion: Superior part of the medial border of the scapula
- Action: Elevates and rotates the scapula downward
- Innervation: Dorsal scapular nerve

iv. Rhomboid Major

- Origin: Spinous processes of T2–T5
- Insertion: Medial border of the scapula (below the spine)
- Action: Retracts and rotates the scapula
- Innervation: Dorsal scapular nerve

v. Rhomboid Minor

- Origin: Spinous processes of C7–T1
- Insertion: Medial border of the scapula (at the level of the spine)
- Action: Retracts and stabilizes the scapula
- Innervation: Dorsal scapular nerve

The intermediate back muscles are also part of the extrinsic group, meaning they originate embryologically outside the back. These muscles lie beneath the superficial layer and are primarily involved in respiratory functions, specifically elevating and depressing the ribs during breathing. There are two main intermediate muscles:

i. Serratus Posterior Superior

- Origin: Spinous processes of C7–T3 and the nuchal ligament
- Insertion: Upper borders of ribs 2–5
- Action: Elevates ribs during inspiration
- Innervation: Intercostal nerves (T2–T5)

ii. Serratus Posterior Inferior

- Origin: Spinous processes of T11–L2
- Insertion: Lower borders of ribs 9–12

- Action: Depresses ribs during forced expiration
- Innervation: Intercostal nerves (T9–T12)

The deep muscles of the back, also known as the intrinsic back muscles, develop within the back itself and are responsible for maintaining posture and controlling movements of the vertebral column, including extension, rotation, and lateral flexion. These muscles are innervated by the posterior rami of spinal nerves and are arranged into three layers: superficial, intermediate, and deep.

1. Superficial Layer (Spinotransversales group): Includes muscles that mainly act on the head and neck.

i. Splenius Capitis

- Origin: Nuchal ligament and spinous processes of C7–T3/4
- Insertion: Mastoid process and lateral part of the superior nuchal line
- Action: Extends, rotates, and laterally flexes the head and neck
- Innervation: Posterior rami of cervical spinal nerves

ii. Splenius Cervicis

- Origin: Spinous processes of T3–T6
- Insertion: Transverse processes of C1–C3
- Action: Same as above – head and neck extension, rotation, and lateral flexion
- Innervation: Posterior rami of spinal nerves

2. Intermediate Layer (Erector Spinae group): These are the main extensor muscles of the vertebral column, running vertically along the spine. From lateral to medial, they include:

i. Iliocostalis (lumborum, thoracis, cervicis)

- Origin: Iliac crest, sacrum, and lumbar vertebrae
- Insertion: Ribs and cervical transverse processes

- Action: Extends and laterally flexes the vertebral column
- Innervation: Posterior rami of spinal nerves

ii. Longissimus (thoracis, cervicis, capitis)

- Origin: Transverse processes of lumbar and lower thoracic vertebrae
- Insertion: Transverse processes of vertebrae above, ribs, and mastoid process
- Action: Extends and laterally flexes the vertebral column and head
- Innervation: Posterior rami of spinal nerves

iii. Spinalis (thoracis, cervicis, capitis)

- Origin: Spinous processes of lower vertebrae
- Insertion: Spinous processes of upper vertebrae
- Action: Extends the vertebral column
- Innervation: Posterior rami of spinal nerves

3. Deep Layer (Transversospinales group): These muscles run obliquely between vertebrae and are important for stability and fine motor control of the spine.

i. Semispinalis (thoracis, cervicis, capitis)-Spans 4–6 vertebrae; primarily extends and rotates the head and spine.

ii. Multifidus-Best developed in the lumbar region; spans 2–4 vertebrae. It provides stability to the vertebral column.

iii. Rotatores-Smallest and deepest; span 1–2 vertebrae. It is important in proprioception and fine adjustments during spinal movement.

3. Nerves Supply and Blood vessels

The arterial supply to all layers of the back muscles is primarily provided by branches of the deep cervical arteries, posterior intercostal arteries, subcostal arteries, and lumbar arteries (Henson et al., 2020). The nerve supply to the back muscle comes from both the ventral (anterior) and dorsal (posterior) rami of the spinal nerves:

- Extrinsic back muscles (superficial and intermediate layers) are innervated by the anterior rami.
- The splenius capitis receives innervation from the lateral branches of the C2–C3 dorsal rami.
- The splenius cervicis is supplied by lateral branches of the lower cervical dorsal rami.
- The erector spinae group is innervated by the dorsal rami:
- The iliocostalis is supplied by the lateral branches.
- The longissimus is innervated by the intermediate branches.
- The transversospinalis group (including semispinalis, multifidus, and rotatores) is innervated by the primary branches of the dorsal rami from C1 to L5 (Eovaldi & Varacallo, 2019; Henson et al., 2020).

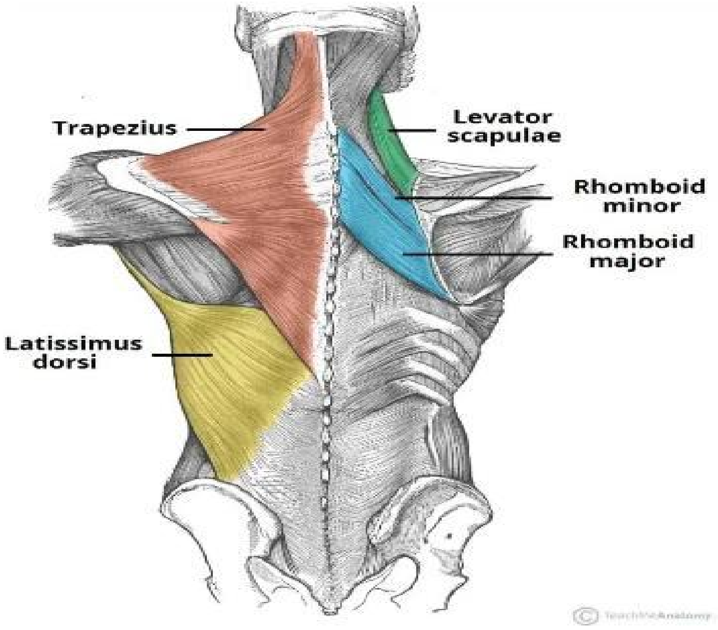


Figure 3: Superficial muscles of the back

Image source: https://teachmeanatomy.info/back/muscles/

2.5 Pathophysiology of Musculoskeletal Pain

Musculoskeletal pain arises from prolonged repetitive motion, poor ergonomics, or sustained postures, leading to microtrauma in muscles, tendons, and soft tissues leading to Repetitive Stress Injury (RSI). This initiates a local inflammatory response, releasing mediators such as prostaglandins, bradykinin, and cytokines, which activate and sensitize peripheral nociceptors, causing localized pain and tenderness. With persistent stress and insufficient healing, central sensitization may develop, in which spinal and supraspinal neurons become hyper-responsive, leading to amplified pain and spread beyond the original injury site (Woolf, 2011). Chronic RSI may also involve neuromuscular dysfunction, including altered motor patterns, muscle guarding, and impaired proprioception (Sterner et al., 1998). Psychosocial factors, such as occupational stress or fear-avoidance behaviors, can perpetuate pain perception and disability, particularly in chronic RSI cases (Linton, 2000).

2.6 Etiology

Postural Strain: Prolonged static sitting with poor ergonomics is widely recognized as a key contributor to musculoskeletal pain in office workers and frequent computer users. Markova et al. (2024) noted that "prolonged static sitting at the workplace is considered one of the main risks for the development of musculoskeletal disorders," with poor posture and extended sitting linked to lumbar discomfort and low back pain. Likewise, a scoping review by Alaca et al. (2025), found that longer sitting time, poor sitting posture, and fewer breaks are strongly associated with a higher incidence of low back pain. Extended periods of slouching or bent posture impose extra biomechanical stress on the lumbar spine.

Degenerative Spine Changes: Age-related degenerative changes in the spine – such as intervertebral disc degeneration, facet joint arthritis (spondylosis), and osteophyte formation

– often lead to mechanical nerve compression and radicular pain. In general, nerve root compression in the spine most often results from herniated discs or spondylotic changes. Likewise, degenerative arthritis of spinal joints can narrow the spinal canal or nerve foramina (spinal stenosis), causing chronic back pain and neurologic symptoms. Indeed, degenerative lumbar spinal stenosis (narrowing of the canal by age-related changes) a major cause of low back pain and associated disability. Thus, degenerative spondylosis, disc bulges, and stenosis all contribute to spine pain syndromes through chronic nerve impingement (radiculopathy) and back pain.

Trauma and Overuse Injuries: Acute injuries and repetitive microtrauma can both precipitate musculoskeletal pain. Acute trauma (from accidents, falls, sports injuries or whiplash) often causes sudden strains, sprains, or fractures of bones and soft tissues, leading to immediate pain (and in some cases chronic pain syndromes). More broadly, most adults experience musculoskeletal pain episodes linked to injury or overuse in their lifetime. Shaballout et al. (2021) report that "most adults have experienced one or more brief episodes of musculoskeletal pain associated with injury or overuse," affecting roughly 13–47% of the population. Overuse injuries arise from the cumulative effect of repetitive microtrauma to muscles, tendons, ligaments, or joints. As Franco et al. (2021) explains, overuse injuries result from the cumulative process of repetitive microtrauma and overload on the musculoskeletal system, which causes tissue damage. Both acute injury and chronic overuse are therefore important causes of musculoskeletal pain in active individuals.

Infections and Autoimmune Disorders: Certain infections and inflammatory diseases can produce serious musculoskeletal pain. Spinal infections such as tuberculosis (Pott's disease) or pyogenic spondylodiscitis (bacterial vertebral osteomyelitis/discitis) typically cause intense back pain. Spinal tuberculosis often presents with chronic, dull low back pain that gradually worsens.

2.7 Risk Factors

Musculoskeletal pain arises from a variety of risk factors and typically has multiple causes. These include not only work-related tasks but also recreational and everyday activities that place excessive strain or stress on the musculoskeletal system (Punnett & Wegman, 2004). The contributing risk factors can be categorized as individual, physical, and psychosocial.

Risk factors for the development of musculoskeletal symptoms include:

i. Gender: Various 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 variations in anatomical make up. Sex-based differences in musculoskeletal pain are evident even among younger populations, with female children and adolescents more frequently reporting pain within the past seven days compared to their male peers (Keeratisiroj et al., 2018). A research by Kazeminasab et al. (2022) shows a higher prevalence of neck pain in females, with the risk of developing neck pain increasing up to the 35–49 age range, after which it begins to decline. Musculoskeletal conditions—particularly neck pain, back pain, osteoarthritis, and rheumatoid arthritis—are both more common and more severe in females than in males (Overstreet et al., 2023).

ii. Level of physical activity: 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 leads to strengthening of the muscles and other tissues, improves blood circulation to the musculoskeletal tissues and the oxygenation of these tissues, leading to a reduced rate of injury and greater rate of repair from injury (Karen & Gisela, 2017). Sedentary lifestyle and lack of physical activity also predisposes to MSK pain (Zheng et al., 2024).

iii. 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. (Xing et al., 2025; Gu et al., 2022; Nygaard et al., 2022).

iv. 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. Studies have shown increased association between awkward body postures and a high prevalence of musculoskeletal symptoms (Anita et al, 2014; Chen & Mu, 2018). A research by Tella et al. (2021), showed a as 70% prevalence upper limb pain observed among respondents of the study with a range of 4–9 hours spent on the computer. This is as a result of forward head flexion for a long period of hours causing overuse of neck muscles, affecting changes in the muscular responses and passive structures of the cervical spine.

2.8 Clinical Presentation

Musculoskeletal pain can affect any structure within the musculoskeletal system—including muscles, bones, joints, ligaments, tendons, and associated soft tissues. While the specific symptoms depend on the underlying cause and location, there are several common clinical features observed across MSK conditions.

i. Pain Characteristics: MSK pain can vary widely in intensity and quality. It may present as: A dull, constant ache often indicative of muscle or ligament strain. A sharp or stabbing pain which may suggest nerve involvement or acute joint injury. A burning or tingling sensation—sometimes associated with nerve irritation or compression. Pain may be localized to a specific area or radiate, especially in cases involving nerve root irritation, such as sciatica. In the case of low back pain (LBP), pain may radiate to the buttocks, hips, or down one or both legs, often following a dermatomal distribution if a nerve is affected.

ii. Inflammation: Inflammatory signs are commonly present and include: Swelling, redness, and warmth over the affected area. Morning stiffness and pain that worsens with rest and improves with activity in systemic inflammatory disorders.

iii. Muscle Spasm: Muscle spasms are involuntary contractions that may range from mild tightness to severe, painful cramping. In low back pain, spasms in the paraspinal muscles can lead to restricted motion and postural abnormalities, often causing the patient to bend or twist to avoid pain.

iv. Limited Mobility: Individuals with MSK pain often experience difficulty in movement, which can affect daily activities such as walking, bending, lifting, or climbing stairs. In severe cases, pain and stiffness may impede standing or walking, especially in acute lower back or hip injuries.

v. Local Tenderness: On physical examination, patients often report localized soreness or tenderness when the affected area is palpated. This may indicate soft tissue involvement, trigger points, or joint inflammation.

vi. Referred and Radiating Pain: Pain may be felt away from the actual site of injury. Pain from the lower spine can radiate to the buttocks, thighs, or legs. Shoulder pain may refer from the neck or upper thoracic spine.

vii. Postural Changes: To alleviate pain, patients may adopt abnormal postures. In low back pain, individuals may tilt to one side or maintain a flexed posture. In neck pain, the head may be held rigidly or tilted.

2.9 Diagnosis

Diagnosis of musculoskeletal pain requires a thorough clinical evaluation that includes the:

Patient’s history: A detailed patient history is usually the foundation of the diagnosis. Healthcare providers look at when the pain started, its location, characteristics, duration, aggravating and relieving factors. They also consider work-related activities and risks linked to posture or movement. Pain can be localized, like in the shoulder or lower back, or widespread, as seen in conditions like fibromyalgia. It might be due to mechanical issues, inflammation, or nerve problems. A comprehensive patient history is essential for identifying underlying conditions and informing clinical decision-making. Using open-ended questions encourages patients to share their symptoms, experiences, and concerns, offering valuable insights. Important components of history-taking include the onset of symptoms, their nature, progression, duration, related factors, and the patient's initial response to the illness (Nichol et al., 2023).

