ASSESSMENT OF KNOWLEDGE OF STROKE AMONG CLINICAL UNDERGRADUATES IN THE SCHOOL OF BASIC MEDICAL SCIENCES, UNIBEN.

BY

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

OCTOBER 2025

CERTIFICATION

This dissertation by Ileabumah Favour Akata is accepted in its presented 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**

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DEDICATION

This dissertation is dedicated to EL-ROI, my supervisor, Pa Suyi, my late father, Mr. Sunday Eguakhide, my mother, Mrs. Glory Eguakhide, and my siblings, whose unwavering support and encouragement made this work possible.

ABSTRACT

Background:

Stroke remains one of the leading causes of death and long-term disability worldwide, with an increasing incidence in low- and middle-income countries such as Nigeria. Early recognition and appropriate response to stroke symptoms are critical to improving outcomes. Medical students, as future healthcare providers, play a vital role in promoting stroke awareness and emergency response.

Objective:

This study assessed the level of knowledge of stroke, its risk factors, warning signs, and appropriate emergency responses among clinical undergraduate students in the School of Basic Medical Sciences (SBMS), University of Benin.

Methods:

A descriptive cross-sectional survey design was employed. A structured, self-administered questionnaire was distributed to 322 clinical undergraduates selected through stratified random sampling. Data were analyzed using descriptive and inferential statistics, including frequency, percentage, and chi-square tests at a 0.05 significance level.

Results:

Findings revealed a generally high level of stroke awareness among respondents. Most participants (94.1%) correctly identified the brain as the organ affected by stroke, and 98.4% recognized that stroke is preventable. Hypertension (77.0%), old age (73.3%), and diabetes were the most frequently identified risk factors. Paralysis of one side of the body (78.6%) and speech difficulty (77.3%) were the most recognized warning signs. A significant association existed between level of study and knowledge of stroke risk factors ($p = 0.035$) and between gender and planned response to stroke events ($p = 0.02$).

Conclusion:

Clinical undergraduates of the University of Benin demonstrated commendable theoretical knowledge of stroke, its risk factors, and warning signs. However, gaps remain in the understanding of lifestyle-related risk factors and practical emergency response.

Keywords: Stroke, Knowledge, Risk Factors, Clinical Undergraduates, University of Benin.

ACKNOWLEDGEMENT

I am deeply grateful to EL-ROI for his divine guidance, protection, and grace which have sustained me throughout my academic journey and enabled the successful completion of this research work.

My profound appreciation goes to my supervisor, Mr. E. Okhuahesuyi, for his continuous guidance, constructive feedback, and encouragement during the course of this study. Despite his demanding schedule, he devoted time to review my work, provide valuable insights, and offer meaningful corrections. His support was instrumental to the successful completion of this dissertation.

I wish to express my sincere appreciation to the Ag. Head of Department, Dr. (Mrs.) C. Obaseki, the pioneer Head of Department, Prof. Kayode Oke, and all academic staff of the Department of Physiotherapy, University of Benin — including Rev. Sister Henrietta Fawole, Dr. (Mrs.) S. Kubeyinje, Dr. Hammed Adebisi, Dr. Nicholas Oghumu, Prof. Joseph Umunnah, Prof. Obinna Ezeukwu and Dr. Nelson Ezekwu for their dedication to teaching, mentorship, and academic excellence.

My gratitude also goes to Mr. Taiwo Oyewumi (Head of Department, Physiotherapy, University of Benin Teaching Hospital), as well as the directors, clinicians, and non-academic staff of the Department of Physiotherapy, University of Benin Teaching Hospital, for their invaluable contributions to my learning and professional growth.

I remain eternally thankful to my parents, Mr. and Mrs. Eguakhide, my brothers Mr. Thompson Eguakhide, Mr. Victor Ileabumah and Mr. Kingsley Ileabumah, my sister, Miss Faith Ileabumah**,** my sisters-in-law Mrs Blessing and Mrs Mercy and my mentor, Mrs. Bimpe Bamgbose-Martins (S.M.I.L.E) for their unwavering prayers, encouragement, moral support, and financial assistance throughout the period of this study.

I wish to express my sincere appreciation to my dearest friend, Desmond, for his unwavering support and willingness to assist me even during inconvenient times. I am also grateful to my besties, Tobe and Tutu, as well as my MIT and my shawty, for their companionship, encouragement, and for contributing to a memorable academic journey. I also acknowledge others whose names the confines of this page will not permit me to mention.

I sincerely appreciate PT Kay and Waka Physio for always responding to my questions and for making this research easy for me and all the students who voluntarily participated in this study. Their cooperation and contribution were vital to the success of this research.

Lastly, I acknowledge myself for staying resilient — for pushing through every challenge and never giving up, even when it felt overwhelming. This milestone is a testament that hard work and perseverance truly pays off.

TABLE OF CONTENTS

Title Page i

Certification ii

Dedication iii

Abstract iv

Acknowledgement v

Table of Contents vii

List of Tables xi

List of Figures xii

CHAPTER ONE:12INTRODUCTION 2

1.1 Background of the Study 2
1.2 Statement of the Problem 4
1.2.1 Research Questions 6
1.3 Aim of the Study 7
1.3.1 Specific Objectives 7
1.4 Hypotheses 7
1.4.1 Main Hypothesis 7
1.4.2 Sub-hypotheses 8
1.5 Significance of Study 9
1.6 Scope and Delimitation of the Study 10
1.7 Definition of terms 11
1.8 List of Abbreviations 11

CHAPTER TWO: LITERATURE REVIEW 12

2.1 Stroke 12
2.1.1 Definition 12
2.1.2 Epidemiology 12

2.1.3 Pathophysiology 14
2.1.4 Risk Factors 15
2.1.5 Modifiable Risk Factors 15
2.1.6 Non-Modifiable Risk Factors 17
2.2 Relevant Anatomy 19
2.2.1 The Brain 19
2.2.2 Parts of the Brain 19
2.2.3 Arterial Blood Supply of the Brain 21
2.2.4 Circle of Willis 26
2.3 Types of Stroke 28
2.3.1 Ischemic Stroke 29
2.3.2 Hemorrhagic Stroke 30
2.4 Aetiology of Stroke 31
2.5 Clinical Presentations of Stroke 31
2.6 Diagnosis of Stroke 32
2.6.1 Physical Examination 32
2.6.2 Neuroimaging Examination 33
2.6.3 Laboratory Investigation 33
2.7 Stroke Management 34
2.7.1 Surgical Management 34
2.7.2 Conservative Management of Stroke 35
2.8 Stroke Recovery 37
2.8.1 Brunnstrom Stage of Motor Recovery 38
2.9 Outcome Measures of Stroke Rehabilitation 38
2.10 Prognosis of Stroke 39
2.11 Stroke Prevention 40
2.12 Complications of Stroke 40
2.13 Empirical Review of Literature 41
CHAPTER THREE: METHODS 50

3.1 Participants 50
3.1 Selection Criteria 50
3.1.1 Inclusion Criteria 50

3.1.2 Exclusion Criteria 50
3.2 Materials 51
3.2.1 List of Instruments 51
3.2.2 Description of Instrument 51
3.3 Methods 53
3.3.1 Research Design 53
3.3.2 Sampling Technique/Sample Size Calculation 53
3.3.4 Procedure for Data Collection 54
3.3.5 Ethical Considerations 54
3.3.6 Analysis of Data 55
CHAPTER FOUR: RESULTS 56
4.1 Preamble 56
4.1.1 Sociodemographic characteristics of the respondents 56
4.1.2 Knowledge of stroke among the respondents 58
4.1.3 Level of stroke-related knowledge among the respondents 65
4.1.4 Association between gender and level of stroke-related knowledge among the respondents 67
4.1.5 Association between department and level of stroke-related knowledge among the respondents 69
4.1.6 Association between level of study and level of stroke-related knowledge among the respondents 70
4.2 Hypothesis Testing 71
CHAPTER FIVE DISCUSSION, CONCLUSION AND RECOMMENDATIONS 76
5.1 Discussion of Findings 76
5.1.1 General Knowledge of Stroke 76
5.1.2 Knowledge of Causes and Risk Factors of Stroke 77
5.1.3 Knowledge of Stroke Warning Signs 77
5.1.4 Planned Response to Stroke Events 78
5.1.5 Sources of Information on Stroke 78
5.1.6 Association between Demographic Variables and Knowledge 79
5.2 Conclusion 79
5.3 Recommendations 80
5.4 Implications for Public Health and Education 81

REFERENCES 82

APPENDICES 106

Ethical Approval 106
Informed Consent Form 108
Questionnaire 108

LIST OF TABLES

Table 4.1: Sociodemographic characteristics of the respondent…….58

Table 4.2: Knowledge of stroke among the respondents……60

Table 4.3: Level of stroke-related knowledge among the respondents……67

Table 4.4: Chi-square association between gender and level of stroke-related knowledge……...69

Table 4.5: Chi-square association between department and level of stroke-related knowledge……...……71

Table 4.6: Chi-square association between level of study and level of stroke-related knowledge…….....73

LIST OF FIGURES

Figure 1. Structures of the Midbrain……...20

Figure 2. Internal carotid artery with its divisions and course…….23

Figure 3. Vertebral artery parts and its course…….25

Figure 4. The Circle of Willis…….....27

Figure 4.1: Frequency distribution of perceived causes of stroke among respondents…….....61

Figure 4.2: Frequency distribution of perceived risk factors of stroke among respondents……..62

Figure 4.3: Frequency distribution of perceived warning signs of stroke among respondents……..63

Figure 4.4: Frequency distribution of the respondents' planned response to a stroke event……64

Figure 4.5: Frequency distribution of stroke information source among the respondents…….65

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Stroke remains a major global health concern and is one of the leading causes of death and long-term disability worldwide (Feigin et al., 2022). Despite significant advances in medical technology and healthcare systems, the incidence of stroke continues to increase, especially in Low and Middle-Income Countries (LMIC). This rising burden is worsened by a lack of awareness and delayed recognition of stroke warning signs, particularly among younger populations, including university students.University students are at a critical life stage where lifelong health behaviors form. This demographic is particularly important not just because they may engage in risky health behaviors, but also because many of them will evolve into future healthcare providers, educators, and policy influencers. However, a growing body of evidence suggests that awareness of stroke—its risk factors, symptoms, and appropriate emergency responses—is insufficient among this group.

Stroke is defined as the sudden onset of neurological impairment due to either a blockage (ischemia) or rupture (hemorrhage) of blood vessels in the brain (Murphy & Werring, 2020), is the second most common cause of death globally and ranks third in terms of combined mortality and disability impact (Feigin et al., 2022). The Global Burden of Disease (GBD) Study 2019 reported approximately 12.2 million new stroke cases worldwide in that year alone, resulting in 143 million disability-adjusted life years (DALYs) and around 6.6 million deaths (GBD 2019 Stroke Collaborators, 2021). These figures reflect the immense global health implications of stroke, with an estimated 12

million people affected annually, including nearly 795,000 in the United States (World Stroke Organization et al., 2025).

Strokes are broadly classified into ischemic (about 87% of cases), which result from reduced blood flow to the brain, and hemorrhagic (around 13%), which occur due to bleeding in or around the brain (Hinkle & Cheever, 2018). Multiple modifiable risk factors have been identified, including hypertension, diabetes mellitus, dyslipidemia, smoking, physical inactivity, obesity, and heart conditions like atrial fibrillation. Of these, hypertension alone accounts for about 37% of stroke-related deaths globally (Patil et al., 2021), highlighting the importance of effective preventive strategies.

Unfortunately, unhealthy habits such as smoking, poor dietary patterns, and sedentary lifestyles—common among university students—place them at increased risk (Pengpid & Peltzer, 2015). Yet, studies indicate that many students lack critical knowledge about stroke. For instance, a study involving undergraduate students from Abubakar Tafawa Balewa University (ATBU) Bauchi, Federal University Kashere (FUK) Gombe, and Federal College of Education Yola (FCEY) Adamawa found that only 13.2% had adequate knowledge of stroke, with a majority unaware that the brain is the primary organ affected (Alkali et al., 2022). Similarly, while many students in this study recognized stress and hypertension as risk factors, none identified smoking as a contributor (Kaddumukasa et al., 2015). In Saudi Arabia, although 83% of university students acknowledged hypertension as a stroke risk factor, only a third recognized muscle weakness as a symptom, and fewer than a quarter recognized speech disturbances (Khalafalla et al., 2022).

The deficiency in stroke awareness is not limited to a particular region; it spans both urban and rural settings. Delays in seeking medical help often stem from an inability to recognize stroke signs, leading to increased mortality and disability (Jiang et al., 2016; Lachkhem et al., 2018). Early detection and prompt intervention are therefore critical in improving outcomes.

Given these realities, this study focused on assessing the knowledge of stroke among clinical undergraduate students of the School of Basic Medical Sciences (SBMS) at the University of Benin. Understanding and addressing this gap through enhanced awareness initiatives and curriculum integration could play a transformative role in stroke prevention and management, potentially saving lives and reducing the disease burden in future generation.

1.2 Statement of the Problem

Stroke remains a critical global public health concern, consistently ranking as the second leading cause of mortality and the third leading cause of disability worldwide. In 2021 alone, stroke accounted for approximately 12 million new cases, over 7 million deaths, and more than 160 million Disability-Adjusted Life Years (DALYS) lost globally (Feigin et al., 2022). The burden is especially profound in Low- and Middle-Income Countries (LMICS), which contribute an estimated 87% of global stroke-related deaths and 89% of total DALYs. These figures highlight the urgent need for improved preventive, acute care, and rehabilitative strategies in such settings.

In Nigeria—an LMIC—factors such as insufficient public awareness, under-resourced healthcare infrastructure, and the effects of rapid urbanization have compounded the rising incidence and poor outcomes associated with stroke (Adeloye et al., 2019; Akinyemi et al., 2021). Although stroke has long been regarded as a disease of older adults, emerging data suggest a disturbing rise in incidence among younger populations, including university students largely attributed to the increasing prevalence of modifiable risk factors such as hypertension, sedentary behavior, obesity, smoking, alcohol consumption, and substance use (Marwat et al., 2017; Hachinski, 2015; Li et al., 2020).

A particularly troubling issue in this context is the widespread lack of knowledge of stroke among young adults, especially university students. Many are unable to identify common symptoms, understand risk factors, or recognize the urgency of prompt medical intervention—leading to dangerous delays in treatment and increased risk of disability or death (Jiang et al., 2016; Lachkhem et al., 2018). This knowledge gap is further exacerbated by low health literacy, persistent misconceptions, and the absence of tailored health education campaigns targeting younger audiences (Saengsuwan et al., 2017; Alkali et al., 2016).

