Extracranial Carotid Artery Stenosis Among Ischemic Stroke and Transient Ischemic Attack Patients at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia: A Cross-Sectional Study

By

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List of Abbreviations and Acronyms

- IS – Ischemic Stroke
- TIA- Transient Ischemic Stroke
- DUS- Duplex Ultrasound
- CAS- Carotid Artery Stenosis
- ICA- Internal Carotid Artery
- PAD –Peripheral Artery Disease
- CVD – Cerebrovascular Disease
- CAD – Coronary Artery Disease
- TOAST -Trial of ORG 10172 in Acute Stroke Treatment
- NASCET- North American Symptomatic Carotid Endarterectomy Trial
- ECST- European Carotid Surgery Trail
- CTA - Computed Tomography Angiography
- MRA -Magnetic Resonance Angiography
- CEA- Carotid Endarterectomy
- CAS -Carotid Artery Stent
- IHD- Ischemic Heart Diseases
- TASH – Tikur Anbessa Specialized Hospital
- DM – Diabetes Mellitus
- BMI – Body Mass Index
- ETB – Ethiopian Birr

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Abstract

Background: Carotid artery stenosis, a common large artery disease caused by atherosclerosis, can lead to ischemic stroke or TIA. Early revascularization in severe cases significantly lowers the risk of recurrent stroke. Although well-studied in developed countries, data from developing regions are scarce. This study aimed to assess the prevalence and associated factors of carotid artery stenosis among ischemic stroke patients, as no prior research has been conducted in our country

Objective: To assess clinical profile, prevalence and corelated factors associated with extra cranial carotid artery stenosis among ischemic stroke and TIA patients.

Methods: A cross-sectional study was conducted at a single tertiary hospital on 186 patients with ischemic stroke and transient ischemic attack (TIA) who were either being followed at the neurology referral clinic or newly admitted to the hyperacute stroke unit between November 1, 2024, and April 30, 2025. All patients who underwent carotid Doppler ultrasonography were included. Data on demographic characteristics and vascular risk factors were collected. Carotid Doppler ultrasound findings, including the degree of stenosis and the anatomical distribution of lesions in the extracranial carotid arteries, were recorded.

Results: The prevalence of significant extra cranial CAS among ischemic stroke and TIA patients was 21.5% with the internal carotid artery (67.5%) being the most frequently affected site in our study. Moderate stenosis (50–69%) was the most frequently observed, particularly in unilateral cases, which accounted for 80% of the total. Patients with significant CAS were slightly older and more often female. Multivariable analysis identified female sex (AOR = 0.339; 95% CI: 0.139–0.800; p = 0.020), hypertension (AOR = 3.458; 95% CI: 1.304–9.421; p = 0.014), and dyslipidemia (AOR = 6.789; 95% CI: 2.017–22.848; p = 0.004 as significant predictors of CAS.

Conclusion: This study highlights a substantial burden of significant extra cranial carotid artery stenosis (CAS) among ischemic stroke and TIA patients in a developing country setting, emphasizing the importance of routine carotid screening. Identifying high-risk groups can guide targeted prevention and timely intervention, potentially reducing recurrent stroke through appropriate management such as revascularization.

1. Introduction

1.1. Background

Stroke, an eminent global health challenge, looms larger in our collective future. The most recent estimate from the Global Burden of Disease, Injuries, and Risk Factors Study indicates a continued transition away from communicable diseases, maternal issues, and nutritional causes towards noncommunicable diseases, such as stroke. It remains the second leading cause of death worldwide with an annual mortality rate of more than 5 million(1). In 2021, stroke was the third most common global burden diseases (GBD) level 3 cause of 7·3 million deaths after ischaemic heart disease and COVID-19, and the fourth most common cause of all disability-adjusted life-years (2) .

As a formidable contributor to both mortality and disability worldwide, stroke affected a staggering 25.7 million individuals with 10.3 million experiencing their first stroke as estimated in 2013(3,4). Although there has been a worldwide decrease in the age-standardized stroke death rate, this decline has been more gradual in low-income and lower-middle-income countries (21–23%) compared to middle-income and high-income countries (5). At the start of the century, communicable diseases were the most prevalent in Africa, while non-communicable diseases, such as stroke, were seen as uncommon, especially in sub-Saharan Africa. However, current evidence indicates that Africa could have up to 2–3-fold greater rates of stroke incidence and higher stroke prevalence than westerns(6). In Ethiopia, ischemic stroke accounted for 59.34% of all stroke cases and the combined burden of hemorrhagic and ischemic strokes is 46.42% and 51.40%, respectively which was reported from systematic meta-analysis study (7,8).

Ischemic stroke, an interruption of the blood supply to a part of the brain due to occlusion of a blood vessel results in sudden loss of function, accounts approximately 80% stroke cases (9). According to the Trial of ORG 10172 in Acute Stroke Treatment (TOAST) classification, stroke is classified into five major subtypes of ischemic stroke: cardioembolic, large vessel disease, small vessel disease, unusual causes, and undetermined etiology(10,11).

Large artery atherosclerotic disease involves the buildup of plaques within the large arteries that supply blood to the brain. This condition can lead to ischemic strokes, which occur when the blood flow to a part of the brain is obstructed. It is an important cause of stroke that produces a higher risk of early recurrent ischemia than any other stroke subtype which includes carotid artery stenosis (CAS). According to population-based studies, large artery atherosclerosis accounts for approximately 15% to 46% of all ischemic strokes, indicating its substantial role in the occurrence of these events(12–14).

Carotid artery stenosis is a major subtype of large artery occlusive disease, caused by atherosclerotic narrowing of the internal carotid artery (ICA) or common carotid artery (CCA). This condition can lead to ischemic stroke or transient ischemic attack due to thromboembolism or hypoperfusion in the brain (15). Carotid artery occlusion is predominantly triggered by a thrombotic event but further exacerbated by embolization, as well as hemodynamic complications, chiefly stemming from atherosclerosis and hypertension. Such an occlusion can precipitate cerebral ischemia /stroke which is severe medical emergency. Without prompt and effective intervention, this can escalate to a life-threatening stage. The presence of hypotension, volume loss, and heart failure will worsen cerebral hypoperfusion even in mild CAS(9,16,17).

According to North American Symptomatic Carotid Endarterectomy Trial (NASCET) classification, carotid artery stenosis (CAS) is defined as low (< 50%), moderate (50–69%) or severe (70–99%) or total-occlusion (100%) based on measuring the size of the residual lumen (R) and comparing it with the size of the original vessel lumen(D) **i.e. (D-R/D) x 100** (18).

The European Carotid Surgery Trial (ECST) classifies carotid artery stenosis (CAS) by estimating the normal lumen diameter at the site of the lesion. This estimation is based on a visual assessment of where the normal arterial wall would have been prior to the development of the stenosis, meaning that the denominator for measurement is taken precisely at the site of the lesion(19).

Several risk factors have been identified as predisposing conditions for ischemic stroke in patients with carotid artery stenosis. Studies have shown that the following variables predict

both moderate and severe carotid stenosis: advanced age, male sex, history of vascular disease, hypertension, dyslipidemia, diabetes, and current smoking (13,20–22).

The clinical presentation of carotid artery stenosis may be asymptomatic or include symptoms of ischemic stroke or transient ischemic attack. Ischemic stroke related to the carotid artery can present with sudden focal deficit i.e. contralateral sensorimotor loss, speech deficit, and ipsilateral monocular blindness. In a transient ischemic attack (TIA), the symptoms last few minutes to hours but not more than a day, and the ischemic parenchyma recovers and returns function to baseline. The presence of carotid thrill or bruit on physical examination will suggest the diagnosis of CAS related ischemic stroke. To diagnose CAS, the current gold standard diagnostic modality is a duplex ultrasound (DUS), assisted by both computed tomography angiography (CTA) and magnetic resonance angiography (MRA) to assess the severity of stenosis and stability of plaque(23,24).

Management options depend on the type of CAS, the level of luminal blockage, and whether the patients suffered from symptoms (TIA or stroke) or not. Lifestyle modifications such as dietary adjustments, regular exercise, and cessation of smoking, along with medical treatments and surgical interventions like endarterectomy or stenting, constitute the treatment approaches for carotid artery stenosis (CAS). Carotid intervention including carotid endarterectomy(CAE) or carotid artery stent (CAS) are indicated in symptomatic patients with moderate (50-69%) or severe (70 -99%) stenosis, as well as asymptomatic severe ICA stenosis if perioperative stroke and death rate is less than 3% and if the patient has at least a 3 to 5 year life expectancy (25,26).

