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On current risk factors associated with stroke types across gender and age in Southern Nigeria

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Abstract. Stroke is the second leading cause of death worldwide, and remains one of the main causes of death in Nigeria, with its economic impact on the rise. Over the years, hospital-based studies in Nigeria often only report the traditional risk factors, with high blood pressure as the leading risk factor for cardiovascular disease, particularly stroke, in the country, without reporting any infectious risk factors. In this study, we will statistically assess all probable traditional and infectious risk factors associated with stroke. We aim to identify the current significant risk factors related to the prevalent type of stroke in Nigeria. This was a retrospective study conducted at a tertiary referral hospital, Federal Medical Centre (FMC), in Asaba, Delta State, Nigeria. We conducted a retrospective audit of medical records from 2019 to 2022 for adult stroke patients admitted to the medical ward. Data extracted included demographic characteristics, clinical variables, and relevant data. Identified risk factors associated with stroke types across gender and age were investigated using multinomial logistic regression. From the result, out of the recorded 907 stroke patients, 457 (50.39%) were female, while 450 (49.61%) were males. The age group (61-80) had more recorded cases totaling 426(47%). Hypertension, diabetes mellitus, heart disease, malaria, and pneumonia were the significant risk factors associated with the prevalent stroke type. Therefore, there is a need to step up measures aimed at increasing public awareness of emerging infectious risk factors associated with stroke and effective preventive measures. Prioritizing interventions directed towards cost-effective treatment of hospitalized stroke patients is imperative as this will hopefully improve the overall outcomes in resource-constrained settings such as Nigeria.

Keywords: Stroke types; traditional risk factors; infectious risk factors; multinomial logistic regression.

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1. Introduction

A stroke is a sudden condition that leads to several related physical and cognitive impacts such as challenges with mobility, difficulty in communication, memory loss, depression, and sometimes being bedridden. It is an acute fo-

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cal brain dysfunction originating from vessels and lasting 24 hours or longer. (Saengsuwan and Suangpho, 2019). According to the classification of the American Heart Association (AHA) report, the two major categories of strokes are ischemic and hemorrhagic stroke. Ischemic stroke, the most prevalent type, occurs from decreased or obstructed blood supply to the brain tissues, while hemorrhagic stroke occurs due to the burst of weakened blood vessels within the brain (Rink and Khanna, 2011). In Africa, the yearly incidence rate of stroke is about 316 cases per 100,000 person-years, while the prevalence rate is about 1,460 cases per 100,000 person-years (Akinyemi et al., 2021). Also, Africa has a 3-year fatality rate greater than 80%, with stroke-related deaths being about 5.5% to 11% of mortality (Akinyemi et al., 2021). Current evidence indicates that Africa could have up to 2-3-fold greater rates of stroke incidence and higher stroke prevalence than Western Europe and the USA (Tamer et al., 2020). The increase in stroke burden in Africa is being driven mostly by growing trends in the prevalence of modifiable risk factors (which include smoking, hypertension, dyslipidemia, hyperlipidemia, diabetes, poor diet, abdominal obesity, physical inactivity, atrial fibrillation, high salt intake), and also regulated by non-modifiable risk factors (such as race, sex, age, geographic locations, and heredity) (Onwuakagba et al., 2023). Nigeria, similar to many other low-income and middle-income countries in Sub-Saharan Africa, has been experiencing a significant increase in stroke burden with an estimated yearly incidence rate of 1.14 per 1000 persons/year (Moghtaderi and Alavi-Naini, 2012). The increasing number of cardiovascular diseases (CVD), especially stroke, is partly attributed to the growing presence of both modifiable and non-modifiable risk factors. Additionally, urbanization and the adoption of Western lifestyles, characterized by sedentary lifestyles, harmful habits like tobacco and alcohol consumption, and high fat/cholesterol diets, also contribute to this rise. (Omigbile et al., 2023; Ike and Onyema, 2020). Stroke remains a leading cause of physical or mental impairment, and the second most common cause of death globally and is associated with substantial economic costs for the sufferers, and families (Onwuakagba et al., 2023; Teh et al., 2018). Surprisingly, the consequences on patients and their families are often unexplainable and can even be referred to as tragic because of the enormous psychological, social, and financial burden associated with stroke.