While the national universities commission mandates the inclusion of general health education courses in Nigerian tertiary institutions—covering hypertension, lifestyle diseases, and nutrition—the effectiveness of these curricula in enhancing practical stroke awareness and preparedness remains questionable (National Universities Commission, 2014). Available evidence indicates that students often complete these courses without

gaining adequate knowledge or developing the confidence to take appropriate action during stroke emergencies (Alkali et al., 2016).

To the best of the researcher's knowledge, no published studies have specifically assessed the level of stroke-related knowledge of stroke among clinical undergraduate students of SBMS, University of Benin. This presents a significant knowledge gap, given the university's large and diverse student population. The current study therefore aims to address this gap by evaluating stroke awareness among students at UNIBEN. The findings are expected to inform the development of more effective, evidence-based educational interventions, strengthen stroke prevention strategies, and contribute to improve curriculum planning within tertiary institutions.

1.2.1 Research Questions

i. What will be the level of knowledge about stroke among clinical undergraduate students in the School of Basic Medical Sciences at the University of Benin?
ii. Will there be significant differences in stroke-related knowledge between male and female SBMS clinical undergraduates at the University of Benin?
iii. To what extent will SBMS clinical undergraduates at the University of Benin identify major stroke risk factors such as hypertension, smoking, and diabetes?
iv. To what extent will SBMS clinical undergraduates recognize common warning signs of stroke, such as sudden numbness, confusion, or speech difficulty?
v. Are there significant differences in stroke-related knowledge across different academic levels among SBMS clinical undergraduates?

1.3 Aim of the Study

This study aims to assess the knowledge of stroke among clinical undergraduate students in the School of Basic Medical Sciences (SBMS) at the University of Benin.

1.3.1 Specific Objectives

i. To assess the level of knowledge about stroke among SBMS clinical undergraduates at the University of Benin.
ii. To compare stroke-related knowledge between male and female SBMS clinical undergraduates.
iii. To examine variation in stroke-related knowledge different academic levels among SBMS clinical undergraduates.
iv. To assess the ability of SBMS clinical undergraduates to identify common stroke risk factors (e.g., hypertension, smoking, and diabetes) and warning signs (e.g., numbness, confusion, speech difficulty).

1.4 Hypotheses

1.4.1 Main Hypothesis

There would be no significant difference in stroke-related knowledge between male and female undergraduate students in the School of Basic Medical Sciences at the University of Benin.

1.4.2 Sub-hypotheses

i. There is no significant difference between male and female SBMS clinical undergraduates in identifying common causes of stroke.

ii. There is no significant difference between male and female SBMS clinical undergraduates in identifying common risk factors of stroke.

iii. There is no significant difference between male and female SBMS clinical undergraduates in identifying common warning signs of stroke.

iv. There would be no significant difference between male and female SBMS clinical undergraduates in appropriate planned response to a stroke event.

v. There is no significant difference across departments of SBMS clinical undergraduates in identifying common causes of stroke.

vi. There is no significant difference across departments of SBMS clinical undergraduates in identifying common warning signs of stroke.

vii. There is no significant difference across departments of SBMS clinical undergraduates in identifying common warning signs of stroke.

viii. There is no significant difference across departments of SBMS clinical undergraduates in appropriate planned response to a stroke event.

ix. There is no significant difference across study levels of SBMS clinical undergraduates in identifying common causes of stroke.

x. There would be no significant difference across study levels of SBMS clinical undergraduates in identifying common risk factors of stroke.

xi. There is no significant difference across study levels of SBMS clinical undergraduates in identifying common warning signs of stroke.

xii. There is no significant difference across study levels of SBMS clinical undergraduates in appropriate planned response to a stroke event.

1.5 Significance of Study

Stroke is a leading cause of death and long-term disability globally, with an increasingly heavy burden in low- and middle-income countries like Nigeria. This study is significant for several reasons:

- **Public health relevance:** By assessing the knowledge of stroke among clinical undergraduates in the School of Basic Medical Sciences (SBMS) at the University of Benin, the study highlights the preparedness of future health professionals to recognize, prevent, and respond to stroke events. These students are expected to serve as frontline advocates for community health education in the future.
- **Early detection and prevention**: Identifying knowledge gaps and misconceptions about stroke among students will inform targeted interventions and stroke awareness campaigns that promote early recognition of symptoms and lifestyle modification to reduce risk.
- **Academic and curriculum development**: Findings may provide feedback to curriculum designers on the strengths and weaknesses of current health education could enhance course content to ensure better student competence in real-world health emergencies.
- **Evidence for policy and advocacy**: The results will contribute empirical data for university management, public health authorities, and NGOs to develop stroke education policies tailored to youth and tertiary institutions.

- **Research gap filling**: It will contribute to the sparse literature on stroke awareness among Nigerian university students, providing a benchmark for similar research in other institutions.

1.6 Scope and Delimitation of the Study

This study focused specifically on undergraduate students in the clinical department of the School of Basic Medical Sciences (SBMS) at the University of Benin. It was limited to students from the 300 to 500 levels across departments within the division. The departments include Medical Laboratory Science, Nursing, Physiotherapy, and Radiography.

The core construct assessed in this study includes:

- Knowledge of stroke (causes, risk factors, warning signs, emergency response).

The research further compared these constructs between sexes (male and female) and across academic levels (from 300 to 500 levels). It also evaluated students' ability to identify major stroke risk factors and early warning signs.

Delimitations of the study

- The study was limited to students in the clinical department of the School of Basic Medical Sciences
- Postgraduate students were excluded, as the focus is on undergraduate awareness, particularly those still undergoing health-related / clinical training.
- The study did not assess clinical competence or diagnostic ability but rather focuses on general stroke-related knowledge.

- Data was collected using a self-administered structured questionnaire, which relied on self-reported responses. This may introduce bias due to social desirability or misinterpretation of questions.
- The cross-sectional nature of the study did not permit causal inferences but rather provided a snapshot of stroke-related awareness at a single point in time.

1.7 Definition of terms

i. **Knowledge:** knowledge is the fact or condition of knowing something with familiarity gained through experience or association. (Merriam-Webster Dictionary (2025)

ii. **Stroke:** A clinical syndrome characterized by rapidly developing clinical signs of focal (or global) disturbance of cerebral function, with symptoms lasting more than 24 hours or leading to death, with no apparent cause other than that of vascular origin. (World Health Organization)

1.8 List of Abbreviations

i. DALY: Disability-Adjusted Life Years

ii. WHO: World Health Organization

iii. SBMS: School of Basic Medical Sciences

iv. GBD: Global Burden of Disease

v. LMICS: Low- And Middle-Income Countries.

CHAPTER TWO

LITERATURE REVIEW

2.1 Stroke

2.1.1 Definition

Over the past few decades, the World Health Organization (WHO) defined stroke as the rapid onset of clinical symptoms caused by a localized (or generalized) disruption in brain function that lasts for more than 24 hours or leads to death, with no other clear explanation except for a vascular origin (World Health Organization, 1970), a definition that remains widely accepted. However, the American Heart Association/American Stroke Association has since labelled this definition as outdated, arguing that it only considers the clinical symptoms of stroke and fails to incorporate significant advances in the understanding of stroke's nature, timing, clinical recognition, its mimics, and imaging findings, which require a more current definition (Coupland *et al*., 2017). The American Heart Association/American Stroke Association now defines stroke as the objective evidence of irreversible brain, spinal cord, or retinal cell death from a vascular source, supported by pathological, imaging, or clinical findings, with or without neurological symptoms (Sacco *et al*., 2013).

2.1.2 Epidemiology

Globally, more than 15 million people are estimated to suffer a stroke each year, with 5 million fatalities and another 5 million experiencing permanent disability, placing significant burdens on caregivers (Grysiewicz *et al*., 2008). Studies have shown that in

2005, 87% of stroke-related deaths occurred in low- and middle-income countries. Without effective interventions, it is expected that by 2030, there will be about 23 million new stroke cases, with 7.8 million deaths (Strong *et al*., 2007; Mukherjee and Patil, 2011). As the global population of individuals over 65 years continues to grow by approximately 9 million annually, the prevalence of stroke, which is often associated with aging, is anticipated to rise significantly (Mukherjee and Patil, 2011). Africa faces the highest burden of hypertension, the most common modifiable stroke risk factor (Owolabi *et al*., 2018). While stroke was once considered rare among black Africans, it has become more prevalent, now accounting for 4-9% of deaths and 6.5-41% of hospital admissions across the continent (Osuntokun, 1994). In 2009, Adeloye (2014) reported over 483,000 new stroke cases in Africa, with an annual incidence of 81.2/100,000 for those aged 15 years and older, 305,000 cases in men, and over 178,000 in women.

Limited research has been conducted on stroke epidemiology in Nigeria. A study by Enwereji et al. (2014) found a stroke prevalence of 1.63 per 1,000 population in 2011, with higher rates in men (1.99 per 1,000) compared to women (1.28 per 1,000). In a study by Adeloye et al. (2019), the annual incidence of stroke in Nigeria was 26.0/100,000, with a higher rate in men (34.1/100,000) than women (21.2/100,000). The prevalence of stroke survivors was highest in the South-South region (13.4/100,000) and among rural populations (10.8/100,000). Danesi et al. (2007) conducted a study in Lagos with 13,127 participants, diagnosing stroke in 15 individuals, resulting in a prevalence rate of 1.14/1,000, with higher prevalence in men (1.15/1,000) compared to women (0.69/1,000). In a study in the Niger Delta with 2,028 participants, 27 individuals were diagnosed with stroke, yielding a prevalence rate of 13.31/1,000 (Ezejimofor et al., 2017).

2.1.3 Pathophysiology

Stroke also referred to as a cerebrovascular accident (CVA), occurs when there is a disruption to the flow of blood to the brain, leading to permanent neurological damage. Strokes are broadly categorized into two types: **ischemic stroke**, which results from an insufficient supply of oxygen and blood to a specific brain region, and **hemorrhagic stroke**, triggered by bleeding due to a leaking/ruptured blood vessel in the brain.

CVA involves a disruption in the brain's vascular supply, typically due to a blocked blood vessel. This blockage can be caused by an embolus that has travelled from another part of the body or by a thrombus formed due to atherosclerosis within the vessel walls. The reduction in blood flow leads to decreased cerebral perfusion, and when cerebral blood flow drops below 10 ml/100g/min, irreversible neuronal damage occurs, resulting in significant functional impairment (Mir et al., 2014).

i. **Haemorrhagic Stroke**: Marked by the rupture of blood vessels, leading to increased intracranial pressure and a subsequent drop in cerebral perfusion pressure. This results in reduced oxygen and ATP levels within cells, ultimately causing cerebral ischemia (Mir et al., 2014).

ii. **Ischemic Stroke**: Resulting from the obstruction or blockage of blood vessels, either by emboli that travel from distant sites or by locally formed thrombi, primarily due to atherosclerosis. This decreases cerebral blood flow to below 10 mL/100 g/min, causing irreversible neuronal damage, as noted by Mir et al. (2014). Additionally, cerebral perfusion pressure declines, leading to reduced oxygen and ATP levels within cells, ultimately causing cerebral ischemia

According to Broughton et al. (2009), both haemorrhagic and ischemic strokes trigger a cascade of damaging processes, including organelle swelling, plasma membrane disruption, and leakage of cellular components into the extracellular space. These pathological changes result in irreversible neuronal damage through mechanisms such as oxidative and nitrosative stress, calcium overload, acidosis, ionic imbalance, excitotoxicity, and the activation of inflammatory pathways, ultimately leading to apoptotic or necrotic cell death in brain tissue (Kuriakose & Xiao, 2020).

The ischemic penumbra, a region of viable but functionally impaired neurons surrounding the infarcted core, suffers from reduced blood flow due to inadequate collateral circulation. Without timely intervention, gradual cell death within the penumbra enlarges the necrotic core, emphasizing the need for therapeutic strategies aimed at restoring blood flow to salvage at-risk tissue (Mir et al., 2014).

The effects of stroke extend beyond neuronal injury, leading to sensory, motor, and cognitive impairments that significantly affect daily functioning, self-care, and social participation, as highlighted by Mayo et al. (1999).

2.1.4 Risk Factors

2.1.5 Modifiable Risk Factors

These are factors that can be managed or avoided to lower the risk of an individual experiencing a stroke.

i. **Hypertension**: Hypertension is the most significant modifiable risk factor for stroke, showing a strong and direct relationship between blood pressure levels and stroke risk (Wahab et al., 2017). Persistently high blood pressure exerts excessive

strain on cerebral blood vessels, often resulting in lacunar infarcts or intracerebral hemorrhage (Pandian et al., 2018). In Nigeria, hypertension remains the leading modifiable risk factor for stroke (Amu et al., 2005).

ii. **Smoking**: This is the leading modifiable risk factor for subarachnoid hemorrhage (Wahab et al., 2017). Nicotine and carbon monoxide in tobacco smoke lower oxygen levels in the bloodstream, contributing to vascular damage. While quitting smoking significantly reduces the elevated risk, it does not completely eliminate it (O'Neill et al., 2003). Smoking doubles the likelihood of stroke by promoting atherosclerosis and increasing blood coagulation factors (Bhat et al., 2008).

iii. **Obesity**: Excess body weight and obesity are linked to an increased risk of conditions like hypertension, diabetes, and stroke (Onabajo, 2016). Obesity is categorized as having a Body Mass Index (BMI) of 30 kg/m^2 or higher. In Nigeria, the prevalence of obesity is rapidly growing due to inadequate physical activity and poor dietary habits, further increasing the likelihood of stroke (Komolafe et al., 2015).

iv. **Diabetes Mellitus (DM)**: Diabetes mellitus (DM) doubles the risk of stroke compared to non-diabetic individuals, with one in five diabetic patients succumbing to stroke (Pikula et al., 2018; Olesen et al., 2019). Diabetic patients are prone to complications such as myocardial infarctions and peripheral vascular disease, which can ultimately contribute to stroke development (Omotosho et al., 2009).

v. **Physical Inactivity**: Leaving a sedentary lifestyle intensify the threat of developing hypertension, diabetes, obesity and cardiovascular diseases, all of

which contribute to stroke risk. Increasing physical activity may help lower the chances of stroke, particularly in older adults (Willey et al., 2017). A meta-analysis by Lee et al. (2003) found that engaging in moderate to high-intensity exercise is linked to a reduced risk of both ischemic and hemorrhagic stroke.

vi. **Hypercholesterolemia**: Cholesterol, a flexible waxy substance found in blood lipids and all body cells, plays a crucial role in building cell membranes, producing hormones, and supporting various bodily functions (O'Regan et al., 2008). While elevated serum cholesterol levels are strongly associated with increased mortality from ischemic stroke in Western countries (Peters et al., 2013), they do not appear to be a significant risk factor among Africans (Connor et al., 2005).

vii. **Excess Alcohol Consumption**: Although alcohol is acknowledged as a risk factor for stroke, its exact mechanism of influence remains unclear. Some studies propose that excessive alcohol intake activates the clotting cascade, elevates blood pressure, and reduces cerebral blood flow, thereby heightening the risk of thromboembolic stroke (Ifeanyi et al., 2020). Conversely, another perspective suggests that high to moderate alcohol consumption increases the likelihood of ischemic stroke, while low to moderate intake does not appear to significantly elevate stroke risk (Smyth et al., 2023).