Physical examination: During the physical exam, swelling, deformities, or any differences in body symmetry should be examined. They feel for tenderness and trigger points, test how well joints move, and assess muscle strength and nerve function. Special orthopedic tests may be done to provoke symptoms and identify which areas are affected like Spurling’s test for neck issues or the Straight Leg Raise for lower back disc problems.

Radiological Investigation: Imaging tests such as X-rays, Magnetic Resonance Imaging, or Computed Tomography scans may be necessary to further diagnose and differentiate between different MSK symptoms. MRIs are especially good at finding soft tissue injuries and disc problems. For inflammatory or autoimmune MSK conditions, laboratory tests may be necessary. In the end, correctly diagnosing MSK pain depends on identifying whether it is caused by mechanical issues, inflammation, or systemic problems so that proper treatment can follow.

2.10 Prognosis

The prognosis of musculoskeletal pain varies depending on factors such as the duration of symptoms, ergonomic habits, and engagement in physical activity. In most cases, acute MSK pain can resolve within weeks if ergonomic corrections and exercise interventions are implemented promptly (Elsiddig et al., 2022). However, without intervention, repetitive poor posture and extended screen time increase the risk of chronicity, especially in the neck and lower back regions (Musaad et al., 2024). A longitudinal study revealed that over 30% of students with neck pain reported persistent symptoms six months later due to continued poor posture and screen habits (Gotum et al., 2025). The use of ergonomic workstations, regular stretching, and posture awareness significantly improves outcomes and reduces recurrence (Abbas et al., 2021). Conversely, sedentary lifestyle and lack of physical activity have been linked to delayed recovery and increased disability (Alyahya et al., 2023). Therefore, while the prognosis is generally favorable with timely lifestyle adjustments, the risk of chronic pain and associated functional limitations remains substantial if behavioral and ergonomic factors are not addressed.

2.11 Management of Musculoskeletal pain

Musculoskeletal pain stems from various causes and risk factors; effective management involves addressing these elements and correcting any related dysfunctions. Key components include:

1. Patient education and self-management
2. Exercise therapy
3. Manual therapy
4. Pharmacological treatments, primarily analgesics and NSAIDs (Nicholas et al., 2023)

Treatment strategies differ depending on the specific disorder and affected body region.

MSK pain can be managed using the following strategies:

i. Early activity and exercise, contemporary guidelines recommend that patients with acute LBP remain active while tailored exercise is essential for chronic cases. Extended bed rest is discouraged (Nicholas et al., 2023). In the management of neck and shoulder pain, strategies include postural re-education, early mobilization and range-of-motion exercises (Morris et al., 2023).

ii. Analgesia: NSAIDs are regularly advised to manage pain in both acute and subacute MSK pain. It offers short-term benefits (Traeger et al., 2021).

iii. Manual therapy: When combined with exercise and education, manual techniques like mobilization or manipulation can be as effective as alternative therapies for pain relief.

iv. Bracing: Lumbar support belts may reduce work absenteeism, although they may not significantly relieve pain (Annaswamy et al., 2021).

2.12 Outcome Measures

2.12.1 Numeric Pain Rating Scale

The Numeric Pain Rating Scale (NPRS) is a unidimensional measure of pain intensity in which patients rate their pain on a scale from 0 (no pain) to 10 (worst imaginable pain). It is widely used in both clinical and research settings due to its simplicity, responsiveness, and ease of administration. The NPRS has demonstrated good reliability, validity, and sensitivity to change in musculoskeletal populations, including those with back, neck, and joint pain (Hawker et al., 2021). It is used in monitoring changes in pain intensity over time or after an intervention.

2.12.2 Oswestry Disability Index

The Oswestry Disability Index (ODI) is a gold-standard questionnaire used to assess disability and functional impairment related to low back pain. It consists of 10 sections, each scored from 0 to 5, covering domains such as pain intensity, personal care, lifting, walking, sitting, standing, sleeping, social life, traveling, and employment/homemaking. The total score is converted into a percentage (0–100%), with higher scores indicating greater disability (Fairbank & Pynsent, 2021). It is used in assessing the impact of low back pain on daily activities and evaluating treatment outcomes. It has a high reliability and construct validity for both acute and chronic low back pain (Rinne et al., 2024; Kilimanjaro et al., 2023).

2.12.3 Neck Disability Index

The Neck Disability Index (NDI) is a self-report measure used to evaluate the level of disability due to neck pain. Similar in structure to the ODI, it contains 10 items scored from 0 to 5, assessing pain intensity and functional activities such as personal care, lifting, reading, headaches, concentration, work, driving, sleeping, and recreation. The total score is expressed as a percentage, with higher percentages indicating more severe disability (Vernon & Mior, 1991). It is widely applied in clinical assessments and research on neck pain outcomes.

2.12 Empirical Review

Ayeni et al. (2024) conducted a cross-sectional study that evaluated ergonomic conditions of office workstations among civil servants in Ondo State, Nigeria. Structured questionnaires were used to assess ergonomic designs in offices and prevalence of pain. There was 92.7%, 59.1% and 19.4% of 12 months, one week and point pain prevalence respectively among the 273 respondents that participated fully in the study. Most respondents have poor knowledge of ergonomics (61.9%) but 96.7% have good ergonomic practices (96.7%). The study concluded that ergonomic design is not a determinant for the prevalence of WRMSD. However, the knowledge and correct practice of ergonomic among office-based civil servants can help to reduce the prevalence of WRMSD.

Bare et al. (2021) conducted a study on effects of computer-based work on the musculoskeletal discomfort among college students using a cross-sectional survey. Participants reported on musculoskeletal discomfort across different body regions and provided contextual data regarding work duration, posture, and workstation setup. The survey revealed notable prevalence of discomfort in the neck, shoulders, and upper back, which correlated positively with prolonged screen time, improper seating, and non-ergonomic workstation arrangements. The authors emphasized that computer-based academic activities can significantly contribute to musculoskeletal discomfort among college students.

A cross-sectional study, conducted by Hasan et al. (2018) surveyed 400 medical and 350 non-medical students using a modified Nordic questionnaire to assess musculoskeletal pain. Pain characteristics were documented and graded. The average age was around 21 for both groups, with a higher prevalence of musculoskeletal pain among females, especially medical students—most commonly in the neck. Pain was notably frequent during the previous week. Despite medical students reporting longer study hours and more computer use, no significant link to pain was found, unlike in non-medical students. Most participants had normal BMI, and no correlation between BMI and pain was observed. Medical students with pain tended to have longer commutes and were more likely to use backpacks, which showed an association with pain. Physical activity, such as exercise and sports, showed no significant effect. The study concludes that musculoskeletal pain is highly prevalent, particularly among medical students, and calls for further research into contributing factors.

Legan, M. & Zupan, K. (2020) conducted a cross-sectional internet-based survey in October 2020 at the University of Ljubljana's Faculty of Chemistry and Chemical Technology. A total of 535 working university students (63% female, 37% male; aged 18+) reported their mobile device usage patterns and any musculoskeletal pain experienced over the previous 12 months. The prevalence of musculoskeletal pain was 39.6%, with pain most frequently reported in the back (57.1%) and shoulders (50%). Gender differences in both device exposure and pain incidence were statistically significant. The conclusion of the study was mobile-device–related musculoskeletal symptoms are common among working students and stress the importance of ergonomic knowledge to mitigate these risks.

Olawale et al. (2025) conducted a cross-sectional survey was conducted among Nigerian college students (n ≈ 500) via structured questionnaires, asking about the incidence of neck and lower back pain over the previous 12 months, along with personal (e.g. BMI, gender, physical activity), academic (e.g. study hours, posture habits), and lifestyle factors . The study revealed a high 12-month prevalence of low back pain (66.1%) and neck pain (60.8%), consistent with regional and international figures. The authors concluded that neck and low back pain are highly prevalent among Nigerian college students and linked primarily to modifiable ergonomics and posture.

Ozdemir et al. (2021) conducted a cross-sectional study with 2,221 Turkish adolescents. Data collection included demographics, pain assessment across 14 body regions, and the Back Pain and Body Posture Evaluation Instrument (BackPEI) to assess posture profiles. A high prevalence of low back pain (73.3%) and general back pain (68.4%) was found. Participants frequently attributed pain to poor sitting posture (38.1%) and backpack use (84.1%). The BackPEI scores showed significant relationships with physical activity levels, school desk comfort, and negatively with academic grades. The researchers concluded that posture-related factors are strongly linked to musculoskeletal pain in adolescents and advocate for teaching ergonomic posture and appropriate furniture use in educational settings.

Another study by Rashwan et al. (2024) on the relationship of computer misuse-related body pain with awareness of workstation ergonomics during digital learning era found that 62.4% of participants reported mild pain and 37.6% moderate to severe MS pain. Average ergonomics knowledge was moderate (mean score 3.42 ± 1.03). Importantly, those with good to very good ergonomics knowledge had a 62% lower risk of moderate/severe pain. It was a cross-sectional study conducted at the University of Bahrain, in which 173 faculty members who had engaged in e-learning for at least one academic year were surveyed. They reported musculoskeletal (MSK) pain using a Body Map Tool, alongside an ergonomics knowledge questionnaire to assess awareness. It was concluded that greater awareness of workstation ergonomics correlates with reduced severity of computer-related MS pain.

A cross-sectional study was conducted by Shahnaz Shahrjerdi (2021) in the faculties of humanities and engineering of Arak University in Arak City, Iran. Out of 520 students of Arak University in the two faculties of humanities and engineering, 464 completed the Nordic questionnaire. 63.4% reported spinal pain; within this group, 27.6% had back pain, 23.5% neck pain, and 21.8% shoulder pain in the past year. Engineering students (especially software/chemical streams) showed higher rates of neck, shoulder, wrist, and hand pain linked to intensive computer use and study hours. Humanities students exhibited more back and lower back pain, attributed to physical inactivity and higher waist-to-hip ratios. The study concluded that MSK pain is common among students and varies by faculty due to differences in academic workload and lifestyle. It recommended addressing risk factors like poor posture and sedentary behavior through education and preventive measures.

A cross-sectional observational study by Shahwan et al. (2022) on the evaluation of computer workstations ergonomics and its relationship with reported musculoskeletal and visual symptoms among University employees in Jordan, recruited 231 university office employees using stratified random sampling. Ergonomic features of their workstations were directly observed and assessed via the Occupational Safety and Health Administration (OSHA) Ergonomic Computer Workstation Evaluation Checklist. Participants self-reported musculoskeletal (MSK) pain and visual symptoms over the past week and 12 months through standardized questionnaires. The study revealed widespread ergonomic deficiencies, especially related to seating, work surface, and input-device placement. Within the past year, participants commonly reported MS symptoms, with shoulders (37%), lower back (34%), and neck (29%) most affected. Demographics and work patterns (age, gender, computer-use duration) also significantly predicted symptom prevalence. In conclusion, suboptimal ergonomics directly contribute to both MSK pain and visual symptoms among university staff.

Another study done by Tella et al. (2021) assessed computer-using bank employees, collecting data on arm, neck, and shoulder complaints. Maastricht Upper Extremity Questionnaire (MUEQ) was used to collect the data. Both physical (ergonomic features of workstation, posture, duration of computer use) and psychosocial risk factors (job stress, work demands) were measured through the questionnaire. A 70% 1 year prevalence rate of Complaints of arm, neck, and shoulders (CANS) was obtained. Poor body posture was significantly associated with the complaints of shoulder, arm, and elbow. High job demand was significantly associated with the complaints of the shoulder and lower arm, while poor work environment was significantly associated with the occurrence of CANS. The study concluded that physical and psychosocial risk factors of body posture, job demand, and work environment are associated with the prevalence of CANS among Nigerian bank employees.

Table 1: Empirical Review

Author/Year	**Title**	**Methodology**	**Result**	**Conclusion**
Ayeni et al. (2024)	Ergonomic Design as a Determinant for the Prevalence of Work-Related Musculoskeletal Disorders among Office-Based Civil Servants in Ondo State, Nigeria	Cross-sectional with 308 participants using structured and adapted questionnaire to assess ergonomic designs and prevalence of pain.	Office ergonomic practice was not linked to the prevalence of work related MSK disorders (WRMSD)..	Ergonomic design is not a determinant for the prevalence of WRMSD. However, the knowledge and correct practice of ergonomics can help reduce the prevalence of WRMSD.

Bare et al. (2021)	Effects of Computer-Based Work on the Musculoskeletal Discomfort Among College Students	A cross-sectional, descriptive and non-experimental questionnaire study.	Notable prevalence of discomfort in the neck, shoulders, and upper back, which correlated positively with prolonged screen time, improper seating, and non-ergonomic workstation arrangements.	Computer-based tasks contribute substantially to musculoskeletal discomfort among college students.
Hasan et al. (2018)	Frequency of Musculoskeletal Pain and Associated Factors among Undergraduate Students	A cross-sectional study assessing 400 medical and 350 non-medical students using a modified Nordic questionnaire to assess musculoskeletal pain.	Higher prevalence of musculoskeletal pain among females, especially medical students—most commonly in the neck.	Musculoskeletal pain is highly prevalent, particularly among medical students, and calls for further research into contributing factors
Legan, M. & Zupan, K. (2020)	Prevalence of mobile device-related musculoskeletal pain among working university students: a cross-sectional study	A cross-sectional study of 535 working university students.	The prevalence of musculoskeletal pain was frequently reported in the back and shoulders and was more in females.	Mobile-device–related musculoskeletal symptoms are common among working students and ergonomic knowledge will help to mitigate these risks.
Olawale et al. (2025)	Prevalence and Risk Factors for Neck Pain and Low Back Pain Among College Students in Nigeria	A cross-sectional survey conducted among 500 Nigerian college students via structured questionnaires.	High 12-month prevalence of low back pain and neck pain consistent with regional and international figures.	Neck and low back pain are highly prevalent among Nigerian college students and linked primarily to modifiable

				ergonomics and posture.
Ozdemir et al. (2021)	Musculoskeletal Pain, Related Factors, and Posture Profiles Among Adolescents: A Cross-Sectional Study From Turkey	A cross-sectional study with 2,221 Turkish adolescents. Assessment was done across 14 body regions, and the Back Pain and Body Posture Evaluation Instrument (BackPEI).	A high prevalence of low back pain and general back pain was found and posture-related factors are strongly linked to musculoskeletal pain in adolescents.	Teaching ergonomic posture and appropriate furniture use in educational settings may reduce the incidence of musculoskeletal pain.
Rashwan et al. (2024)	Relationship of Computer Misuse-Related Body Pain with Awareness of Workstation Ergonomics during Digital Learning Era	A cross-sectional study assessing 173 faculty members. Musculoskeletal pain was reported using a Body Map Tool, alongside an ergonomics knowledge questionnaire.	Greater awareness of workstation ergonomics correlates with reduced severity of computer-related MS pain.	Improving the awareness of workstation ergonomics may be key in reducing MSK pain associated with computer use.
Shahnaz Shahrjerdi (2021)	Prevalence and associated factors of musculoskeletal pain in students of engineering and humanities faculties of Arak university in 2018-2019	A cross-sectional study of 464 students using the Nordic questionnaire.	Engineering students showed higher rates of MSK pain linked to intensive computer use and study hours. Humanities students exhibited MSK pain, attributed to physical inactivity and higher waist-to-hip ratios.	MSK pain is common among students and varies by faculty. Addressing risk factors like poor posture and sedentary behavior can mitigate these risk.