Several hospital-based studies in Nigeria have documented cardiovascular disease, particularly stroke, as the most common cause of neurological admissions and medical coma (Talabi, 2003; Ojini and Danesi, 2003; Ogun et al., 2005; Ekenze et al., 2010; Eze and Kalu, 2014; Kayode-Iyasere et al., 2019; Arabambi et al., 2021; Osuegbu et al., 2021; Nwazor et al., 2024). The common risk factors identified by these hospital-based studies in Nigeria are high blood pressure, diabetes, consuming tobacco products, physical inactivity, unhealthy diet, and aging. While traditional cardiovascular risk factors had been reported as common causes for most strokes in Nigeria, Sub-Saharan Africa and other parts of the globe, infectious pathogens have also been reported to increase the risk, and in some cases, have a direct causal role (Moghtaderi and Alavi-Naini, 2012; Jennifer and Fugate, 2020; Hameed et al., 2024). Important examples of infectious pathogens or infectious diseases of stroke (i.e. parasitic, bacterial, viral, or fungal infections) that can result in stroke include cerebral malaria (Carod-Artal,

2007; Leopoldino et al., 1999; Periyasamy et al., 2023), tuberculous meningitis (Wasay et al., 2018), pneumonia (Ingeman et al., 2011; Kim et al., 2017; Grossmann et al., 2021; Watila et el., 2019; Olajide et al., 2021), HIV/AIDS (Grau et al., 2010; Thakur et al., 2016), cysticercosis (Alarcón et al., 1992a; Alarcón et al., 1992b), syphilis (Jennifer and Fugate, 2020), chronic hepatitis infection (Cojocaru et al., 2005; Sung et al., 2007), Chagas disease (Lage et al., 2022), and most recently, coronavirus disease 2019 (COVID-19) (Khan et al., 2023). Notably, infectious risk factors or tropical diseases such as malaria, pneumonia, and HIV/AIDS that are not frequently among the primary risk factors in developed countries, are endemic in Nigeria. In 2021, Nigeria recorded an estimated 68 million cases and 194,000 deaths from malaria (WHO, 2022). Some case presentations on stroke have indicated a link with the most severe complication of malaria caused by Plasmodium falciparum, also known as cerebral malaria (CM), which could be accountable for up to 10% of strokes in endemic regions like Nigeria (Carod-Artal, 2007; Leopoldino et al., 1999; Periyasamy et al., 2023). Similarly, Warren-Gash et al. (2018) in their study found that individuals with pneumonia could have an increased risk of heart attack for up to one week after infection, and stroke for up to 28 days. In Nigeria, community-acquired pneumonia (CAP) accounts for 2.5% to 5.7% of medical admissions and between 15.3% and 24.9% of respiratory admissions in tertiary health facilities. Previous surveys have shown that mortality rates among admitted patients with CAP range from 7.4% to 26% in the country. Besides the infectious risk factors, environmental risk factors are also emerging as non-traditional risk factors associated with stroke (Hameed et al., 2024). Important examples include air pollution (Wellenius et al., 2012; Feigin et al., 2016), climate change (Chu et al., 2018; Atwoli et al., 2021), and high altitude (Jaillard et al., 1995; Lu et al., 2020; Liu et al., 2021). Air pollution, which is more noticeable in developing countries, is a recognized risk factor for cardiovascular disease and reportedly accounts for 14% of all stroke-associated mortality (Verhoeven et al., 2021). Currently, Nigeria like many other Sub-Saharan African (SSA) countries is generally going through health transition. This transition is characterized by increasing urbanization and lifestyle changes, resulting in a more prevalence of cardiovascular diseases, as well as infectious and environmental risk factors associated with stroke.

Many hospital-based studies have confirmed cardiovascular disease, particularly stroke, as the most common cause of neurological admissions and medical coma in Nigeria. However, these studies often only report the traditional risk factors, with high blood pressure as the primary risk factor for stroke in Nigeria, without reporting any infectious risk factors. Against this background, this study employed multinomial logistic regression to ascertain if there are significant relationships between any infectious risk factors and stroke types in Southern Nigeria, relying on the evidence from retrospective hospital data. We aim to identify the current significant risk factors associated with the prevalent type of stroke in Nigeria. The specific objectives of this study are: (1) To evaluate the association between different age groups and various types of strokes. (2) To evaluate the association of sex and various types of strokes. (3) To statistically ascertain the current traditional and infectious risk factors associated with the types of strokes in Nigeria. To achieve these objectives, the remainder of the

paper is structured as follows: Section 2 describes the research materials and methods employed in the study. Section 3 discusses the results of our inquiry, while Section 4 presents our concluding remarks.