2.1.6 Non-Modifiable Risk Factors

Non-modifiable risk factors are characteristics or conditions that an individual cannot change or control.

i. **Age**: The prevalence of stroke risk factors differs among age groups, likely due to the cumulative effects of age-related cardiovascular changes and coexisting health conditions. Stroke incidence approximately doubles every decade after the age of 55 (Lloyd-Jones et al., 2010; Yousufuddin & Young, 2019). Notably, all other stroke risk factors are influenced by age.

ii. **Race**: Significant differences exist in stroke incidence and mortality among racial groups, with Black individuals, particularly African Americans, experiencing higher rates compared to whites. The incidence among African Americans is nearly twice that of whites, which may be influenced by factors such as lower socioeconomic status, genetic predispositions, and a greater prevalence of specific risk factors (Bravata et al., 2015).

iii. **Genetics**: Although the role of genetics in stroke was once uncertain, recent studies suggest that genetic disorders can contribute to the development of individual stroke risk factors. Polygenic conditions may influence multiple bodily systems, leading to the presence of several risk factors and ultimately increasing the likelihood of stroke (Boehme et al., 2017).

iv. **Sex**: Stroke is generally more prevalent in males across all age groups. However, in younger individuals, women exhibit a slightly higher incidence, which may be influenced by hormonal changes during pregnancy, the postpartum period, and the effects of contraceptives (Boehme et al., 2017). After the age of 30, the risk becomes greater in men but equalizes in older age, possibly due to women's longer lifespan or the impact of postmenopause (Lisabeth & Bushnell, 2012; Rexrode et al., 2022).

2.2 Relevant Anatomy

2.2.1 The Brain

The brain is responsible for regulating and coordinating nearly all bodily functions. It is the organ that distinguishes humans from other animals. Despite being a delicate structure, it is safeguarded by a strong skull. However, it remains vulnerable to damage from severe injuries, tumor-induced compression, or oxygen deprivation caused by a rupture or blockage in a cerebral artery (Moore et al., 2017).

2.2.2 Parts of the Brain

The brain is composed of three major regions: the cerebrum, cerebellum, and brainstem.

I. **Cerebrum (Cerebral Hemisphere)**: The cerebrum consists of three poles, three surfaces, and four lobes.

II. **Brainstem**: The brainstem is an elongated structure located between the forebrain (comprising the cerebral hemispheres and diencephalon) and the spinal cord. It is divided into three sections: the midbrain, the pons, and the medulla oblongata (Bruni, 2009).

The midbrain is the shortest and most rostral part of the brainstem, measuring approximately 2 cm in length. It is positioned between the diencephalon above and the pons below, extending through the tentorial incisure. The midbrain also houses the nuclei of origin for cranial nerves III and IV (Bruni, 2009; Bhuiyan et al., 2014).

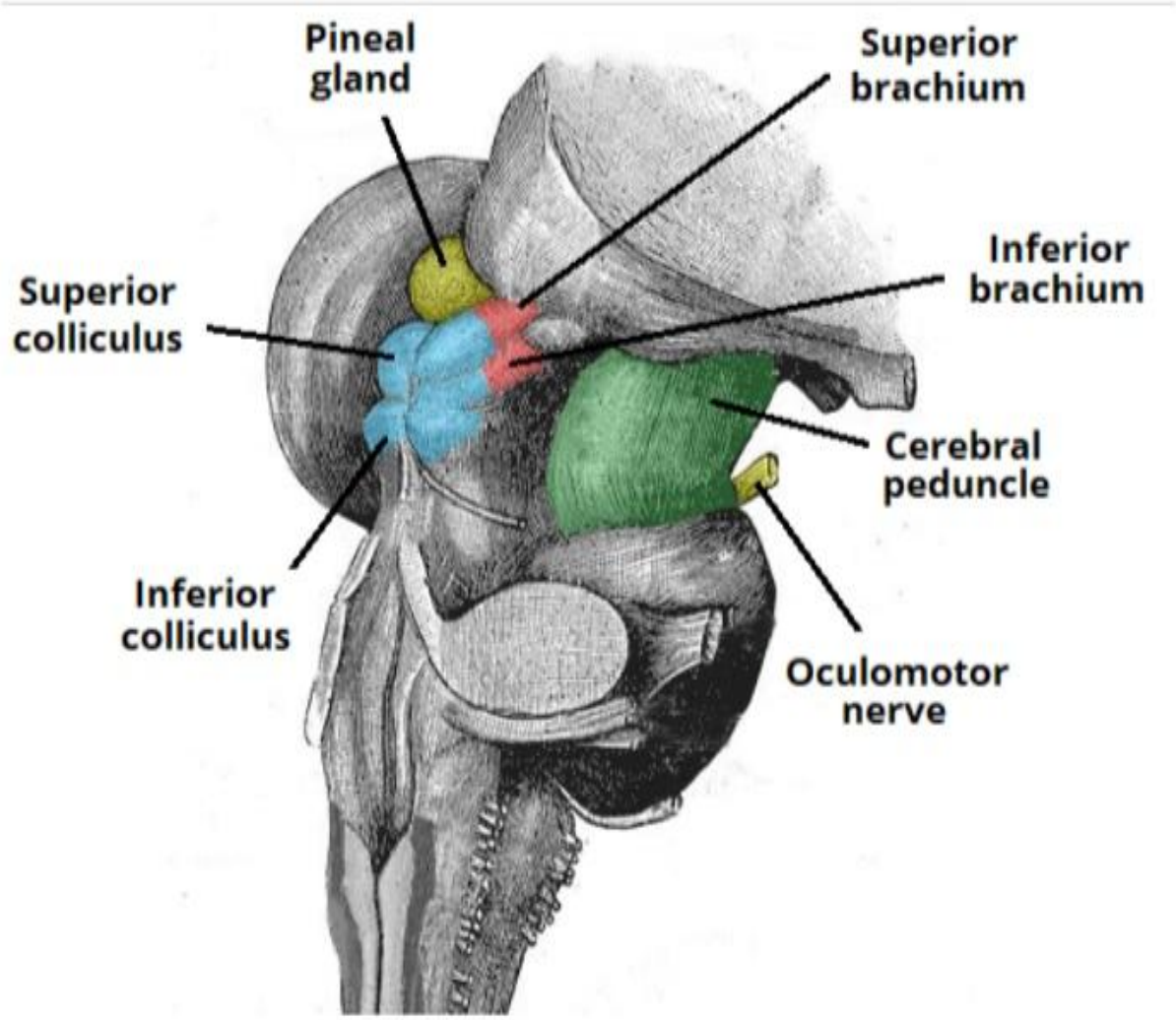

Figure 1. Structures of the Midbrain

Image source: https://teachmeanatomy.info/neuroanatomy/brainstem/midbrain.

III. **Cerebellum**: The cerebellum is a key brain structure responsible for regulating and coordinating voluntary motor activities. It fine-tunes muscle tone, helps maintain balance, and ensures that muscular actions are smooth, coordinated, and precise (Bruni, 2009). It consists of a central region called the vermis and two lateral hemispheres. The cerebellum has two surfaces: superior and inferior. The superior surface shows no clear separation between the vermis and the hemispheres, whereas the inferior surface has a deep depression, known as the vallecula, which divides the two hemispheres (Bhuiyan et al., 2014).

2.2.3 Arterial Blood Supply of the Brain

Although the human brain constitutes only about 2.5% of total body weight, it receives nearly one-sixth of the cardiac output and utilizes one-fifth of the body's oxygen consumption at rest (Moore et al., 2017). The brain's blood supply is entirely dependent on two sets of arteries originating from the dorsal aorta: the vertebral arteries and the internal carotid arteries, the latter being a branch of the common carotid artery (Purves et al., 2001).

A. **Internal Carotid Arteries**: The internal carotid arteries emerge as the terminal branches of the common carotid artery at the level of the C4 vertebra in the neck. Each artery ascends within the carotid sheath and enters the cranial cavity via the carotid canal and the upper portion of the

foramen lacerum (Bhuiyan et al., 2014). The internal carotid artery follows a path divided into four segments: cervical, petrous, cavernous, and cerebral. The cerebral portion gives rise to several branches, including the ophthalmic artery, anterior choroidal artery, posterior communicating artery, anterior cerebral artery, and middle cerebral artery (Bhuiyan et al., 2014).

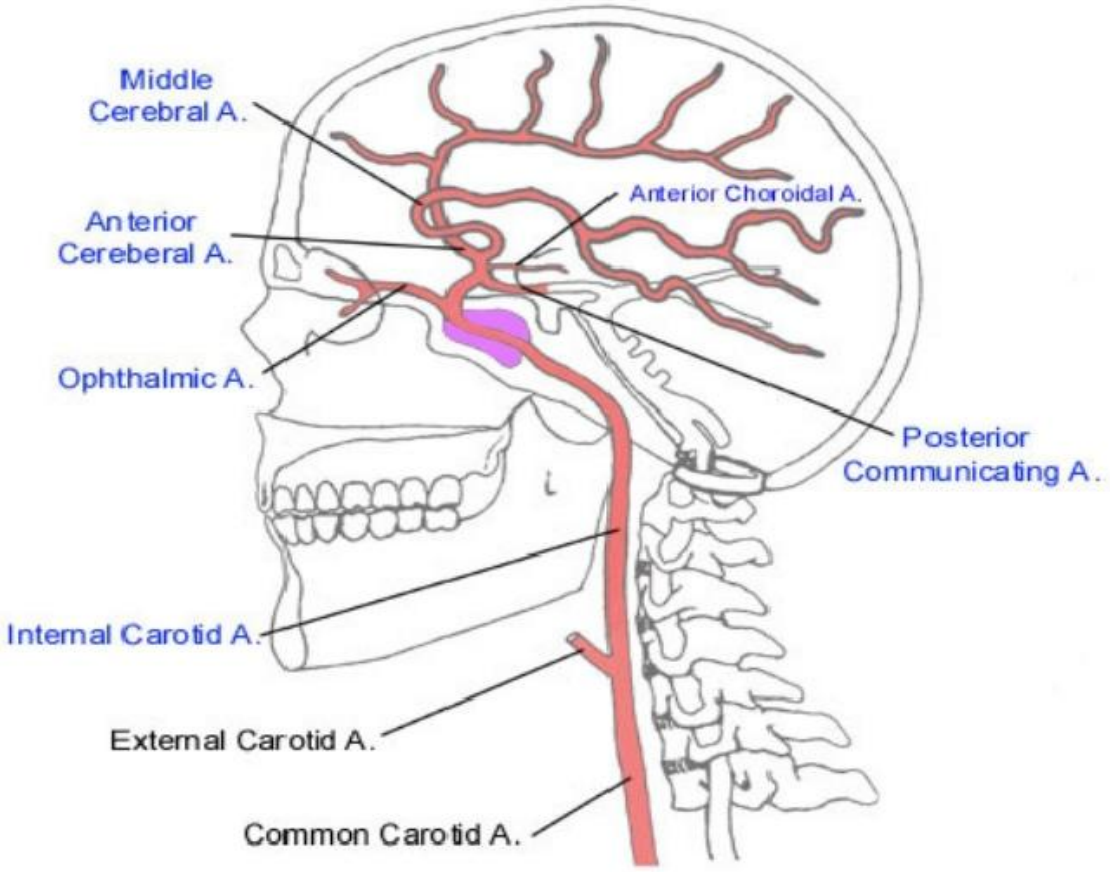

Figure 2. Internal carotid artery with its divisions and course Image source: https://www.meddean.luc.edu/lumen/meded/neuro/neurovasc/navigation/ica.htm

B. **Vertebrobasilar Arteries**: The vertebral arteries originate from the subclavian arteries at the root of the neck, specifically from their first branches (Moore et al., 2017). These arteries are often asymmetrical in size, with the left typically being larger than the right. Their course is divided into four segments: cervical, vertebral, suboccipital, and cerebral. The cerebral segment gives rise to several branches, including the anterior and posterior spinal arteries, the posterior inferior cerebellar artery, medullary branches, and meningeal branches.

The two vertebral arteries ascend and merge at the pontomedullary junction, forming the basilar artery. The basilar artery courses through the basilar sulcus of the pons and bifurcates at the pontomesencephalic junction into two posterior cerebral arteries. The branches of the internal carotid and vertebrobasilar arteries interconnect at the base of the brain, forming the arterial circle of Willis.

