USE OF RADIODIAGNOSTIC MODALITIES AMONG BARBERS WHO COMPLAIN OF SYMPTOMS OF CARPAL TUNNEL SYNDROME

BY

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CERTIFICATION

This is to certify that the project on **PREVALENCE OF CARPAL TUNNEL SYNDROME AMONG MALE BARBERS IN BENIN METROPOLIS: IMPLICATIONS TO RADIOGRAPHY** was written by **WOGHIREN OSAMA JOEL** with the matriculation number **BMS2001309** in partial fulfillment of the Bachelor of Radiography (B.Rad) degree in the department of Radiography and Radiation science, School of Basic Medical Sciences, College of Medical Sciences, University of Benin.

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DEDICATION

I dedicate this project first to God Almighty, whose grace, wisdom and unfailing guidance has been my greatest strength. To my beloved parents whose love, sacrifices and unwavering support have shaped my journey- I am a forever grateful! This project is a reflection of your love, sacrifices and the values you have instilled in me.

A special tribute to my father, Barr, Osahon Woghiren, whose words have been guiding my light, reminding me that hard work and perseverance always lead to success.

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ABSTRACT

Carpal Tunnel Syndrome (CTS) is a prevalent occupational health concern among workers performing repetitive hand movements. This cross-sectional study investigated the prevalence of CTS among male barbers in Benin Metropolis and assessed the utilization of radiological examinations in diagnosis. A total of 142 male barbers aged 18-50 years were recruited using convenience sampling from barbershops across Oredo, Egor, and Ikpoba-Okha Local Government Areas. Data were collected using structured questionnaires covering sociodemographic information, occupational factors, CTS symptoms, and radiological examination history. Statistical analysis was performed using SPSS version 28, with chi-square tests examining associations between variables at $p<0.05$ significance level. Results showed a clinically diagnosed CTS prevalence of 23.9% and symptom-based prevalence of 62.7%, substantially higher than general population estimates. Significant associations were found between CTS symptoms and years of experience ($p=0.019$), daily working hours ($p=0.010$), and grip style ($p=0.001$). Among symptomatic barbers, only 46.1% sought medical care, and merely 22.0% received radiological examinations. Plain radiography predominated (17.1%) despite limited diagnostic value, while nerve conduction studies (9.8%) and ultrasound (4.9%) were rarely utilized. The study confirms male barbers as a high-risk occupational group for CTS and reveals significant gaps in healthcare-seeking behavior and diagnostic imaging utilization. Comprehensive occupational health interventions including ergonomic education, workplace modifications, and improved access to appropriate diagnostic services are urgently needed.

Keywords: Carpal Tunnel Syndrome, occupational health, male barbers, radiography, nerve conduction studies, ultrasound, prevalence, Benin Metropolis, diagnostic imaging, ergonomics

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Carpal Tunnel Syndrome (CTS) is one of the most frequent kinds of peripheral neuropathy, produced by the compression of the median nerve as it travels through the carpal tunnel in the wrist. This illness is marked by symptoms such as discomfort, numbness, tingling, and weakness in the hand, which normally develop with time and can lead to major functional deficits if left untreated (Bicha et al., 2024; Kraut et al., 2024). CTS is known to be frequent in many occupational contexts, particularly those that entail repetitive hand movements, forceful grips, and poor ergonomic standards (Feng et al., 2021; Demissie et al., 2023)).

The general prevalence of CTS in the population is thought to range from 3% to 6%, however it is much greater among certain occupational groups. Industries such as manufacturing, construction, and office work, which include repetitive actions such as typing, heavy lifting, or using vibrating equipment, are regarded as high-risk areas for CTS development (Bicha et al., 2024; Kraut et al., 2024). Additionally, women are known to be at a higher risk for getting CTS compared to men, with an incidence rate around 1.5 times higher (Demissie et al., 2023). This gap has been related to anatomical and hormonal reasons that may make women more prone to the illness.

Barbers, as a professional group, are one of the lesser-studied populations in terms of CTS prevalence, despite the fact that their vocation entails extensive durations of utilizing hand-held instruments such as clippers, scissors, and razors. These tools generally require repetitive wrist movements, powerful grips, and awkward postures, all of which are known as contributing factors to CTS. The job conditions of barbers in Benin Metropolis, characterized by long working hours and a strong need for manual dexterity, suggest that this group would be at elevated risk for CTS. Yet, no systematic studies have been undertaken to determine the prevalence of CTS among male barbers in the area.

CTS can be diagnosed through clinical examination and supported by radiological investigations. The radiographic assessment of CTS often involves the use of imaging techniques such as nerve conduction studies (NCS), electromyography (EMG), and wrist X-rays. These radiological studies help in verifying the diagnosis by measuring nerve function and ruling out other potential illnesses that could cause similar symptoms (Kraut et al., 2024; Bicha et al., 2024)). Nerve conduction tests analyze the speed at which electrical signals flow along the median nerve, while electromyography evaluates the electrical activity in muscles regulated by the median nerve (Demissie et al., 2023). In more severe or advanced cases of CTS, wrist radiographs might be conducted to rule out other skeletal anomalies or to assess the amount of nerve compression (Feng et al., 2021). However, among barbers, the role of radiography in diagnosing CTS is not well-documented, and it remains unknown how frequently barbers seek radiographic exams for CTS.

Radiographers, as medical specialists educated in imaging techniques, play a significant role in diagnosing CTS. Accurate diagnosis by radiography can guide proper treatment, including physical therapy, medicines, and, in certain situations, surgery. Yet, the access to radiological facilities and the understanding of CTS among barbers may influence the amount to which radiographic tests are used. This study, therefore, attempts to fill the gap in knowledge regarding the use of radiodiagnostic modalities among barbers who complain of symptoms of carpal tunnel syndrome.

1.2 Statement of the Problem

Carpal Tunnel Syndrome (CTS) is a frequent and severe disorder that significantly impacts the quality of life, particularly for persons who engage in activities involving repetitive hand movements. Male barbers in Benin Metropolis, a group that has not been widely researched in this setting, are likely at elevated risk for CTS due to the nature of their occupation, which requires extensive use of hand-held tools for long hours. Despite the potential occupational risk, there is inadequate evidence on the prevalence and risk factors of CTS among male barbers in Benin Metropolis. Moreover, while radiographic examinations like nerve conduction studies and wrist radiographs are critical in the diagnosis and management of CTS, there is little information about whether these examinations are commonly used by barbers or health professionals when diagnosing CTS in this population. This dearth of data inhibits the development of focused strategies for early diagnosis, prevention, and therapy of CTS in barbers. This study seeks to investigate the use of radiodiagnostic modalities among barbers who complain of symptoms of carpal tunnel syndrome

1.3 Research Questions

1. What is the prevalence of Carpal Tunnel Syndrome (CTS) symptoms among male barbers in Benin Metropolis?
2. What are the risk factors associated with CTS among male barbers in Benin Metropolis?
3. What radiodiagnostic modalities are utilized in diagnosing CTS among male barbers who complain of symptoms in Benin Metropolis?

1.4 Objectives of the Study

1. To determine the prevalence of CTS symptoms among male barbers in Benin Metropolis.
2. To identify the risk factors associated with CTS in this population.
3. To assess the types and frequency of radiodiagnostic modalities used in diagnosing CTS among male barbers who complain of symptoms.

1.5 Hypotheses

There is no significant association between prevalence of CTS among male barbers in Benin metropolis and their years of experience in barbing.

1.6 Significance of the Study

This study is significant because it will give much-needed data on the prevalence of CTS among male barbers, an occupational group that is generally ignored in the literature. By identifying the risk factors for CTS in this population, the study will contribute to the development of targeted health interventions, workplace ergonomics, and occupational health policies for barbers. Furthermore, by studying the role of radiography in the diagnosis and management of CTS among barbers, the study will reveal potential gaps in diagnostic methods and offer recommendations for enhancing early detection and treatment of CTS. This could ultimately improve the quality of life for male barbers and lessen the economic and societal consequences associated with untreated CTS.

1.7 Scope of the Study

The study will focus on male barbers working in several barbershops across Benin Metropolis. The target population includes barbers aged 18-50 years, as this group is most likely to be employed in this sector. The study will be cross-sectional and will gather data through surveys, clinical examinations, and radiographic assessments, thus providing a comprehensive analysis of CTS prevalence and diagnostic methods within this professional group.