Shahwan et al. (2022)	Evaluation of computer workstation ergonomics and its relationship with reported musculoskeletal and visual symptoms among university employees in Jordan	A total of 231 university office employees were selected using stratified random sampling.	Widespread ergonomic deficiencies linked with prevalence of MSK pain.	Suboptimal ergonomics directly contribute to both MSK pain and visual symptoms among university staff.
Tella et al, (2021)	Association of Complaints of Arm, Neck, and Shoulders with Physical and Psychosocial Risk Factors among Computer Users of Nigerian Bank Employees	Study on 260 Nigerian bank employees using the Maastricht Upper Extremity Questionnaire (MUEQ)	Poor body posture was significantly associated with the complaints of shoulder, arm, and elbow.	Ergonomic training and workplace adjustments can help prevent such complaints.

2.13 Summary

Employing a computer for long periods is frequently linked to pain in the muscles and joints, especially in the neck, shoulders, upper back, and lower back. Several studies involving university students, office workers, and general computer users have found that spending too much time on screens, having poor posture while sitting, using non-ergonomic workstations, and not taking sufficient breaks can greatly raise the chances of developing musculoskeletal (MSK) pain. Other factors like gender, age, stress levels, and a lack of knowledge about ergonomics can also make pain more severe and frequent.

Students who study online or spend many hours studying often report discomfort because they do not have good ergonomic setups (they might use laptops while sitting on beds or at low desks). In workplaces, bank employees and office staff also experience a high rate of MSK pain due to repetitive tasks and sitting for long stretches. This research will provide insight into the computing habits of engineering students in South-South, Nigeria. Encouraging physical activity and teaching about good posture have been found as effective ways to prevent or lessen musculoskeletal pain related to computer use. Overall, cutting down on screen time and improving ergonomic practices are important steps to reduce health risks from extended computer usage.

From the reviewed literature, there is still a limited understanding between the interplay of MSK pain and prolonged computer usage with its other intervening variables like posture, ergonomic setup and break frequency.

CHAPTER THREE

MATERIALS AND METHODS

This chapter describes the methodology of the study, including the research design, participants, participant selection process, data collection tools, and methods of data analysis. It also describes ethical considerations and the research procedure.

3.1 Participants

3.1.1 Participant selection

This study was conducted among male and female undergraduate students currently enrolled at the Faculty of Engineering, University of Benin. Participants selected represented the entire faculty.

3.1.2 Inclusion Criteria

i. Aged 18 years and above.
ii. Students with unrestricted access to a computer (laptop or desktop).
iii. Participants must be willing and able to give informed consent.

3.1.3 Exclusion Criteria

i. Students with significant communication impairments.
ii. Students with pre-existing diagnosed musculoskeletal disorders not related to computer use.

3.2 Materials

3.2.1 List of Instruments

i. The Nordic Musculoskeletal Questionnaire (NMQ)
ii. The Student Laptop Use and Musculoskeletal Posture (SLUMP) Questionnaire

3.2.2 Description of Instruments

i. The Nordic Musculoskeletal Questionnaire (NMQ) is a standardized instrument developed by Kuorinka et al. (1987) to provide a straightforward and reliable means of identifying musculoskeletal disorders, particularly in occupational health research. This questionnaire was employed in the research of Tabiti et al. (2025), Abaraogu et al. (2015), Oluka et al. (2020) among others.

   This tool is intended to collect data on musculoskeletal symptoms experienced in the following body regions: Neck, shoulders, upper back, lower back, wrists/hands, hips/thighs, knees and ankles/feet. The NMQ is structured to determine whether individuals have experienced musculoskeletal symptoms, as well as the factors that worsen these symptoms and their severity.

   It is divided into two main sections: General Section – This section asks whether the respondent has had any symptoms such as pain, discomfort, or numbness in any of the nine body areas over the past 12 months or the past 7 days.

   Detailed Section – For body region where symptoms are reported, further questions explore the intensity of symptoms, their impact on daily activities, and whether medical attention was sought.

ii. The Student Laptop Use and Musculoskeletal Posture (SLUMP) Questionnaire is a 51-item self-report instrument developed by (D’Silva et al., 2015) to evaluate university students’ laptop usage patterns and their associated postural behaviors and musculoskeletal symptoms. It was created in response to the growing concern about the impact of prolonged and improper laptop use on students' musculoskeletal health. The SLUMP questionnaire is divided into several key sections: Demographics and Laptop Use Context (includes age, gender, academic year, and study field and it gathers information on where laptops are used), laptop use duration and frequency (it asks about daily use in hours, session lengths, and break patterns), posture assessment, use of accessories and ergonomics and musculoskeletal discomfort (includes items on frequency and severity of discomfort in areas such as the neck, shoulders, upper/lower back, arms, and wrists, specifically related to laptop use).

Psychometric Properties

Validity

NMQ- The construct validity test showed a similarity between the self-administered NMQ and the interview results and the specificity value was obtained in the lower back, neck and shoulder region above 85% with a specificity value reaching 100% (Aulia Chairani, 2020).

SLUMP- Face and Content Validity was evaluated by experts in ergonomics, physiotherapy, and occupational health, who confirmed that the items were relevant, clear, and covered essential ergonomic risk factors (D'Silva et al., 2019).

Reliability

NMQ- Cronbach's $\alpha > 0.945$ (Aulia Chairani, 2020) indicating an excellent internal consistency.

SLUMP- Test–Retest Reliability was obtained in a study with 91 students (D'Silva et al., 2019), items were repeated after a 7-day interval and 72.5% of items had weighted kappa

(Kw) ≥ 0.60, indicating substantial agreement while 29.4% achieved Kw ≥ 0.80, suggesting almost perfect agreement.

3.3 Methods

3.3.1 Research Design

This study employed a descriptive cross-sectional design to assess the relationship between prolonged computer use and musculoskeletal pain at a specific point in time. Quantitative data was obtained through the questionnaires.

3.3.2 Sampling Technique

Participants were selected from the faculty of Engineering via convenience sampling technique.

3.2.3 Sample Size

Sample size was calculated using Taro Yamane's (Taro Yamene, 1967) formula for a known population:

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

n= sample size

N= estimated population of the faculty of Engineering which is 7000

e= margin of error (0.05)

$$\frac{7000}{1 + 7000(0.05)^2} \approx 378$$

Therefore, 378 participants were recruited for this study.

3.2.4 Procedure for Data Collection

The study was carried out in several phases to ensure comprehensive data collection and integrity of the process. Ethical approval was obtained from the appropriate Research Ethics Committee (School of Basic Medical Sciences). Once approval was secured, participants were approached and the purpose of the study was explained in simple, understandable terms, and individuals who meet the inclusion criteria were invited to participate. Informed consent was obtained from all participants before any data is collected. Following the data collection phase, quantitative data was entered into SPSS for statistical analysis.

3.3.5 Ethical Considerations

Ethical approval was obtained from the University of Benin Research Ethics Committee. All respondents were informed of the study's objectives and procedures, and informed consent was obtained. Confidentiality and anonymity of respondents was assured by researcher. Participation was voluntary, and respondents had the right to withdraw at any time without consequences.

3.2.6 Data Analysis

Quantitative Data from the questionnaires was analyzed using SPSS version 27.0. Descriptive of frequency and percentage were used to summarize the socio-demographic characteristics of the respondents while inferential statistics of Spearman’s rank correlation, Kruskal–Wallis test and Chi square were used to test the hypotheses. Significance was set at $p < 0.05$.

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents the results of the study on the interdependence of prolonged computer usage and musculoskeletal (MSK) pain among University of Benin Engineering students. A total of 378 valid responses were analyzed using the Statistical Package for the Social Sciences (SPSS). The findings are organized in line with the study objectives, beginning with the socio-demographic and academic characteristics of respondents, followed by analyses of MSK pain prevalence, affected body regions, the relationship between usage duration and pain severity, and the influence of posture, ergonomics, break habits, demographic and academic factors. Both descriptive and inferential statistics are employed to provide a comprehensive understanding of the patterns and associations observed.

4.2 Socio-Demographic and Academic Characteristics of respondents

This section presents the socio-demographic and academic characteristics of the 378 participants who participated in the study. The variables described include gender, age group, handedness, department, and educational level. The distributions are highlighted in Table 2 and further displayed using pie charts for clarity and ease of interpretation.

Table 2: Socio-demographic and academic characteristics of respondents

Variable	Category	Frequency(n)	Percentage(%)
Gender	Male	205	54.2
	Female	173	45.8
Age Group (years)	18–25	360	95.2
	26–30	18	4.8
Handedness	Right-handed	344	91.0
	Left-handed	34	9.0
Department	Civil Engineering	59	15.6
	Electrical/Electronics Eng.	57	15.1
	Industrial Engineering	56	14.8
	Computer Engineering	40	10.6
	Marine Engineering	38	10.1
	Production Engineering	36	9.5
	Chemical Engineering	30	7.9
	Petroleum Engineering	22	5.8
	Mechanical Engineering	20	5.3
	Structural Engineering	18	4.8
	Mechatronics	2	0.5
Academic level	100 Level	58	15.3
	200 Level	69	18.3
	300 Level	122	32.3
	400 Level	85	22.5
	500 Level	44	11.6

The gender distribution in Figure 4 shows that a higher proportion of respondents were male (54.2%) than female students (45.8%). This reflects the male-dominated enrollment pattern often observed in engineering faculties, where male students typically outnumber their female counterparts.

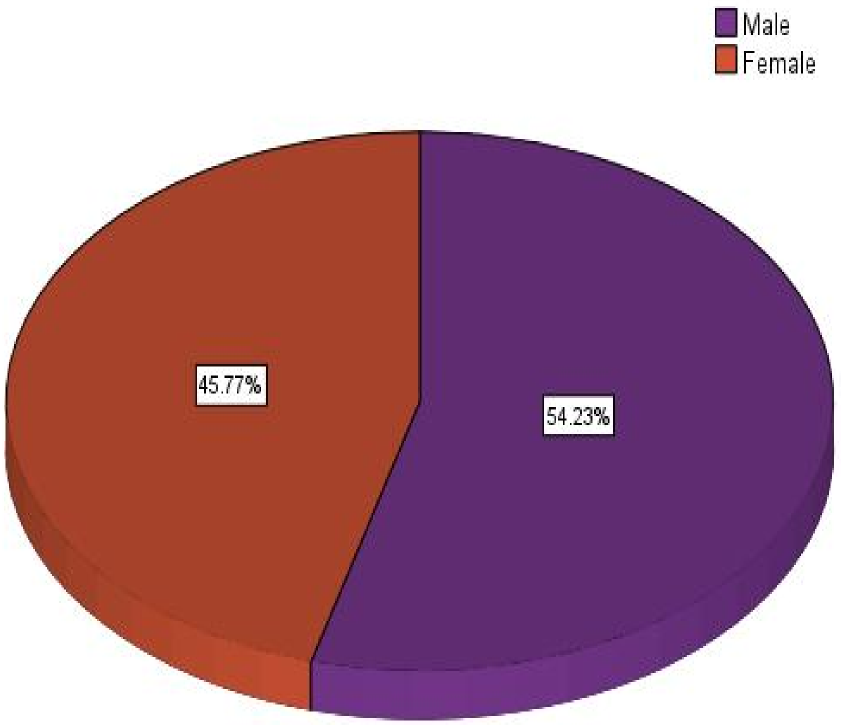


Figure 4: Pie Chart Showing Gender Distribution of Respondents

The age distribution of respondents is presented in Figure 5. Most respondents (95.2%, n=360) were between 18 and 25 years old, while only a small proportion (4.8%, n=18) fell within the 26–30 age bracket.

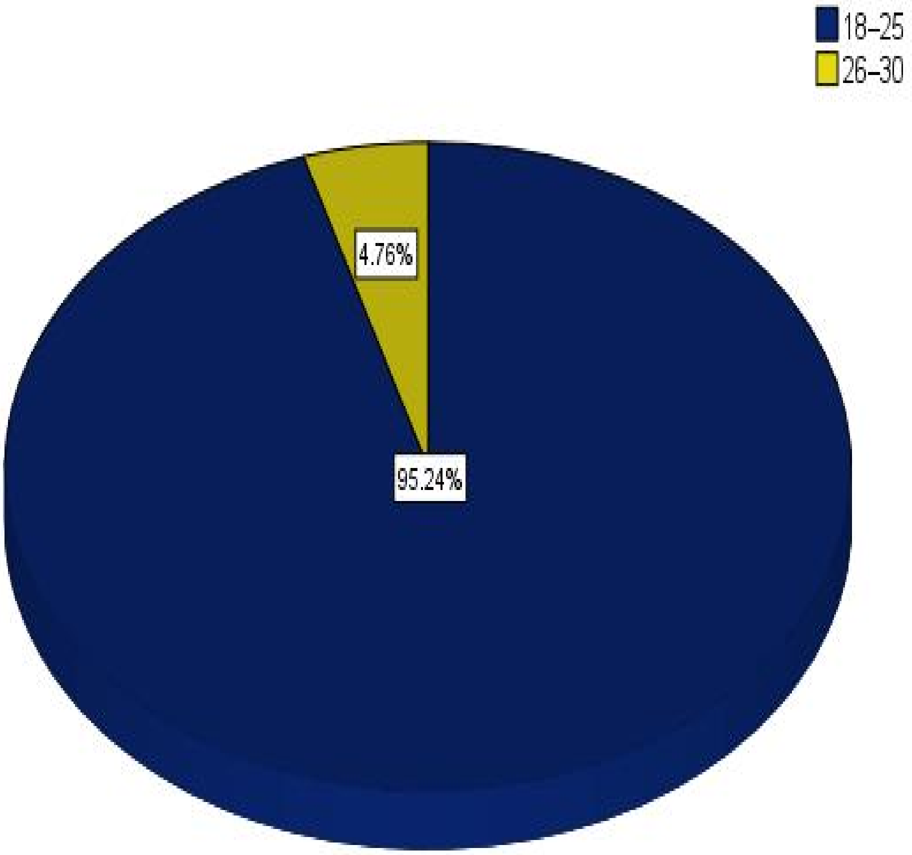


Figure 5: Pie Chart Showing Age Group of Respondents

Figure 6 shows the distribution of handedness among respondents. Most students (91.0%) reported being right-handed, while a smaller proportion (9.0%) were left-handed. This finding is consistent with the general population trend, where right-handedness is predominant.