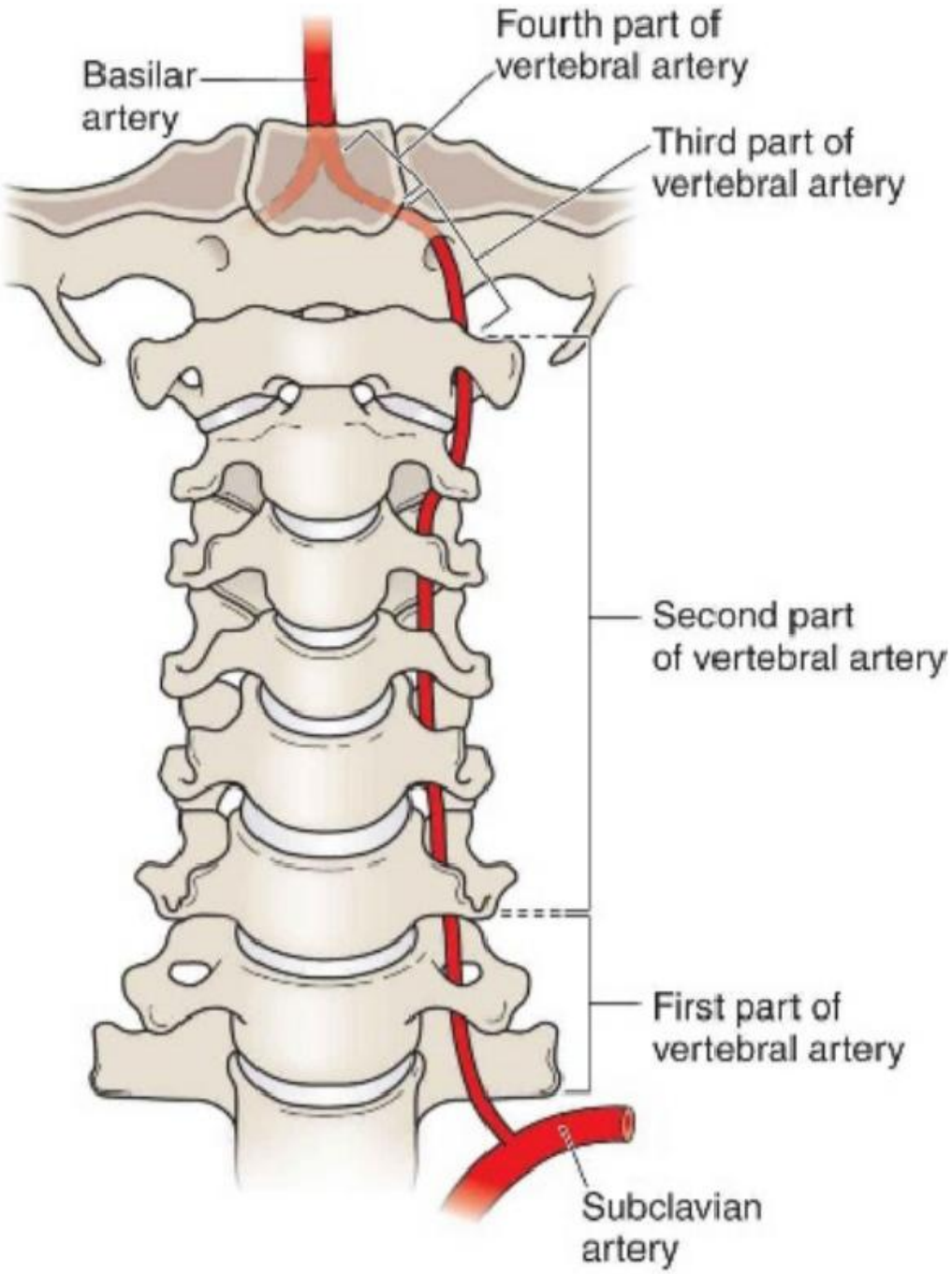

Figure 3. Vertebral artery parts and its course

Image source: https://musculoskeletalkey.com/vertebral-artery.

The two vertebral arteries ascend and unite at the pontomedullary junction to form the basilar artery. The basilar artery runs in the basilar sulcus of the pons and at the pontomesencephalic junction divides into two posterior cerebral arteries. The branches of internal carotid artery and the branches of vertebrobasilar artery anastomose in the base of the brain to form the arterial circle of Willis.

2.2.4 Circle of Willis

Four hundred years ago, Thomas Willis gave the detailed anatomic description of the arterial anastomosis at the base of the brain that is surrounded by cerebrospinal fluid, he called it the circle of Willis (CW) (Vrselja et al., 2014). It is closely related to the optic chiasma, tuber cinereum, mammillary bodies and posterior perforated substance (Bhuiyan et al., 2014). In the work done by Thomas Willis, he states that Circle of Willis functions as a compensatory mechanism in the case of occlusion or stenosis of internal carotid artery or vertebral artery. (Vrselja et al., 2014; Rosner et al., 2023).

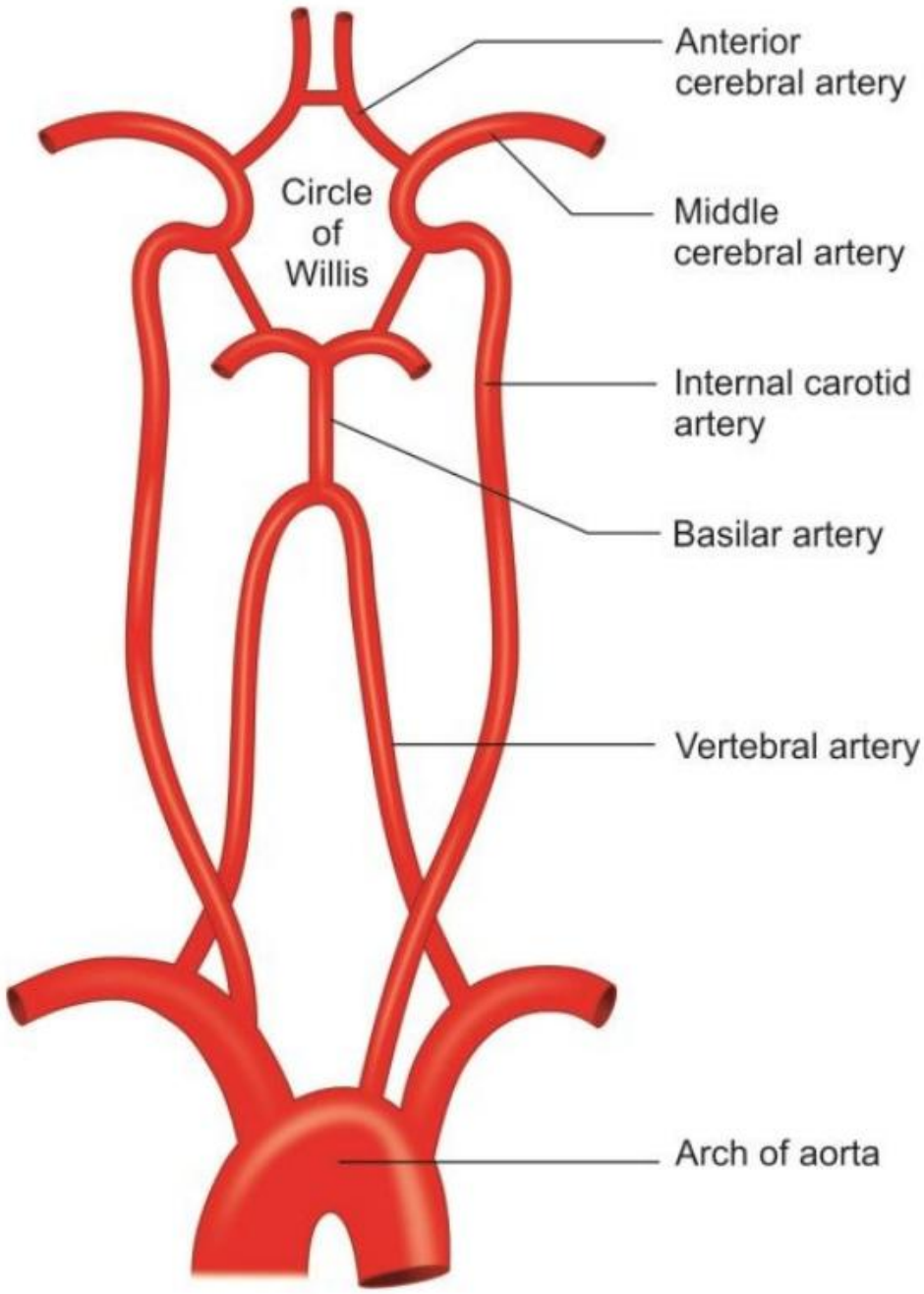

Figure 4. The Circle of Willis

Image source: Bhuiyan, Inderbir Singh's Textbook of Human Neuroanatomy. 9th Edition. Pg. 40.

In summary, the circle of Willis is formed by;

i. The anterior communicating artery, which connects the right and left anterior cerebral arteries, forms the anterior part of the circle of Willis.
ii. The anterior cerebral artery forms the anterolateral part on each side.
iii. The lateral part is formed by the termination of internal carotid artery on each side.
iv. The circle is completed posteriorly by the bifurcation of basilar artery into the right and left posterior cerebral arteries.
v. Posterolaterally, the posterior communicating artery is the connecting link between the internal carotid and the posterior cerebral artery (Bhuiyan et al., 2014). It should be noted that the middle cerebral artery does not take part in the formation of the circle of Willis (Bhuiyan et al., 2014).

2.3 Types of Stroke

There are two main types of stroke. These are ischemic and hemorrhagic stroke. Ischemic stroke happens to be the most common type of stroke with over 80% of stroke occurrence. While hemorrhagic stroke occupies less than 20% of stroke incidence (Grysiewicz et al., 2008). There is high mortality rate among patients with hemorrhagic stroke than ischemic stroke (Andersen et al., 2009). Henriksson et al. (2012) reported that, patients with hemorrhagic stroke had a higher risk of dying within the first 30 days after stroke

compared to patients with ischemic stroke. Also, in term of severity, stroke is more severe in patients with hemorrhagic stroke than ischemic stroke (Andersen et al., 2009).

2.3.1 Ischemic Stroke

Ischemic stroke, which is also known as cerebral infarction is most common type of stroke. It is characterized by hypoxia or reduced oxygenation to the brain tissues as a result of poor blood supply (Martin and Kessler, 2015). There are two types of ischemic stroke, they are, thrombolism and embolism ischemic stroke.

I. **Thrombolism**: A thrombolic stroke is a type of ischemic stroke that results from the formation of thrombus in the cerebral arteries. Atherosclerosis is the main cause of them. As plaque is accumulated within the arterial walls, it causes the lumen of artery to become narrow. As a result, there is a decreased blood flow through the vessel, which restricts the amount of oxygen that can reach the cerebral areas. The tissue supplied by the artery will die or suffer a cerebral infarction if the plaque fully blocks the vessel (Martin and Kessler, 2015).

II. **Embolism**: Embolic stroke occurs as a result of formation of thrombus at a distant or extracerebral arteries which are transported to the lumen of the cerebral arteries. The embolus may get stuck in a blood vessel in the brain, obstruct it, and then injure the brain tissue as a result. They are usually associated with cardiovascular diseases, specifically atrial fibrillation (Martin and Kessler, 2015).

2.3.2 Hemorrhagic Stroke

Hemorrhagic stroke (HS) also known as cerebral hemorrhage is characterized by abnormal bleeding on the brain tissues as a result of rupturing of cerebral arteries walls (Martin and Kessler, 2015). It comprises of approximately 20% of stroke incidence (Montaño et al., 2021). It is subdivided into two main types, this includes, intracerebral hemorrhage (ICH) and subarachnoid hemorrhage (SAH).

I. **Intracerebral hemorrhage (ICH)**: This happens to be the most common type of hemorrhagic stroke, accounts for over 10% of HS (Grysiewicz et al., 2008; Montaño et al., 2021). Incidence of intracerebral hemorrhage is low in those under age of 45 and rises beyond the age of 65. Arteriovenous malformation (AVM), alterations in the integrity of the blood vessels brought on by the effect of hypertension and aging, and ICH are frequently linked. (Martin and Kessler, 2015). A capillary bed is not present as arteries and veins join together directly in AVMs. Within the brain, blood vessels enlarge and group together to form masses. Due to this development, blood vessel walls become more vulnerable to rupture and result in hemorrhagic strokes. (Martin and Kessler, 2015).

II. **Subarachnoid hemorrhage (SAH)**: It accounts for less than 10% of HS (Grysiewicz et al., 2008). It occurs as a result of bleeding into the subarachnoid space. Subarachnoid space is a space between the subarachnoid matter and pia matter of the brain meninges. The most common cause of SAH is aneurysm which account for approximately

90% of the SAH. Aneurysms means the ballooning or outpouching of cerebral vascular walls, this tends to weaken the cerebral vessel walls and can lead to rupture, causing bleeding on the brain tissues. A vessel malformation can also lead to SAH (Martin and Kessler, 2015).

2.4 Aetiology of Stroke

Stroke is a multifactorial disease. Just like most neurological diseases, it is not attributed to a particular cause. There are various factors that contribute or increase the risk of stroke in individuals. These factors are divided into modifiable and non-modifiable risk factors. There are numbers of modifiable risk factors, but for the sake of this current study, some of them are; hypertension, alcohol consumption, diabetes, heart failure, obesity, cigarette smoking, and physical inactivity (O'Donnell et al., 2016, Guo et al., 2016, Hackshaw et al., 2018, Willey et al., 2017, Andersen and Olsen, 2015, Kim and Kim, 2018). The non-modifiable risk factors are, age, gender, race and family history of stroke (Choudhury et al., 2015). It has been reported that pregnancy, oral contraceptives, hormone replacement therapy and reduction in estrogen after menopause are risk factors to stroke unique to women (Mirzaei, 2017).

2.5 Clinical Presentations of Stroke

Clinical presentations of stroke refer to the signs and symptoms that occur due to an interruption in blood flow to the brain. The clinical presentations of stroke can vary depending on the type of stroke and the area of the brain affected (Johnston et al., 2018). Some of them include, weakness or numbness in the face, arm, or leg, difficulty speaking or understanding speech, vision problems, dizziness, loss of balance and coordination, severe headache, nausea, vomiting, weakness, seizures, loss of consciousness, dysarthria,

dysphagia, sensory deficit, cognitive impairment, hemineglect, thalamic pain syndrome, and pusher syndrome (Martin and Kessler, 2015; Johnston et al., 2018). It is important to recognize the clinical presentations of stroke as early intervention can help reduce the risk of permanent brain damage and disability.

The American Stroke Association recommends using the "FAST" acronym as a tool to help recognize the signs of stroke: F for Face drooping, A for Arm weakness, S for Speech difficulty, and T for Time to call emergency services. If any of these symptoms are present, it is important to seek immediate medical attention (American Stroke Association, 2022).

2.6 Diagnosis of Stroke

The diagnosis of stroke involves multidisciplinary approach which comprises of three major assessment procedures. They include, physical examination, neuroimaging examination and laboratory investigations. It is important to note that physical examination or laboratory testing alone is not sufficient for diagnosing stroke, therefore imaging studies are typically required to confirm the diagnosis. (National Institute of Neurological Disorder and Stroke.

2.6.1 Physical Examination

The physical examination is done to determine the history of the stroke and also to evaluate motor, sensory, speech, and reflex function. It begins with subjective assessment under which questions like What, Where, When and How is asked from the patient or a family member. The second part of the physical examination is the objective assessment, where the physiotherapist makes use of specific neurological assessment tools and tests to

reproduce or confirmed the information provided to him by the patient or his/her family member in the previous phase of the examination (subjective phase). Some of the neurological assessment tools or tests include, Modified Ashworth scale, Oxford muscle grading scale, reflex hammer, Mini mental status scale, Romberg test, hand to nose test, sensation examinations, functional independence measure etc. (Martin and Kessler, 2015).