1.2. Statement of the problem

Stroke is the world's second leading cause of disability and death, exerting a profound impact on individuals and society. While progress in treating hemorrhagic stroke has been gradual, the advent of surgical procedures for large vessel occlusion (LVO) has revolutionized the prevention disabilities in certain acute ischemic stroke patients. In 2010, the estimated number of incident ischemic strokes (IS) across the globe was 11.6 million of which 63% of IS occurred in low- and middle-income countries. In the same year, 5.5 million deaths worldwide were attributed to stroke; from this IS accounted for 2.7 million death(27,28).

Large cerebral vessels occlusive disease is a significant contributor to stroke, presenting a heightened risk of early recurrent ischemia compared to other stroke subtypes. The risk factors associated with large vessel disease are distinct from those of other types of strokes. Notably, in cases of stroke or transient ischemic attack (TIA) resulting from severe extracranial internal carotid artery (ICA) stenosis early revascularization (CEA or CAS) can significantly lower the likelihood of subsequent strokes than best medical treatment alone (29).

While extensive research on carotid artery stenosis related ischemic stroke has been conducted in developed countries, the burden of this condition has not been adequately addressed in developing countries. Because of increased metabolic risk factors, industrialization, and urbanization, the prevalence of carotid artery stenosis related ischemic stroke is expected to be increased in developing countries.

Research into the prevalence and contributing factors of carotid artery stenosis in patients with ischemic stroke offers valuable insights for clinical and public health applications. Furthermore, to our knowledge, no studies have been conducted regarding this topic in the study area as well as within the country.

1.3. Significance and Rationale of the Study

Among the five different etiological subtypes of ischemic stroke, patients with large-artery atherosclerosis, including those affecting the internal carotid artery, were found to have the highest risk of early recurrent stroke(30). Specifically, severe stenosis of the extracranial internal carotid artery leading to stroke or TIA can be effectively treated with carotid endarterectomy or stent to greatly reduce the risk of recurrence or future stroke(15).

Henceforth, this study was going to assess the prevalence and correlated factors of carotid artery stenosis within a cohort of ischemic stroke patients, aiding in the development of a well-established management protocol and strengthening surgical intervention for carotid artery stenosis at TASH, which is the only vascular surgery training center in Ethiopia. Moreover, it will also be a ground for further studies to be undertaken in the future.

1.4. Research Questions

1. What was the prevalence of extra cranial carotid artery stenosis among ischemic stroke and TIA patients?
2. What was the clinical profile of extra cranial carotid artery stenosis among ischemic stroke and TIA patients?
3. What were the factors associated with of extra cranial carotid artery stenosis among ischemic stroke and TIA patients?

2. Literature review

2.1. Epidemiology of stroke

In 2016, worldwide stroke prevalence was 80.1 million of population affected which was higher in female individuals (41.1 million). In the United States, stroke affects around 7 million of the population in which the prevalence was about 3% in adults 20 years or older. Of all strokes, ischemic stroke accounts 87%, the rest is hemorrhage stroke (27,31).

A comprehensive meta-analysis of population and hospital studies conducted globally between 1993 and 2015 revealed the distribution of ischemic stroke subtypes as follows: cardioembolism represented approximately 22%, large artery atherosclerosis 23%, small vessel occlusion 22%, other specified causes 3%, and undetermined causes 26%(2).

A systematic review of all published stroke articles in the Middle East from 1980 to 2015 found that the prevalence rate of stroke ranged from 508 to 777 per 100,000 population. Ischemic stroke was the most commonly reported type, followed by hemorrhagic stroke. Among the studies included, 75% noted a significant male-to-female ratio, and the average age of stroke patients was between sixty and seventy years (32).

A retrospective cross-sectional study that examined the medical records of patients diagnosed with acute ischemic stroke at King Fahd Hospital of the University in Al-Khobar, Saudi Arabia, from 2008 to 2015 found that small vessel occlusion was the most prevalent etiologic subtype of ischemic stroke (32.1%), followed by cardioembolism (21.9%) and large artery atherosclerosis (14.6%) (33).

In Africa, studies published in the last ten years indicate that the annual incidence rate of stroke is 316 per 100,000, with a prevalence of 1,460 per 100,000. The research also revealed that the three-year fatality rate exceeds 80%, and many Africans experience a stroke during their forties to sixties(6).

A retrospective survey was conducted to examine patients admitted for stroke from January 2015 to December 2019 in rural Southwestern Nigeria. The study found that

ischemic stroke comprised 60.1% of cases, while hemorrhagic stroke accounted for 39.9% (34).

A systematic review and meta-analysis conducted in Ethiopia revealed that ischemic stroke represented 59.34% of all stroke cases (95% CI: 53.73-64.95). Among the risk factors identified, substance abuse was the second most common at 36.58% (95% CI: 25.22–47.93), following hypertension, which was at 50.90% (95% CI: 43.77–56.27) (7).

2.2. Classification of Subtype of Acute Ischemic Stroke/ TOAST criteria

Previously, ischemic stroke classification has been based primarily on risk factor, clinical profile of the stroke, and the findings on brain imaging studies (CT or MRI). But these features are overlap and are not specific for any particular subtype of ischemic stroke(35). The most frequently used method to classify the pathophysiology of the index ischemic stroke is the Trial of Org 101072 in Acute Stroke Treatment (TOAST) classification. It consists of the following five groups: large artery atherosclerosis (≥50% stenosis), cardioembolism , small vessel occlusion , other determined etiology, and undetermined etiology(11).

The TOAST system now demonstrates moderate overall inter-rater agreement. However, reliability varies among subtypes: it is high for large vessel occlusion (LVO) and cardioembolism ($\kappa = 0.80$), but lower for small vessel disease ($\kappa = 0.53$) and strokes of undetermined origin ($\kappa = 0.40$) (36,37)

2.3. Prevalence of CAS

The prevalence of significant carotid artery stenosis (≥ 50%,), in patients experiencing acute ischemic strokes was once estimated to lie between 15% and 20%. However, these figures stem from studies conducted over decades ago and most them are from developed countries. This left us noticeable gap about the epidemiology of carotid artery stenosis in developing countries with limited resource(21).

The Preventive Antibiotics in Stroke Study (PASS) involved a substantial cohort of acute stroke patients in the Netherlands, revealing that 18.7% had carotid artery stenosis(21).

Observational study conducted at University College London hyperacute stroke unit. In this study where a total of 2707 patients were included; half had an ischemic event and the majority had carotid imaging (1252 of 1444) showed that carotid stenosis accounts 50% of as cause of ischemic stroke or TIA(15).

Another cross-sectional, hospital-based investigation was executed at Sree Balaji Medical College and Hospital, revealing prevalence of Carotid Artery Stenosis (CAS) as of 46%. Within this cohort, a substantial 10% of cases were identified with severe stenosis, while moderate and mild stenosis constituted 12% and 24%, respectively(20).

Another study conducted as part of the Greater Cincinnati/Northern Kentucky Stroke Study (GCNKSS) observed low prevalence rates of significant carotid artery stenosis, with moderate, severe, and total occlusion rates of 4.0%, 1.3%, and 0.5%, respectively.(29).

In the municipality of Tromsø, Norway, a comprehensive study conducted at a single center surveyed the local population and discovered that 6.5% of the residents were affected by carotid stenosis regardless of degree of stenosis. The prevalence (95% CI) was 3.8% among men and 2.7% among women.(22).

In the Framingham Study, the occurrence of carotid artery stenosis was in 7% of women and 9% of men. This condition was more common in people at risk for atherosclerosis (11%), those with heart disease (18%), and those who had just suffered a stroke (60%). Clearly, the likelihood of this illness increases with age and the presence of risk factors for atherosclerosis(38).

Additionally, a separate study in Austria focusing on older adults, aged 60 to 79 as part of the prospective Bruneck Ischemic Heart Disease and Stroke Prevention Study revealed that 10.5% of men and 5.5% of women had ICA stenosis, as determined through duplex ultrasound scanning(39).

Research across multi-ethnic groups indicates that Caucasians generally have a higher incidence of carotid artery stenosis (CAS) compared to other ethnicities. In the U.S., the highest community prevalence of CAS is seen in Native Americans, with a lower prevalence in African Americans and Asians. Hospital-based studies in the U.S. show that 9.2% of Caucasians have significant CAS, while the rates are lower in Hispanics, African Americans,

and Asians. In the Netherlands, 16% of Caucasians have CAS, compared to 10% of individuals of African descent and 9% of Asians, indicating that the likelihood of having CAS is higher in Caucasians compared to non-Caucasians. In Canada, Europeans show slightly higher measurements of carotid atherosclerosis than South Asians and Chinese populations(13,40–43).