1.8 Operational Definition of Terms

Carpal Tunnel Syndrome (CTS): A syndrome caused by compression of the median nerve at the carpal tunnel, characterized by symptoms such as pain, numbness, tingling, and weakness in the hand and wrist.

Radiography: The use of imaging techniques to diagnose medical disorders. In the context of CTS, it refers to wrist radiography and nerve conduction investigations used to diagnose nerve compression and other anatomical anomalies.

Barbering Occupation: A vocation including the cutting, style, and grooming of hair, often conducted in barbershops. It involves the usage of clippers, scissors, and other hand-held instruments that may contribute to repeated wrist motions and strain.

CHAPTER TWO

LITERATURE REVIEW

2.1 Conceptual Review

Carpal Tunnel Syndrome

Carpal tunnel syndrome (CTS) is a nerve compression syndrome caused when the median nerve, in the carpal tunnel of the wrist, becomes compressed. CTS can affect both wrists when it is known as bilateral CTS (Medical News Today, 2024). After a wrist fracture, inflammation and bone displacement can compress the median nerve. With rheumatoid arthritis, the enlarged synovial lining of the tendons causes compression (Burton et al., 2014; Cooke et al., 2023).

The main symptoms are numbness and tingling of the thumb, index finger, middle finger, and the thumb side of the ring finger, as well as pain in the hand and fingers (Burton et al., 2014). Symptoms are typically most troublesome at night (National Institute of Neurological Disorders and Stroke, 2016). Many people sleep with their wrists bent, and the ensuing symptoms may lead to awakening. People wake less often at night if they wear a wrist splint (American Academy of Orthopaedic Surgeons, 2020). Untreated, and over years to decades, CTS causes loss of sensibility, weakness, and shrinkage (atrophy) of the thenar muscles at the base of the thumb. Work-related factors such as vibration, wrist extension or flexion, hand force, and repetitive strain are risk factors for CTS. Other risk factors include being female, obesity, diabetes, rheumatoid arthritis, thyroid disease, and genetics (American Academy of Orthopaedic Surgeons, 2016; Padua et al., 2016; Shiri, 2014).

Diagnosis can be made with a high probability based on characteristic symptoms and signs. It can also be measured with electrodiagnostic tests (Graham, 2008). Injection of corticosteroids may or may not alleviate symptoms better than simulated (placebo) injections (Adindu et al., 2024; Huisstede et al., 2018). There is no evidence that corticosteroid injection sustainably alters the natural history of the disease, which seems to be a gradual progression of neuropathy (Adindu et al., 2024). Surgery to cut the transverse carpal ligament is the only known disease modifying treatment (American Academy of Orthopaedic Surgeons, 2016).

Anatomy

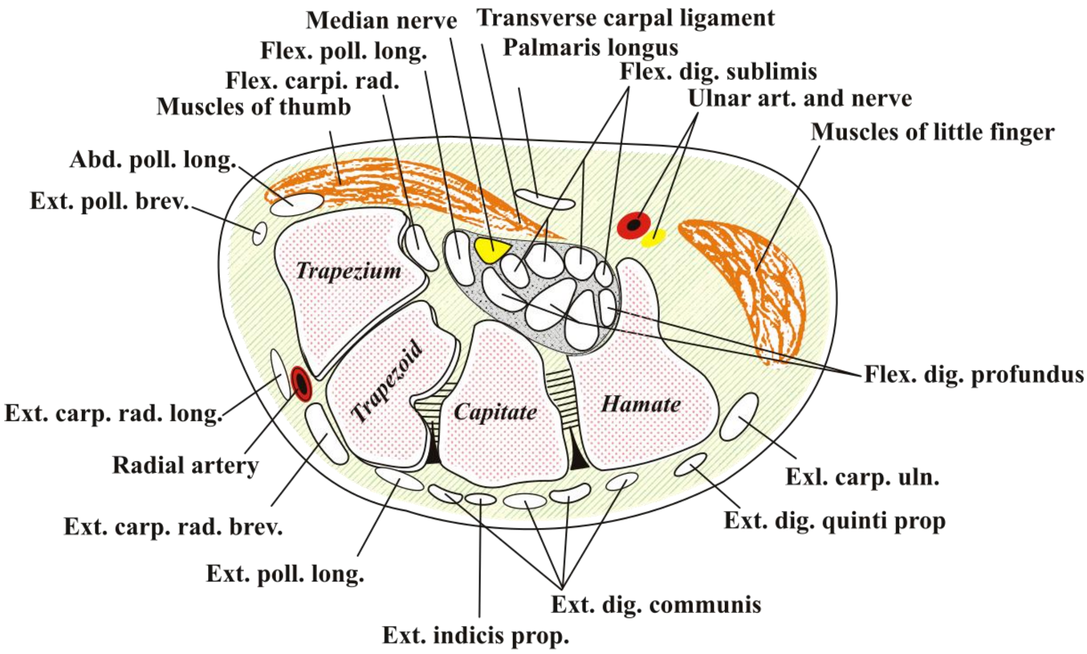

Figure 2.1: Transverse section across the wrist and carpals; the palm is at the top (carpal tunnel not labeled but visible at centre)

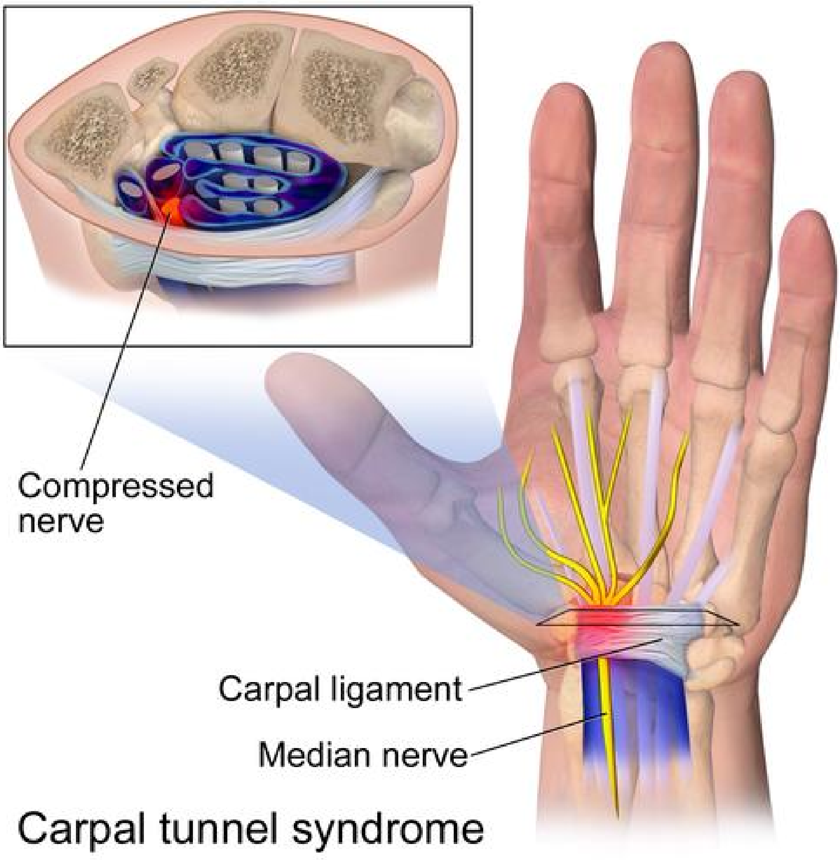

Figure 2.2: Anatomy of the carpal tunnel, showing the median nerve passing through the tight space it shares with the finger tendons

The carpal tunnel is an anatomical compartment located at the base of the palm. Nine flexor tendons and the median nerve pass through the carpal tunnel, which is surrounded on three sides by the carpal bones that form an arch. The median nerve provides feeling or sensation to the thumb, index finger, long finger, and half of the ring finger. At the level of the wrist, the median nerve supplies the muscles at the base of the thumb that allow it to abduct, move away from the other four fingers, as well as move out of the plane of the palm. The carpal tunnel is located at the middle third of the base of the palm, bounded by the bony prominence of the scaphoid tubercle and trapezium at the base of the thumb, and the hamate hook that can be palpated along the axis of the ring finger. From the anatomical position, the carpal tunnel is bordered on the anterior surface by the transverse carpal ligament, also known as the flexor retinaculum. The flexor retinaculum is a strong, fibrous band that attaches to the pisiform and the hamulus of the hamate. The proximal boundary is the distal wrist skin crease, and the distal boundary is approximated by a line known as Kaplan's cardinal line (Brooks et al., 2003). This line uses surface landmarks, and is drawn between the apex of the skin fold between the thumb and index finger to the palpated hamate hook (Vella et al., 2006).