2.6.2 Neuroimaging Examination

Neuroimaging is majorly carried out either with a computed tomography scan (CT) or a magnetic resonance imaging (MRI) scan to determine whether the stroke is the result of ischemic or hemorrhagic injury and the information from the result guides medical treatment. However, it has been reported that MRI is a much preferable scan to be done at the acute stage of stroke as it diagnoses an ischemic event within 2 to 6 hours after the initial onset (Martin and Kessler, 2015).

2.6.3 Laboratory Investigation

Laboratory tests can also help to confirm the diagnosis of stroke, rule out other possible causes, and guide treatment decisions. One of the most commonly used laboratory tests for stroke diagnosis is a complete blood count (CBC), which can help to identify anaemia, thrombocytopenia, and other blood disorders that may contribute to stroke. (Mehta, 1984). Another important test is a coagulation profile, which can help to identify abnormalities in blood clotting that may increase the risk of stroke or affect the patient's response to anticoagulant therapy (Watson et al., 2009). Blood glucose levels may also be checked, as hypoglycemia can cause symptoms that mimic stroke (Johnston et al., 2019). In addition, a lipid test may be performed to assess the patient's cholesterol levels, which can play a role in the development of atherosclerosis and stroke. (Naci et al., 2013).

2.7 Stroke Management

Management of stroke patients involves a multidisciplinary approach, and it comprises of two primary phases. This includes, the acute management phase and post stroke rehabilitation phase. The acute management phase is aimed to stabilize the patients after stroke onset so as to prevent further brain damage. While the post stoke rehabilitation phase is aimed to improve the lost functions of the patients after he/she has suffered stroke. In the acute phase, treatment is more effective when it is provided within 3hours of stroke onset. While for post rehabilitation phase, treatments yield a good outcome when it is provided within the first 3 – 6 months of stroke (Martin and Kessler, 2015).

Generally, stroke management is divided into two. These are, conservative management and surgical management. Conservative management are non-invasive treatments approach given to a stroke patient and they include, medical management, physiotherapy management, occupational therapy, speech therapy, psychological therapy. Surgical management involves the use of invasive procedures to treat stroke patients. Examples include, hemicraniectomy, decompressive craniectomy, vascular clipping, carotid endarterectomy (Martin and Kessler, 2015.

2.7.1 Surgical Management

I. Ischemic stroke: Some of the surgical procedures for ischemic stroke patients include; decompressive hemicraniectomy, carotid endarterectomy (Doberstein et al., 2017).

II. Hemorrhagic stroke: Some of the surgical procedures for hemorrhagic stroke include; open craniotomy, stereotaxic aspiration (Zuccarello et al., 1999).

2.7.2 Conservative Management of Stroke

I. **Medical Management**: Stroke treatment at the acute stage typically involves pharmacological interventions. For ischemic stroke, medications such as tissue plasminogen activator (tPA), heparin, warfarin, and aspirin are commonly administered (Goldstein, 2014). In cases of hemorrhagic stroke, drug therapy aims to alleviate excessive intracranial pressure caused by bleeding and to manage elevated blood pressure within the cerebral vessels. Medications used for this purpose include diuretics, beta-blockers, and angiotensin-converting enzyme inhibitors (Martin & Kessler, 2015).

II. **Physiotherapy Management**: The primary objective of rehabilitative physiotherapy in stroke patients is to minimize impairments and disabilities, thereby enhancing their ability to perform daily self-care activities independently (Dobkin & Dorsch, 2013). Several physiotherapy approaches exist for stroke rehabilitation, with the Bobath concept being one of the most widely employed methods (Paci, 2003). This approach is based on the principle that the central nervous system possesses neuroplasticity, allowing it to reorganize and compensate for lost cognitive and motor functions (Dobkin & Dorsch, 2013). However, studies indicate that the Bobath approach is not significantly superior to other rehabilitation techniques (Paci, 2003; Van Vliet et al., 2005). Common physiotherapy interventions for stroke management include:

i. **Strengthening Exercises**: Stroke often leads to muscle weakness and impaired motor control. Strength training is implemented to enhance mobility, strength, and overall functional ability, typically involving repetitive and progressive resistance exercises targeting affected muscle groups (Dobkin & Dorsch, 2013).

ii. **Proprioceptive Neuromuscular Facilitation (PNF)**: This method is employed to enhance motor coordination, range of motion, and functional performance by incorporating diagonal movement patterns, resistance, and stretching techniques (Dobkin & Dorsch, 2013).

iii. **Functional Electrical Stimulation (FES)**: Electrical stimulation is used to activate muscles, assist in movement, improve walking patterns, and enhance upper limb function in stroke patients (Dobkin & Dorsch, 2013).

iv. **Balance and Coordination Training**: Since stroke often affects balance and postural control, training programs focus on exercises that address these deficits, including weight shifting, standing balance, and dynamic stability (Dobkin & Dorsch, 2013).

v. **Constraint-Induced Movement Therapy (CIMT)**: This approach encourages functional use of the affected limb by restricting movement of the unaffected limb, thereby promoting neural adaptation and motor recovery (Dobkin & Dorsch, 2013).

vi. **Sustained Passive Stretching (SPS)**: Spasticity and contractures following stroke limit joint mobility. SPS involves prolonged stretching to improve muscle length, joint range of motion, and functional outcomes (Dobkin & Dorsch, 2013).

vii. **Mirror Therapy**: This technique utilizes a mirror to create the illusion of movement in the affected limb, stimulating mirror neurons and facilitating neuroplasticity (Dobkin & Dorsch, 2013).

viii. **Body Weight-Supported Treadmill Training (BWSTT)**: This method assists stroke patients with walking difficulties by supporting a portion of their body weight while they practice gait on a treadmill, allowing safe and controlled movement training (Werner et al., 2022).

ix. **Transcranial Direct Current Stimulation (tDCS)**: Low-intensity electrical currents are applied to the scalp to modulate brain activity, enhance neuroplasticity, and facilitate motor recovery (Hummel et al., 2005).

x. **Virtual Reality (VR)**: VR-based rehabilitation utilizes interactive computer-generated environments to promote motor learning, sensory feedback, and cognitive engagement in stroke patients (Dobkin & Dorsch, 2013).

2.8 Stroke Recovery

Many stroke survivors experience long-term neurological impairments that prevent them from returning to their pre-stroke functional status (Martin & Kessler, 2015). The most significant recovery occurs within the first 3–6 months, though goal-directed rehabilitation can lead to improvements for up to 2–3 years post-stroke (Cumming et al., 2011). Statistics indicate that within a year following a stroke, 10% of patients fully recover, 25% experience mild impairments, 40% sustain moderate to severe impairments, 10% require institutional care, and 15% die shortly after the event (National Stroke Association, 2014).

Recovery from stroke is driven by a process known as neuroplasticity, in which surviving neurons reorganize to compensate for lost functions by forming new neural connections (Murphy & Corbett, 2009). Rehabilitation plays a crucial role in enhancing this process,

leading to improvements in sensory, motor, and cognitive abilities (Murphy & Corbett, 2009).

2.8.1 Brunnstrom Stage of Motor Recovery

Motor recovery typically follows a pattern described by the Brunnstrom Stages of Recovery.

Stage 1: Complete flaccidity (absence of movement).

Stage 2: Emergence of spasticity.

Stage 3: Peak spasticity, with voluntary movement limited to synergistic patterns.

Stage 4: Reduction of spasticity, enabling movement outside of synergy patterns.

Stage 5: Further decline in spasticity, with greater voluntary control.

Stage 6: Disappearance of spasticity, allowing isolated and combined movements.

Stage 7: Full restoration of normal motor function (Martin & Kessler, 2015).

Although all patients typically progress through these stages, the speed of recovery varies. Some may advance rapidly, while others plateau at a certain stage, preventing full recovery (Martin & Kessler, 2015).

2.9 Outcome Measures of Stroke Rehabilitation

Outcome measures are essential for assessing treatment efficacy, tracking patient progress, and guiding rehabilitation. Two commonly used measures are:

I. **Functional Independence Measure (FIM)**: This tool evaluates a stroke patient's ability to perform activities of daily living (ADLs). It consists of 18

items divided into motor (13 items) and cognitive (5 items) domains, scored on a scale of 1 (completely dependent) to 7 (fully independent), with a maximum total score of 126. Scores below 60 indicate dependence, while scores above 76 signify full independence (Dodds, 1993; Hoyer et al., 2013).

II. **Barthel Index (BI)**: This scale measures independence in ADLs, assessing ten functional activities, such as mobility, toileting, and stair climbing. Scores range from 0 (total dependency) to 100 (complete independence) (Mahony & Barthel, 1965).

2.10 Prognosis of Stroke

Stroke prognosis refers to the likelihood of recovery, which is influenced by several factors including:

I. **Age**: Older stroke survivors often experience greater disability (Alawieh et al., 2018).

II. **Gender**: Women are more likely than men to remain functionally impaired post-stroke (Weimar et al., 2002; Alawieh et al., 2018).

III. **Diabetes**: Elevated blood sugar levels are associated with poorer outcomes (Ogunrin & Ogundare, 2017).

IV. **Stroke Type:** Although hemorrhagic strokes cause greater initial impairment, they often show faster recovery than ischemic strokes (Alawieh et al., 2018).

V. **Severity of Injury**: The extent of brain damage determines the potential for functional recovery (Alawieh et al., 2018).

VI. **Previous Stroke:** Recurrent strokes generally result in worse outcomes (Weimar et al., 2002).

VII. **Post-Stroke Depression:** Depression negatively affects recovery (Carson et al., 2000).

VIII. **Comorbidities:** Additional health conditions can impede rehabilitation progress (Alawieh et al., 2018).

2.11 Stroke Prevention

Preventive strategies include lifestyle modifications, antiplatelet and anticoagulant therapy, lipid management, and carotid interventions (Martínez-González et al., 2010; Rerkasem et al., 2020).

2.12 Complications of Stroke

Common complications include contractures, hemiplegic shoulder pain, post-stroke seizures, falls, deep vein thrombosis, fatigue, and depression. Preventive measures and rehabilitative strategies help mitigate these risks (Chohan et al., 2019; Batchelor et al., And 2010; Sico et al., 2016).

2.13 Empirical Review of Literature

TITLE	AUTHOR/YEAR	LOCATION OF STUDY	AIM OF STUDY	METHODS	RESULTS	DISCUSSIONS/ FINDINGS
Knowledge and risk factors for stroke among undergraduates in southwestern Nigeria	Adebimpe, W. (2018)	Nigeria	To assess community knowledge and risk factors of stroke among university undergraduates in Osogbo, southwestern Nigeria.	Descriptive cross-sectional study using self-administered questionnaires among 420 male undergraduates.	Good knowledge scores found; most knew stroke affects the brain; risk perception was low; hypertension was a common risk factor.	Poor warning sign knowledge and low risk perception; public awareness needed to improve prevention strategies.
Effect of an educational intervention on knowledge and perception of individuals at risk for stroke in	Albalawi et al., 2020	Saudi Arabia	To test knowledge of stroke and assess effects of an educational program on individuals at risk.	Quasi-experimental one-group pre-post design; interviews before and after educational intervention.	313 participants completed study; 49.2% female; education increased knowledge of stroke risk factors.	Education improved recognition of stroke symptoms and risk factors; similar methods may aid other health awareness.

Tabuk, Saudi Arabia						
Sex Differences in Presentation of Stroke: A Systematic Review and Meta-Analysis	Ali et al., 2022		To investigate whether there are sex differences in clinical presentation of acute stroke or transient ischemic attack.	We conducted a systematic review and meta-analysis according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement	We included 60 studies (n=582 844; 50% women). In women, headache (pooled odds ratio [OR], 1.24 [95% CI, 1.11–1.39]; I^2=75.2%; 30 studies) occurred more frequently than in men with any type of stroke. Aspecific or other neurological symptoms (nonrotatory dizziness and non-neurological	There may be substantive differences in nonfocal and focal stroke symptoms between men and women presenting with acute stroke or transient ischemic attack, but sufficiently high-quality studies are lacking. More studies are needed to address this because sex differences in presentation may

					symptoms) occurred less frequently in women	lead to misdiagnosis and undertreatment
Stroke-related knowledge and attitudes among university students in Northeast Nigeria	Alkali et al., 2022	Nigeria	To assess stroke knowledge and attitudes among undergraduate students at three Nigerian universities.	Cross-sectional study using self-administered questionnaires; purposive sampling.	824 participants; brain identified as stroke site by only 15.7%; most would take stroke victims to hospital.	Limited stroke knowledge; lack of formal education noted; curriculum improvement recommended.
Knowledge and Perception of Stroke among Nursing Students	Badria et al., 2022	Saudi Arabia	To explore knowledge and perception of stroke among nursing students to provide high quality of care.	Descriptive quantitative study using structured questionnaires among 192 female students.	Majority were aware of stroke; moderate knowledge of risk factors and symptoms; poor knowledge of complications.	Higher year students had better knowledge; recommends student self-learning and future interventional studies.
Knowledge, attitude, and practice in relation to stroke: A community-based	Das et al., 2016	India	To compare stroke-related KAP among participants from stroke-affected vs. non-affected families.	Three-phase house-to-house survey using a validated questionnaire in Kolkata, India.	97% had knowledge of stroke; SAF group had better knowledge; stroke seen as an emergency.	Stroke perceived as preventable and serious; highlights need for targeted education.

study from Kolkata, West Bengal, India						
Knowledge, attitude, and practice of stroke and thrombectomy among medical students in Henan, China	Gao et al., 2024	China	To assess KAP toward stroke and thrombectomy among medical students.	Cross-sectional survey of 1105 students across 5 universities using structured questionnaires.	Adequate knowledge and positive attitudes; KAP influenced by demographics and education.	Need to improve female students' practice and awareness of thrombolysis time window.
Gender differences in feelings and knowledge about stroke	Itzhaki et al., 2016	Isreal	To examine gender differences in knowledge and feelings about stroke among ≥40 years old population.	Data were collected from a convenience sample using semi-structured personal interviews. Participants were representative of Israeli sub-populations aged ≥40 with no history	One hundred and seventy-seven participants were interviewed, 79/177 (44·6%) men and 98/177 (55·4%) women. Rates of self-reported hypertension [33/79 (41·8%) men, 25/98 (25·5%)	Stroke knowledge is poor among men and women. Higher level of education is a predictor of stroke knowledge among both genders. Gender-specific differences in stroke risk factors and

				of stroke. Knowledge of stroke was studied with quantitative methods while constant comparative analysis was used for the qualitative data analysis of feelings evoked by stroke.	women] and current smoking [29/79 (36·7%) men, 18/98 (18·4%) women] were significantly higher in men than women. Over 50% men and women mentioned one-side sudden weakness or paralysis as a stroke symptom, however, other stroke symptoms were not recognised by most participants. Education was associated with the number of identified	feelings about stroke in different sub-populations should be taken into account to improve prevention of stroke through education programmes.