A study analyzing data from Erasmus MC (University Medical Center Rotterdam) and St. Antonius Ziekenhuis Nieuwegein in The Netherlands found that 12.5% of Dutch patients who had recently experienced a transient ischemic attack (TIA) or an ischemic stroke had significant internal carotid artery stenosis (ICA stenosis)(44).

A population-based study on stroke in the Middle East identified 72 cases of incident large artery disease (LAD) strokes, with a rate of 15.99 per 100,000. Of these cases, 77% involved extracranial LAD, while the remaining 23% were intracranial LAD strokes (45).

A tertiary hospital-based study in Malaysia was conducted to evaluate the prevalence of extracranial carotid atherosclerosis in patients with CAD. The study found that 67 patients (56.3%) had increased carotid intima-media thickness, 89 patients (74.8%) had plaques, and 10 patients (8.4%) had stenosis in the internal and common carotid arteries(46).

A hospital-based study in southern Egypt aimed to assess the frequency and risk factors of carotid artery disease among ischemic stroke patients. Among 142 patients included in the study, 66 (35.7%) showed no atherosclerotic changes, 75 (40.5%) had stenosis of less than 70%, and 44 (23.8%) had stenosis of 70% or more(47).

Previously, there have been almost no community-based stroke epidemiological data for sub-Sahara Africa. The recent Tanzanian Stroke Incidence Project (TSIP) provided much needed community- based incidence data for the region. In this study 132 incident stroke cases were identified over the whole study period. Only one case had evidence of right internal carotid artery stenosis, with a mild degree of stenosis of around 50% among those who had screened with carotid doppler study(48,49) .

A prospective study at the University Hospital Centre of Yaoundé, Cameroon, aimed to evaluate the prevalence of significant carotid stenosis and other risk factors in patients with

acute ischemic stroke. Out of 35 participants, only 3 patients exhibited carotid stenosis ranging from 50% to 75%, and none had stenosis exceeding 75%(50).

A cross-sectional study conducted at two tertiary care facilities in Uganda examined the prevalence of significant carotid stenosis in 64 participants with ischemic stroke. The findings revealed that 12.5% had significant stenosis, with 7.8% experiencing severe stenosis and 4.7% having moderate stenosis. Additionally, the prevalence of high carotid intima media thickness (CIMT) and atherosclerotic plaques was found to be 31.6% and 26.3%, respectively(51).

2.4. Associated Factors of CAS

A sub study in the Preventive Antibiotics in Stroke Study (PASS) Twan which is a large Dutch randomized, multicentre, open-label phase III trial aimed to determine prevalence, predictors and outcome of carotid stenosis has identified age (p=0.031), hypertension (0.016), male gender (P<0.001), and smoking habits (p=0.002) as significant predictors for carotid artery stenosis among ischemic stroke patients(21).

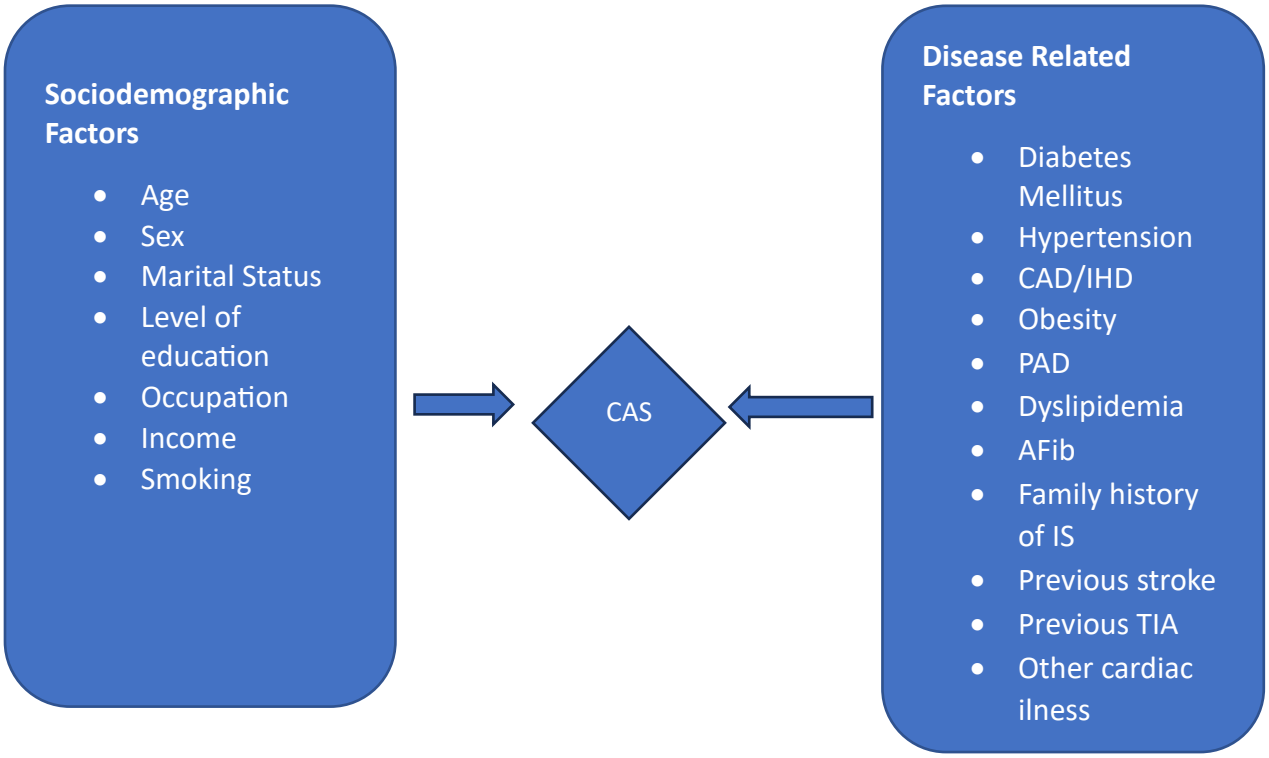
A large, population-based study at University of Tromsø, Norway was done to assess factors associated with CAS. This study identified several factors that were significantly linked to the occurrence of Carotid Artery Stenosis (CAS), including advancing age (p=0.0001), the presence of dyslipidemia (p=0.001), hypertension (p=0.04), a history of smoking (p=0.03), and previous coronary heart disease (p=0.03)(22).

A cross-sectional study conducted at a tertiary care hospital in India aimed to identify the risk factors for carotid artery stenosis in patients with ischemic stroke. The findings revealed that the prevalence of carotid stenosis increased with age: 30% in patients under 50, 43% in those aged 50 to 69, and 53% in those over 60. The condition was more prevalent in males (46%) compared to females (44%), and it was more common in diabetics (64%) than in non-diabetics (32%). Additionally, hypertensive patients (57%) had a higher incidence than those with normal blood pressure (32%), and smokers showed a greater prevalence (66%) compared to non-smokers (32%). Dyslipidemia was also identified as a significant risk factor, with increased cholesterol levels (over 200 mg/dL) found in 64% of patients, elevated triglycerides (over 150 mg/dL) in 59%, low HDL (under 40 mg/dL) in 80%, and high LDL (over 130 mg/dL) in 67%(20).

Another hospital-based study in the south Egypt was done to evaluate risk factors of carotid artery disease among ischemic stroke patients. The most prevalent modifiable risk factors in this study for atherosclerosis were hypertension (74.8%), hyperlipidemia (70.6%), smoking (59.7%) and DM (45.4%)(47).

A prospective study at the University Hospital Centre of Yaoundé, Cameroon, was also done to assess risk factors CAS in patients with acute ischemic stroke. Hypertension was identified as the major risk factor, present in 60% of cases, followed by dyslipidemia at 3.3% (45).

2.5. Conceptual Framework



3. Objectives

3.1. General Objective

- To assess clinical profile, prevalence and corelated factors associated with extra cranial significant carotid artery stenosis among ischemic stroke and TIA patients at TASH, Addis Ababa, Ethiopia.

3.2. Specific Objectives

- To assess clinical profile, prevalence and corelated factors associated with significant extra cranial carotid artery stenosis among ischemic stroke and TIA patients at TASH, Addis Ababa, Ethiopia.

4. METHODOLOGY

4.1. Study Area and Period

The study was conducted at Tikur Anbessa specialized hospital (TASH) from December, 2024 to May, 2025.