Pathophysiology

The carpal bones and the transverse carpal ligament form the carpal tunnel. The median nerve passes through this space along with the flexor tendons. Increased compartmental pressure for any reason can squeeze the median nerve (Joshi et al., 2022). Theoretically, increased pressure can interfere with normal intraneural blood flow, eventually causing a cascade of physiological changes in the nerve itself (Mackinnon, 2002). There is a dose-respondent curve such that greater and longer periods of pressure are associated with greater nerve dysfunction (Mackinnon, 2002). The symptoms and signs of carpal tunnel syndrome causes are hypertrophy of the synovial tissue surrounding the flexor tendons such as with rheumatoid arthritis (Aboonq, 2015; Joshi et al., 2022).

Prolonged pressure can lead to a cascade of physiological changes in neural tissue. First, the blood-nerve barrier breaks down (increased permeability of perineureum and endothelial cells of endoneural blood vessels) (Mackinnon, 2002). If the pressure continues, the nerves will start the process of demyelination under the area of compression (Mackinnon, 2002). This will result in abnormal nerve conduction even when the pressure is relieved leading to persistent sensory symptoms until remyelination can occur. If the compression continues and is severe enough, axons may be injured and Wallerian degeneration will occur (Lundborg & Dahlin, 1996). At this point there may be weakness and muscle atrophy, depending on the extent of axon damage (Menorca et al., 2013).

The critical pressure above which the microcirculatory environment of a nerve becomes compromised depends on diastolic/systolic blood pressure. Higher blood pressure will require higher external pressure on the nerve to disrupt its microvascular environment (Szabo et al., 1983). The critical pressure necessary to disrupt the blood supply of a nerve is approximately 30mm Hg below diastolic blood pressure or 45mm Hg below mean arterial pressure (Szabo et al., 1983). For normohypertensive (normal blood pressure) adults, the average values for systolic blood pressure is 116mm Hg diastolic blood pressure is 69mm Hg (Wright et al., 2011). Using this data, the average person would become symptomatic with approximately 39mm Hg of pressure in the wrist (69 - 30 = 39 and 69 + (116 - 69)/3 - 45 ~ 40). Carpal tunnel syndrome patients tend to have elevated carpal tunnel pressures (12-31mm Hg) compared to controls (2.5 - 13mm Hg) (Gelberman et al., 1981; Luchetti et al., 1989; Rojviroj et al., 1990). Applying pressure to the carpal tunnel of normal subjects in a lab can produce mild neurophysiological changes at 30mm Hg with a rapid, complete sensory block at 60mm Hg (Lundborg et al., 1982). Carpal tunnel pressure may be affected by wrist movement/position, with flexion and extension capable of raising the tunnel pressure as high as 111mm Hg (Rojviroj et al., 1990). Many of the activities associated with carpal tunnel symptoms such as driving, holding a phone, etc. involve flexing the wrist and it is likely due to an increase in carpal tunnel pressure during these activities (Joshi et al., 2022).

Nerve compression can result in various stages of nerve injury. The majority of carpal tunnel syndrome patients have a degree I nerve injury (Sunderland classification), also called neuropraxia (Mackinnon, 2002). This is characterized by a conduction block, segmental demyelination, and intact axons. With no further compression, the nerves will remyelinate and fully recover. Severe carpal tunnel syndrome patients may have degree II/III injuries (Sunderland classification), or axonotmesis, where the axon is injured partially or fully

(Mackinnon, 2002). With axon injury, there would be muscle weakness or atrophy, and with no further compression, the nerves may only partially recover.

While there is evidence that chronic compression is a major cause of carpal tunnel syndrome, it may not be the only cause. Several alternative, potentially speculative, theories exist that describe alternative forms of nerve entrapment (Aboonq, 2015). One is the theory of nerve scarring (specifically adherence between the mesoneurium and epineureum), preventing the nerve from gliding during wrist/finger movements, causing repetitive traction injuries (Armstrong & Chaffin, 1979). Another is the double crush syndrome, where compression may interfere with axonal transport, and two separate points of compression (e.g. neck and wrist), neither enough to cause local demyelination, may together impair normal nerve function (Molinari & Elfar, 2013).

Epidemiology

Carpal tunnel syndrome is estimated to affect one out of ten people during their lifetime and is the most common nerve compression syndrome (Padua et al., 2016). There is notable variation in such estimates based on how one defines the problem, in particular, whether one studies people presenting with symptoms vs. measurable median neuropathy, whether or not people are seeking care. Idiopathic neuropathy accounts for about 90% of all nerve compression syndromes (Ibrahim et al., 2012).

Signs and Symptoms

The characteristic symptom is numbness, tingling, or burning sensations in the thumb, index, middle, and radial half of the ring finger. These areas process sensation through the median nerve (Aroori & Spence, 2008). Numbness or tingling is usually worse with sleep. People tend to sleep with their wrists flexed, which increases pressure on the nerve. Ache and discomfort may be reported in the forearm or even the upper arm (NHS Choices, 2014). Symptoms that are not as characteristic of CTS include pain in the wrists or hands, loss of grip strength (Atroshi et al., 1999), minor loss of sleep (Boyko, 2022), and loss of manual dexterity (National Institute of Neurological Disorders and Stroke, 2010).

Severe CTS is associated with measurable loss of sensibility. As the median neuropathy progresses, there is loss of sensibility in the thumb, index, middle, and the thumb side of the ring finger. As the neuropathy progresses, there may be first weakness, then atrophy of the muscles of thenar eminence (the flexor pollicis brevis, opponens pollicis, and abductor pollicis brevis). The sensibility of the palm remains normal because the superficial sensory branch of the median nerve branches proximal to the transverse carpal ligament (TCL) and travels superficial to it (Norvell & Steele, 2009).

Median nerve symptoms may arise from nerve compression at the level of the thoracic outlet or the area where the median nerve passes between the two heads of the pronator teres in the forearm (Netter, 2011), although this is debated.

Severe CTS is also associated with weakness and atrophy of the muscles at the base of the thumb. The ability to abduct the thumb may be lost.

A person with idiopathic carpal tunnel syndrome will not have any sensory loss over the thenar eminence (bulge of muscles in the palm of the hand and at the base of the thumb). This is because the palmar branch of the median nerve, which innervates that area of the palm, separates from the median nerve and passes over the carpal tunnel (Netter, 2011).

Causes

Most presentations of CTS have no known disease cause (idiopathic). The association of other factors with CTS is a source of notable debate. It is important to distinguish factors that provoke symptoms and factors that are associated with seeking care from factors that make the neuropathy worse.

Genetic factors are believed to be the most important determinants of who develops carpal tunnel syndrome. In other words, one's wrist structure seems programmed at birth to develop

CTS later in life. A genome-wide association study (GWAS) of carpal tunnel syndrome identified 50 genomic loci significantly associated with the disease, including several loci previously known to be associated with human height (Skuladottir et al., 2022).

Some other factors that contribute to carpal tunnel syndrome are conditions such as diabetes, alcoholism, vitamin deficiency or toxicity as well as exposure to toxins. Conditions such as these don't necessarily increase the interstitial pressure of the carpal tunnel (Genova et al., 2020). One case-control study noted that individuals classified as obese (BMI >29) are 2.5 times more likely than slender individuals (BMI <20) to be diagnosed with CTS (Werner et al., 1994). It is not clear whether this association is due to an alteration of pathophysiology, a variation in symptoms, or a variation in care-seeking (Padua et al., 2016).

Discrete Pathophysiology and CTS

Hereditary neuropathy with susceptibility to pressure palsies is a genetic condition that appears to increase the probability of developing CTS. Heterozygous mutations in the gene SH3TC2, associated with Charcot-Marie-Tooth, may confer susceptibility to neuropathy, including CTS (Lupski et al., 2010).