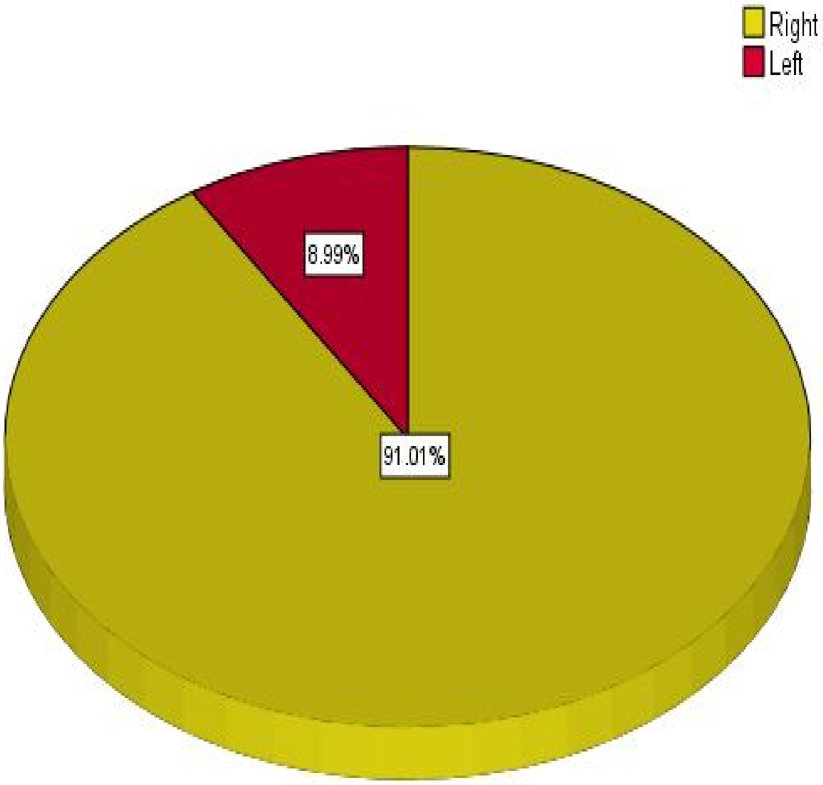


Figure 6: Pie Chart Showing Handedness of Respondents

The participants were drawn from eleven engineering departments, as shown in Figure 7. Civil Engineering (15.6%, n=59), Electrical/Electronics Engineering (15.1%, n=57), and Industrial Engineering (14.8%, n=56) had the most significant representation. Smaller proportions were from Computer Engineering (10.6%, n=40), Marine Engineering (10.1%, n=38), and Production Engineering (9.5%, n=36). Other departments, such as Chemical (7.9%, n=30), Petroleum (5.8%, n=22), Mechanical (5.3%, n=20), Structural (4.8%, n=18), and Mechatronics (0.5%, n=2), had fewer respondents. The distribution highlights the diverse participation across the engineering faculties, ensuring representation from larger and smaller programs.

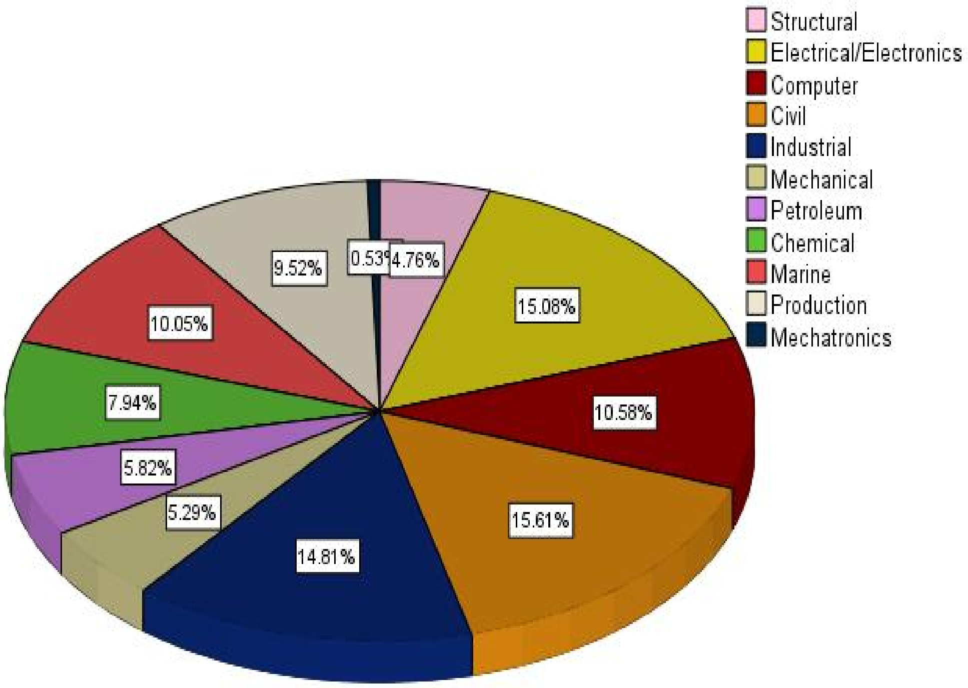


Figure 7: Pie Chart Showing Departmental Distribution of Respondents

The academic level of respondents is presented in Figure 8. The highest proportion of students was in the 300 Level (32.3%, n=122), followed by those in the 400 Level (22.5%, n=85), and the 200 Level (18.3%, n=69). Students in 100 Level (15.3%, n=58) and 500 Level (11.6%, n=44) formed the remaining groups. This indicates a balanced representation across levels, though the mid-level students constituted the majority.

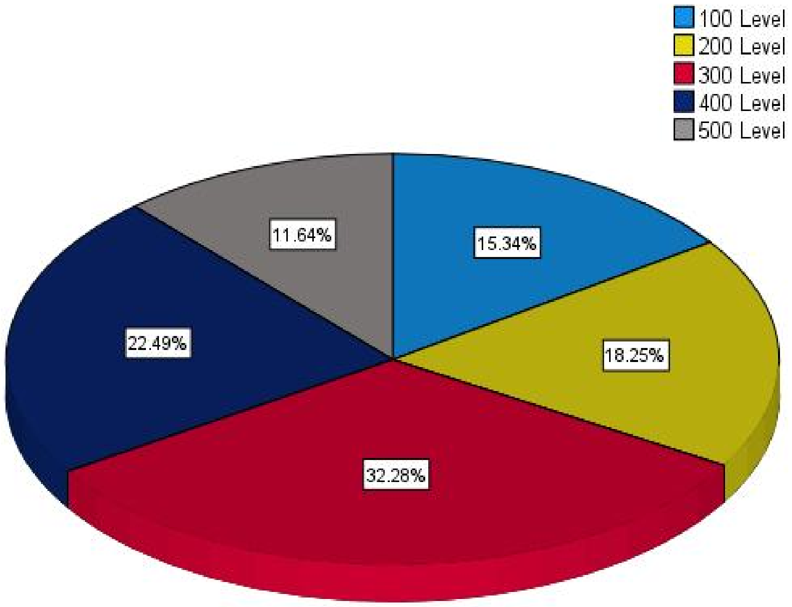


Figure 8: Pie Chart Showing Academic Level of Respondents

4.3 Prevalence of Musculoskeletal Pain among Respondents

This section presents the prevalence of musculoskeletal (MSK) pain among respondents and within subgroups defined by prolonged daily computer use. Consistent with the objective, results are summarized for: (i) MSK pain in the last 12 months (neck/shoulder/arm/wrist/hand), (ii) pain after laptop use and (iii) duration of pain after laptop use.

4.3.1 Overall Prevalence

Table 3 shows that 82.5% (n=312/378) reported MSK pain in the last 12 months, while 17.5% (n=66/378) reported no MSK pain. As shown in Table 3, 52.1% (n=197/378) reported pain after laptop use. Regarding duration of pain after computer use, the table indicates that 23% reported pain lasting less than 30 minutes, followed by 30–60 minutes (15.9%), 1–6 hours (8.5%), and 6–24 hours (4.7%).

Table 3: MSK overall prevalence

Variable	Frequency(n)	Percentage(%)
12 months prevalence of MSK pain		
No	66	17.5
Yes	312	82.5
Pain after computer use		
No	181	47.9
Yes	197	52.1
Duration of pain after computer use		
0 minutes	181	47.9
Less than 30 minutes	87	23.0
30–60 minutes	60	15.9
1–6 hours	32	8.5
6–24 hours	18	4.7

4.3.2 Prevalence of MSK pain among respondents based on usage duration

Among students classified as prolonged users at the ≥4 h/day threshold, 83.4% (n=266/319) reported MSK pain in the last 12 months (Table 4). Pain after laptop use was reported by 56.7% (n=181/319). The duration profile in this subgroup remained concentrated in the shorter categories: <30 minutes (48.2%) and 30–60 minutes (26.9%), with 1–6 hours (15.5%) and 6–24 hours (9.3%) less common. Within the ≥8 h/day subgroup, 91.2% (n=135/148) reported MSK pain in the last 12 months and 67.6% (n=100/148) reported pain after laptop use. The duration distribution showed a larger contribution of longer pain durations compared with the overall group: <30 minutes (35.8%), 30–60 minutes (24.5%), 1–6 hours (22.6%), and 6–24 hours (17.0%).

The prevalence of MSK pain is high in the overall cohort and rises with increasing daily computer use, from 82.5% in the full sample to 83.4% among ≥4 h/day users and 91.2% among ≥8 h/day users. Pain after laptop use follows a similar gradient (52.1% overall; 56.7% at ≥4 h/day; 67.6% at ≥8 h/day). While short-duration pain (<60 minutes) remains the most common overall, heavier users exhibit a shift toward longer durations (1–24 hours), underscoring the potential dose–response nature of exposure to prolonged computer use.

Table 4: Prevalence of MSK pain among respondents based on usage duration

Variable	N	%	Total
12 months prevalence of MSK pain(computer usage ≥4 hours/day)			N=319
No	53	16.6	
Yes	266	83.4	
Pain after laptop use(computer usage ≥4 hours/day)			N=319
No	138	43.3	
Yes	181	56.7	
12 months prevalence of MSK pain(computer usage ≥8 hours/day)			N=148
No	13	8.8	
Yes	135	91.2	
Pain after laptop use(computer usage ≥8 hours/day)			N=148
No	48	32.4	
Yes	100	67.6	
Duration category(≥4 h/day)			N=193
Less than 30 minutes	93	48.2	
30–60 minutes	52	26.9	
1–6 hours	30	15.5	
6–24 hours	18	9.3	
Duration category(≥8 h/day)			N=106
Less than 30 minutes	38	35.8	
30–60 minutes	26	24.5	
1–6 hours	24	22.6	
6–24 hours	18	17.0	

4.4 Body Regions Most Affected by Musculoskeletal Pain

This section describes the distribution of musculoskeletal (MSK) pain across specific body regions using prevalence thresholds of 0-10: No pain (0), mild pain (≥1), moderate pain (≥4), and severe pain (≥7).

4.4.1 Body Regions Most Affected by Musculoskeletal Pain among respondents (computer usage ≥4 h/day and ≥8 h/day)

This subsection presents regional pain intensity and prevalence among respondents who reported prolonged daily computer use. Overall, mean pain ratings in the prolonged-use group remained highest for the neck, followed by the shoulder and lower back. Prevalence patterns mirror the intensity profile: neck and lower back remain the most affected regions, with shoulder and wrists/hands contributing substantially to symptom burden. Among heavy users (≥8 h/day), the neck remains the most frequently affected region for both mild pain and moderate pain, while the lower back carries the highest burden of severe pain.

Table 5: Prevalence of mild pain by region among respondents (computer usage ≥4 hours/day and ≥8 hours/day)

Region	(≥4 h/day)%	(≥8 h/day)%
Neck	61.1	66.2
Shoulder	46.1	44.6
Upper back	31.3	36.5
Lower back	39.8	31.1
Elbows	21.0	18.2
Wrists/Hands	36.4	35.8
Hips/Thighs	20.4	21.6
Knees	17.9	22.3
Ankles/Feet	23.2	18.9

Table 6 indicates that neck (31.7%) and lower back (22.3%) remain the leading regions at the moderate threshold, followed by shoulder (19.1%), wrists/hands (14.4%), and upper back (12.5%) for the ≥4h/day threshold. At the clinically more meaningful threshold, neck (35.1%) remains the leading region, followed by shoulder (17.6%), lower back (17.6%), wrists/hands (12.8%), and upper back (9.5%) for the ≥8h/day threshold.

Table 6: **Prevalence of moderate pain by region among respondents (computer usage ≥4 hours/day)**

Region	%(≥4h/day)	% (≥8h/day)
Neck	31.7	35.1
Shoulder	19.1	17.6
Upper back	12.5	9.5
Lower back	22.3	17.6
Elbows	5.6	2.7
Wrists/Hands	14.4	12.8
Hips/Thighs	6.9	9.5
Knees	7.2	8.8
Ankles/Feet	10.0	5.4

At the severe threshold, neck (6.3%) and lower back (5.6%) predominate, with shoulder and upper back each at 4.4% for the ≥4h/day threshold. For the ≥8h/day threshold, the lower back shows the highest prevalence (6.8%), with neck and shoulder each at 2.7%. Severe symptoms were otherwise uncommon across regions.