TASH, Ethiopia's largest specialized teaching and referral public hospital, is affiliated with Addis Ababa University. The hospital offers diagnosis and treatment for approximately 370,000-400,000 patients a year. The hospital receives patients who are referred from across the country as well as from Addis Ababa. This is the only hospital in the country with a dedicated vascular surgery center. This unit has around 15 beds and receives vascular case referrals from across the country. Additionally, this hospital has the country's first neurology training center with an established stroke unit which has 4 beds.

It was selected because it is the largest tertiary referral hospital and it was possible to obtain a sufficient number of patients that comes from different parts of Ethiopia.

4.2. Study Design

Tertiary hospital based cross-sectional study was conducted to determine clinical profile, prevalence and corelated factors of significant extra cranial carotid artery stenosis among ischemic stroke patients at TASH.

4.3. Source Population

All patients with diagnosis of stroke who came for follow up at TASH, neurology outpatient department or newly admitted to inpatient ward.

4.4. Study population

Adult patients with diagnosis of ischemic stroke or TIA who came for follow up at TASH neurology outpatient department or newly admitted to inpatient ward from November, 2024 to April, 2025.

4.5. Eligible criteria

4.5.1. Inclusion criteria

Patients with diagnosis of TIA or ischemic stroke in one of the ICA territories, and who were attend the OPD follow up or newly admitted to inpatient ward between November, 2024 to April, 2025.

4.5.2. Exclusion criteria

Patients with known source of cardio embolism, including history of atrial flutter, valvular heart disease or cardiac valve replacement, diagnosed by electrocardiography/ transesophageal /transthoracic echocardiography during hospitalization and follow up were excluded.

Patients with vertebrobasilar ischemic stroke, carotid artery dissection or vasculitis, and previous carotid endarterectomy or stenting were excluded too.

4.6. Sample size determination and sampling procedure

All consecutive patients with diagnosis of ischemic stroke and TIA who had undergone carotid doppler study during the study period and who fulfilled the inclusion criteria were included (**Fig 2.**).

4.7. Study variables

4.7.1. Independent variable

1. Socio demographic characteristics (age, sex, religion, and others)
2. Vascular risk factors
    1. Hypertension
    2. Diabetes mellitus
    3. Dyslipidemia
    4. Symptomatic PAD
    5. CAD
    6. Atrial fibrillation
    7. Current smoking
    8. Previous smoking
    9. Previous IHD
    10. Previous stroke
    11. Previous TIA

4.7.2. Dependent variable

- Occurrence of atherosclerotic significant extra cranial carotid artery stenosis

4.8. Operational definitions

Ischemic stroke was defined as the sudden onset of neurological dysfunction resulting from interruption of cerebral blood flow due to arterial occlusion, with symptoms persisting for more than 24 hours.

Transient ischemic attack (TIA) referred to a transient neurological deficit with stroke-like features that resolved within 24 hours**.**

Recurrent ischemic stroke/TIA described a new cerebrovascular event occurring after a prior ischemic stroke, following a period of clinical stability (typically ≥24 hours), and not attributable to progression of the initial infarct (52).

Central obesity (abdominal obesity) Central (abdominal) obesity was determined using waist-to-hip ratio (WHR), with cutoffs of ≥0.90 for men and ≥0.85 for women (53).

Regular exercise: was defined as at least 150–300 minutes of moderate-intensity aerobic exercise per week, or 75–150 minutes of vigorous-intensity activity, combined with muscle-strengthening exercises involving major muscle groups on two or more days weekly(54). Carotid artery stenosis (CAS) was described as atherosclerotic narrowing of the extracranial internal carotid artery (ICA) or carotid bifurcation. The severity of stenosis was graded as mild (<50%), moderate (50–69%), severe (70–99%), or total occlusion (100%) using the North American Symptomatic Carotid Endarterectomy Trial (NASCET) method, which compares the residual lumen (R) to the original vessel diameter (D): (D–R / D) × 100 which was begun in **1987** (55). Significant extracranial CAS was defined as stenosis of 50–100%. Degree of stenosis was assessed by radiologists using carotid Doppler ultrasound.

Peripheral arterial disease (PAD) was considered symptomatic in patients presenting with intermittent claudication or limb ischemia and an ankle–brachial index (ABI) < 0.9. Dyslipidemia, diabetes mellitus, atrial fibrillation, and hypertension were diagnosed based on documented medical history, discharge summaries, or follow-up clinical records.

4.9. Data Collection Tool

Data were collected from eligible patients identified by their medical record numbers among all stroke patients who presented for follow-up or were newly admitted to the stroke unit. Information was obtained through direct interviews using an interviewer-administered, semi-structured questionnaire in Amharic. The questionnaire included

questions on socio-demographic characteristics, type of stroke, anatomic location and degree of stenosis of CAS, and factors such as hypertension, diabetes mellitus, dyslipidemia, ischemic heart disease (IHD), smoking, and peripheral arterial disease (PAD). The wording and sequence of questions were designed to ensure a logical flow of ideas from general to specific and from easy to difficult questions. Information on socio-demographic characteristics such as sex, age, marital status, occupation, smoking status, and lifestyle-related factors was collected through face-to-face interviews. Both patient chart and I-care reviews were undertaken to gather clinical data. The questionnaire was pretested and modified accordingly. All data collectors were trained to ensure uniformity and minimize inter-observer bias during data collection. Data collectors included residents and interns from the departments of surgery, neurology, and internal medicine. The purpose and procedure of the study were explained to all study participants prior to data collection. Written informed consent was obtained from all study participants, and personal identifiers were not collected.

4.10. Data Quality Management

Prior to data collection, the data collectors received both theoretical and practical training on the study objectives, the use of the questionnaire, and data collection procedures. The training sessions were conducted by the principal investigator.

During the data collection phase, the principal investigator provided close supervision. Data were checked in real time for completeness and consistency, and questionnaires with missing information were returned to data collectors for correction through participant revisits.

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4.11. Data processing and analysis

Data Data were coded in EPI Data version 3.1 and analyzed in SPSS version 29. Continuous variables were summarized as mean ± SD or median (IQR), and categorical variables as frequencies and percentages. The prevalence of internal carotid artery (ICA) stenosis among patients with TIA or ischemic stroke was first determined. Associations between potential risk factors and significant ICA stenosis were evaluated using univariable analysis, with categorical

variables dichotomized based on clinical relevance. Variables with <5% missing data were included, and those with $p < 0.10$ in univariable analysis were entered into multivariable logistic regression; statistical significance was set at $p < 0.05$.

4.12. Ethical consideration

Ethical approval for this study was obtained from the Institutional Review Board of the Department of Surgery, School of Medicine, College of Health Sciences, Addis Ababa University, with the approval number DOSIREC/127/2025/2017. Additionally, permission to conduct the research and collect data was granted by Tikur Anbessa Specialized Hospital (TASH).

During data collection, each participant provided either written or oral informed consent after the study objectives were clearly explained. To ensure confidentiality, personal identifiers such as names were excluded from the questionnaire. Participants were informed that their involvement was voluntary and that any information provided, whether orally or in writing, would be used exclusively for research purposes and kept strictly confidential. The potential benefits of the study were explained, emphasizing that it posed no physical or invasive risk. Participants were also made aware of their right to decline participation or withdraw from the study at any time.

4.13. Result dissemination plan

The finding of the study will be disseminated to Department of surgery and neurology, Addis Ababa University, Ministry of Health, Addis Ababa City Health Bureau, and Tikur Anbessa Specialized Hospital. In addition, great efforts will be made to disseminate the results through presentation in different seminars, workshop, and scientific conference. Attempts will also be made to publish the information on reputable peer reviewed journal.

5. Result

5.1. Socio demographic characteristics

A total of 186 consecutive patients presenting with ischemic stroke or transient ischemic attack, who were either admitted to the hyperacute stroke unit or followed up at the neurology referral clinic, and who underwent carotid Doppler evaluation during the study period, were included in this analysis (**Figure 2**). The mean age of the patients was approximately 59 years (mean ± SD: 58.89 ± 14.07). Patients with significant carotid stenosis (50–100%) were slightly older (mean age 60.98 vs. 58.18 years) and had a higher proportion of females (57.5% vs. 46.6%) compared to those with less than 50% stenosis or no stenosis (n = 146). Overall, the gender distribution was nearly balanced, with 48.9% male and 51.1% female patients. While urban residency was more common overall, a greater proportion of patients with significant stenosis lived in rural areas (20% vs. 8.9%). Unemployment was more prevalent among patients with mild or no stenosis (54.8%), whereas those with significant stenosis were engaged in a wider range of occupations (**Table 1**).