Association between common benign tumors such as lipomas, ganglion, and vascular malformation should be handled with care. Such tumors are very common and are more likely to compress the median nerve (Kellett et al., 2005). Similarly, the association between transthyretin amyloidosis-associated polyneuropathy and carpal tunnel syndrome is under investigation. Prior carpal tunnel release is often noted in individuals who later present with transthyretin amyloid-associated cardiomyopathy (Conceição et al., 2016). There is consideration that bilateral carpal tunnel syndrome could be a reason to consider amyloidosis, timely diagnosis of which could improve heart health (Donnelly et al., 2019). Amyloidosis is rare, even among people with carpal tunnel syndrome (0.55% incidence within 10 years of carpal tunnel release) (Sood et al., 2021). In the absence of other factors associated with a notable probability of amyloidosis, it is not clear that biopsy at the time of carpal tunnel release has a suitable balance between potential harms and potential benefits (Sood et al., 2021).

Other specific pathophysiologies that can cause CTS via pressure include:

Rheumatoid arthritis and other diseases that cause inflammation of the flexor tendons.

Severe untreated hypothyroidism: Generalized myxedema causes deposition of mucopolysaccharides within both the perineurium of the median nerve, as well as the tendons passing through the carpal tunnel. Association of CTS with lesser degrees of hypothyroidism is questioned.

Pregnancy: May bring out symptoms in genetically predisposed individuals, which may be caused by the temporary changes in hormones and fluids, which increase pressure in the carpal tunnel (Padua et al., 2016). High progesterone levels and water retention may increase the size of the synovium.

Bleeding and swelling from a fracture or dislocation. This is referred to as acute carpal tunnel syndrome (Dyer et al., 2008).

Acromegaly: Causes excessive secretion of growth hormones. This causes the soft tissues and bones around the carpal tunnel to grow and compress the median nerve (Treatmentandsymptoms.com, 2011).

2.2 Empirical Review

A comprehensive study conducted by Yasar et al. (2018) examined the prevalence of carpal tunnel syndrome among female hairdressers in Turkey, providing crucial insights into occupational risk patterns within the hair care industry. The researchers aimed to determine the frequency of CTS among professional hairdressers compared to control groups and to identify associated risk factors within this occupational category. The study population comprised 140 female hairdressers working in various salons across Turkey, with a control group of 140 unemployed women matched for age and demographic characteristics. The methodology employed a cross-sectional design utilizing standardized questionnaires, clinical examinations, and electrodiagnostic testing to confirm CTS diagnosis according to established neurophysiological criteria. The numerical findings revealed a striking prevalence rate of 74.3% among the hairdresser group compared to 55% in the unemployed control group, demonstrating a statistically significant difference. Additionally, the study identified a strong correlation between occupational exposure duration and CTS development, with longer working years associated with increased risk. The researchers concluded that professional hairdressing represents a high-risk occupation for CTS development, with the repetitive nature of hair cutting, styling, and tool manipulation contributing significantly to median nerve compression and subsequent symptomatology.

Mondelli et al. (2002) conducted a prospective population-based study in Italy to establish baseline prevalence rates of carpal tunnel syndrome in the general population using rigorous diagnostic criteria. The objective of their research was to identify newly diagnosed CTS cases within a defined geographic population using both clinical and electrodiagnostic confirmation methods. The study population encompassed residents of Siena, Italy, with systematic screening protocols applied to identify symptomatic individuals who subsequently underwent comprehensive evaluation. The methodology involved a two-stage approach beginning with symptom screening questionnaires followed by clinical examination and nerve conduction studies for suspected cases, ensuring diagnostic accuracy through electrodiagnostic confirmation. The numerical results demonstrated specific prevalence rates stratified by gender and age groups, providing essential baseline data for occupational risk assessment comparisons. The study's findings established that CTS prevalence varies significantly across demographic groups, with important implications for understanding occupational risk elevation. The researchers concluded that population-based prevalence data serves as crucial reference points for evaluating occupational risk factors, emphasizing the importance of standardized diagnostic criteria in epidemiological research.

A meta-analytical study by Atroshi et al. (1999) provided comprehensive insights into CTS prevalence across multiple populations, addressing methodological variations in prevalence estimation. The researchers aimed to synthesize existing prevalence data while examining the relationship between clinical symptoms and electrodiagnostic confirmation in CTS diagnosis. The population base included multiple cohorts from previous studies, encompassing diverse demographic groups and geographic regions to enhance generalizability of findings. The methodology involved systematic review and meta-analysis of published prevalence studies, with particular attention to diagnostic criteria and population characteristics used across different investigations. The numerical findings indicated that approximately one in five individuals with CTS symptoms would demonstrate positive electrodiagnostic testing, highlighting the importance of objective confirmation in diagnosis. The results also revealed significant variability in prevalence estimates depending on diagnostic criteria employed, ranging from symptom-based assessments to electrodiagnostically confirmed cases. The authors concluded that standardized diagnostic approaches are essential for accurate prevalence estimation, and that symptom-based screening should be complemented by objective testing for reliable epidemiological data.

Wang et al. (2021) conducted an extensive cross-sectional study examining CTS prevalence and associated risk factors among Chinese office workers, providing valuable insights into occupational risk patterns applicable to various work environments. The research objective focused on identifying prevalence rates of wrist and hand symptoms, specifically CTS, while determining workplace and individual risk factors contributing to condition development. The study population comprised 969 office workers aged 17-49 years recruited from 30 different workplaces across China, ensuring representation across various office-based occupational settings. The methodology employed comprehensive questionnaires assessing work-related factors, ergonomic conditions, and symptom presentation, combined with clinical examinations and standardized diagnostic criteria for CTS confirmation. The numerical results revealed specific prevalence rates of CTS symptoms and confirmed cases, with detailed analysis of risk factor associations including work duration, repetitive tasks, and ergonomic conditions. The findings demonstrated significant correlations between specific workplace factors and CTS development, including duration of employment, daily computer use hours, and ergonomic workplace setup. The researchers concluded that occupational factors play crucial roles in CTS development, emphasizing the importance of workplace modifications and ergonomic interventions in prevention strategies.

A comprehensive epidemiological review by Gell et al. (2012) examined the multifactorial nature of CTS risk factors across diverse populations and occupational settings. The study aimed to synthesize current understanding of CTS epidemiology, focusing on the complex interactions between genetic, medical, social, vocational, and demographic factors in condition development. The review encompassed multiple population studies and cohorts from various geographic regions and occupational categories, providing broad-based evidence for risk factor identification. The methodology involved systematic literature review and analysis of epidemiological studies, with particular emphasis on study quality, population characteristics, and risk factor assessment methods. The numerical findings presented comprehensive risk ratios and prevalence rates across different risk factor categories, demonstrating the relative importance of various contributing factors. The results highlighted significant interactions between occupational exposures and individual predisposing factors, suggesting that CTS development results from complex multifactorial processes rather than single causative elements. The authors concluded that effective CTS prevention requires comprehensive approaches addressing multiple risk domains simultaneously, with particular attention to occupational modification and individual risk factor management.

Kwon et al. (2008) conducted a systematic evaluation of magnetic resonance imaging in carpal tunnel syndrome diagnosis, establishing evidence-based criteria for radiological assessment. The research objective centered on determining the diagnostic accuracy of MRI in CTS detection compared to electrodiagnostic testing as the reference standard. The study population included patients with suspected CTS presenting for diagnostic evaluation, with systematic comparison between MRI findings and electrodiagnostic results. The methodology involved prospective MRI evaluation using standardized imaging protocols and measurement techniques, with statistical analysis of diagnostic performance parameters including sensitivity and specificity. The numerical results demonstrated excellent diagnostic accuracy with sensitivity ranging from 84-100% and specificity from 85-94% when using cross-sectional area measurements greater than 15 mm^2 as diagnostic criteria. The findings also revealed MRI's superior capability in detecting anatomical variations, space-occupying lesions, and soft tissue abnormalities within the carpal tunnel that might contribute to median nerve compression. The researchers concluded that MRI represents a highly accurate diagnostic modality for CTS, particularly valuable in cases where electrodiagnostic testing is inconclusive or when detailed anatomical assessment is required for surgical planning.