					stroke signs. Knowledge of stroke-warning signs was better in women. The main feelings expressed by both genders were fear of dying and disability, self-concern about survival, blaming fate and self-accusation.	
Knowledge, attitudes and perceptions of stroke: a cross-sectional survey in rural and urban Uganda	Kaddumukasa et al., 2015	Uganda	To assess stroke knowledge and perceptions in urban and rural communities in Uganda.	Cross-sectional study with face-to-face interviews during a neurological survey.	57% knew no warning signs; paralysis and weakness commonly cited where known.	Need for public education emphasizing prevention and emergency response.
Awareness of	Khalafalla et al.,	Saudi	To assess awareness of	Analytic cross-	Hypertension was the	Room for improved

stroke signs, symptoms, and risk factors among Jazan University students	2022	Arabia	stroke signs and risk factors among Jazan University students.	sectional study via online questionnaire among 897 students.	most identified risk factor; 84.8% had heard of stroke.	knowledge despite generally good awareness levels.
Awareness of Stroke Risk Factors and Warning Signs in Nigerian Adolescents Compared with Adults	Komolafe et al., 2014	Nigeria	To compare awareness of stroke risk factors and signs between students and teachers.	Cross-sectional survey using questionnaires in 5 secondary schools.	Hypertension most cited risk factor; differences in knowledge between groups.	Students knew more signs, teachers knew more risk factors; TV use recommended.
Knowledge, attitude, and practice of stroke and thrombolysis among students preparing for undergraduate	Pradhan et al., 2021	Nepal	To assess KAP about stroke and thrombolysis among entrance exam students.	Cross-sectional study using self-structured questionnaires among 378 students.	88.4% heard about stroke; poor knowledge about thrombolysis.	Males more knowledgeable; need for educational campaigns.

medical entrance examination in Kathmandu, Nepal						
Assessment of Knowledge and Attitude Towards Stroke among the UAE Population During the COVID-19 Pandemic	Ramadan et al., 2023	UAE	To assess public knowledge and attitude towards stroke during the pandemic.	Cross-sectional study with self-administered questionnaires among 500 adults.	Suboptimal stroke knowledge; mean score 13.66; hypertension most known risk factor.	Urgent need for public health education to improve awareness.
Knowledge, Attitude, and Practice of Stroke and Its Risk Factors and Warning Signals Among the Students of the College of Applied	Rizvi et al., 2023	Saudi Arabia	To assess KAP of stroke among university students.	Self-administered questionnaires with convenience sampling among 284 students.	Only 5.3% had good knowledge; majority identified stroke as an emergency.	Urgent need for student-targeted awareness initiatives.

Medicine at Majmaah University						
Evaluation of knowledge of risk factors and warning signs of stroke – An observational study among future health care professionals	Syed et al., 2023	Saudi Arabia	To evaluate stroke knowledge among healthcare students at KSU.	Online cross-sectional study using 34-item questionnaires among 205 students.	88.8% identified high blood pressure as risk; 32.2% had good overall knowledge.	Need to improve awareness of warning signs and stroke prevention.
Knowledge, attitude, and practice of stroke among high school students in Nepal	Thapa et al., 2016	Nepal	To report baseline KAP of stroke among high school students.	Pre-tested self-structured questionnaire distributed in schools under supervision.	71.1% had heard of stroke; hypertension and limb weakness most cited signs.	Students had satisfactory knowledge but some misconceptions exist.

CHAPTER THREE

METHODS

3.1 Participants

This study involved clinical undergraduate students in the School of Basic Medical Sciences (SBMS), College of Medical Sciences, University of Benin. The clinical departments include Nursing, Physiotherapy, Radiography, and Medical Laboratory Science.

3.1 Selection Criteria

Participants were selected from the clinical departments within SBMS. These departments—Nursing, Physiotherapy, Medical Laboratory Science, and Radiography—have direct clinical exposure, making their knowledge of stroke especially relevant.

3.1.1 Inclusion Criteria

i. Registered undergraduate students in the clinical departments (Nursing, Physiotherapy, Radiography, and Medical Laboratory Science) of SBMS.
ii. Students in 300 level and above.
iii. Students who voluntarily provided informed consent.

3.1.2 Exclusion Criteria

i. Students from non-clinical departments (e.g., Anatomy, Physiology, Medical Biochemistry).
ii. Students unwilling to participate or who decline to provide consent.
iii. Students in 100 and 200 levels.

3.2 Materials

Data was collected using a structured, researcher-adapted questionnaire derived from standardized tools previously validated in sub-saharan Africa settings (Akinyemi et al., 2009; Nakibuuka et al., 2014; Droste et al., 2014; Kaddumukasa et al., 2015), designed to assess stroke-related knowledge.

The questionnaire was divided into two main sections:

- **Section A:** socio-demographic information (Name, sex, department, academic level, etc.).
- **Section B:**
    - Knowledge of stroke (definition, causes, risk factors, warning signs, planned response).

3.2.1 List of Instruments

- Stroke Knowledge Questionnaire

3.2.2 Description of Instrument

- **Stroke Knowledge Questionnaire:** The instrument assessed knowledge across four domains: (i) causes of stroke, (ii) risk factors, (iii) warning signs (iv) planned response to a stroke event. Each domain comprised a single multiple-response item in which more than one option could be correct.
- Responses were scored by awarding one point for each correct option selected. Incorrect options, omissions of correct options, and “I do not know” responses

were assigned a score of zero. The total score for each domain was calculated as the sum of correctly identified options.

- Domain scores were classified as follows:

    i. Poor knowledge: no correct responses (score = 0)

    ii. Fair knowledge: one to three correct responses

    iii. Good knowledge: four or more correct responses

- **Reliability:** The Stroke Questionnaire should demonstrate good internal consistency, targeting Cronbach's alpha values of **≥ 0.7** for each domain (knowledge), which indicates reliable measurement. Test-retest reliability should be assessed by administering the questionnaire to 30–50 students twice (1–2 weeks apart), to achieve Intraclass Correlation Coefficients (ICCs) **≥ 0.7** to confirm stability over time.
- **Validity:** The Stroke Questionnaire should show strong construct validity, with Exploratory Factor Analysis (EFA) confirming distinct knowledge domain, and Confirmatory Factor Analysis (CFA) validating the factor structure in a larger sample (200–300 students). Criterion validity must be established by correlating scores with external measures, such as academic performance in neurology (target r = 0.6–0.8). Content validity should be ensured through expert review (e.g., neurologists, medical educators), aiming for an Item-Content Validity Index (I-CVI) **≥ 0.78** and a Scale-Content Validity Index (S-CVI) **≥ 0.8**.

Discriminant validity should be confirmed by distinguishing between students with different clinical exposure (e.g., preclinical vs. clinical students).

3.3 Methods

3.3.1 Research Design

A cross-sectional analytical study design was adopted to assess knowledge of stroke at a single point in time among the target population.

3.3.2 Sampling Technique/Sample Size Calculation

A convenience sampling method was employed to recruit participants. Students were approached during lectures, clinical sessions, or departmental gatherings.

The sample size for this study was calculated using the Taro Yamane formula:

$n = N / (1+N (e)^2$

Where n = sample size

N = population size

e = margin of error (set at 0.05)

Population Data Source: Class Representatives for each departmental level.

Given:

- N = 1664
- e = 0.05

Now plug the values into the formula:

n = {1664} / {1 + 1664(0.05) ^2}

n = {1664} / {1 + 1664(0.0025)}

n = {1664} / {1 + 4.16}

n = {1664} / {5.16}

n= 322.48

Final Answer:

The sample size was approximately 322 respondents.

3.3.4 Procedure for Data Collection

Eligible students were approached and informed about the purpose and procedures of the study. Informed consent was obtained prior to participation. Questionnaires were administered in person, and the researcher was available to clarify any uncertainties.

- The structured, self-administered questionnaire was completed on the spot to minimize response bias and incomplete data. Collected data included both socio-demographic details and responses related to stroke knowledge. All responses were anonymized and coded.

3.3.5 Ethical Considerations

Ethical approval was obtained from the research and ethics committee of the University of Benin. Participants were informed about their rights, including the voluntary nature of the study and the freedom to withdraw at any point. All data were handled confidentially and used solely for academic and research purposes.

3.3.6 Analysis of Data

Data was coded and entered into the Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarize demographic characteristics and responses.

Inferential statistics (Chi-square tests) were used to assess the association between socio-demographic variables and knowledge scores. The significance level was set at $p < 0.05$.

CHAPTER FOUR

RESULTS

4.1 Preamble

The primary aim of this study was to assess the knowledge of stroke among clinical undergraduate students in the School of Basic Medical Sciences (SBMS) at the University of Benin. A total of 322 students were recruited from the departments of Medical Laboratory Science, Nursing, Physiotherapy and Radiography.

4.1.1 Sociodemographic characteristics of the respondents

Table 4.1. shows the sociodemographic characteristics of the respondents.

220 (68.3%) of the respondents were female. The distribution across departments was relatively even, with Nursing having the highest proportion (25.8%) of female respondent with 400- level students forming the largest group (34.5%).

Table 4.1: Sociodemographic characteristics of the respondents

	Frequency	Percentage
Gender		
Male	102	31.7
Female	220	68.3
Department		
Medical Laboratory Science	81	25.2
Nursing	83	25.8
Physiotherapy	78	24.2
Radiography	80	24.8
Level		
300 Level	110	34.2
400 Level	111	34.5
500 Level	101	31.4

4.1.2 Knowledge of stroke among the respondents

This is presented in Table 4.2, 303 of the respondents (94.1%) correctly identified the brain as the organ affected by stroke. A vast majority (98.4%) recognized that stroke is preventable and that it can occur more than once (90.7%). 315 of the respondents (97.8%) acknowledged its impact on daily activities, while 312 (96.9%) reported knowing at least one risk factor and 297 (92.2%) were aware of warning signs of stroke.

Table 4.2: Knowledge of stroke among the respondents

	Frequency	Percentage
What organ of the body is affected by stroke?		
Brain	303	94.1
Heart	9	2.8
Liver	1	0.3
Others	3	0.9
Don't know	6	1.9
Is stroke preventable?		
Yes	317	98.4
No	5	1.6
Can a person have stroke more than once?		
Yes	292	90.7
No	30	9.3
Does stroke have an effect on daily activities?		
Yes	315	97.8
No	7	2.2
Do you know any risk factors for stroke?		
Yes	312	96.9
No	10	3.1
Do you know any warning signs of stroke?		
Yes	297	92.2
No	25	7.8

Figure 4.1 shows Hypertension was the most frequently reported perceived cause of stroke, by (n=257, 79.8%) of the respondents. God's will was the least perceived cause of stroke (n = 3, 0.9%).

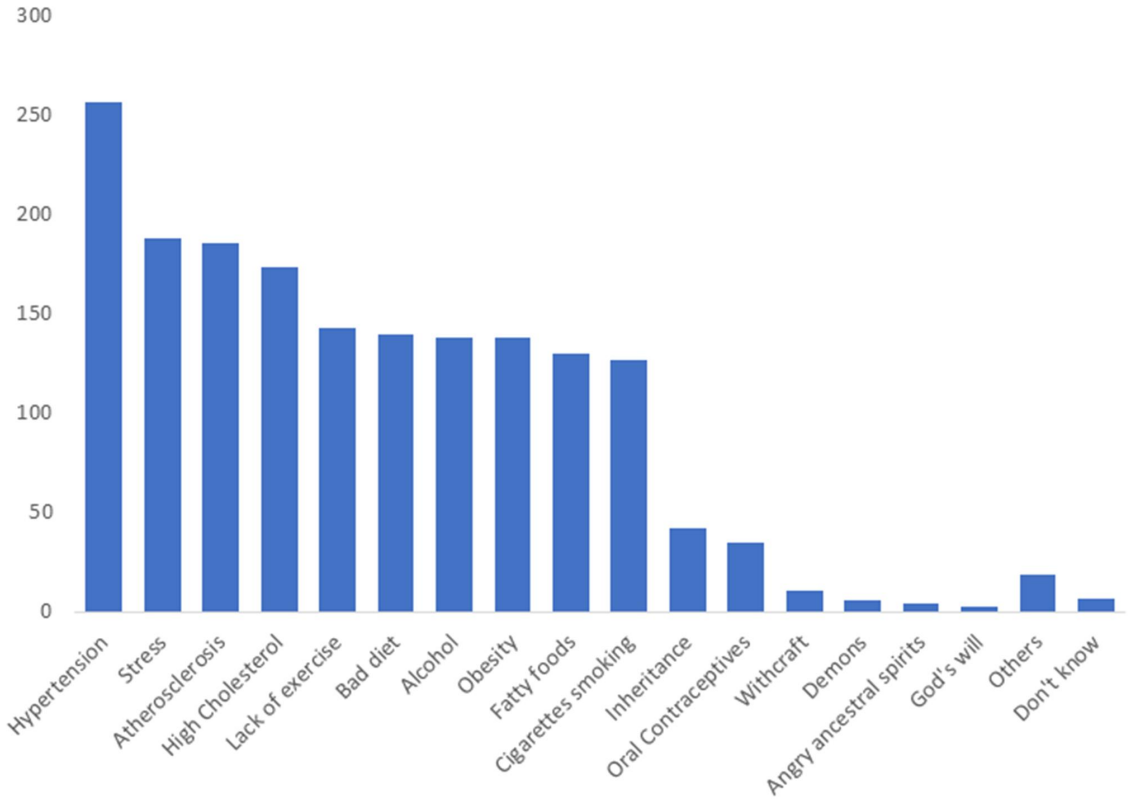

Figure 4.1: Frequency distribution of perceived causes of stroke among respondents

Figure 4.2 shows that the most commonly perceived risk factor for stroke was hypertension (n = 248, 77%) followed by old age (n = 236, 73.3%).