2. Materials and Method

2.1 *Study Design and Data Sources*

This hospital-based retrospective study was conducted at the Federal Medical Centre (FMC) in Asaba. Asaba town is the capital of Delta State in Southern Nigeria located at the western bank of the Niger River. Asaba, with a population of 149,603 as of the 2006 census, is close to Onitsha, Owerri, and Enugu, which are known major cities in Southeastern Nigeria. This makes FMC, Asaba a referral center for major cities in both the South-South and South-East regions of Nigeria. The target population comprises patients having cerebrovascular accident (CVA) or presenting with acute stroke at FMC, Asaba, between August 2019 and September 2022. Medical records of 907 stroke patients were retrieved, and relevant information was extracted using a structured questionnaire. The questionnaire contained relevant information such as a unique case identifier, age, sex, duration to presentation, duration to outcome, length of hospitalization, clinical indications (stroke type), risk factors (both vascular and infectious risk factors), and access to neuroimaging. Eight categories of stroke type were identified as reported in their admission records. These include Transient Ischemic Stroke (TIS), Ischemic Stroke (IS), Acute Stroke (AS), Hemorrhagic Stroke (HS), Left Hemispheric Stroke (LHS), Left Hemispheric Ischemic Stroke (LHIS), Right Hemispheric Stroke (RHS), and Right Hemispheric Ischemic Stroke (RHIS).
Ethical clearance for this study was obtained from the Research and Ethical Committee, Federal Medical Centre, Asaba. The ethical reference number was FMC/ASB/A81 VOL XII/268. The permission to collect data from the patient's medical records was also obtained from the Department of Medical Records. During the research, we ensured anonymity and confidentiality were upheld to the highest standard.

2.2 *Statistical Analysis*

The obtained data was inputted into IBM Statistical Package for the Social Sciences (SPSS) Statistics Version 26 Data Editor for the analysis. Before starting the analysis, we checked for missing values and used the SPSS multiple imputation technique to handle them. SPSS descriptive statistics; frequencies (percentages) for categorical variables were used to describe the data distributions of some sociodemographic characteristics and other variables of the sample data for presentation. We then applied SPSS multinomial logistic regression to assess the association between different age groups and sex with the types of strokes, and to identify the current significant risk factors associated with the types of strokes. Because we are analyzing a set of categorical variables, and one is a "response" while the others are predictors, we adopted the multinomial logistic regression to achieve our objectives. For a multinomial logistic regression, the

predicted probability of having success in the k^{th} category and a given input x is given in Equation 2.1a

$$P(Y_j = k|X_{1,i}\,, \cdots\,, X_{p,i}\,) = \frac{\exp(\beta_k x_i)}{1 + \sum_{j=0}^{K-1} \exp(\beta_j x_i)} \tag{2.1a}$$

To ensure identifiability (a unique solution), one class is chosen as the reference class, and its coefficients are set to zero. Hence, the predicted probability becomes

$$P(Y_j = k|X_{1,i}\,, \cdots\,, X_{p,i}\,) = \frac{\exp(\beta_k x_i)}{1 + \sum_{j=0}^{K-1} \exp(\beta_j x_i)}\ for k = 1, \cdots, K-1 \tag{2.1b}$$

The k^{th} logistic regression model for the variables applicable in this study is given by

$$ln\left[\frac{P(Y_j = k|X_{1,i}\,, \cdots\,, X_{8,i}\,)}{P(Y_j = 0|X_{1,i}\,, \cdots\,, X_{8,i}\,)}\right] = \beta_{o,k} + \beta_{1,k}\, x_1 + \beta_{2,k}\, x_2 + \cdots + \beta_{8,k}\, x_8$$
$$for k = 1, \cdots, 5 \tag{2.2}$$

where Y_j is the value of the multinomial response variable for the i^{th} unit, $X_{1,i}\,, \cdots\,, X_{8,i}$ are the eight categories of stroke type or predictor variables that were identified as reported in their admission records, $\beta_0, \beta_1, \cdots, \beta_8$ are the coefficients of the eight categories of stroke type, and Kth category (which is the sixth category of stroke type) is the reference category. Each coefficient β_i in the kth category of stroke type represents the log-odds change of being in category k relative to the reference class, for a one-unit increase in the predictor X_i. In the analysis of multinomial logistic regression outputs, the probabilities obtained from Equation 2.1b will enable us to determine classification, while the coefficients that will be obtained from Equation 2.2 will guide us in understanding the influence or assessing the association of risk factors with the prevalent type of stroke, which is the primary focus of this study.