Table 7: **Prevalence of severe pain by region among respondents (computer usage ≥4 hours/day)**

Region	**n (≥4h/day)**	**% (≥8h/day)**
Neck	6.3	2.7
Shoulder	4.4	2.7
Upper back	4.4	1.4
Lower back	5.6	6.8
Elbows	3.8	1.4
Wrists/Hands	5.0	1.4
Hips/Thighs	1.3	1.4
Knees	0.6	1.4
Ankles/Feet	1.9	1.4

4.5 Relationship between Duration of Daily Computer Use and Severity of Pain

This section examines whether daily computer-use duration is associated with musculoskeletal pain severity. Analyses include correlation between total daily hours and severity; group comparisons across usage bands; and linear regression with pain severity as a continuous outcome.

4.5.1 Correlation between total daily hours and pain severity

Spearman's rank correlation indicated a small, negative and non-significant association between total daily laptop use and pain severity ($\rho = -0.072$; $p = 0.160$; $n = 377$), suggesting no monotonic relationship overall.

Table 8: Spearman correlation between total daily laptop usage and pain severity

Measure	Total Daily Laptop Usage (hours/day)	Pain Severity
Spearman’s ρ	1.000	–0.072
Sig. (2-tailed)	—	0.160
N	377	377–378

4.5.2 Group differences across usage bands

To explore potential non-linear patterns, respondents were grouped into usage bands: 0–<2 hours, 2–<4 hours, 4–<6 hours, 6–<8 hours, and ≥8 hours per day. The Kruskal–Wallis test detected a significant difference in pain severity across bands ($H = 11.737$, df = 4, $p = 0.019$), indicating that severity varies with exposure level (Table 9).

Table 9: **Kruskal–Wallis test of pain severity across usage bands**

Statistic	**Value**
Kruskal–Wallis H	11.737
Df	4
Asymp. Sig.	0.019

4.5.3 Linear regression

A simple linear regression (dependent variable: pain severity) using total daily hours as the sole predictor showed a small negative association ($B = –0.076$, SE = 0.037, $\beta = –0.106$, $t = –2.057$, $p = 0.040$), but the explained variance was minimal ($R^2 = 0.011$), indicating limited predictive value of hours alone.

Table 10: **Model summary (linear regression, dependent: pain severity)**

Model	R	R^2	Adj. R^2	SEE
1 (hours only)	0.106	0.011	0.009	3.166

Collinearity diagnostics were unremarkable (Tolerance = 1.000; VIF = 1.000; Condition Index < 10), indicating no collinearity concerns (Table 4.32).

Table 11: Collinearity diagnostics.

Dimension	Eigenvalue	Condition Index	Variance Proportions (Const., Hours)
1	1.853	1.000	0.07, 0.07
2	0.147	3.551	0.93, 0.93

4.6 Effect of Posture, Ergonomics, and Break Habits on Pain

This section examines whether posture, workstation ergonomics, and break practices are associated with the occurrence of musculoskeletal (MSK) pain (defined as regional pain rating ≥ 1).

4.6.1 Ergonomics device count and pain occurrence

A three-level ergonomics index (0 = none, 1 = one device, 2 = two devices used $\geq 50\%$ of the time) was cross-tabulated with pain occurrence. Pain prevalence was 68.8% among those using no ergonomic devices, 74.5% among those using one, and 75.0% among those using two devices. The association was not statistically significant (Pearson $\chi^2 = 1.286$, df = 2, $p = 0.526$).

Table 12: MSK pain (≥1) by ergonomics device count.

Ergonomics devices (≥50% use)	**No pain *n* (%)**	**Pain *n* (%)**	**Total**
None	81 (31.2)	179 (68.8)	260
One	26 (25.5)	76 (74.5)	102
Two	4 (25.0)	12 (75.0)	16
Total	111 (29.4)	267 (70.6)	378
Pearson $\chi^2 = 1.286$, *df* $= 2$, *p* $= 0.526$.			

4.6.2 Break adequacy and pain occurrence

Breaks were classified as adequate if students reported taking breaks with ≤1-hour intervals and ≥5-minute duration. Pain prevalence was 72.7% among students with inadequate breaks and 67.1% among those with adequate breaks; the difference was not statistically significant ($\chi^2 = 1.307$, df = 1, $p = 0.253$). The odds ratio comparing *adequate vs inadequate* breaks was 0.77 (95% CI: 0.49–1.21), suggesting a non-significant protective tendency.

Table 13: MSK pain (≥1) by break adequacy

Breaks	**No pain *n* (%)**	**Pain *n* (%)**	**Total**
Inadequate	65 (27.3)	173 (72.7)	238
Adequate	46 (32.9)	94 (67.1)	140
Total	111 (29.4)	267 (70.6)	378

Pearson $\chi^2 = 1.307$, $df = 1$, $p = 0.253$. OR (Adequate vs Not) = 0.77, 95% CI: 0.49–1.21.

4.6.3 Break frequency (interval) and duration in relation to pain

Break intervals (≤30 min, ≤1 h, >1–2 h, >2 h) showed borderline evidence of association with pain (Pearson $\chi^2 = 7.683$, df = 3, $p = 0.053$; Likelihood Ratio = 8.095, $p = 0.044$). Pain prevalence ranged from 83.1% (≤30 min) to 63.2% (>2 h).

Table 14: MSK pain (≥1) by break interval band.

Break interval	**No pain *n* (%)**	**Pain *n* (%)**	**Total**
≤30 min	10 (16.9)	49 (83.1)	59
≤1 h	42 (33.3)	84 (66.7)	126
>1–2 h	31 (27.0)	84 (73.0)	115
>2 h	28 (36.8)	48 (63.2)	76
Total	111 (29.5)	265 (70.5)	376

Pearson $\chi^2 = 7.683$, $df = 3$, $p = 0.053$; *Likelihood Ratio* = 8.095, $p = 0.044$.

By contrast, break duration displayed a strong association with pain ($\chi^2 = 27.016$, df = 3, $p < 0.001$): prevalence decreased as duration increased, from 86.7% (<5 min) and 100% (5–9 min; small $n = 20$) to 61.6% (≥20 min).

Table 15: MSK pain (≥1) by break duration band

Break duration	**No pain *n* (%)**	**Pain *n* (%)**	**Total**
<5 min	6 (13.3)	39 (86.7)	45
5–9 min	0 (0.0)	20 (100)	20
10–19 min	14 (18.9)	60 (81.1)	74
≥20 min	91 (38.4)	146 (61.6)	237
Total	111 (29.5)	265 (70.5)	376

Pearson $\chi^2 = 27.016$, $df = 3$, $p < 0.001$.

4.6.4 Correlation of posture, ergonomics, and breaks with pain severity

Spearman correlations were used for pain severity (0–10) against continuous exposures. Average break duration showed a small-to-moderate negative correlation with severity ($\rho = -0.239$, $p < 0.001$), indicating longer breaks relate to lower severity. Correlations for non-neutral posture hours ($\rho = -0.114$, $p = 0.027$) and break frequency ($\rho = -0.061$, $p = 0.238$) were small; ergonomics score and neutral posture hours were non-significant.

Table 16: Spearman correlations with pain severity

Predictor	**ρ with severity**	***P***
Non-neutral posture hours/day (Figs 2–5)	–0.114	0.027
Ergonomics device score (0–3)	+0.054	0.293
Break frequency (hours between breaks)	–0.061	0.238
Average break duration (minutes)	**–0.239**	**<0.001**
Neutral posture hours/day (Fig 1)	+0.049	0.343

4.6.5 Multivariable logistic regression (occurrence of pain)

A logistic regression model with occurrence of pain (any region ≥ 1) as the dependent variable included: non-neutral posture hours/day, ergonomics score, break adequacy, break frequency (hours), and average break duration (minutes). The model showed no overall significance (Omnibus $\chi^2 = 5.194$, df = 5, $p = 0.393$), very low explanatory power (Nagelkerke $R^2 = 0.020$), and poor calibration (Hosmer–Lemeshow $\chi^2 = 36.248$, df = 8, $p < 0.001$). None of the predictors reached statistical significance.

Table 17: Logistic regression for any MSK pain (≥1)

Predictor	**aOR**	**95% CI**	***P***
Non-neutral posture hours/day	0.993	0.942–1.047	0.807
Ergonomics device score (0–3)	1.312	0.866–1.988	0.199
Breaks adequate (≤1 h & ≥5 min)	0.672	0.406–1.112	0.122
Break frequency (hours)	0.915	0.815–1.027	0.132
Average break duration (minutes)	1.000	1.000–1.000	0.715
Model fit		Omnibus $p = 0.393$; H–L $p < 0.001$; Nagelkerke $R^2 = 0.020$	

4.7 Influence of Demographic and Academic Factors on Pain

This section examines whether socio-demographic (gender, age group, handedness) and academic (department, level) factors are associated with the occurrence of musculoskeletal (MSK) pain (defined as *any pain in any region, rating ≥1*).

4.7.1 Gender

Pain prevalence was similar in males (71.7%) and females (69.4%). The association between gender and pain was not significant (Pearson $\chi^2 = 0.248$, df = 1, $p = 0.618$).

4.7.2 Academic level

Pain prevalence varied significantly across levels (Pearson $\chi^2 = 15.253$, df = 4, $p = 0.004$). The highest proportions with pain were observed at 100 level (82.8%) and 300–400 levels (73.8–75.3%), while the 500 level had the lowest pain prevalence (54.5%).

4.7.3 Department

Pain prevalence differed significantly by department (Pearson $\chi^2 = 21.238$, df = 10, $p = 0.019$). Higher pain proportions were seen in Computer (80.0%), Electrical/Electronics (78.9%), Structural (77.8%), Industrial (75.0%), and Petroleum (81.8%). Lower proportions were observed in Marine (47.4%) and Chemical (53.3%).

4.7.4 Age group

Pain was less common in the 26–30 group (44.4%) than in the 18–25 group (71.9%). The association was significant (Pearson $\chi^2 = 6.250$, df = 1, $p = 0.012$).

4.7.5 Handedness

Pain prevalence did not differ significantly between right-handed (71.2%) and left-handed (64.7%) students (Pearson $\chi^2 = 0.633$, df = 1, $p = 0.426$).

Overall, academic level and department showed statistically significant associations with MSK pain occurrence, while gender and handedness did not. Age group (18–25 vs 26–30 years) showed a significant difference, with a lower prevalence of pain in the older group.

4.8 Hypothesis Testing

This section presents the testing of the study's hypotheses, using inferential statistical analyses carried out on the data obtained from 378 respondents. Each hypothesis was examined in relation to the relevant objectives and statistical results reported in earlier sections. The significance threshold for all tests was set at $p < 0.05$.

4.8.1 Main Hypothesis

H_{01}: ***There is no significant relationship between prolonged computer use and the prevalence of musculoskeletal (MSK) pain among University of Benin, engineering students.***

Alpha level: 0.05

Test statistic: Kruskal–Wallis H test

Observed: $p = 0.019$

Since the observed p value was less than 0.05 Alpha level, the hypothesis was therefore REJECTED. This indicates that prolonged computer usage is significantly associated with the prevalence of MSK pain among university students.

4.8.2 Sub-Hypothesis 1

H_{02}: *There is no significant relationship between the duration of daily computer use and the severity of MSK pain.*

Alpha level: 0.05

Test statistic: Spearman's correlation

Observed: $\rho = -0.072$, $p = 0.160$

Since the observed p-value (0.160) was greater than the 0.05 alpha level, the hypothesis was NOT REJECTED. This indicates that there was no significant monotonic relationship between daily computer usage duration and MSK pain severity.

4.8.3 Sub-Hypothesis 2

H_{03}: *There is no significant relationship between gender and the occurrence of MSK pain.*

Alpha level: 0.05

Test statistic: Chi-square (χ^2)

Observed: $\chi^2 = 0.248$, $p = 0.618$

Since the observed p-value (0.618) was greater than the 0.05 alpha level, the hypothesis was NOT REJECTED. This indicates that gender was not significantly associated with the occurrence of MSK pain among university students.

4.8.4 Sub-Hypothesis 3

H_{04}: *There is no significant relationship between age and the occurrence of MSK pain.*

Alpha level: 0.05

Test statistic: Chi-square (χ^2)

Observed: $\chi^2 = 6.250$, $p = 0.012$

Since the observed p-value (0.012) was less than the 0.05 alpha level, the hypothesis was REJECTED. This indicates that age group was significantly associated with MSK pain occurrence, with older students (26–30 years) reporting lower prevalence compared to younger students (18–25 years).

4.8.5 Sub-Hypothesis 4

H_{05}: *There is no significant relationship between posture and the occurrence of MSK pain.*

Alpha level: 0.05

Test statistic: Logistic regression and Spearman's correlation

Observed: Logistic regression $p = 0.807$; $\rho = -0.114$, $p = 0.027$

Despite a weak correlation, logistic regression results were not significant ($p = 0.807$). Therefore, the hypothesis was NOT REJECTED, indicating that posture, as measured in this study, was not significantly related to MSK pain occurrence.

4.8.6 Sub-Hypothesis 5

H_{06}: *There is no significant relationship between break duration and the occurrence of MSK pain.*

Alpha level: 0.05

Test statistic: Chi-square (χ^2)

Observed: $\chi^2 = 27.016$, $p < 0.001$

Since the observed p-value (< 0.001) was less than the 0.05 alpha level, the hypothesis was REJECTED. This indicates that break duration was significantly associated with the occurrence of MSK pain. Students who took longer breaks (≥20 minutes) reported lower pain prevalence and severity, suggesting that extended breaks play a protective role.

4.8.7 Sub-Hypothesis 6

H_{07}: *There is no significant relationship between break frequency and the occurrence of MSK pain.*

Alpha level: 0.05

Test statistic: Chi-square (χ^2)

Observed: $\chi^2 = 1.307$, $p = 0.253$

Since the observed p-value (0.253) was greater than the 0.05 alpha level, the hypothesis was NOT REJECTED. This indicates that the frequency of breaks was not significantly associated with the occurrence of MSK pain among university students.

4.8.8 Sub-Hypothesis 7

H_{08}: *There is no significant relationship between academic level and the occurrence of MSK pain.*

Alpha level: 0.05

Test statistic: Chi-square (χ^2)

Observed: $\chi^2 = 15.253$, $p = 0.004$

Since the observed p-value (0.004) was less than the 0.05 alpha level, the hypothesis was REJECTED. This indicates that academic level was significantly associated with the occurrence of MSK pain with those in 100 level reporting higher prevalence and final year students reporting lowest.