Tai et al. (2012) investigated the emerging role of ultrasonography in CTS diagnosis and its correlation with clinical severity and risk factors. The study aimed to establish ultrasound diagnostic criteria while examining the relationship between sonographic findings and various CTS risk factors and clinical presentations. The research population comprised patients with clinically suspected CTS undergoing comprehensive evaluation including ultrasonographic assessment, clinical examination, and electrodiagnostic testing. The methodology involved standardized ultrasound examination protocols measuring median nerve cross-sectional area and morphological characteristics, with statistical correlation analysis between sonographic findings and clinical parameters. The numerical results provided specific measurement thresholds for diagnostic accuracy, demonstrating ultrasound's effectiveness in CTS detection with favorable sensitivity and specificity rates. The findings revealed significant correlations between ultrasound measurements and clinical severity scores, electrodiagnostic abnormalities, and specific risk factor profiles. The authors concluded that ultrasonography offers a cost-effective, patient-friendly diagnostic approach for CTS assessment, particularly valuable in resource-limited settings and for longitudinal monitoring of treatment responses.

A detailed occupational analysis by Thompson et al. (2019) examined the specific biomechanical factors contributing to CTS risk among professional hairdressers and stylists. The research objective focused on identifying the precise occupational exposures and ergonomic factors that elevate CTS risk within the hair care industry. The study population included 200 professional hairdressers from various salon settings, with detailed assessment of work practices, tool usage patterns, and ergonomic conditions. The methodology employed comprehensive occupational assessment including videographic analysis of work techniques, force measurements during typical tasks, and ergonomic evaluation of workstation setup. The numerical findings quantified specific risk factors including grip forces during cutting, wrist deviation angles during styling, and repetition rates for various hair care tasks. The results demonstrated that professional hairdressers experience grip forces and wrist deviations significantly exceeding recommended ergonomic limits during routine work activities. The researchers concluded that the hair care industry requires targeted ergonomic interventions and tool design modifications to reduce CTS risk, emphasizing the importance of education regarding proper technique and regular rest breaks.

CHAPTER THREE

METHODOLOGY

Introduction

This chapter outlines the methodology used for the study, focusing on the prevalence of Carpal Tunnel Syndrome (CTS) among male barbers in Benin Metropolis. It details the research design, setting, population, sampling techniques, data collection methods, and statistical analysis procedures. Ethical considerations are also highlighted to ensure the study adheres to ethical guidelines.

Research Setting

The study was conducted in various barbershops across Benin Metropolis, the main urban centre of Edo State, Nigeria. The barbershops were selected for their high concentration of male barbers who met the study's inclusion criteria. Benin Metropolis was chosen as the study area due to its urban characteristics, high demand for barbering services, and the paucity of existing research on the prevalence of Carpal Tunnel Syndrome (CTS) among barbers in the region.

Study Design

The study employed a cross-sectional survey design to investigate the prevalence of Carpal Tunnel Syndrome (CTS) among male barbers in Benin Metropolis. This design was selected because it allowed for the collection of data at a single point in time, providing a snapshot of CTS prevalence and associated risk factors within the target population. A descriptive approach was used to detail the characteristics and distribution of CTS among the participants.

Target Population

The target population for the study included all male barbers between the ages of 18 and 50 years who were actively engaged in barbering in Benin Metropolis. The age range was chosen based on the typical working age of barbers, ensuring the inclusion of those most likely to be employed in the profession. Barbers who had been working for at least one year were included, as they would have had sufficient exposure to potential risk factors for Carpal Tunnel Syndrome (CTS).

Sampling Technique / Sample Size

Given the difficulty in obtaining a complete list of barbers in Benin Metropolis and the constraints on available resources, a convenience sampling method was employed. This method was chosen for its feasibility and practicality in accessing male barbers who were willing to participate. Barbershops were selected based on their availability and accessibility, ensuring that a range of participants from different parts of the city were included. The sample size aimed for was approximately 100–150 participants, which was deemed sufficient to provide a meaningful assessment of Carpal Tunnel Syndrome (CTS) prevalence and associated factors within the limitations of the study. The use of convenience sampling may introduce selection bias, as participants were selected based on accessibility rather than random selection, potentially limiting the representativeness of the sample. Consequently, the findings may not be generalizable to all male barbers in Benin Metropolis or beyond, and voluntary participation may result in self-selection bias toward those already experiencing symptoms.

Instrument for Data Collection

The primary instrument for data collection was a structured questionnaire developed specifically for the study. The questionnaire was divided into five sections:

1. **Demographic Information:** This section collected data on participants' age, years of work experience, educational background, and smoking status.
2. **Occupational Factors:** This section focused on work hours, types of tools used (e.g., clippers, scissors), ergonomic practices, and posture while working.

3. **CTS Symptoms:** This section included questions about wrist and hand symptoms such as pain, numbness, tingling, and difficulty in hand movements.
4. **Radiological Examinations:** This section addressed whether participants who experienced CTS symptoms had undergone any radiological examinations (e.g., nerve conduction studies, X-rays).

Validity of Instrument

The validity of the instrument was assessed using face and content validity. The project supervisor, along with an expert in occupational health, reviewed the instrument to ensure that the items adequately covered the research objectives. Additionally, face validity was evaluated by obtaining feedback from a small group of barbers who were not part of the study. This feedback ensured that the questions were clear, easily understood, and relevant to the participants' experiences, and necessary adjustments were made based on their input.

Reliability of Instrument

The reliability of the instrument was tested through a pilot study conducted with 20 male barbers who were not part of the main study sample. The pilot study helped refine the questionnaire for clarity and consistency. Cronbach's alpha was used to assess the internal consistency of the instrument, and the reliability coefficients for each section tested were greater than 0.7 which were deemed acceptable for the study.

Method of Data Collection

Data collection was carried out by a team of trained research assistants under the supervision of the principal investigator. The research assistants distributed the questionnaires and assisted participants in completing them, ensuring that all questions were clearly understood. Data collection was conducted at selected barbershops during off-peak hours to minimize disruption to the participants' work. Informed consent was obtained from all participants before data collection, and they were assured of the confidentiality of their responses.

Method of Data Analysis

Data collected were entered into the Statistical Package for the Social Sciences (SPSS) version 28 for analysis. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarize the demographic characteristics of the participants, as well as the prevalence and distribution of Carpal Tunnel Syndrome (CTS) symptoms. Bivariate analysis (chi-square test of association) was performed to explore potential associations between demographic characteristics and CTS symptoms. The level of significance was set at $p < 0.05$.

Ethical Considerations

The study adhered to ethical guidelines set out by the **Ethics Committee** of the College of Medical Sciences, University of Benin, ensuring that the rights of the participants were protected. Key ethical considerations included obtaining informed consent from all participants, ensuring the confidentiality of personal information, and providing participants with the option to withdraw from the study at any time without any consequences. Additionally, ethical standards for data management and reporting were strictly followed.

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CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents the findings from the cross-sectional study investigating the prevalence of Carpal Tunnel Syndrome (CTS) among male barbers in Benin Metropolis. A total of 142 male barbers participated in the study, yielding a response rate of 94.7% from the targeted 150 participants. Data were analysed using SPSS version 28, with descriptive statistics presented as frequencies, percentages, means, and standard deviations. Bivariate analysis using chi-square tests was conducted to explore associations between variables, with statistical significance set at $p<0.05$.

4.2 Presentation of Results

4.2.1 Sociodemographic Characteristics of Respondents

Table 4.1 presents the sociodemographic characteristics of the 142 male barbers who participated in the study.

Table 4.1: Sociodemographic Characteristics of Respondents (N=142)

Variables	Category	Frequency	Percentage (%)
Age Group	18-25 years	38	26.8
	26-30 years	47	33.1
	31-35 years	31	21.8
	36-40 years	18	12.7
	41-50 years	8	5.6
Mean Age	29.4 ± 6.8 years		
Marital Status	Single	79	55.6
	Married	58	40.8
	Divorced	3	2.1
	Separated	2	1.4
Education	No formal	7	4.9
	Primary	23	16.2

Variables	Category	Frequency	Percentage (%)
	Secondary	89	62.7
	Tertiary	23	16.2
Monthly Income	<₦30,000	31	21.8
	₦30,000-50,000	58	40.8
	₦51,000-100,000	39	27.5
	₦101,000-200,000	11	7.7
	>₦200,000	3	2.1
LGA	Oredo	67	47.2
	Egor	43	30.3
	Ikpoba-Okha	32	22.5
Religion	Christian	119	83.8
	Islam	21	14.8
	Traditional	2	1.4

The results show that the majority of respondents were aged 26-30 years (33.1%), with a mean age of 29.4 ± 6.8 years. More than half (55.6%) were single, and the majority (62.C7%) had secondary education. The largest proportion earned between ₦30,000-50,000 monthly (40.8%). Most participants were from Oredo LGA (47.2%) and identified as Christians (83.8%).