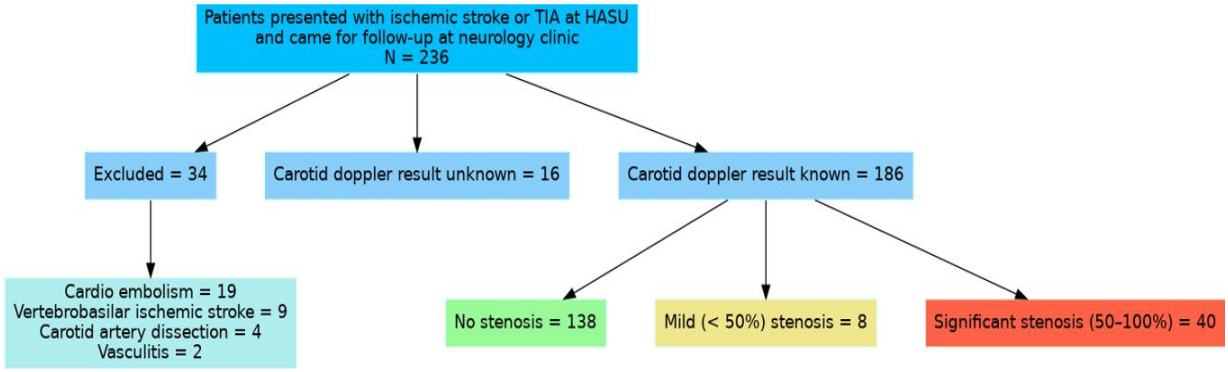

Fig 2: flow chart of patients with significant CAS

Table 1: Socio demographic characteristics of included ischemic stroke patients stratified by degree of stenosis, n= 186

Variables	Categories	**Total, n (%)**	**50–100% stenosis (n=40)**	**<50% or no stenosis (n=146)**

Age	(mean ± SD)	58.89±14.07	60.98±12.89	58.18±14.38
Sex	Male	91 (48.9%)	17 (42.5%)	78 (53.4%)
	Female	97 (51.1%)	23 (57.5%)	68 (46.6%)
Education	Illiterate	69 (37.1%)	22 (55.0%)	47 (32.2%)
	Literate*	117 (62.9%)	18 (45.0%)	99 (67.8%)
Marital status	Single	10 (5.4%)	2 (5.0%)	8 (5.5%)
	Married	143 (76.9%)	32 (80.0%)	111 (76.0%)
	Divorced	10 (5.4%)	1 (2.5%)	9 (6.2%)
	Widowed	23 (12.4%)	5 (12.5%)	18 (12.3%)
Religion	Orthodox	147 (79.0%)	8 (20.0%)	18 (12.3%)
	Muslim	26 (14.0%)	29 (72.5%)	118 (80.8%)
	Other (Protestant, Catholic)	13 (7.0%)	3 (7.5%)	10 (6.8%)
Residency	Rural	21 (11.3%)	8 (20.0%)	13 (8.9%)
	Urban	165 (88.7%)	32 (80.0%)	133 (91.1%)
Occupation	Unemployed	102 (54.8%)	6 (15.0%)	3 (2.1%)
	Business	9 (4.8%)	7 (17.5%)	26 (17.8%)
	Farmer	10 (5.4%)	3 (7.5%)	7 (4.8%)
	Employed	33 (17.7%)	3 (7.5%)	0 (0.0%)
	Retired	30 (16.1%)	7 (17.5%)	22 (15.1%)

Note: *Someone who can, with understanding, both read and write a short, simple statement about their everyday life.

5.2. Prevalence and anatomic distribution extracranial carotid stenosis

The overall prevalence of significant extracranial carotid stenosis among ischemic stroke and TIA patients was 21.5%. Among the 40 patients identified with extracranial carotid stenosis, the internal carotid artery (ICA) was most frequently affected (67.5%), followed by involvement of both the ICA and carotid bifurcation (17.5%), and bifurcation alone (15%). Moderate stenosis (50–69%) was most common, particularly in unilateral cases, which represented 60% of the cohort. Severe stenosis (≥70%) and complete occlusion were less frequently observed, and no instances of bilateral complete occlusion were reported (Table 2).

Table 2: Anatomic distribution of extracranial carotid stenosis of based on doppler imaging finding, n= 40

	Total, n=40 (%)	Moderate (50%–69%) Stenosis (n, %)	Severe (≥70%)	Complete occlusion

				Stenosis (n, %)	
Affected artery	ICA	27 (67.5%)	18 (45.0%)	7 (17.5%)	2 (5.0%)
	Carotid bifurcation	6 (15.0%)	2 (5.0%)	4 (10.0%)	0 (0.0%)
	Both bifurcation and ICA	7 (17.5%)	4 (10.0%)	2 (5.0%)	1 (2.5%)
Location	Unilateral	32 (80.0%)	19 (47.5%)	10 (25.0%)	3 (7.5%)
	Bilateral	8 (20.0%)	5 (12.5%)	3 (7.5%)	0 (0.0%)

ICA: Internal Carotid Artery

5.3. Distribution of diagnosis and clinical presentation stratified by degree of carotid artery stenosis

Among the 186 patients evaluated, ischemic stroke was the predominant diagnosis, accounting for 164 cases (88.2%), while transient ischemic attack (TIA) was identified in 22 patients (11.8%). Among patients with significant carotid artery stenosis (≥50%), 4.3% had a diagnosis of TIA and 17.2% had ischemic stroke. Recurrent cerebrovascular events were notably higher in those with significant stenosis (22.5% vs 12.3%). Clinically, hemiparesis was the most prevalent symptom (75.3%) across both groups, followed by aphasia (22.6%) and dysarthria (19.4%). Carotid bruit was exclusively found in patients with significant stenosis, present in 85% of that subgroup **(Table 3).**

Table 3: Distribution of diagnosis and clinical presentation stratified by degree of carotid artery stenosis: n= 186

Variables	Categories	**Total, N (%)**	**Significant stenosis (n=40)**	**No or /<50 % stenosis (n=146)**
Diagnosis	TIA	22 (11.8%)	8 (4.3%)	14 (7.5%)
	Ischemic stroke	164 (88.2%)	32 (17.2%)	132 (70.9%)
	Frist ever	159 (85.5%)	31 (16.7%)	128 (68.8%)
	Recurrent	27 (14.5%)	9 (4.8%)	18 (9.7%)
Clinical presentation	Hemiparesis	140 (75.3%)	28 (15.1%)	112 (60.2%)
	Hemiplegia	28 (15.1%)	8 (4.3%)	20 (10.8%)
	Altered mentation	13 (7.0%)	7 (3.8%)	6 (3.2%)
	Dysarthria	36 (19.4%)	15 (8.1%)	21 (11.3%)
	Aphasia	42 (22.6%)	9 (4.8%)	23 (12.4%)
	Loss of vision	7 (3.8%)	2 (1.1%)	5 (2.7%)
	Carotid bruit	34 (18.3%)	34 (18.3%)	0 (0.0%)

5.4. Frequency of vascular risk factors of carotid artery stenosis

Among vascular risk factors, dyslipidemia (90% vs. 65.8%), central obesity (65% vs. 35.6%), and coronary artery disease (22.5% vs. 11%) were notably more frequent in patients with significant carotid artery stenosis. Although hypertension was common overall (78.5%), it was slightly less prevalent in the ≥50% stenosis group. Recurrent cerebrovascular events were also more frequent in patients with significant stenosis (22.5% vs. 12.3%), while regular physical activity was markedly lower in this group (5% vs. 13%) (**Table 4).**

Table 4: **Distribution of vascular risk factors stratified by degree of carotid artery stenosis**

Variables	Categories	**Total, n (%)**	**50–100% stenosis (n=40)**	**<50% or no stenosis**
Diabetes Mellitus	Yes	29 (15.6%)	5 (12.5%)	24 (16.4%)
Hypertension	Yes	146 (78.5%)	28 (70.0%)	118 (80.8%)
CAD/IHD	Yes	25 (13.4%)	9 (22.5%)	16 (11.0%)
Atrial fibrillation	Yes	9 (4.8%)	1 (2.5%)	8 (5.5%)
Dyslipidemia	Yes	132 (71.0%)	36 (90.0%)	96 (65.8%)
Symptomatic PAD	Yes	7 (3.8%)	4 (10.0%)	3 (2.1%)
Smoking (stopped)	Yes	8 (4.3%)	3 (7.5%)	5 (3.4%)
Family history of stroke	Yes	2 (1.1%)	0 (0.0%)	2 (1.4%)
Regular Exercise	Yes	21 (11.3%)	2 (5.0%)	19 (13.0%)
Central obesity based on WHR	Yes	78 (41.9%)	26 (65.0%)	52 (35.6%)