4.8.9 Sub-Hypothesis 8

H_{09}: *There is no significant relationship between the department and the occurrence of MSK pain.*

Alpha level: 0.05

Test statistic: Chi-square (χ^2)

Observed: $\chi^2 = 21.238$, $p = 0.019$

Since the observed p-value (0.019) was less than the 0.05 alpha level, the hypothesis was REJECTED. This indicates that the department was significantly associated with the occurrence of MSK pain.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

This study examined the interdependence between prolonged computer use and musculoskeletal (MSK) pain among engineering undergraduates at the University of Benin. Guided by the study objectives and hypotheses, the analysis proceeded from prevalence estimates to regional pain patterns, explored the relationship between daily exposure and pain severity, and then assessed the influence of posture/ergonomics and break habits, before interrogating demographic and academic correlates. Several key findings emerged. The study recorded a high overall prevalence of MSK pain in the past 12 months (82.5%), with pain/discomfort after laptop use reported by 52.1%. Prevalence rose stepwise in prolonged (≥4 h/day: 83.4%) and heavy users (≥8 h/day: 91.2%). Heavier users also reported longer episodes of pain after computer use (≥1–24 h) more often than the full sample, suggesting an exposure–response tendency. University cohorts frequently display high MSK symptom loads, commonly above 50% and often concentrated in the spine (Dockrell *et al.*, 2015; Borhany *et al.*, 2018). Studies conducted during and after the pandemic also reported elevated neck and low-back complaints in student populations exposed to extended screen work and less formal ergonomic setups (Symanzik *et al.*, 2022; Janc *et al.*, 2023). The prevalence aligns with these patterns and with more recent reports that place student MSP around 60–90%, with the axial skeleton most affected (Kandasamy *et al.*, 2024; Alanazi *et al.*, 2025).

The high prevalence—paired with the shift toward longer symptom duration among heavy users—points to cumulative loading and tissue strain associated with frequent, prolonged, or constrained postures. Although pain after laptop use was reported by only about half of respondents, 12-month symptoms were much more prevalent, indicating that not all pain episodes are temporally or perceptually tied to single bouts of laptop use; instead, pain may reflect aggregate exposures across academic tasks, non-academic device use, stress, and sleep (a biopsychosocial pattern).

The neck had the highest mean intensity overall, with the lower back and shoulder following. For "any pain" (≥1), the neck (59.0%), shoulder (44.2%) and lower back (41.5%) predominated; for moderate-or-greater pain (≥4), the neck (30.4%) and lower back (25.1%) led; for severe pain (≥7), the lower back ranked highest (9.0%). These patterns persisted in prolonged (≥4 h/day) and heavy (≥8 h/day) subgroups, though the lower back increasingly dominated the severe category. Comparable cohorts report the neck and lower back as the principal sites of discomfort, with prevalence and intensity sensitive to sitting time, visual display height/tilt, and input device use (Pattath *et al.*, 2022; Blumenberg *et al.*, 2021; Alanazi *et al.*, 2025). Among university students, neck pain often exceeds 40–60% annually, and lower-back pain ~40–50%—magnitudes closely mirroring our sample (Pattath, 2022; Alanazi, 2025).

The distribution highlights two mechanisms. First, cranio-cervical loading from forward head posture during close-range screen and keyboard tasks stresses the cervical extensors and scapular stabilisers, predisposing to neck and shoulder complaints. Second, lumbar loading from prolonged sitting and flexed postures increases intradiscal pressure and paraspinal fatigue, predisposing to low-back pain; this may help explain the concentration of severe symptoms in the lower back among heavy users. The pattern is consistent with sedentary-time reviews linking long daily seated screen exposure (especially phone and computer use) to elevated neck pain risk (systematic reviews report markedly higher odds above ~6 hours/day) (Kandasamy *et al.*, 2024).

The monotonic correlation between total daily hours and pain severity was weak and non-significant. However, group contrasts were significant: severity was highest in the 0–<2 h band, lowest at 6–<8 h, and slightly higher again at ≥8 h (Kruskal–Wallis $p = 0.019$; ANOVA $p = 0.008$). Post-hoc tests showed significantly lower severity at 6–<8 h and ≥8 h compared with 0–<2 h. A simple linear model found a minimal ($R^2 = 0.011$) negative slope (–0.076/unit hour), statistically significant but practically trivial. The wider literature frequently but not uniformly reports positive associations between more extended computer use and neck and low-back pain. Some studies show more discomfort with >8 h/day and prolonged sitting or awkward postures (Pattath *et al.*, 2022). Others suggest near-linear increases in low-back pain probability per additional hour of daily computer use (Kandasamy *et al.*, 2024). However, experimental and field data also show that break behaviour and task organisation can modify the exposure-symptom link, producing non-linear or threshold effects (Luger *et al.*, 2019; McLean *et al.*, 2001).

The U-shaped pattern—higher severity in the lowest-use band, lowest at moderate use, with a slight rise at ≥8 h—likely reflects confounding and effect modification. Students reporting very low daily laptop use may constitute a group with pre-existing pain (who avoid use), students constrained by other stressors (e.g., manual projects) that drive pain independently of laptop hours, or students with sporadic but intense “cramming” sessions that concentrate exposure into fewer days. Moderate users may have better self-pacing, more structured study habits, or more consistent micro-breaks. The slight rise at ≥8 h likely signals the toll of sustained exposure when breaks and posture variability are insufficient. The weak linear association and significant group differences underscore that “hours alone” is an imprecise risk metric without contextual variables (breaks, posture, device/desk configuration, assessment cycles). This aligns with the biopsychosocial model, which anticipates multi-determinant symptom expression rather than simple dose-response (Gatchel *et al.*, 2007; Meints *et al.*, 2018; Smart, 2023).

In bivariate cross-tabs, the count of ergonomic devices used ≥50% of the time was not significantly related to pain occurrence. Break adequacy (≤1-hour intervals and ≥5-minute duration) was also non-significant for occurrence, though the odds ratio favoured adequacy (0.77). Break interval exhibited borderline association, and break duration showed a strong graded association with pain occurrence: pain prevalence fell steadily as average break duration increased, with ≥20-minute breaks associated with the lowest pain. For severity, average break duration correlated inversely ($\rho = -0.239$, $p<0.001$). In multivariable logistic regression including posture hours, ergonomics score, break adequacy, interval, and duration, no variable independently predicted pain occurrence; model fit and explained variance were poor. Evidence on breaks is more consistent than evidence on single-component ergonomics or isolated posture coaching. Systematic reviews and field trials indicate that micro-breaks (very short, frequent) and longer breaks can reduce discomfort and improve performance, with larger effects as break duration increases (Luger *et al.*, 2019; Albulescu *et al.*, 2022). Conversely, several randomised trials of postural interventions alone show limited or null prevention effect on upper-extremity symptoms in computer users—highlighting that posture cues without task/break redesign are often insufficient (Gerr *et al.*, 2005). Participatory or multi-component ergonomic programmes can help, especially when they modify task cycles and user behaviour, but effects vary (Jin *et al.*, 2025; Santos *et al.*, 2025).

The strong break-duration effect in the present data coheres with the literature: recovery time (and likely micro-movement) interrupts static loading, allowing reperfusion and reducing nociceptive input. The lack of significance for ergonomic device count does not imply that ergonomics are irrelevant; rather, device presence is a weak proxy for practical use (e.g., a laptop stand unused, or a chair with lumbar support not adjusted). Similarly, the non-significant multivariable model likely reflects measurement limits (self-reported posture hours; coarse device counts), collinearity among behaviours, and the reality that occurrence (any pain ≥1) is a broad endpoint influenced by many unmeasured factors (sleep, stress, fitness). The consistent inverse association between break duration and severity argues that behaviour-level changes—simple, teachable, and schedule-embedded—may yield the most leverage in this population.

Pain occurrence did not differ significantly by gender in this cohort. While many student studies report higher symptom odds among women—often attributed to anthropometry, workstation mismatch, and psychosocial stressors (Pattath *et al.*, 2022; Alanazi *et al.*, 2025)—null findings are not uncommon when exposure distributions and department-level demands are accounted for. These results imply that programme demands and behaviours may overshadow gender differences in this setting. Also, students aged 26–30 reported lower pain prevalence than those aged 18–25. This might reflect better pacing strategies, accumulated self-regulation, or less "all-nighter" behaviour among older students. Alternatively, age may proxy selection into less computing-intensive roles or better ergonomic awareness. It is also noteworthy that first-year students exhibited the highest pain prevalence (82.8%), while final-year students displayed the lowest (54.5%). This gradient plausibly reflects (i) adaptation—students internalise self-management and ergonomic strategies over time; (ii) assessment design—early curricula may emphasise foundational computing tasks (note-taking, coding basics) with dense seated time; and (iii) departmental rotations—senior students may spend more time in fieldwork, labs, or project meetings that diversify posture. The pattern signals a prevention window in the first year. Finally, significant differences by department (highest in Computer, Petroleum, Electrical/Electronics; lowest in Marine, Chemical) likely mirror task/assessment profiles (e.g., extended coding and simulation vs. more lab and ship-system practicals) and cultural norms around breaks and all-night work. These findings argue for department-tailored interventions.

5.2 Conclusion

This study demonstrates a high burden of MSK pain among engineering undergraduates. It shows that the distribution of symptoms is concentrated in the neck and lower back, with the lower back carrying the most significant share of severe pain. While daily laptop hours showed only a weak linear relation to severity, exposure bands differed significantly, indicating a non-linear pattern likely shaped by break behaviour, task organisation, and department-specific demands. Among behavioural factors, break duration was a consistent protective correlate for both occurrence and severity, whereas posture and simple counts of ergonomic devices were poor predictors when considered in isolation. Differences by academic level and department underscore the importance of early, discipline-tailored prevention.

The findings argue for multi-component, behaviour-centred strategies that emphasise frequent micro-recovery, periodic longer breaks, task/posture variability, and simple, correctly applied ergonomic adjustments embedded within course delivery and space design. Such an approach is squarely aligned with the biopsychosocial model of pain, recognising that physical exposure, behavioural regulation, and contextual features of academic life jointly shape MSK risk and recovery trajectories in student populations.

5.3 Strengths and Limitations

This study leveraged a large sample spanning eleven departments and five academic levels, enabling meaningful subgroup contrasts by level and department. It differentiated usage bands and jointly assessed break behaviour, posture/ergonomics, and pain outcomes. It triangulated bivariate, non-parametric, and parametric analyses (Kruskal–Wallis, with post-hoc tests, logistic regression, and correlations), strengthening inferences about non-linear exposure patterns and protective effects of breaks.

However, its cross-sectional design limits causal claims, and reverse causality may partly account for high severity among very low-hour users if symptomatic students restrict laptop time. Self-reported posture hours, ergonomics device count and breaks are coarse and vulnerable to recall and social-desirability biases, with device count a weak proxy for effective configuration. The broad occurrence endpoint (any pain ≥1) risks diluting associations by including low-intensity, transient symptoms. Residual confounding (e.g., sleep, physical activity, stress, non-laptop screen time, pervious injury) was not fully controlled. Finally, single-institution sampling may constrain external validity.

5.4 Recommendations

5.4.1 Student-Level Actions

Students should prioritize structured recovery strategies during computer-based study at the individual level. A practical approach is adopting a two-tier break strategy, consisting of micro-breaks every 20–40 minutes combined with longer pauses of 10–20 minutes after each hour of concentrated work. Such a pattern reduces fatigue while maintaining focus. Equally important is the optimization of ergonomics through simple adjustments. Elevating the screen so that the top third aligns with eye level, keeping the keyboard and mouse within close reach, and maintaining elbow angles of approximately 90 degrees can significantly reduce musculoskeletal strain. Students should also plan and pace their workload by distributing coding or report-writing tasks across several days rather than compressing them into extended single sessions. Structured work–recovery cycles, such as the “25–5” or “50–10” approach, may be beneficial during intensive project weeks. Additionally, incorporating a minimum level of movement into each study hour, whether through stretching or a brief walk, can mitigate the effects of prolonged sedentary behaviour.

5.4.2 Department-Level Actions

At the departmental level, sustainable practices should be embedded into teaching and assessment design. First-year induction modules can include practical training on work–recovery techniques and basic ergonomics, while refresher sessions may be offered before major project courses to reinforce these behaviours. Departments should also ensure that studio and laboratory environments are ergonomically supportive by providing low-cost laptop risers, external keyboards, and mice on loan, alongside various seating and standing options. Visible signage reminding students to take micro-breaks can further encourage consistent behaviour. Assessment design should also be reviewed to avoid clustering deadlines, as concentrated workload periods increase the likelihood of musculoskeletal strain and all-night study sessions. Similarly, integrating programmed break prompts into long practical classes or time-limited examinations ensures that healthy work rhythms are maintained. Finally, adopting participatory ergonomics—where students are actively involved in the iterative redesign of studio layouts and usage protocols—has enhanced compliance and fostered a sense of ownership (Jin, 2025).

5.4.3 Institution-Level Actions

The university can consolidate these initiatives at the institutional scale by embedding recovery-supportive practices into its wider policies and infrastructure. Digital nudges, such as automated break reminders within learning management systems, can provide consistent prompts during practical sessions or examinations. Campus-wide guidelines on healthy computing hours, supported by visible communications and resources, would further reinforce these practices. In addition, classrooms and laboratories should be regularly checked against ergonomic standards, including correct screen positioning, adjustable seating, lighting adequacy, and glare reduction. Collaboration with student health services can extend support by offering brief musculoskeletal screenings and targeted exercise classes in the lead-up to examinations, thereby addressing issues before they become entrenched. Together, these measures demonstrate how coordinated action at multiple levels—student, departmental, and institutional—can meaningfully reduce the risk of musculoskeletal problems while promoting a healthier, more sustainable study culture.

5.5 Implications for Further Study

Future studies should use longitudinal designs to untangle causality and possible reverse causality (e.g., whether pre-existing pain shapes computer-use patterns), pair self-reports with objective posture and activity data from wearables and computer-use logs to capture micro-break quality and timing. Mechanistic studies are needed to test how work organisation—such as burst versus paced schedules, night-time study, and deadline clusters—modifies musculoskeletal risk independent of total hours. Department-tailored, multi-component trials that combine structured breaks, task rotation, and ergonomics training should be prioritised, as posture-only trials have shown mixed effects (Gerr, 2005) while broader participatory approaches tend to perform better (Jin, 2025; Santos, 2025). Finally, models should incorporate psychosocial moderators, including stress, sleep, and fear-avoidance, to fully represent biopsychosocial influences.