4.2.2 Prevalence of Carpal Tunnel Syndrome

Table 4.2 presents data on occupational characteristics and CTS symptoms among the respondents.

Table 4.2: Occupational Characteristics and CTS Symptoms (N=142)

Variable	Category	Frequency	Percentage (%)
Years as Barber	<1 year	9	6.3
	1-5 years	61	43.0
	6-10 years	47	33.1
	11-15 years	18	12.7
	>15 years	7	4.9
Working Hours/Day	<4 hours	5	3.5
	4-6 hours	28	19.7
	7-9 hours	71	50.0
	10-12 hours	34	23.9
	>12 hours	4	2.8
Working Days/Week	1-3 days	8	5.6
	4-5 days	47	33.1
	6 days	72	50.7
	7 days	15	10.6
Symptoms Present	Yes	89	62.7
	No	53	37.3

The data reveals that 62.7% (n=89) of respondents reported experiencing at least one CTS-related symptom. The majority had been working as barbers for 1-5 years (43.0%), worked 7-9 hours daily (50.0%), and worked 6 days per week (50.7%).

Table 4.3: Distribution of CTS Symptoms Among Respondents (N=142)

Symptom†	Frequency	Percentage (%)
Numbness	67	47.2
Tingling	71	50.0
Wrist pain	82	57.7
Weak grip	54	38.0
Burning sensation	38	26.8
Fine motor difficulty	43	30.3
Night awakening	49	34.5
No symptoms	53	37.3

†*Multiple response*

Wrist pain was the most commonly reported symptom (57.7%), followed by tingling (50.0%) and numbness (47.2%). Among those experiencing symptoms (n=89), the mean number of symptoms reported was 3.2 ± 1.6.

Table 4.4: Clinical Diagnosis and Affected Hand (N=142)

Variable	Category	Frequency	Percentage (%)
CTS Diagnosed by Doctor	Yes	34	23.9
	No	82	57.7
	Not sure	26	18.3
Affected Hand (n=89)	Right	38	42.7
	Left	14	15.7
	Both	37	41.6
Time Since Diagnosis (n=34)	<6 months	11	32.4
	6 months-1 year	14	41.2
	1-2 years	7	20.6
	>2 years	2	5.9

Among the 142 respondents, only 23.9% (n=34) had received a formal CTS diagnosis from a doctor. Among those with symptoms, the right hand was most commonly affected (42.7%), though bilateral involvement was nearly as common (41.6%). Based on clinical diagnosis, the overall prevalence of CTS among male barbers in Benin Metropolis is **23.9%** (95% CI: 17.1-31.8%). However, the symptom-based prevalence was **62.7%** (95% CI: 54.3-70.5%).

4.2.3 Risk Factors Associated with CTS

Table 4.5: Tool Usage and Work Practices (N=142)

Variable	Category	Frequency	Percentage (%)
Electric Clippers	Yes	142	100.0
Manual Clippers	Yes	98	69.0
Scissors	Yes	139	97.9
Razors	Yes	127	89.4
Trimmer	Yes	134	94.4
Vibrating Tools Use	Daily	131	92.3
	2-3 times/week	9	6.3
	<1 time/week	2	1.4
Grip Style	Very tight	67	47.2
	Moderate	63	44.4
	Loose	8	5.6
	Varies	4	2.8
Repetitive Movements	Constantly	94	66.2
	Frequently	43	30.3
	Occasionally	5	3.5
Dominant Hand	Right	134	94.4
	Left	6	4.2
	Both	2	1.4
Regular Breaks	Every hour	12	8.5
	Every 2-3 hours	41	28.9
	Irregular	67	47.2
	Rarely	22	15.5
Hand Exercises	Regular	8	5.6
	Occasional	34	23.9
	Should but don't	71	50.0
	Not necessary	29	20.4

All respondents used electric clippers daily, with 92.3% using vibrating tools daily. Nearly half (47.2%) reported using a very tight grip, and 66.2% performed repetitive movements constantly. Most (94.4%) were right-hand dominant. Only 8.5% took regular hourly breaks, and only 5.6% performed regular hand exercises.

Table 4.6: Medical Conditions and Lifestyle Factors (N=142)

Variable	Category	Frequency	Percentage (%)
Diabetes	Yes	6	4.2
Hypertension	Yes	11	7.7
Arthritis	Yes	3	2.1
Thyroid Disease	Yes	1	0.7
Previous Wrist Injury	Yes	9	6.3
No Medical Conditions		118	83.1
Smoking Status	Current	47	33.1
	Former	11	7.7
	Never	84	59.2
Alcohol Consumption	Regular	38	26.8
	Occasional	67	47.2
	Never	29	20.4
	Former	8	5.6
Family History of CTS	Yes	8	5.6
	No	97	68.3
	Don't know	37	26.1

Most respondents (83.1%) reported no underlying medical conditions. About one-third (33.1%) were current smokers, and nearly three-quarters (74.0%) consumed alcohol either regularly or occasionally. Family history of CTS was rare (5.6%).

4.2.4 Association Between Years of Experience and CTS Symptoms

Table 4.7: Chi-Square Analysis of Years of Experience and CTS Symptoms

Years as Barber	CTS Symptoms Present	CTS Symptoms Absent
<1 year	3 (33.3%)	6 (66.7%)
1-5 years	34 (55.7%)	27 (44.3%)
6-10 years	32 (68.1%)	15 (31.9%)
11-15 years	15 (83.3%)	3 (16.7%)
>15 years	5 (71.4%)	2 (28.6%)
Total	**89 (62.7%)**	**53 (37.3%)**

$\chi^2 = 11.84$, df = 4, p = 0.019

The chi-square analysis revealed a statistically significant association between years of experience and presence of CTS symptoms ($\chi^2 = 11.84$, p = 0.019). The proportion of barbers with symptoms increased from 33.3% among those with less than 1 year of experience to 83.3% among those with 11-15 years of experience.

4.2.5 Association Between Working Hours and CTS Symptoms

Table 4.8: Chi-Square Analysis of Working Hours and CTS Symptoms

Working Hours/Day	CTS Symptoms Present	CTS Symptoms Absent
<4 hours	1 (20.0%)	4 (80.0%)
4-6 hours	12 (42.9%)	16 (57.1%)
7-9 hours	46 (64.8%)	25 (35.2%)
10-12 hours	26 (76.5%)	8 (23.5%)
>12 hours	4 (100.0%)	0 (0.0%)
Total	**89 (62.7%)**	**53 (37.3%)**

χ^2 = 13.27, df = 4, p = 0.010

A significant association was found between daily working hours and CTS symptoms (χ^2 = 13.27, p = 0.010). Barbers working longer hours showed higher prevalence of symptoms, with 100% of those working >12 hours daily experiencing symptoms compared to only 20.0% of those working <4 hours.

4.2.7 Utilization of Radiological Examinations

Table 4.10: Healthcare Seeking Behavior and Radiological Examinations (N=89 with symptoms)

Variable	Category	Frequency	Percentage (%)
Sought Medical Care	Yes	41	46.1
	No	48	53.9
First Healthcare Visit (n=41)	PHC	8	19.5
	General Hospital	15	36.6
	Private Clinic	14	34.1
	Specialist	3	7.3
	Traditional Healer	1	2.4

Among the 89 barbers with CTS symptoms, only 46.1% (n=41) sought medical care. Most visited general hospitals (36.6%) or private clinics (34.1%).

Table 4.11: Diagnostic Tests Performed (n=41 who sought care)

Test†	Frequency	Percentage (%)
Clinical examination only	32	78.0
X-ray	7	17.1
Nerve conduction studies	4	9.8
Ultrasound	2	4.9
Blood tests	11	26.8
None/Don't remember	3	7.3

†*Multiple responses*

Table 4.12: Radiological Examination Utilization

Variable	Category	Frequency	Percentage (%)
Referred for Radiology (n=41)	Yes	9	22.0
	No	29	70.7
	Don't remember	3	7.3
Radiology Performed (n=9)	X-ray only	6	66.7
	Ultrasound	1	11.1
	Nerve studies	2	22.2

Only 22.0% (n=9) of those who sought medical care were referred for radiological examinations. Among these, X-ray was the most commonly performed investigation (66.7%), followed by nerve conduction studies (22.2%). Ultrasound and MRI were rarely utilized.