Note: TIA – Transient Ischemic Attack, CAD – Coronary Artery Disease, IHD – Ischemic Heart Disease, PAD – Peripheral Artery Disease, WHR:Waist-to-Hip Ratio i.e. men ≥ 0.9 and women ≥0.85

5.5. Risk factors associations with significant carotid artery stenosis

Bivariant and multivariant analyses were conducted and revealed several significant associations between risk factors and the presence of significant carotid artery stenosis. Male sex was associated with significantly lower odds of CAS compared to females (AOR = 0.339; 95% CI: 0.139–0.800; $p = 0.020$). Patients with hypertension had over three times higher odds of significant CAS than those without hypertension (AOR = 3.458; 95% CI: 1.304–9.421; $p = 0.014$). Dyslipidemia emerged as a strong predictor, with affected individuals having nearly seven times the odds of CAS (AOR = 6.789; 95% CI: 2.017–22.848; $p = 0.004$). Interestingly, individuals with coronary artery disease (CAD) or peripheral artery disease (PAD) had significantly lower odds of CAS (AORs = 0.228 and 0.145 respectively; $p < 0.05$ for both). was inversely associated with CAS (AOR = 0.365; 95% CI: 0.162–0.835; $p = 0.016$). Other vascular risk factors including age, regular exercise activity, smoking, central obesity, history of TIA or ischemic stroke were not significantly associated with CAS in this study **(Table 5).**

Table 5: Bivariable and multivariable analyses to measure associations between variables and significant carotid artery stenosis (50–100%)

Risk Factor	Category	**50–100% stenosis (n=40)**	**<50% or no stenosis (n=146)**	**AOR**	**p-value**
Sex	Female	14 (35.0%)	66 (45.2%)	**1**	
	Male	26 (65.0%)	80 (54.8%)	0.339 (0.139–0.800)	**0.020**
Hypertension	No	12 (30.0%)	28 (19.2%)	1	
	Yes	28 (70.0%)	118 (80.8%)	3.458 (1.304–9.421)	**0.014**
Dyslipidemia	No	4 (10.0%)	50 (34.2%)	1	
	Yes	36 (90.0%)	96 (65.8%)	6.789 (2.017–22.848)	**0.004**
CAD/IHD	No	31 (77.5%)	130 (89.0%)	1	
	Yes	9 (22.5%)	16 (11.0%)	0.228 (0.072–0.682)	**0.011**
Symptomatic PAD	No	36 (90.0%)	143 (97.9%)	1	
	Yes	4 (10.0%)	3 (2.1%)	0.145 (0.027–0.761)	**0.024**
DM	No	35 (87.5%)	122 (83.6%)	1	
	Yes	5 (12.5%)	24 (16.4%)	3.577 (1.029–13.726)	0.061

Note: TIA – Transient Ischemic Attack, CAD – Coronary Artery Disease, IHD – Ischemic Heart Disease, PAD – Peripheral Artery Disease, DM- Diabetes Mellitus

6. Discussion

In this study, 186 patients with ischemic stroke or transient ischemic attack (TIA) who underwent carotid Doppler evaluation prospectively over six month (from November 1, 2024 to April 30, 2025) were included. The overall prevalence of significant extracranial carotid artery stenosis (CAS ≥50%) was 21.5%. Patients with significant CAS were slightly older, more likely to be female (57.5% vs. 46.6%), and more frequently lived in rural areas (20% vs. 8.9%) compared to those with no or mild stenosis. Ischemic stroke accounted for the majority of diagnoses (88.2%), with hemiparesis being the most common clinical presentation on both groups. The internal carotid artery was the most commonly affected segment (67.5%), and moderate unilateral stenosis predominated. Risk factors significantly associated with CAS included female sex, hypertension, and dyslipidemia. Dyslipidemia showing the strongest association (AOR = 6.789, p = 0.004).

6.1. Prevalence and anatomic distribution extracranial carotid stenosis among ischemic stroke and TIA patients

The present study found a 21.5% prevalence of significant extracranial carotid stenosis (≥50%) among patients with ischemic stroke or TIA. This finding is consistent with earlier estimates from studies conducted in developed countries, where the prevalence ranged from 15% to 20% (21). Mettananda et al. (2021) in Sri Lanka reported a prevalence of 20.4% (13), while Cheng et al. (2019) in the UK found a prevalence of 22.8% among ischemic stroke patients(46). Similarly, van Velzen et al. (2021) in the Netherlands observed significant CAS in about 18% of stroke patients(21). These findings collectively highlight a consistent burden of carotid atherosclerosis across diverse geographic and socioeconomic settings, reinforcing the importance of vascular imaging in the stroke workup.

Regionally, studies from other low- and middle-income countries show variable prevalence rates, often influenced by differences in methodology, population risk profiles, and diagnostic access. A study from Egypt by Khedr et al. (2021) found a significant CAS prevalence of 16%(47), while in Cameroon, Ntone et al. (2016) reported 15.6% (50). Interestingly, the current study demonstrated a relatively higher prevalence compared to other reports from Sub-Saharan Africa, including 12.5% reported by Walubembe et al. in Uganda (51) and approximately 6% reported by Connor (2012) in South Africa(48). This may suggest a possible upward trend or reflect increased diagnostic vigilance in tertiary care centers.

The internal carotid artery (ICA) was the most frequently involved vessel segment (67.5%), which is consistent with multiple studies highlighting the ICA as the predominant site of atherosclerotic involvement, as reported by Flaherty et al. in 2012(21). The predominance of moderate, unilateral stenosis in our study also aligns with findings from Brok et al. (2020), who reported that moderate, unilateral involvement constituted the majority of carotid artery stenosis (CAS) presentations (44). The predominance of moderate stenosis (50–69%), particularly unilateral cases (80%), is somewhat consistent with the Egyptian hospital-based study, where 40.5% of patients had less than 70% stenosis (47). However, our rates of severe

stenosis and total occlusion were lower than those reported in the same Egyptian cohort (23.8% ≥70%) and in the Indian population, where 10% had severe stenosis (20).

6.2. Risk factors for carotid artery stenosis among ischemic stroke and TIA patients

1. Age and Sex

Although age was not a statistically significant independent predictor in our multivariable model, patients with significant carotid artery stenosis (CAS) were slightly older (mean age 60.98 vs. 58.18 years), suggesting a possible trend. This aligns with findings from the Tromsø Study by Mathiesen et al., which reported a strong association between increasing age and CAS ($p = 0.0001$) (22). Similarly, Rajesh et al. in a cross-sectional study from India found a progressive increase in CAS prevalence with age 30% in those under 50, 43% in the 50–69 age group, and 53% in those over 60 (20).

In contrast to much of the existing literature, our study found that male sex was associated with significantly lower odds of CAS (AOR = 0.339; 95% CI: 0.139–0.800; $p = 0.020$). This is in direct contradiction to findings from the PASS sub study by Twan et al., where male sex was a strong predictor of CAS ($p < 0.001$) (21). Similarly, Rajesh et al. reported a slightly higher prevalence of CAS in males (46%) compared to females (44%) (20). These divergent findings may reflect local sociocultural, biological, or healthcare access differences and warrant further investigation.

2. Hypertension

Hypertension was found to be a significant independent risk factor for CAS in this study, with hypertensive individuals having over three times higher odds of significant stenosis (AOR = 3.458; 95% CI: 1.304–9.421; $p = 0.014$). This finding is consistent with prior studies: the PASS sub study identified hypertension as a significant predictor ($p = 0.016$) (21), as did the Tromsø Study ($p = 0.04$) (22), and Rajesh et al., who found higher CAS prevalence among hypertensives (57%) compared to normotensives (32%) (20). Similarly, studies by Ahmed et al. in Egypt (74.8%) and Aminde et al. in Cameroon (60%) reported hypertension as the most prevalent risk factor for CAS

among ischemic stroke patients (45,47). These findings consistently underscore the critical role of blood pressure control in stroke prevention.