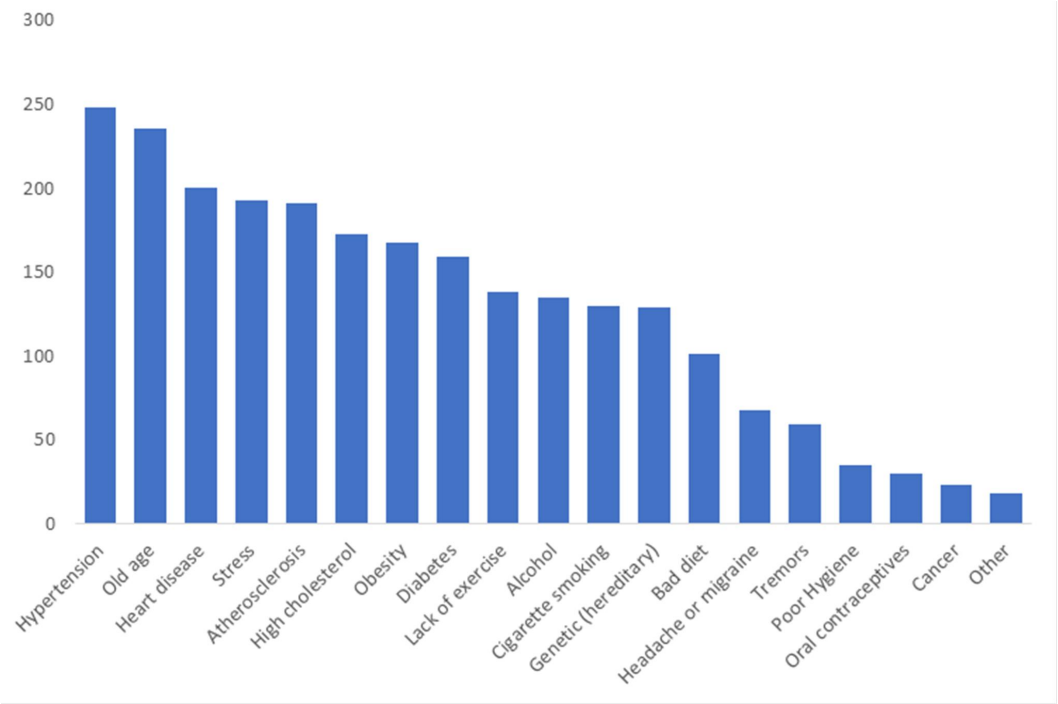

Figure 4.2: Frequency distribution of perceived risk factors of stroke among respondents

Figure 4.3 shows that 253 (78.6%) of the respondents correctly answered that paralysis of one side of the body was a warning sign for stroke, 249 (77.3) correctly picked sudden difficulty in speaking, understanding or reading as a warning sign.

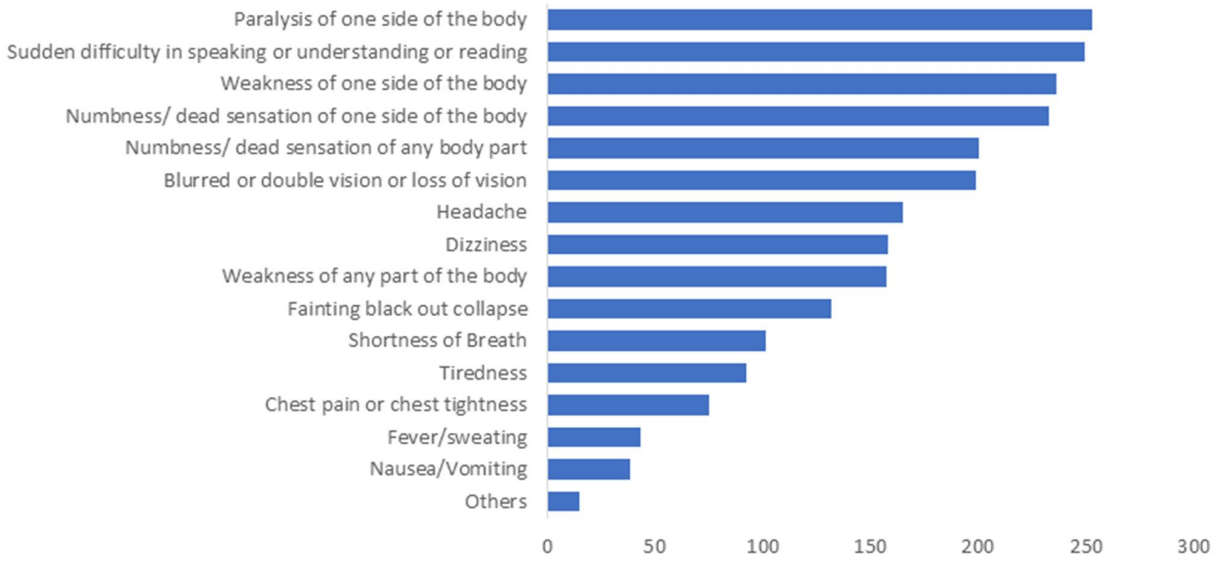

Figure 4.3: Frequency distribution of perceived warning signs of stroke among respondents

Figure 4.4. shows that 250 (77.6%) of the respondents reported that their planned response in the event of a stroke would be to go to an hospital, 4 (1.2%) reported that they would opt for self-medication.

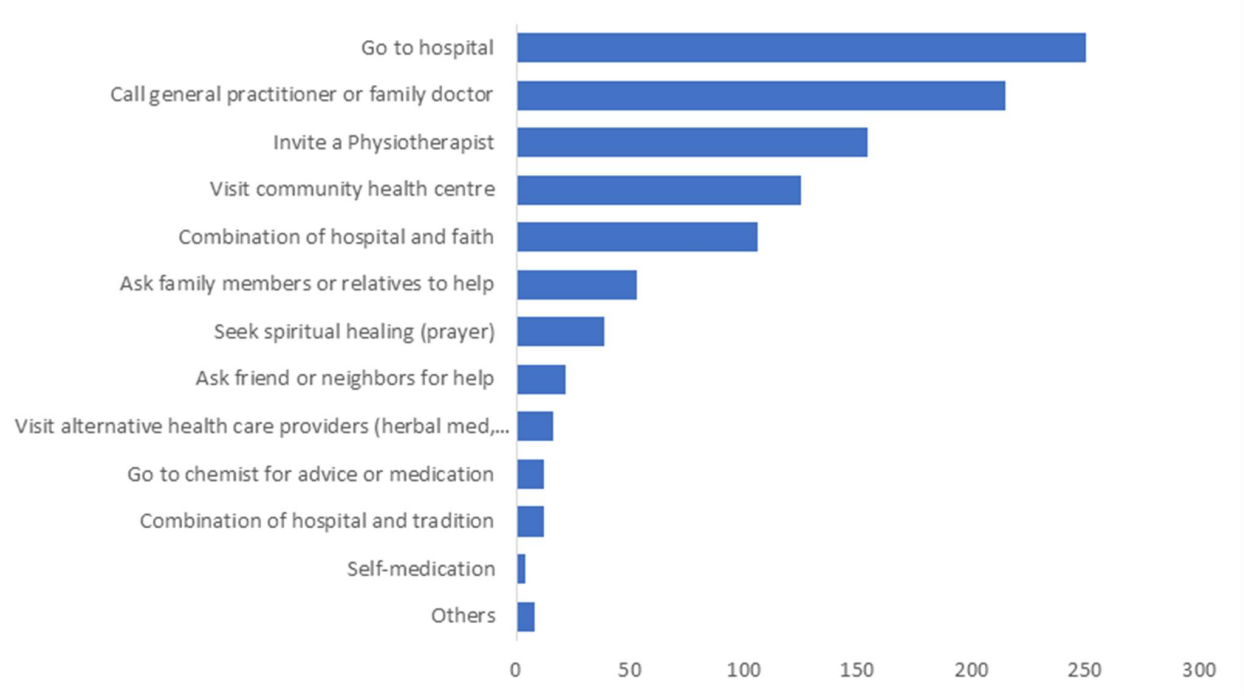

Figure 4.4: Frequency distribution of the respondents' planned response to a stroke event

Figure 4.5 shows the most common source of information regarding stroke was from Health care providers, as reported by 253 (78.6%) of the respondents, followed by electronic media (59.6%).

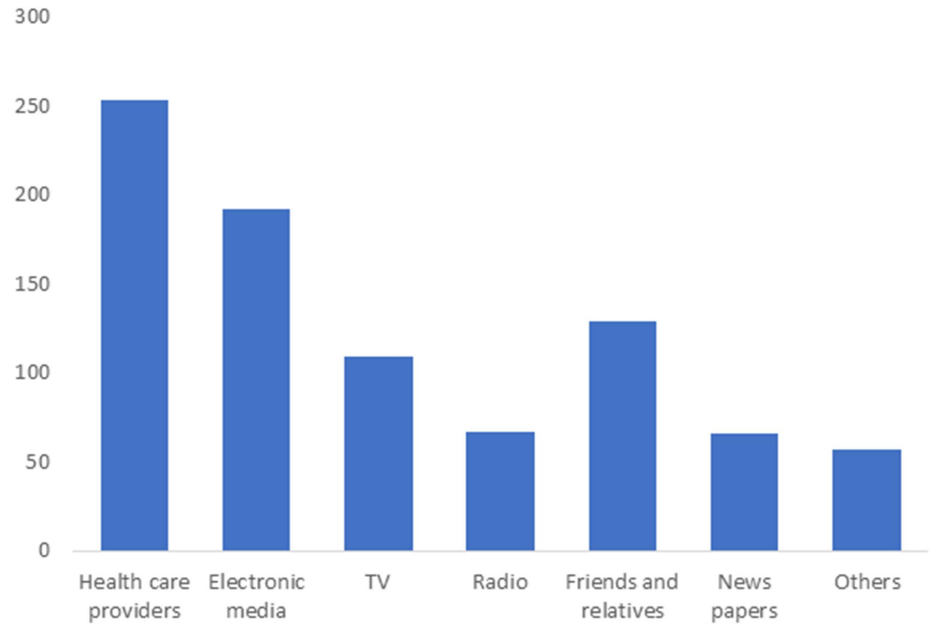

Figure 4.5: Frequency distribution of stroke information source among the respondents

4.1.3 Level of stroke-related knowledge among the respondents

This is presented in Table 4.3. 209 (64.9%) of the respondents knew at least 4 appropriate causes of stroke. 240 (74.5%) knew at least four correct risk factors of stroke, 264 (82%) correctly identified at least 4 warning signs of stroke. 199 (61.8%) of the respondents provide 1 to 3 appropriate planned responses in the event of a stroke.

Table 4.3: Level of stroke-related knowledge among the respondents

	Frequency	Percentage
Causes of stroke		
None	9	2.8
1 - 3	104	32.3
At least 4	209	64.9
Risk factors for stroke		
None	7	2.2
1 - 3	75	23.3
At least 4	240	74.5
Warning signs of stroke		
None	6	1.9
1 - 3	52	16.1
At least 4	264	82.0
Planned response to stroke event		
None	4	1.2
1 - 3	199	61.8
At least 4	119	37.0

4.1.4 Association between gender and level of stroke-related knowledge among the respondents

This is presented in Table 4.4. There was a significant association between the gender of the respondents and the level of knowledge on appropriate planned response to a stroke event among the respondents ($X^2 = 7.873$, $p = 0.02$).

Table 4.4: Chi-square association between gender and level of stroke-related knowledge

Gender	None	1 – 3	At least 4	X^2	p
Causes of stroke					
Male (%)	2 (2.0)	(33.3)	66 (64.7)	0.422	0.810
Female (%)	7 (3.2)	70 (31.8)	143 (65.0)		
Stroke risk factors					
Male (%)	1 (1.0)	27 (26.5)	74 (72.5)	1.705	0.426
Female (%)	6 (2.7)	48 (21.8)	166 (75.5)		
Stroke warning signs					
Male (%)	1 (1.0)	19 (18.6)	82 (80.4)	1.239	0.538
Female (%)	5 (2.3)	33 (15.0)	182 (82.7)		
Planned response to stroke event					
Male (%)	1 (1.0)	52 (51.0)	49 (48.0)	7.873	0.02
Female (%)	3 (1.4)	147 (66.8)	70 (31.8)		

4.1.5 Association between department and level of stroke-related knowledge among the respondents

This is presented in Table 4.5. There was no significant association between the department of the respondents and their level of stroke-related knowledge.

Table 4.5: Chi-square association between department and level of stroke-related knowledge

Department	None	1 – 3	At least 4	X^2	p
Causes of stroke					
MLS (%)	5 (6.2)	25 (30.9)	51 (63.0)	5.995	0.424
Nursing (%)	1 (1.2)	28 (33.7)	54 (65.1)		
Physiotherapy (%)	2 (2.6)	22 (28.2)	54 (69.2)		
Radiography (%)	1 (1.3)	29 (36.3)	50 (62.5)		
Stroke risk factors					
MLS (%)	4 (4.9)	19 (23.5)	58 (71.6)	11.321	0.729
Nursing (%)	1 (1.2)	16 (19.3)	66 (79.5)		
Physiotherapy (%)	0 (0)	14 (17.9)	64 (82.1)		
Radiography (%)	2 (2.5)	36 (32.5)	52 (65.0)		
Stroke warning signs					
MLS (%)	3 (3.7)	17 (21.0)	61 (75.3)	11.877	0.065
Nursing (%)	1 (1.2)	17 (20.5)	65 (78.3)		
Physiotherapy (%)	0 (0)	5 (6.4)	73 (93.6)		
Radiography (%)	2 (2.5)	13 (16.3)	65 (81.3)		
Planned response to stroke event					
MLS (%)	1 (1.2)	45 (55.6)	35 (43.2)	3.981	0.679
Nursing (%)	1 (1.2)	58 (69.9)	24 (28.9)		
Physiotherapy (%)	1 (1.3)	46 (59.0)	31 (39.7)		
Radiography (%)	1 (1.3)	50 (62.5)	29 (36.3)		

4.1.6 Association between level of study and level of stroke-related knowledge among the respondents

This is presented in Table 4.6. There was a significant association between the level of study and the level of knowledge on stroke risk factors among the respondents (X^2 = 10.358, p = 0.035).

Table 4.6: Chi-square association between level of study and level of stroke-related knowledge

		Causes of stroke			
Level	**None**	**1 – 3**	**At least 4**	**X^2**	**p**
300 Level (%)	6 (5.5)	39 (35.5)	65 (59.1)	9.064	0.060
400 Level (%)	0 (0)	39 (35.1)	72 (64.9)		
500 Level (%)	3 (3.0)	26 (25.7)	72 (71.3)		
		Stroke risk factors			
300 Level (%)	5 (4.5)	33 (30.0)	72 (65.5)	10.358	0.035
400 Level (%)	1 (0.9)	25 (22.5)	85 (76.6)		
500 Level (%)	1 (1.0)	17 (16.8)	83 (82.2)		
		Stroke warning signs			
300 Level (%)	2 (1.8)	23 (20.9)	85 (77.3)	9.08	0.059
400 Level (%)	0 (0)	12 (10.8)	99 (89.2)		
500 Level (%)	4 (4.0)	17 (16.8)	80 (79.2)		
		Planned response to stroke event			
300 Level (%)	1 (0.9)	64 (58.2)	45 (40.9)	6.112	0.191
400 Level (%)	0 (0)	68 (61.3)	43 (38.7)		
500 Level (%)	3 (3.0)	67 (66.3)	31 (30.7)		

4.2 Hypothesis Testing

Hypothesis 1: There is no significant difference between male and female SBMS clinical undergraduates in identifying common causes of stroke.