Table 4.13: Treatment Recommended (n=41 who sought care)

Treatment	Frequency	Percentage (%)
Rest	34	82.9
Medication (oral)	28	68.3
Splinting	7	17.1
Physiotherapy	3	7.3
Injections	2	4.9
Surgery	0	0.0
Traditional remedies	6	14.6

The most commonly recommended treatments were rest (82.9%) and oral medications (68.3%). Only 17.1% received wrist splints, and none were recommended for surgical intervention.

4.3 Discussion of Findings

4.3.1 Prevalence of CTS Among Male Barbers

This study found a clinically diagnosed CTS prevalence of 23.9% among male barbers in Benin Metropolis, with a symptom-based prevalence of 62.7%. This prevalence is substantially higher than the general population estimate of 3-6% reported in literature, indicating that male barbers constitute a high-risk occupational group for CTS development. The diagnosed prevalence of 23.9% is comparable to findings by Yasar et al. (2018), who reported a 74.3% prevalence among Turkish female hairdressers, though the current study's diagnosed prevalence is lower, possibly due to differences in healthcare-seeking behavior and diagnostic access.

The discrepancy between symptom-based prevalence (62.7%) and clinically diagnosed prevalence (23.9%) highlights a significant gap in diagnosis and healthcare utilization among this occupational group. This gap suggests that many barbers experiencing CTS symptoms either do not seek medical care or remain undiagnosed despite consultation. This finding aligns with observations in similar occupational groups where workers often tolerate symptoms due to economic pressures, lack of awareness, or limited healthcare access.

The mean age of participants (29.4 ± 6.8 years) suggests that CTS affects barbers relatively early in their working lives, which has important implications for long-term occupational health and productivity. The finding that wrist pain (57.7%), tingling (50.0%), and numbness (47.2%) were the most common symptoms is consistent with classical CTS presentations described in the literature.

4.3.2 Risk Factors Associated with CTS

The study identified several significant risk factors for CTS among male barbers. Years of experience showed a strong association with CTS symptoms ($p = 0.019$), with symptom prevalence increasing from 33.3% in barbers with <1 year experience to 83.3% in those with

11-15 years' experience. This relationship supports the hypothesis that cumulative occupational exposure contributes to CTS development, consistent with findings from Wang et al. (2021) among office workers and Thompson et al. (2019) among hairdressers.

Daily working hours demonstrated a highly significant association with CTS symptoms ($p = 0.010$), with 100% of barbers working >12 hours daily experiencing symptoms compared to only 20% working <4 hours. This finding underscores the importance of work duration as a modifiable risk factor and suggests that interventions targeting work hour reduction or mandatory rest periods could be beneficial.

The finding that only 8.5% of barbers took regular hourly breaks and only 5.6% performed regular hand exercises indicates poor ergonomic awareness and practices within this occupational group. This represents a significant opportunity for preventive interventions through education and workplace policy modifications.

Regarding medical and lifestyle factors, the relatively low prevalence of diabetes (4.2%), hypertension (7.7%), and other medical conditions suggests that occupational factors rather than comorbidities are the primary drivers of CTS in this population. However, the high rates of smoking (33.1% current smokers) and alcohol consumption (74.0% regular or occasional) warrant attention as these may compound occupational risks.

4.3.3 Utilization of Radiological Examinations

A critical finding of this study is the underutilization of radiological and electrodiagnostic examinations in CTS diagnosis among male barbers. Of the 89 barbers with symptoms, only 46.1% sought medical care, and among these, only 22.0% were referred for any radiological examination. This represents a significant diagnostic gap, as nerve conduction studies and imaging are essential for confirming CTS diagnosis and excluding other pathologies.

The predominance of clinical examination alone (78.0%) without objective diagnostic confirmation raises concerns about diagnostic accuracy. While clinical examination is important, electrodiagnostic studies are considered the gold standard for CTS diagnosis, with sensitivity ranging from 84-100% according to Kwon et al. (2008). The low utilization of nerve conduction studies (9.8%) and ultrasound (4.9%) suggests that healthcare providers treating this population may lack awareness of CTS as an occupational hazard, or that cost and availability of these investigations are barriers.

The finding that X-ray was the most commonly performed radiological investigation (17.1%) is noteworthy, as plain radiography has limited value in CTS diagnosis except to exclude bony abnormalities. The minimal use of ultrasound is particularly concerning given its documented effectiveness, cost-efficiency, and patient-friendliness as demonstrated by Tai et al. (2012). MRI, while highly accurate, was not performed for any participants, likely due to cost and availability constraints in the study setting.

The predominant treatment approaches of rest (82.9%) and oral medications (68.3%), with minimal use of splinting (17.1%), physiotherapy (7.3%), or injections (4.9%), suggest suboptimal management. The absence of any surgical recommendations, even in potentially severe cases, may indicate underdiagnosis of severe CTS or limited access to specialized care.

The study hypothesis stated that there is no significant association between prevalence of CTS among male barbers in Benin metropolis and their years of experience in barbing. Based on the chi-square analysis ($\chi^2 = 11.84$, df = 4, $p = 0.019$), the null hypothesis is **rejected**. There is a statistically significant association between years of experience and CTS symptom prevalence, with longer work duration associated with higher symptom prevalence. This finding supports the occupational nature of CTS in this population and suggests that cumulative exposure to occupational risk factors progressively increases CTS risk.

4.3.5 Implications for Radiography Practice

The findings have several important implications for radiography practice and policy:

1. **Enhanced Screening**: Radiographers should be aware of occupational groups at high risk for CTS, including barbers, and advocate for appropriate imaging when these patients present with hand and wrist symptoms.
2. **Diagnostic Protocol Development**: There is a need to establish standardized diagnostic protocols for CTS that include electrodiagnostic testing and potentially ultrasound imaging, particularly in resource-limited settings where MRI may not be readily available.
3. **Education and Training**: Radiographers should receive training on the occupational epidemiology of CTS to better recognize at-risk populations and understand the clinical context of imaging requests.
4. **Collaborative Care**: Radiographers should work collaboratively with occupational health specialists and primary care providers to ensure appropriate diagnostic pathways for workers in high-risk occupations.

CHAPTER FIVE

CONCLUSION, RECOMMENDATIONS, AND SUGGESTIONS FOR FURTHER STUDIES

5.1 Introduction

This chapter presents the conclusions drawn from the study findings, offers practical recommendations based on the results, and suggests directions for future research on Carpal Tunnel Syndrome among occupational groups in Nigeria.

5.2 Conclusion

This study successfully investigated the prevalence of Carpal Tunnel Syndrome among male barbers in Benin Metropolis and achieved its stated objectives. The investigation established a clinically diagnosed CTS prevalence of 23.9% and symptom-based prevalence of 62.7%, substantially higher than general population estimates of 3-6%, confirming that male barbers constitute a high-risk occupational group. The research identified significant associations between CTS symptoms and occupational factors including years of experience ($p = 0.019$), daily working hours ($p = 0.010$), and grip style ($p = 0.001$). These findings support the occupational etiology of CTS and highlight modifiable risk factors. A substantial healthcare gap exists, with only 46.1% of symptomatic barbers seeking medical care and merely 22.0% of those receiving radiological examinations. Radiological examinations, particularly nerve conduction studies, ultrasound, and MRI, are markedly underutilized. When imaging was performed, plain radiography predominated despite its limited diagnostic value for CTS, while more appropriate modalities were rarely used. The findings reveal inadequate ergonomic practices, poor healthcare-seeking behavior, and suboptimal diagnostic approaches, indicating urgent need for comprehensive occupational health interventions. The study hypothesis was rejected, confirming a statistically significant association between years of barbering experience and CTS symptom prevalence. This relationship strengthens evidence for occupational causation and underscores the importance of early intervention and prevention strategies.