3. Dyslipidemia

Our analysis identified dyslipidemia as a strong and statistically significant predictor of CAS, with nearly sevenfold increased odds among affected individuals (AOR = 6.789; 95% CI: 2.017–22.848; p = 0.004). This is in strong agreement with previous studies: the Tromsø Study reported a significant association (p = 0.001) (22), and Rajesh et al. found high prevalence rates of hypercholesterolemia (64%), elevated LDL (67%), and low HDL (80%) in patients with CAS (20). Additionally, Ahmed et al. documented hyperlipidemia in 70.6% of stroke patients (47). These consistent results reinforce the importance of lipid management in preventing carotid atherosclerosis.

4. Coronary Artery Disease (CAD)

Interestingly, our study found an inverse association between CAD and CAS, with CAD patients having significantly lower odds of CAS (AOR = 0.228; $p < 0.05$). This finding contradicts that of the Tromsø Study, which identified previous coronary heart disease as a significant predictor (p = 0.03) (22). A plausible explanation may be that patients with established CAD are more likely to be on secondary preventive therapies, such as statins and antiplatelets, which could mitigate the progression of atherosclerosis in the carotid arteries. Alternatively, variations in diagnostic practices or residual confounding could also play a role.

Strength and Limitation of the study

One of the main strengths of this research is its cross-sectional design, which provides a clearer snapshot of disease patterns compared to many earlier studies that primarily relied on retrospective data. Another advantage is the inclusion of a comparatively large cohort (n=186) for a single-center study, improving the credibility of the results and making them more applicable both to the national population and to other settings with limited resources.

Despite these strengths, the study also has some limitations. Since it was carried out at a single tertiary hospital where patients present with varied clinical and risk factor profiles, the results may not fully reflect the wider population. Moreover, because carotid Doppler examinations

were interpreted by multiple radiologists, some degree of inter-observer variation in identifying and grading carotid stenosis may have influenced the findings.

Conclusion and recommendation

In this study, 186 patients with ischemic stroke or TIA who underwent carotid Doppler evaluation were analyzed. Significant extracranial carotid stenosis was detected in 21.5% of cases, with the internal carotid artery (ICA) identified as the most frequent site of involvement. Patients with marked stenosis demonstrated a higher rate of recurrent cerebrovascular events. Hypertension and dyslipidemia emerged as major, modifiable contributors to disease progression, emphasizing the importance of early detection and targeted preventive strategies. Carotid Doppler ultrasonography proved valuable not only for diagnosing atherosclerotic disease but also for guiding stroke prevention strategies. These results are expected to inform evidence-based management protocols and strengthen surgical and interventional practices for carotid artery stenosis at Tikur Anbessa Specialized Hospital (TASH), Ethiopia's only vascular surgery training center. This work also lays a foundation for future investigations in this underexplored field.

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Annex I: English version Informed Consent

Addis Ababa University, School of Medicine, Department of Surgery, Vascular and Endovascular Surgery Unit.

Subject Information Sheet

Hello,

My name is ———————————————— I am here on behalf of Dr.Mulugeta Taeme, a student in Addis Ababa University Department of Surgery, Vascular and Endovascular Surgery Unit. He is conducting research on "clinical profile, prevalence and correlated factors of carotid artery stenosis among ischemic stroke patients". He has received permission from Addis Ababa University School of Medicine.

You are selected to participate in this study because you are currently on follow up and fulfill the inclusion criterion during the research conducting period. Your participation on this study will only be on based on your willingness. You have the right to choose not to take part in this study. If you choose to take part, you have the right to stop at any time. If you are willing to participate or refuse or decide to withdraw later, you will not be subjected to any ill-treatment.

If you agree to participate in the study, your weight and height will be measured. You will also be interviewed about socio-demographic status, base line clinical data and your health-related quality of life related questions. You can stop at any time if you don't feel comfortable during an interview and measurement process. The measurement and filling the questionnaire will take about 10 minutes.

This study will help to assess the occurrence of CAS disease and any correlated factors with it. This will help us to design management protocol to prevent stroke recurrence. The information that you provide will be kept confidential by using only code numbers and locking the data. Your name will not be written on the questionnaire. No one will have access to the non-coded data except the principal investigator and the data will not be used for purposes other than the study. Your willingness and active participation is very important for the success of this study.

Informed Consent and/or Ascent Form

Based on the understanding of the above information, are you willing to participate in this study?

A) Yes

B) No

If yes, I will continue and

If no, I will skip to next participant after writing the reasons of refusal ————————————

Respondent

Signature _____Date_____

Data collector

Name_____ Signature_____

Questionnaires ID number_____

Date of data collected_____

Result of data collected

A) Completed

B) Not completed

C) Partially completed

D) Refused

Checked by Supervisor: Name _____Signature_____

For further explanation, use the Principal Investigator's Address;

Name: Dr. Mulugeta Taeme

Email: mullerab1988@gmail.com

Phone no.: +251 904690867

Annex II: English Version Questionnaire

Part 1. Socio-Demographic Data

No.	Questions	Responses	Code
1	Age	_____years	
2	Sex	1. Male 2. Female	
3	Marital status	1. Single 2. Married 3. Divorced 4. Widowed 5. other_____	
4	Religion	1. Orthodox 2. Muslim 3. Protestant 4. Catholic 5. Other_____	
5	Residency	1. Urban 2. Rural	
6	Educational level	1. Can't read or write 2. Can read or write 3. Primary school 4. Secondary school 5. College/tertiary school	
7	Occupation	1. Unemployed 2. Business 3. Farmer 4. Student 5. Employed 6. Retired 7. Others (Specify) _____	
8	Monthly income	1. <10,000 2. 10,000-50000 3.>50,000	

Part 2. Clinical Data

No.	Questions	Responses	Code
9	**Clinical presentation**	**1. Hemiparesis** **2. Hemiplegia** **3. Altered mentation** **4. Dysarthria** **5. Aphasia** **6. Loss of vision** **7. Carotid bruit**	
10	**Type of imaging**	**1. CT** **2. MRI** **3. CTA** **4. MRA** **5. None of are done**	
11	Diagnosis	1. TIA 2. Ischemic stroke 3. Amaurosis fugax 4. Retinal ischemic stroke	
12	Type of diagnosis	1. Frist ever 2. Recurrent	
13	Is TOAST criteria used for diagnosis	1. Yes 2. No	
14	Is carotid doppler done already	1. Yes 2. No	
15	CAS diagnosed using carotid DUS	1. Yes 2. No	
16	Degree of CAS (%) if there is CAS diagnosed	1.normal 2. mild (<50%) 2. moderate (50-69%) 3. severe (70-90%) 4. near occlusion (>90) 5. complete oclussion	
17	Location of CAS	1. Common carotid artery 2. Carotid artery bifurcation	

		3. Extra cranial ICA	
18	Side of CAS	1. Unilateral 2. Bilateral	
19	Is carotid intimal medial thickness measured during Doppler study	1. Yes, measured and normal 2. Yes, measured and abnormal 3. Not measured	
20	Surgical intervention	1. CEA 2. CS 3. Not done	
21	Vertebral artery doppler study finding	1. Normal 2. Abnormal 3. Not done	
22	History of comorbidity	1. Yes 2. No	
23	Types of comorbidities	1. Diabetes Mellitus 2. Hypertension, 3. Coronary artery disease/IHD 4.Atrial fibrillation 5. Dyslipidemia 6. Symptomatic PAD 7. sleep apnea	
24	Types of Dyslipidemia	1. Triglycerides 2. Total cholesterol 3. HDL cholesterol 4. LDL	
25	History of smoking	1. Yes 2. No	
	If yes, Type of smoking	1. Cigarettes 2. Roll-your-own 3. Shisha: 4. E-cigarettes and vaping 5. Cigars 6. Pipe smoking 7. Smokeless tobacco	
26	If yes, are your active smoker?	1.Yes 2.No	
27	If you are smoker, for how long you have been smoked (pack year)	----------	
28			

29	Family history of stroke	1. Yes 2. No	
30	History of drinking alcohol	1.Yes 2. No	
31	Regular Exercise	1. Yes 2. No	
32	Waist circumference	____cm	
33	Hip circumference	_____cm	
34	Ratio of W/H	____	

Annex III: Amharic Version Informed Consent

Addis Ababa University, School of Medicine, Department of Surgery, Vascular and Endovascular Surgery Unit.