Alpha level: 0.05

Test statistic: Chi-square

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The null hypothesis was therefore ACCEPTED.

Hypothesis 2: There is no significant difference between male and female SBMS clinical undergraduates in identifying common risk factors of stroke.

Alpha level: 0.05

Test statistic: Chi-square

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The null hypothesis was therefore ACCEPTED.

Hypothesis 3: There is no significant difference between male and female SBMS clinical undergraduates in identifying common warning signs of stroke.

Alpha level: 0.05

Test statistic: Chi-square

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The null hypothesis was therefore ACCEPTED.

Hypothesis 4: There would be no significant difference between male and female SBMS clinical undergraduates in appropriate planned response to a stroke event.

Alpha level: 0.05

Test statistic: Chi-square

Observed: $p < 0.05$

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

Hypothesis 5: There is no significant difference across departments of SBMS clinical undergraduates in identifying common causes of stroke.

Alpha level: 0.05

Test statistic: Chi-square

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The null hypothesis was therefore ACCEPTED.

Hypothesis 6: There is no significant difference across departments of SBMS clinical undergraduates in identifying common risk factors of stroke.

Alpha level: 0.05

Test statistic: Chi-square

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The null hypothesis was therefore ACCEPTED.

Hypothesis 7: There is no significant difference across departments of SBMS clinical undergraduates in identifying common warning signs of stroke.

Alpha level: 0.05

Test statistic: Chi-square

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The null hypothesis was therefore ACCEPTED.

Hypothesis 8: There is no significant difference across departments of SBMS clinical undergraduates in appropriate planned response to a stroke event.

Alpha level: 0.05

Test statistic: Chi-square

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The null hypothesis was therefore ACCEPTED.

Hypothesis 9: There is no significant difference across study levels of SBMS clinical undergraduates in identifying common causes of stroke.

Alpha level: 0.05

Test statistic: Chi-square

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The null hypothesis was therefore ACCEPTED.

Hypothesis 10: There would be no significant difference across study levels of SBMS clinical undergraduates in identifying common risk factors of stroke.

Alpha level: 0.05

Test statistic: Chi-square

Observed: $p < 0.05$

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

Hypothesis 11: There is no significant difference across study levels of SBMS clinical undergraduates in identifying common warning signs of stroke.

Alpha level: 0.05

Test statistic: Chi-square

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The null hypothesis was therefore ACCEPTED.

Hypothesis 12: There is no significant difference across study levels of SBMS clinical undergraduates in appropriate planned response to a stroke event.

Alpha level: 0.05

Test statistic: Chi-square

Observed: $p > 0.05$

Since the observed p value was greater than 0.05 Alpha level. The null hypothesis was therefore ACCEPTED.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion of Findings

This study assessed the knowledge of stroke among clinical undergraduate students in the School of Basic Medical Sciences (SBMS) at the University of Benin. The findings are discussed below in relation to the research objectives and existing literature.

5.1.1 General Knowledge of Stroke

The results revealed a high level of general awareness of stroke among the respondents. Most students (94.1%) correctly identified the brain as the organ affected by stroke, while 98.4% recognized that stroke is preventable, and 90.7% understood that it can recur. Similarly, 97.8% acknowledged that stroke affects daily activities. This finding suggests that clinical undergraduates possess a solid theoretical understanding of stroke as a neurological and disabling condition, likely reflecting the impact of their medical training.

These results align with Adebimpe (2018) in southwestern Nigeria and Gao et al. (2024) in China, both of which reported satisfactory stroke awareness among medical students. However, this contrasts with studies among non-clinical undergraduates, such as Alkali et al. (2022) and Rizvi et al. (2023), who found generally low awareness of stroke and its risk factors among non-health students. Hence, the current study indicates that clinical exposure and curriculum content in SBMS may contribute positively to stroke literacy.

5.1.2 Knowledge of Causes and Risk Factors of Stroke

A majority (96.9%) of respondents could identify at least one risk factor for stroke, while 74.5% recognized at least four risk factors. The most frequently cited risk factors were hypertension(77%), old age (73.3%), and diabetes.

This pattern is consistent with findings from Khalafalla et al. (2022) in Saudi Arabia and Komolafe et al. (2014) in Nigeria, both of which reported hypertension as the most commonly recognized risk factor.

However, a minority of respondents mentioned factors like smoking and physical inactivity, which are well-established in the literature (Patil et al., 2021; Hinkle & Cheever, 2018). This gap indicates a partial understanding of modifiable risk factors, possibly reflecting insufficient emphasis on lifestyle-related causes within student health education.

A significant association was observed between level of study and knowledge of stroke risk factors ($p = 0.035$), suggesting that higher academic levels correlate with greater knowledge. This trend supports Badria et al. (2022), who found that senior nursing students demonstrated better knowledge of stroke, likely due to increased academic exposure and clinical experience.

5.1.3 Knowledge of Stroke Warning Signs

Most respondents (92.2%) were aware of at least one stroke warning sign, and 82% identified four or more correctly. The most frequently mentioned signs included paralysis of one side of the body (78.6%) and difficulty in speaking or understanding speech (77.3%).

These findings align with Das et al. (2016) in India and Kaddumukasa et al. (2015) in Uganda, where muscle weakness and speech difficulty were the most recognized symptoms. Nonetheless, despite high overall knowledge, a small subset (7.8%) remained unaware of stroke warning signs, which could delay emergency response in real-life scenarios.

The study also found no significant gender difference in recognizing warning signs, consistent with Itzhaki et al. (2016), who concluded that educational exposure rather than gender predicted stroke awareness levels.

5.1.4 Planned Response to Stroke Events

The majority of students (77.6%) reported that they would take a stroke victim to the hospital, indicating an appropriate understanding of emergency response. However, a small number (1.2%) indicated that they would resort to self-medication, reflecting the persistence of some misconceptions even among clinical students.

Interestingly, there was a significant association between gender and level of knowledge on planned response ($p = 0.02$). This may suggest that female students demonstrated more caution or better emergency awareness, aligning with literature suggesting women often exhibit more proactive health-seeking behavior (Itzhaki et al., 2016).

5.1.5 Sources of Information on Stroke

The most common sources of stroke information were healthcare providers (78.6%) and electronic media (59.6%). This supports Ramadan et al. (2023), who found that medical professionals and digital platforms were major information channels. The predominance of professional sources reinforces the value of integrating clinical training and public education as effective means of promoting stroke awareness.

5.1.6 Association between Demographic Variables and Knowledge

No significant differences were found between departments or gender in terms of stroke-related knowledge, but a significant difference existed across levels of study. This implies that while academic specialization may not distinctly influence stroke awareness within SBMS, academic maturity and exposure do, underscoring the importance of continuous reinforcement of cerebrovascular education across successive years.

5.2 Conclusion

The findings of this study revealed that clinical undergraduates in the School of Basic Medical Sciences at the University of Benin possess a generally high level of knowledge about stroke, including its causes and warning signs. Most of the students demonstrated a clear understanding of the nature of stroke as a neurological disorder and were aware of its preventable nature. Hypertension emerged as the most commonly identified risk factor, reflecting sound comprehension of one of the leading contributors to stroke. Similarly, paralysis and speech difficulty were the most frequently recognized warning signs, indicating a commendable awareness of key clinical manifestations.

The study further established a significant relationship between the level of study and knowledge of stroke risk factors, suggesting that senior students are better informed than their junior counterparts. This outcome implies that increased academic exposure and clinical experience contribute positively to students' understanding of stroke. Additionally, a significant gender difference was observed in planned emergency responses to stroke, indicating variations in preparedness between male and female students.

Despite the generally high level of theoretical knowledge demonstrated, certain gaps were identified. Awareness of lifestyle-related risk factors—such as smoking, physical inactivity, and unhealthy dietary habits—remained relatively low, and not all students showed complete understanding of the appropriate emergency responses during a stroke event. These findings suggest that while the students are well grounded in theoretical knowledge, their practical preparedness and awareness of modifiable lifestyle risks need to be strengthened.

Overall, the study concludes that stroke literacy among clinical undergraduates of the University of Benin is commendable. However, there is a clear need for targeted reinforcement of practical awareness, lifestyle-related education, and emergency response training to ensure that these future healthcare professionals are adequately equipped to promote stroke prevention and management in both clinical and community settings.

5.3 Recommendations

Based on the findings, the following recommendations are proposed:

1. **Curriculum Enhancement:**

   The SBMS curriculum should include explicit modules on stroke prevention, emergency recognition, and lifestyle modification, integrated into both pre-clinical and clinical training.

2. **Regular Awareness Campaigns:**

   The university health services and student medical associations should organize annual stroke awareness programs, emphasizing recognition of warning signs, FAST (Face, Arm, Speech, Time) response, and modifiable risk factors.

3. **Interdisciplinary Training:**

   Collaborative simulation exercises among departments (Nursing, Physiotherapy, Radiography, Medical Laboratory Science) should be introduced to build coordinated emergency response skills.

4. **Lifestyle Promotion Programs:**

   Educational interventions promoting healthy living—especially reducing smoking, unhealthy diets, and physical inactivity—should be intensified across campus.

5. **Gender-Sensitive Educational Strategies:**

   Since gender differences were observed in response readiness, stroke education programs should tailor messaging to encourage equal practical preparedness among male and female students.

6. **Further Research:**

   Future studies should explore the relationship between knowledge and actual practice in stroke emergency scenarios and extend investigations to non-clinical faculties for comparison.

5.4 Implications for Public Health and Education

The findings emphasize the critical role of medical students as potential advocates and first responders in stroke prevention. By enhancing their training and engagement, universities can contribute significantly to reducing the burden of stroke in Nigeria through community health education and early intervention.

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APPENDICES

APPENDIX 1

ETHICAL APPROVAL

APPENDIX 2

INFORMED CONSENT FORM

Title of study: Assessment of Knowledge of Stroke among Clinical Undergraduates in the School of Basic Medical Sciences, Uniben.

Researcher: Ileabumah Favour Akata

I am a final-year student of the Department of Physiotherapy, University of Benin, conducting a research study as part of the requirements for the completion of my undergraduate project.

Purpose: This study aims to assess the Knowledge of Stroke among Clinical Undergraduates in the School of Basic Medical Sciences, Uniben.

Participation: Your participation in this study is entirely voluntary. You may choose to withdraw at any time without penalty.

Confidentiality: All information provided will be kept strictly confidential and used solely for research purposes.

Risks/Benefits: There are no known risks associated with participation. The findings may help in recommending better sleeping surfaces to reduce pain and improve comfort.

Consent: By signing below, you agree to participate in the study and affirm that you have understood the purpose and nature of the study.

Participant's Name: _____

Signature: _____ Date: _____

APPENDIX 3

QUESTIONNAIRE

Section 1: Demographics

1.1 Name.……

1.2 Was written Informed Consent obtained? ☐ No ☐ Yes
If no, please do not proceed.

1.3 Gender: ☐ Male ☐ Female

1.4 Department:
☐MLS
☐ Nursing
☐ Radiography
☐ Physiotherapy

1.5 Level: ☐ 300
☐ 400
☐ 500

Section 2: Knowledge about stroke

2.1 What organ of the body is affected by stroke: ☐ Brain ☐ Heart
☐ Kidney ☐ Liver
☐ Lungs ☐ Don't know ☐ Other……

2.2 Is stroke preventable? :☐ Yes ☐ No

2.3 Can a person have stroke more than once? :☐ Yes ☐ No

2.4 Does stroke have an effect on daily activities like driving a car, dressing, use of the toilet and having a job? : ☐ Yes ☐ No

What do you believe causes a stroke? -

☐ Demons	☐ hypertension	☐ don't know
☐ Witch craft	☐ cigarette smoking	☐ Bad diet
☐ God's will	☐ Fatty foods	☐ alcohol
☐ Atherosclerosis	☐ high cholesterol	☐ Stress
☐ Angry ancestral spirits	☐ Obesity	
☐ Oral contraceptives	☐ lack of exercise	
☐ Inheritance		

☐ Others (please specify)……

What do you believe are risk factors for stroke?

3.1 Do you know any risk factors for stroke? ☐ Yes ☐ No

If Yes, what are the risk factors for stroke that you know of? Please tick all that applies

☐ Old age	☐ hypertension
☐ Diabetes	☐ cigarette smoking
☐ Heart disease	☐ alcohol
☐ Atherosclerosis	☐ high cholesterol
☐ Obesity	☐ genetics (hereditary)
☐ Stress	☐ lack of exercise
☐ Poor hygiene	☐ headache or migraine
☐ Cancer	☐ oral contraceptives
☐ Bad diet	☐ tremors
☐ Others	

Knowledge of stroke warning signs

3.2 Do you know any warning signs of stroke? ☐ Yes ☐ No

3.3 If yes, what are the warning signs of stroke that you know of? Please tick all that applies

☐ Dizziness	☐ blurred or double vision or loss of vision
☐ Headache	☐ sudden difficulty in speaking or understanding or reading
☐ Tiredness	☐ fever/sweating
☐ Shortness of breath	☐ Chest pain or chest tightness

☐ Nausea/vomiting ☐ weakness of any part of the body
☐ Weakness of one side of the body ☐ paralysis of any part of the body
☐ Paralysis of one side of the body ☐fainting black out collapse
☐ Numbness tingling sensation or dead sensation of any body part
☐ Numbness tingling sensation or dead sensation of one side of the body
☐Others (please specify……...

What would be your planned response to an event of stroke?

☐ Call general practitioner or family doctor
☐ Ask family members or relatives to help
☐ Go to chemist for advice or medication
☐ Self-medication
☐ Ask friend or neighbours for help
☐ Go to hospital
☐ Visit community health centre
☐ Visit alternative health care providers (herbal med, traditional healers),
☐ Seek spiritual healing (prayer)
☐ Combination of hospital and tradition
☐ Combination of hospital and faith
☐ Invite a Physiotherapist
☐ Others (please specify)

Sources of information about stroke

What are your sources of information about stroke? Please tick all that applies
☐ Health care providers ☐ Friends and relatives
☐ Radio ☐ TV ☐ News papers
☐ Electronic media ☐ others (please specify)……