References

Abbas, A., Rahman, A., & Musa, H. (2021). The effects of ergonomic education and posture awareness on university students' musculoskeletal pain. International Journal of Occupational Health, 26(4), pp.88–94.

Abaraogu, U.O., Duru, D.O., & Ogbu, C.N. (2015). Musculoskeletal disorders and associated risk factors among computer users in a Nigerian university. Journal of Ergonomics and Rehabilitation, 7(2), pp.55–63.

Adarkwah, M.A., (2021). "I'm not against online teaching, but what about us?": ICT in Ghana post Covid-19. Education and Information Technologies, 26(2), pp.1665 1685.

Adelowo, E.O., Oguntona, S.A. & Ayeni, K.O. (2022). Prevalence of musculoskeletal disorders in a Lagos urban community. Nigerian Journal of Orthopaedics, 15(1), pp.33–40.

Afolabi, A.O., Okunola, A.T. & Babalola, O.B. (2025). Musculoskeletal disorders among university students in Nigeria: A cross-sectional study. African Journal of Physiotherapy and Rehabilitation Sciences, 13(2), pp.45–51.

Al-Fraihat, D., Joy, M. & Sinclair, J., (2020). Evaluating E-learning systems success: An empirical study. Computers in Human Behavior, 102, pp.67–86.

Alaca, N., Tunay, M. & Aydos, L., (2025). The relationship between sedentary behavior, low back pain, and posture in university students: A scoping review. Posture and Health Journal, 12(1), pp.20–28.

Alanazi, S.A. and Kashoo, F.Z. (2025) ‘Musculoskeletal pain among university students and its correlations with risk factors: A cross-sectional study’, Journal of Clinical Medicine, 14(17), 6076.

Albulescu, P., Macsinga, I., Rusu, A., Sulea, C., Bodnaru, A. and Tulbure, B.T. (2022) “Give me a break!” A systematic review and meta-analysis on the efficacy of micro-breaks for increasing well-being and performance’, PLOS ONE, 17(8), e0272460.

Anita, R., Kumari, S., & Khan, A. (2014). Relationship between posture and musculoskeletal symptoms in computer users. Journal of Occupational Health Research, 6(1), pp.21–26.

Atalay, M., Johnson, P., & Adeoye, M. (2024). Prevalence of low back pain among workers in sub-Saharan Africa: An occupational perspective. Journal of Workplace Health, 12(3), pp.112–119.

Aulia Chairani, S. (2020). Validity and reliability of the Nordic Musculoskeletal Questionnaire in identifying musculoskeletaldisorders. Indonesian Journal of Health Sciences, 11(1), pp.33–41.

Ayeni, F.A., Ogunleye, A.O. & Bello, S.O. (2024). Ergonomic design as a determinant for the prevalence of work-related musculoskeletal disorders among office-based civil servants in Ondo State, Nigeria. Occupational Health Journal of Nigeria, 9(1), pp.15 22.

Babatunde, O.O., Jordan, J.L. & van der Windt, D.A. (2017). Musculoskeletal pain in Africa: A systematic review of prevalence and contextual factors. BMC Musculoskeletal Disorders, 18(1), p.207.

Bare, A., Kumar, R.., & Singh, D. (2021). Effects of computer-based work on musculoskeletal discomfort among college students. Journal of Human Ergonomics, 30(1), pp.20–27.

Biruk, S., Tadesse, B., & Alemu, M., (2024). Association between prolonged computer use and musculoskeletal pain among Ethiopian university students. Ethiopian Journal of Health Sciences, 34(1), pp.18–25.

Blumenberg, C., Mendonça, J. & Silva, C, (2021). Risk factors associated with musculoskeletal pain in university students. Brazilian Journal of Physical Therapy, 25(3), pp.289–296.

Blumenberg, C., Barros, A.J.D., Dvoskin, R.L. and Bastos, J.L.D. (2021) 'The role of sedentary behaviour and physical activity in musculoskeletal pain: A population-based study of adults', Public Health, 197, pp. 10–16.

Chen, C. & Mu, X. (2018). Ergonomic assessment of posture and musculoskeletal disorders. Chinese Journal of Ergonomics, 24(3), pp.177–183.

D'Silva, A., MacDermid, J.C. & Grewal, R. (2015). Student Laptop Use and Musculoskeletal Posture (SLUMP) Questionnaire: Development and validation. Applied Ergonomics, 51, pp.33–42.

Eovaldi, B. & Varacallo, M. (2019). Back Muscles Anatomy. StatPearls. Available at: https://www.ncbi.nlm.nih.gov/books/NBK532862/ [Accessed 8 June 2025].

Emorinken, M.E., Okon, U.A. & Ibhazehiebo, K.O. (2023). Low back pain prevalence in rheumatology clinics in Edo State. Nigerian Journal of Clinical Practice, 26(1), pp.80–86.

Fairbank, J.C.T. & Pynsent, P.B. (2021). The Oswestry Disability Index. Spine, 46(8), pp.112–119.

Franco, D., Ramírez, A. & Castillo, M., (2021). Ergonomics and musculoskeletal disorders among university students in online learning. International Journal of Occupational Medicine, 18(2), pp.101–110.

GBD 2021 Other Musculoskeletal Disorders Collaborators, (2023). Global burden of musculoskeletal disorders: Findings from the GBD 2021 study. The Lancet Rheumatology, 5(2), pp.e90–e104.

Gotum, Y., Rahman, A. & Liman, K. (2025). Prevalence of musculoskeletal pain among university students during online learning. Asian Journal of Health Research, 9(2), pp.77–85.

Gornitzky, A.L. & Diab, M. (2024). Psychosocial aspects of musculoskeletal pain in youth. Orthopaedic Journal of Children's Pain, 3(1), pp.1–9.

Gu, H., Wang, Y. & Zhou, T. (2022). Degenerative spine changes with age: A review. Spine & Ageing, 9(1), pp.14–22.

Halim, W.I.H.W. & Aziz, A.A. (2022). Relationship between musculoskeletal disorders and computer usage among university students: A review. Malaysian Journal of Medicine and Health Sciences, 18(2), pp.111–116.

Hawker, G.A., Mian, S. & Kendzerska, T. (2021). Measures of adult pain: Visual AnalogScale, Numeric Rating Scale, McGill Pain Questionnaire, and Brief Pain Inventory. Arthritis Care & Research, 63(S11), pp.S240–S252.

Henson, J., Patel, V. & Torres, C. (2020). Anatomy and function of spinal muscles. Journal of Back and Spine Health, 10(1), pp.45–53.

International Association for the Study of Pain. (2020). IASP announces revised definition of pain. Available at: https://www.iasp pain.org/publications/iasp news/iasp-announces-revised-definition of-pain/ [Accessed 10 June. 2025].

Ikenna E.C., Udechukwu, O. & Okoye, U. (2020). Musculoskeleta disorders among students at University of Nigeria, Enugu Campus. Nigerian Journal of Musculoskeletal Health, 6(1), pp.25–33.

Janc, M., Jóźwiak, Z., Jankowska, A., Makowiec-Dąbrowska, T., Kujawa, J. and Polańska, K. (2023) ‘Ergonomics of e-learning workstations and the prevalence of musculoskeletal disorders—Study among university students’, International Journal of Environmental Research and Public Health, 20(4), 3309.

Javed, M., Rasheed, S. and Ahmad, N. (2023). Muscle function and biomechanics in upper limb anatomy. Journal of Anatomy and Movement Science, 15(2), pp.34 42.

Jin, X., Dong, Y., Yang, L., Huang, W., Cao, L., Zhang, Z. and He, L. (2025) ‘Ergonomic interventions to improve musculoskeletal disorders among vehicle assembly workers: A one-year longitudinal study’, BMC Public Health, 25, 21798.

Jung, H., Lee, Y. and Park, S. (2025). Cervical spine structure and function: A modern anatomical review. Journal of Orthopaedic Anatomy, 14(1), pp.12–20.

Karen, M. and Gisela, P. (2017). The impact of physical activity on musculoskeletal health. Journal of Health and Movement, 9(1), pp.40–46.

Kandasamy, G., Elango, M., Elumalai, R., Alrwaily, M., Alanazi, F., Alahmari, K., Alrwaily, A. and Alshehri, M.M. (2024) ‘Prevalence of musculoskeletal pain among undergraduate students: A cross-sectional study from Saudi Arabia’, Frontiers in Medicine, 11, 1403267.

Kazeminasab, A., Nejatian, M. and Ghanbari, A. (2022). Sex differences in neck and back pain prevalence: A longitudinal analysis. BMCMusculoskeletal Disorders, 23(1), pp.1–11.

Keith M. Smart, (2023). Pain management through a biopsychosocial lens. Journal of Contemporary Pain Studies, 8(1), pp.21–30.

Kilimanjaro, B., Musa, P. and Fagbo, D. (2023). Functional disability assessment in back pain: Review of outcome tools. African Journal of Pain Research, 5(2), pp.90–97.

Legan, M. and Zupan, K., (2020). Prevalence of mobile device-related musculoskeletal pain among working university students: A cross-sectional study. BMC Public Health,20(1), pp.1–9.

Linton, S.J., (2000). A review of psychological risk factors in back and neck pain. Spine, 25(9), pp.1148–1156.

Markova, E., Hassan, R. and Majeed, M. (2024). Postural strain and musculoskeletal risk in office work. Journal of Occupational Biomechanics, 19(2), pp.59–66.

Martinez-Calderon, J., Villafañe, J.H. and Doménech-García, V. (2024). Musculoskeletal pain prevalence across Africa: A systematic review. African Journal of Pain and Rehabilitation, 10(1), pp.10–18.

Morris, T., Haider, S. and Danesh, M. (2023). Best practices in managing chronic neck and shoulder pain. Journal of Pain and Therapy, 12(3),pp.130–140.

Musaad, R., Ahmed, H. and Barakat, M. (2024). Chronicity risk in students with postural-related neck pain. Ergonomics and Youth Health Journal, 6(1), pp.22–28.

Nicholas, M.K., (2022). Cognitive-behavioral management of chronic musculoskeletal pain. Pain Research and Management, 15(4),pp.193–199.

Nicholas, M., Molloy, A. and Moore, C. (2023). Multimodal management of musculoskeletal pain. Clinical Pain Practice, 9(1), pp.34–42.

Nichol, K., Benson, T. and Farooq, A. (2023). Psychological dimensions of persistent pain in youth: An emerging perspective. Child and Adolescent Pain Journal, 11(2), pp.60–68.

Nur Aqila Nor, M., Azahari, M. & Hasmira, H. (2022). Prolonged computer use and its musculoskeletal impact among Malaysianstudents. Journal of Occupational Health Asia, 17(4), pp.200–208.

Olawale, A.O., Okonkwo, M.U. & Bamidele, T.K. (2025). Posture-related musculoskeletal complaints among Nigerian undergraduate computer users. Nigerian Journal of Physiotherapy and Health, 14(1), pp.66 74.

Oluwagbejami, A.T., Akinwale, M. & Omoniyi, B.T. (2022). Work-related musculoskeletal disorders among oil industry workers in the Niger Delta.

Occupational Health and Safety Nigeria, 14(2), pp.55–61.

Ozdemir, F., Yildiz, T. & Sarikaya, A.. (2021). Musculoskeletal pain and posture profiles among adolescents: A cross-sectional study from Turkey. Journal of Pediatric Rehabilitation Medicine, 14(2), pp.123 130.

Pattath, S. & Webb, R. (2022). Computer use and musculoskeletal disorders in students: An ergonomic perspective. Journal of Ergonomics and Student Health, 11(3), pp.99-106.

Punnett, L. & Wegman, D.H. (2004). Work-related musculoskeletal disorders: The epidemiologic evidence and the debate. Journal of Electromyography and Kinesiology, 14(1), pp.13–23.

Rashwan, A.A., Salman, F.A. & Al Dossary, A.M. (2024.) Ergonomics awareness and musculoskeletal pain during digital learning. Middle East Journal of Occupational Health, 15(1), pp.1–9.

Rinne, B., Ibekwe, A. & Osei, M. (2024). Reliability of disability outcome scales in low back pain. Journal of Rehabilitation Assessment, 10(1),pp.40–49.

Shahwan, M., Al-Tahat, M. & Jaber, M. (2022). Ergonomics of university computer workstations and their relation to musculoskeletal pain. Work, 71(1), pp.105–112.

Shaballout, N., Al-Zarouni, M. & Nazzal, M. (2021). The impact of e learning on posture and musculoskeletal pain among medical students. Journal of Digital Health Education, 3(1), pp.17–25.

Smith, B.H., Elliott, A.M., & Hannaford, P. (2013). Pain and its management in primary care: Where are we now? British Journal of General Practice, 63(617), pp.403–405

Smart, K.M (2023). Understanding chronic musculoskeletal pain through a biopsychosocial lens. Contemporary Pain Management Journal, 9(2), pp.112 121.

Sterner, B., Gerdle, B. & Linder, J. (1998). Musculoskeletal pain and neuromuscular dysfunction: A review. Clinical Rehabilitation, 12(3), pp.133–145.

Symanzik, C., Jäkel, A., Martin, A., Weitgasser, R. and Dorner, T.E. (2022) 'Back and neck problems as well as disadvantageous computer working conditions are frequent among university students', Wiener MedizinischeWochenschrift, 172(11–12), pp. 289–299.

Tallawy, H.N., Farghaly, W.M. & Shaaban, H.A. (2021). Musculoskeletal pain prevalence in Africa: A comprehensive review. African Journal of Pain and Rehabilitation, 7(1), pp.1–12.

Taro Yamene (1967). Statistics: An Introductory Analysis. 2nd ed. New York: Harper and Row.

Tella, B.A., Akinbo, S.R. & Umebese, P. (2021). Association of arm, neck, and shoulder complaints with risk factors among Nigerian bank employees. Journal of Ergonomic Studies in Africa, 7(2), pp.40–47.

Traeger, A.C., Machado, G.C. & Maher, C.G. (2021). Nonsteroidal anti inflammatory drugs for back pain: A review. BMJ, 372, p.m494.

Uhunmwangho, O.M., Idu, O.E. & Nwankwo, A.E. (2017). Prevalence of musculoskeletal disorders in a semi-urban Nigerian community. West African, Journal of Medicine, 34(4), pp.299–305.