ስሜ ———————————————————— እዚህ የመጣሁት ዶ/ር ሙሉጌታ ጣዕመ ወክዬ አዲስ አበባ ዩኒቨርሲቲ የቀዶ ሕክምና ክፍል፣ የደም ሥር እና የደም ቧንቧ ቀዶ ሕክምና ክፍል ተማሪ። "የአንጎል ደም ወሳጅ ቧንቧ ጥበት እና ተያያዥ የጤና እንከኖች" ላይ ጥናት እያካሄደ ነው። ከአዲስ አበባ ዩኒቨርሲቲ የሕክምና ትምህርት ቤት ፈቃድ አግኝቷል።

በዚህ ጥናት ላይ ለመሳተፍ ተመርጠዋል ምክንያቱም በአሁኑ ጊዜ ክትትል ላይ ስለሆኑ እና በምርምር ጊዜ የማካተት መስፈርቱን አሟልተዋል ። በዚህ ጥናት ላይ ያለዎት ተሳትፎ በእርስዎ ፍላጎት ላይ የተመሰረተ ብቻ ይሆናል። በዚህ ጥናት ውስጥ ላለመሳተፍ የመምረጥ መብት አልዎት። ለመሳተፍ ከመረጡ በማንኛውም ጊዜ ለማቆም መብት አልዎት። ለመሳተፍ ፈቃደኛ ከሆኑ ወይም እምቢ ካሉ ወይም በኋላ ለመውጣት ከወሰኑ ምንም አይነት በደል አይደርስብዎትም።

በጥናቱ ለመሳተፍ ከተስማሙ ክብደትዎ፣ ቁመትዎ ይለካሉ። እንዲሁም ስለ ሶሺዮ-ስነ-ሕዝብ ሁኔታ፣ ስለ መሰረታዊ ክሊኒካዊ መረጃ እና ከጤና ጋር የተገናኙ የህይወት ጥራት ጥያቄዎችን በተመለከተ ቃለ መጠይቅ ይደረግልዎታል። በቃለ መጠይቅ እና በመለኪያ ሂደት ውስጥ ምቾት የማይሰማዎት ከሆነ በማንኛውም ጊዜ ማቆም ይችላሉ. መለኪያው እና መጠይቁን መሙላት 15 ደቂቃ ያህል ይወስዳል።

ይህ ጥናት የስትሮክ ተጠቂ በሆኑ ታካሚዎች ላይ የአንጎል ደም ወሳጅ ቧንቧ ጥበት ምን ያህል መንስዔ እንደሆነ ለማወቅ ከማስቻሉ ባሻገር የቀዶ ህክምናውን ጥራትን ለማሻሻል ፕሮቶኮልን ለመንደፍ ይረዳናል. ያቀረቡት መረጃ ኮድ ቁጥሮችን ብቻ በመጠቀም እና ውሂቡን በመቆለፍ በሚስጥር ይጠበቃል። ስምህ በመጠይቁ ላይ አይጻፍም። ከዋናው መርማሪ በስተቀር ማንም ሰው ኮድ ያልሆነውን መረጃ ማግኘት አይችልም እና ውሂቡ ከጥናቱ ውጭ ለሌላ ዓላማዎች ጥቅም ላይ አይውልም። ለዚህ ጥናት ስኬት የእርስዎ ፍላጎት እና ንቁ ተሳትፎ በጣም አስፈላጊ ነው።

በመረጃ የተደገፈ ስምምነት እና/ወይም የመውጣት ቅጽ

ከላይ ባለው መረጃ መረዳት ላይ በመመስረት፣ በዚህ ጥናት ውስጥ ለመሳተፍ ፈቃደኛ ነዎት?

ሀ) አዎ

ለ) አይ

አዎ ከሆነ እቀጥላለሁ እና

አይደለም ከሆነ፣የእምቢታ ምክንያቶችን ከጻፍኩ በኋላ ወደ ቀጣዩ ተሳታፊ እዘልላለሁ ———

_____ _____

ምላሽ ሰጪ

ፊርማ ____ ቀን____

መረጃ ሰብሳቢ ስም _____ ፊርማ _____

መጠይቆች መታወቂያ ቁጥር _____

የተሰበሰበ መረጃ ቀን _____

የተሰበሰበ መረጃ ውጤት

ሀ) ተጠናቀቀ

ለ) አልተጠናቀቀም

ሐ) በከፊል የተጠናቀቀ

መ) እምቢ አለ።

በተቆጣጣሪ የተረጋገጠ፡ ስም _____ ፊርማ ___

ለበለጠ ማብራሪያ የዋናውን መርማሪ አድራሻ ተጠቀም፤

ስም፡ ዶ/ር ሙሉጌታ ጣዕመ

ኢሜል፡- mullerab1988@gmail.com

ስልክ ቁጥር፡ +251 904690867

Annex IV Amharic Version of Questionnaire

የአንጎል ደም ወሳጅ ቧንቧ ጥበት እና ተያያዥ የጤና እንከኖች የሚዳስሱ ጥያቄዎች

ክፍል አን ድ:- የማህበራዊ ሁኔታ የሚዳሰሱ ጥያቄዎች		
ጥያቄ	Coding categories	Code
1. እድሜ	……	
2. ጾታ	1. ወንድ 2. ሴት	
3. የጋብቻ ሁኔታ	1. ያገባ /ች 4. የሞተበት/ባት 2. ያላገባ/ች 5. ሌላ ካለ…… 3. የፈታ/ች	
4. ሐይማኖት?	1. ኦርቶዶክስ 4. ካቶሊክ 2. ሙስሊም 5. ሌላ ካለ ይጥቀሱ…… 3. ፕሮቴስታንት	
5. የመኖሪያ ቦታ?	1. ከተማ 2. ገጠር	
6. የትምህርት ደረጃ	1. ማንበብ እና መፅሐፍ የማይችል/ት 2. ማንበብ እና መፅሐፍ የሚችል/ት 3. የመጀመራ ደረጃ 4. ሁለተኛ ደረጃ 5. ድፕሎማ ወይም ከዛ በላይ	
7. የሥራ ሁኔታ?	1. የግል ስራ 6. ሲራ የለለ 2. የመንግስት ሰራተኛ 7. ጦረታ የወጣ 3. ገበሬ 8. ሌላ ካለ _____ 4. የንግድ ስራ 5. መንግስታዊ ያልሆነ ስራ	
8. ወርሐዊ አማካይ የቤት ገቢ?	1. <10,000 2. 10,000-50000 3.>50,000	
9. ይህ ስትሮክ የመጀመሪያ ነዉ ወይስ ሁለተኛ?	1. መጀመሪያ 2. ሁለተኛ	

10. ሲጋራ አጭሰው ያውቃሉ?	1. አወ 2. አላውቅም	
11. አሁን ያጨሳሉ ወይስ አቁመዋል ?	1. አሁንም አጨሳለው 2. አቁሜያለሁ	
12. ለምን ያህል ጊዜ ና በቀን ሰንት ሲጋራ ያጨሳሉ / እያጨሱ ነበር?	----------	
13. ከቤተሰቦቻቸው መካከል በስትሮክ የተጠቃ አለ?	1. አወ አለ ፣ 2. የለም	
14. የአልኮል መጠጥ ተጠቃሚ ነወት?	1. አዎ 2. አይደለሁም	
15. ተጠቃሚ ከሆኑ ምን ያህል ይጠጣሉ ?	1. አልፎ አልፎ ፣ 2. በመጠኑ፣ 3. ሁልጊዜ	
16. የአካል እንቅስቃሴ ያደረጉ ነበር ?	1. አዎ 2. አደርጌ አላቅም	

መረጃ ሰብሳቢዉ ስም _____

ፈርማ _____

Declaration

I, Mulugeta Taeme, do hereby declare that this research proposal is a result of the works of my own making except where due is made in a review of previous literature in the content and by my knowledge, has never been submitted for any prior academic award or qualification in this Institution.

Mulugeta Taeme
Signed: _____
Date: Aug 25, 2025

Email: mullerab1988@gmail.com
Phone: +251904690867

Department of Surgery, Vascular Unit Approval

The undersigned have examined the thesis report entitled *"*Extracranial Carotid Artery Stenosis Among Ischemic Stroke and Transient Ischemic Attack Patients at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia: A Cross-Sectional Study*"* presented by Dr. Mulugeta Taeme, with registration number GSR/9470/16, a candidate for the Fellowship Certificate in Vascular and Endovascular Surgery and hereby certify that it is worthy of acceptance.

Advisors:

Dr. Henok T/Selassie
Sign: _____
Date: Aug 25, 2025

Dr.Yared Mamushet
Sign: _____
Date: Aug 25, 2025

External evaluater

Prof. Nebyou Seyoum

Sign: _____

Date: Aug 25, 2025

Dr Dawit Gebregiorgis

Sign: _____

Date: Aug 25, 2025

Department of Surgery Research and Ethics Committee

Sign: _____
Date: _____