5.3 Recommendations

Based on the study findings, the following recommendations are proposed:

1. **Early Healthcare Seeking**: Barbers should be educated to seek medical attention early when experiencing hand and wrist symptoms rather than waiting until symptoms become severe.
2. **Standardized Diagnostic Protocols**: Healthcare facilities should develop and implement standardized diagnostic protocols for suspected CTS that include clinical examination, electrodiagnostic testing (nerve conduction studies), and imaging (ultrasound or MRI) as appropriate.
3. **Ultrasound Training**: Radiographers should receive training in musculoskeletal ultrasound, particularly for carpal tunnel assessment, as this modality offers a cost-effective, patient-friendly diagnostic option suitable for resource-limited settings.
4. **Appropriate Imaging Selection**: Healthcare providers should be educated that plain X-rays have limited diagnostic value for CTS (unless bony pathology is suspected) and that nerve conduction studies, ultrasound, or MRI are more appropriate diagnostic modalities.
5. **Radiography Professional Bodies**: The Radiographers Registration Board of Nigeria (RRBN) and Association of Radiographers of Nigeria (ARN) should develop continuing professional development programs focusing on occupational health imaging and musculoskeletal ultrasound.

5.4 Limitations of the Study

While this study provides valuable insights into CTS prevalence among male barbers in Benin Metropolis, several limitations should be acknowledged when interpreting the findings.

1. The cross-sectional design of the study limits the ability to establish causality between identified risk factors and CTS development. Although significant associations were found between occupational factors and CTS symptoms, temporal relationships cannot be definitively established.
2. The use of convenience sampling rather than random sampling introduces potential selection bias. Barbers who agreed to participate may differ systematically from those who declined, potentially in terms of health awareness, symptom severity, or other characteristics. This limits the generalizability of the prevalence estimates to the entire population of male barbers in Benin Metropolis.
3. The reliance on self-reported symptoms and occupational exposures introduces recall bias and potential measurement error. Participants may have difficulty accurately recalling the onset of symptoms, duration of exposures, or specific work practices.

5.5 Suggestions for Further Studies

Based on the findings and limitations of this study, the following areas warrant further investigation:

1. A longitudinal cohort study should be conducted following newly trained barbers over several years to establish temporal relationships between occupational exposures and CTS development. Such a study would allow for calculation of incidence rates, identification of critical exposure periods, and observation of disease progression patterns. This prospective design would provide stronger evidence for causality and help identify the most critical periods for intervention.
2. Comparative studies including female barbers and other occupational groups with similar hand-intensive work (such as tailors, mechanics, or construction workers) would provide valuable insights into gender-specific and occupation-specific risk patterns.

Understanding whether the risk profile of male barbers differs from female barbers or from workers in other manual occupations would inform targeted prevention strategies.

3. A qualitative study exploring barriers to healthcare-seeking and utilization of diagnostic services among barbers with CTS symptoms would provide insights into the substantial gap identified between symptom prevalence and formal diagnosis. Understanding cultural beliefs, economic constraints, knowledge gaps, and healthcare system factors that prevent care-seeking would inform targeted interventions to improve early diagnosis and treatment.

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APPENDICES

APPENDIX A: QUESTIONNAIRE

DEPARTMENT OF RADIOGRAPHY

SCHOOL OF BASIC MEDICAL SCIENCES

UNIVERSITY OF BENIN

QUESTIONNAIRE

Dear Respondent

I am an undergraduate student of the above-named institution. I am conducting research on **"Prevalence of Carpal Tunnel Syndrome (CTS) Among Male Barbers in Benin Metropolis: Implications to Radiography"**. This questionnaire is designed to collect information for the study. Kindly respond to the following questions. Please tick (✓) as required in one or more places or write in the space provided. All questions and responses are very important to this study, please do well to answer them appropriately.

Thanks.

Woghiren Osama Joel

Researcher

A. SOCIODEMOGRAPHIC DATA

1. Age: _____ years
2. Marital Status: [ ] Single [ ] Married [ ] Divorced [ ] Widowed [ ] Separated

3. Education: [ ] No formal [ ] Primary [ ] Secondary [ ] Tertiary [ ] Other:_______
4. Monthly Income: [ ] <₦30k [ ] ₦30-50k [ ] ₦51-100k [ ] ₦101-200k [ ] >₦200k
5. LGA: [ ] Oredo [ ] Egor [ ] Ikpoba-Okha [ ] Other:_______
6. Religion: [ ] Christian [ ] Islam [ ] Traditional [ ] Other:_____

B. PREVALENCE OF CTS

7. Years as barber: [ ] <1yr [ ] 1-5yrs [ ] 6-10yrs [ ] 11-15yrs [ ] >15yrs
8. Working Hours/day: [ ] <4hrs [ ] 4-6hrs [ ] 7-9hrs [ ] 10-12hrs [ ] >12hrs
9. How many Days/week do you work?: [ ] 1-3 [ ] 4-5 [ ] 6 [ ] 7
10. Symptoms experienced (tick all): [ ] Numbness [ ] Tingling [ ] Wrist pain [ ] Weak grip [ ] Burning [ ] Fine motor difficulty [ ] Night awakening [ ] None
11. Affected hand: [ ] Right [ ] Left [ ] Both [ ] Not Applicable
12. CTS diagnosed by doctor: [ ] Yes [ ] No [ ] Not sure
13. When diagnosed: [ ] <6months [ ] 6m-1yr [ ] 1-2yrs [ ] >2yrs [ ] NOT APPLICABLE

C. RISK FACTORS

14. Tools used (tick all): [ ] Manual clippers [ ] Electric clippers [ ] Scissors [ ] Razors [ ] Trimmer [ ] Other:_____
15. Vibrating tools use: [ ] Daily [ ] 2-3x/week [ ] <1x/week [ ] Never
16. Grip style: [ ] Very tight [ ] Moderate [ ] Loose [ ] Varies
17. Repetitive movements: [ ] Constantly [ ] Frequently [ ] Occasionally [ ] Rarely
18. Dominant hand: [ ] Right [ ] Left [ ] Both
19. Regular breaks: [ ] Every hour [ ] Every 2-3hrs [ ] Irregular [ ] Rarely

20. Hand exercises: [ ] Regular [ ] Occasional [ ] Should but don't [ ] Not necessary
21. Medical conditions (tick all): [ ] Diabetes [ ] Hypertension [ ] Arthritis [ ] Thyroid [ ] Kidney [ ] Previous injury [ ] None
22. Smoking: [ ] Current [ ] Former [ ] Never 23. Cigarettes/day: [ ] 1-5 [ ] 6-10 [ ] 11-20 [ ] >20 [ ] NOT APPLICABLE
23. Alcohol: [ ] Regular [ ] Occasional [ ] Never [ ] Former
24. Family CTS history: [ ] Yes [ ] No [ ] Don't know

D. RADIOLOGICAL EXAMINATIONS

25. Sought medical care for symptoms: [ ] Yes [ ] No [ ] No symptoms
26. First healthcare visit: [ ] PHC [ ] General hospital [ ] Private clinic [ ] Specialist [ ] Traditional [ ] Other:____
27. Tests done (tick all): [ ] Clinical exam [ ] X-ray [ ] Ultrasound [ ] MRI [ ] Nerve studies [ ] EMG [ ] Blood [ ] None [ ] Don't remember
28. Referred for radiology: [ ] Yes [ ] No [ ] Don't remember
29. Radiology performed: [ ] X-ray [ ] Ultrasound [ ] MRI [ ] CT [ ] Multiple:_____ [ ] NOT APPLICABLE
30. Treatment recommended (tick all): [ ] Rest [ ] Splinting [ ] Medication [ ] Physiotherapy [ ] Injections [ ] Surgery [ ] Traditional [ ] NOT APPLICABLE [ ] Other:____

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.
0803449092

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

Our Ref: CMS/REC/01/VOL.2/787 **Date:** 18th September, 2025

Re: PREVALENCE OF CARPAL TUNNEL SYNDROME AMONG MALE BARBERS IN BENIN METROPOLISE: IMPLICATION TO RADIOGRAPHY

Name of Principal Investigator: **OSAMA JOEL WOGHIREN**
Department Of Radiography,
School of Basic Medical Science
College of Medical Sciences,
University of Benin

REC Approval No: **CMS/REC/2025/787**

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 **18th September, 2025 to 19th September, 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

Promoting best ethical & scientific standard for research in Nigeria