Vernon, H. & Mior, S. (1991). The Neck Disability Index: Development and psychometric properties. Journal of Manipulative and Physiological Therapeutics, 23(2), pp.75–80.

Vanti, C., Ferrari, S. & Monticone, M. (2022). Effectiveness of lumbarsupport belts in chronic back pain: A systematic review. Journal of Spine Rehabilitation, 11(2), pp.77–85.

World Health Organization (2019). Musculoskeletal conditions. Geneva: WHO. Available at: https://www.who.int/news-room/fact sheets/detail/musculoskeletal conditions [Accessed 10 June 2025].

World Health Organization (2020). WHO guidelines on physical activity and sedentary behaviour. Geneva: WHO. Available at: https://www.who.int/publications/i/item/9789240015128 [Accessed 10 June 2025].

World Health Organization (2022). Global burden of musculoskeletal conditions. Geneva: WHO. Available at: https://www.who.int/news room/events/detail/2024/01/31/addressing-musculoskeletal conditions—an opportunity-for-health-systems-globally [Accessed 10 June 2025].

Woolf, C.J. (2011). Central sensitization: Implications for the diagnosis and treatment of pain. Pain, 152(3), pp.S2–S15.

Xing, H., Zhang, Y. & Wu, L. (2025). Age-related spinal degeneration and low back pain. Journal of Aging and Musculoskeletal Health, 13(1), pp.20–28.

Zheng, M., Li, P. & Chen, S. (2024). Sedentary behavior and MSK symptoms: The role of physical inactivity. Journal of Public Health and Fitness, 10(3), pp.110–117.

APPENDICES

INFORMED CONSENT FORM

My name is OSUNDE OSAYIWENSE GORGEOUS, I am a final year student of the Department of Physiotherapy, School of Basic Medical Sciences, University of Benin. I am conducting a study titled “INTERDEPENDENCE OF PROLONGED COMPUTER USAGE AND MUSCULOSKELETAL PAIN AMONG UNIVERSITY OF BENIN ENGINEERING STUDENTS”. For the purpose of the study, the participants will be required to fill several questionnaires to be used to assess their computer usage patterns and the occurrence of Musculoskeletal Pain in relation to prolonged computer usage. I humbly request your participation in this survey as your response will help assess and expand the knowledge on the relationship between prolonged computer usage and musculoskeletal pain among University of Benin Engineering students. Your responses and participation will be deeply appreciated and kept in strict confidentiality.

NORDIC MUSCULOSKELETAL QUESTIONNAIRE (NMQ)

INSTRUCTION: Please answer by putting a cross in the appropriate box-one cross 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.

1. In the last 3 months, have you had any ache, pain, or discomfort in the following areas?

BODY REGION	YES	NO
Neck		
Shoulders		
Upper back		
Lower back		
Elbows		
Wrists/Hands		

2. In the last 7 days, have you experienced any ache, pain, or discomfort in the following areas?

BODY REGION	YES	NO
Neck		

Shoulders		
Upper back		
Lower back		
Elbows		
Wrists/Hands		

3. In the past 3 months, has this discomfort prevented you from carrying out your normal school activities?

- Yes [ ]
- No [ ]

4. Have you taken time off from school due to this discomfort?

- Yes [ ]
- No [ ]

5. Do you feel that this discomfort is related to work?

- Yes [ ]
- No [ ], if Yes, specify: ______

STUDENT LAPTOP USE AND MUSCULOSKELETAL POSTURE (SLUMP) QUESTIONNAIRE

The purpose of the questionnaire is to measure laptop use among university students—specifically the duration and frequency of use and whether it is associated with neck, back, shoulder, and arm pain.

PART A: DEMOGRAPHICS

1. Gender: **[ ]** Male **[ ]** Female
2. Age: **[ ]** 18-25 **[ ]** 26-30 **[ ]** 31-35
3. Handedness: [ ]Right [ ]Left
4. Department:
5. Level:

PART B: MEDICAL HISTORY

INSRUCTION:

1: Have you experienced pain in your neck, shoulder, arm, wrist or hand in the past year?
[ ] No → Continue to Question 2
[ ] Yes
1a: What do you attribute this pain to-
[ ] Motor Vehicle Accident
[ ] Sports related
[ ] Surgery
[ ] Overuse Work
[ ] Other (Please specify):

2: Do you experience pain or discomfort after using your laptop?

[ ] No → Continue to part C
[ ] Yes

2a: On average, how long do you experience pain or discomfort after using your laptop?
[ ] Less than 30 minutes
[ ] 30-60 minutes
[ ] 1- 6 hours
[ ] 6-24 hours
[ ] More than 1 day

2b: Please indicate ALL of the areas where you experience pain or discomfort and rate your typical pain 0-10. O means no pain at all and 10 means unbearable pain.

BODY REGIONS	PAIN	NO PAIN	RATING
Neck			
Shoulder			
Upper back			
Lower back			
Elbows			
Wrists/Hands			
Hips/Thighs			
Knees			
Ankles/Feet			

PART C: LAPTOP USE

The following questions relate to laptop use academic purposes (i.e. taking notes, reading, completing course work, attending lectures). If the question does not apply to you, please select 0.

3: How many hours per day do you typically use your laptop while sitting at a desk?
______hours/day

4: How many hours per day do you typically use your laptop while on a couch?
______hours/day

5: How many hours per day do you typically use your laptop while on a bed?
______hours/day

6: How many hours per day do you typically use a laptop for academic purposes?
______hours/day

PART D: POSTURE DURING LAPTOP USE

The following questions relate to your posture while using a laptop. Please use the pictures below as reference. If the question does not apply to you, please select 0.
Using the pictures and descriptions provided below, please answer the following when using a laptop.

Fig 1: Neck neutral looking straight ahead at your laptop screen

7a: On a weekday, how many hours per day do you typically use your laptop in the posture illustrated in Fig 1?

______hours/day

7b: On a weekend, how many hours per day do you typically use your laptop in the posture illustrated in Fig 1?

______hours/day

Fig 2: Neck flexed, facing downward at laptop screen

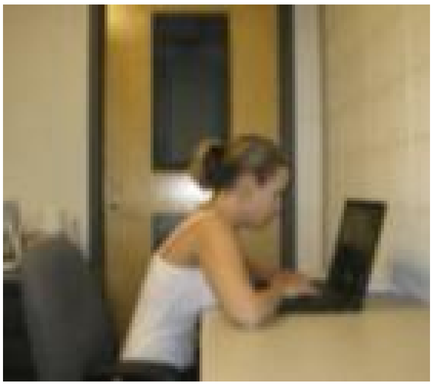
8a: On a weekday, how many hours per day do you typically use your laptop in the posture illustrated in Fig 2?

________hours/day

8b: On a weekend, how many hours per day do you typically use your laptop in the posture illustrated in Fig 2?

________hours/day

Fig 3: Slouching forward, neck slightly extended



9a: On a weekday, how many hours per day do you typically use your laptop in the posture illustrated in Fig 3?
________hours/day
9b: On a weekend, how many hours per day do you typically use your laptop in the posture illustrated in Fig 3?
_______ hours/day

Fig 4: Slouching backwards, neck flexed

10a: On a weekday, how many hours per day do you typically use your laptop in the posture illustrated in Fig 4?
________hours/day
10b: On a weekend, how many hours per day do you typically use your laptop in the posture illustrated in Fig 4?
_______ hours/day

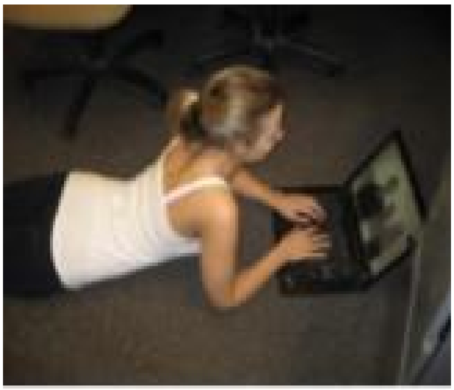


Fig 5: Lying on bed or floor, neck extended

11a: On a weekday, how many hours per day do you typically use your laptop in the posture illustrated in Fig 5?
________hours/day
11b: On a weekend, how many hours per day do you typically use your laptop in the posture illustrated in Fig 5?
________hours/day

12: Do you use an external mouse when using a laptop?
[   ] No → Continue to Question 13
[   ] Yes
12a: What percent of the time do you use an external mouse?
_________%

13: Do you use a laptop riser when using a laptop?
[   ] No → Continue to Question 14
[   ] Yes
13a: What percent of the time do you use a laptop riser?
_________%

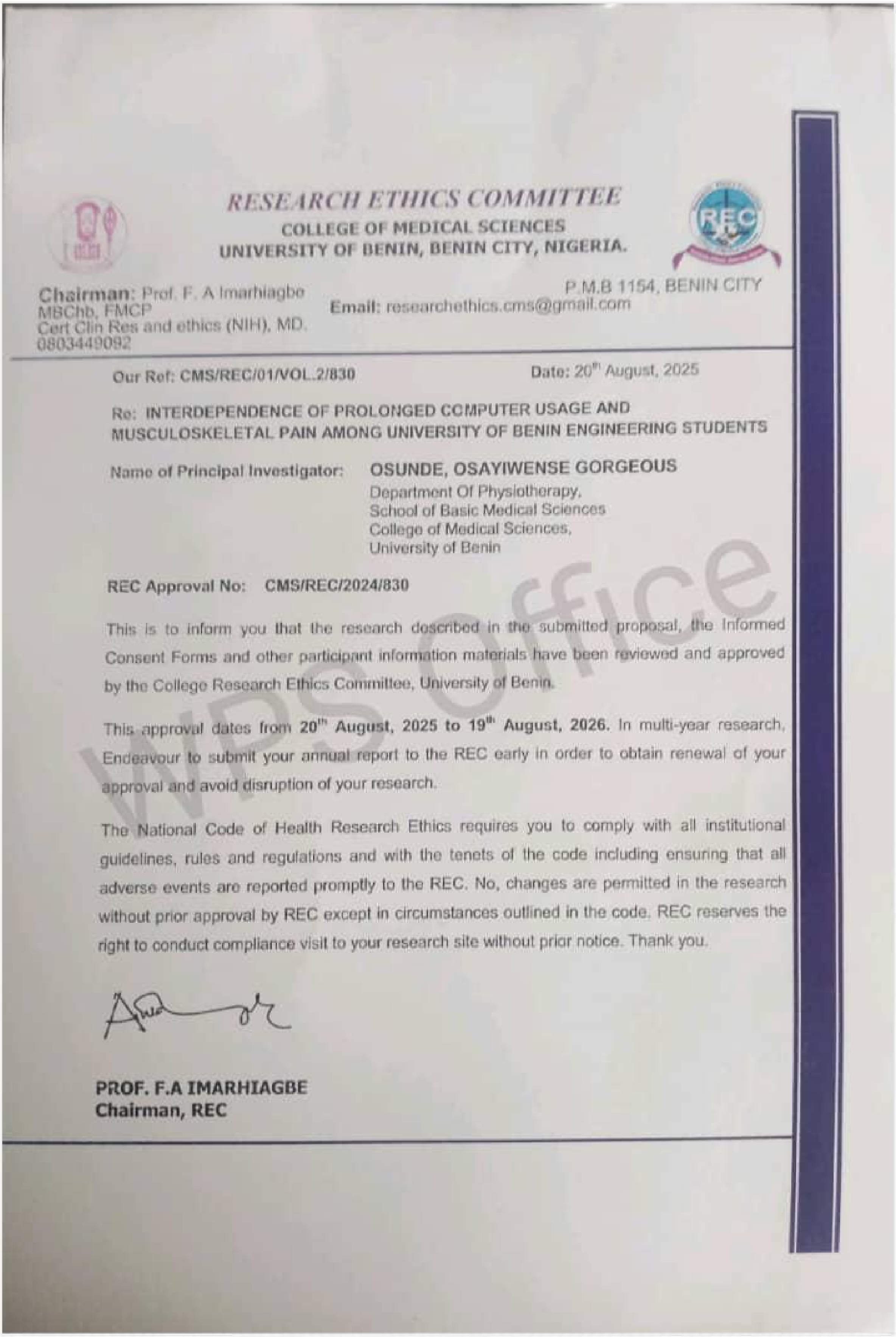
14: Do you use an external monitor when using a laptop?
[   ] No → Continue to Part D
[   ] Yes
14a: What percent of the time do you use an external monitor?
___________%

PART E: BREAKS RELATED TO LAPTOP USE

The following questions ask about taking breaks while using your laptop. Examples of breaks include going for lunch, a coffee/tea break, stretching or resting.

15: Do you take breaks while using your laptop?
[   ] No
[   ] Yes
15a: How often do you take breaks while using a laptop?
Every___________ hours
15b: On average, how long are the breaks?
___________minutes

ETHICAL APPROVAL



RESEARCH ETHICS COMMITTEE
COLLEGE OF MEDICAL SCIENCES
UNIVERSITY OF BENIN, BENIN CITY, NIGERIA.

Chairman: Prof. F. A Imarhiagbe
MBChb, FMCP
Cert Clin Res and ethics (NIH), MD.
08034449092

P.M.B 1154, BENIN CITY
Email: researchethics.cms@gmail.com

Our Ref: CMS/REC/01/VOL.2/830

Date: 20th August, 2025

Re: INTERDEPENDENCE OF PROLONGED COMPUTER USAGE AND MUSCULOSKELETAL PAIN AMONG UNIVERSITY OF BENIN ENGINEERING STUDENTS

Name of Principal Investigator: **OSUNDE, OSAYIWENSE GORGEOUS**
Department Of Physiotherapy,
School of Basic Medical Sciences
College of Medical Sciences,
University of Benin

REC Approval No: CMS/REC/2024/830

This is to inform you that the research described in the submitted proposal, the Informed Consent Forms and other participant information materials have been reviewed and approved by the College Research Ethics Committee, University of Benin.

This approval dates from **20th August, 2025 to 19th August, 2026.** In multi-year research, Endeavour to submit your annual report to the REC early in order to obtain renewal of your approval and avoid disruption of your research.

The National Code of Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenets of the code including ensuring that all adverse events are reported promptly to the REC. No, changes are permitted in the research without prior approval by REC except in circumstances outlined in the code. REC reserves the right to conduct compliance visit to your research site without prior notice. Thank you.

PROF. F.A IMARHIAGBE
Chairman, REC