3. Results and Discussion

3.1 *Differences in stroke type prevalence across patients' sex*

The results in Table 1 showed that there are 457(50.39%) female patients with stroke, and 450 (49.61%) male patients with stroke. Our observed trend of higher stroke prevalence among women aligns with a previous study conducted at FMC, Asaba, Delta State, Nigeria (Ezunu et al., 2023). Upon reviewing Table 1, it is evident that ischemic stroke was more common in females (46.6%), followed by hemorrhagic stroke (11.6%), and right hemispheric stroke (11.2%). Ischemic stroke (55.1%) was also the most common for males, followed by right

hemispheric stroke (12.2%). In the present study, it was found that 461 (50.83%) patients had ischemic stroke, the highest incidence among the patients. This finding is consistent with several other studies conducted in different African countries. The similarity in the genetic makeup of different race/ethnicity may account for this observation. However, only 39 (4.30%) of the patients had acute stroke, which is the lowest type of stroke recorded in this study.

Table 1: Stroke types across sex and their proportions

Stroke Types	No. of Patients	Female	Males
Transient ischemic stroke (TIS)	46(5.07%)	30(6.6%)	16(3.6%)
Ischemic stroke (IS)	461(50.83%)	213(46.6%)	248(55.1%)
Acute stroke (AS)	39(4.30%)	11(2.4%)	28(6.2%)
Hemorrhagic stroke (HS)	84(9.26%)	53(11.6%)	31(6.9%)
Left hemispheric stroke (LHS)	47(5.18%)	28(6.1%)	19(4.2%)
Left hemispheric ischemic stroke(LHIS)	48(5.29%)	34(7.4%)	14(3.1%)
Right hemispheric stroke (RHS)	106(11.69%)	51(11.2%)	55(12.2%)
Left hemispheric ischemic stroke(LHIS)	76(8.38%)	37(8.1%)	39(8.7%)
		457(50.39%)	450(49.61%)

This shows that ischemic stroke was more probable to cause death in the studied population. This finding is consistent with previous conducted studies (Jowi and Mativo, 2008; Zhang et al., 2017; Mulugeta et al., 2020; Arabambi et al., 2021). On the other hand, in other studies in Nigeria and the rest of the world, hemorrhagic stroke was the most common subtype (Gedefa et al., 2017; Zewdie et al., 2018; Maskey et al., 2011; Osuegbu et al., 2021). This difference may be attributed to underlying differences in risk factors (Zhang et al., 2017).

3.2 *Differences in stroke type prevalence across patients' different age groups*

Table 2 shows the distribution of stroke patients by age group. There are 19 patients with stroke in the age group of 20 or younger, 45 patients in the age group 21-40, 286 patients in the age group 41-60, 426 patients in the age group 61-80, and 131 in the age group 81-100. This data indicates that older age groups have a higher prevalence of stroke. The research conducted by Teh et al. in 2018 and Osuegbu et al. in 2021 indicates that as individuals get older, they are more likely to experience a stroke. This could be attributed to the physiological changes that occur in the elderly, as well as the greater complexity and severity of the condition, which tend to increase with age.

Table 2: Stroke types across different age group and their proportions

Stroke Types	20	21-40	41-60	61-80	81-100
TIS	0(0.0%)	2(4.4%)	12(4.2%)	25(5.9%)	7(5.3%)
IS	7(36.8%)	19(42.2%)	143(50.0%)	241(56.6%)	51(38.9%)
AS	2(10.5%)	0(0.0%)	1(0.3%)	20(4.7%)	16(12.2%)
HS	6(31.6%)	6(13.3%)	40(14.0%)	23(5.4%)	9(6.9%)
LHS	0(0.0%)	5(11.1%)	20(7.0%)	18(4.2%)	4(3.1%)
LHIS	2(10.5%)	2(4.4%)	14(4.9%)	20(4.7%)	10(7.6%)
RHS	0(0.0%)	4(8.9%)	34(11.9%)	40(9.4%)	28(21.4%)
RHIS	2(10.5%)	7(15.6%)	22(7.7%)	39(9.2%)	6(4.6%)
	19(2.09%)	45(4.96%)	286(31.54%)	426(46.97%)	131(14.44%)

Consequently, older individuals may require more inpatient health services due to these factors. A cursory look at Table 2 shows that the distribution of stroke types in the age group 61-80 is relatively higher in terms of incidence than in any other age group. This means that older adults dominated the stroke incidence and were more likely to die from a stroke, irrespective of the type of stroke. However, the prevalence of ischemic stroke was higher across the age groups. This again shows that ischemic stroke was more likely to cause death in the studied population.

3.3 *Predominant risk factors across patients' sex*

Table 3 presents the distribution of the predominant risk factors among the studied population. Out of all the potential risk factors listed in the structured questionnaire used for data collection, including cardiovascular diseases and infectious risk factors, only the six risk factors shown in Table 3 were predominantly documented as clinical diagnoses and/or laboratory diagnoses in the medical records of stroke patients.

Table 3: Predominant risk factors across sex and their proportions

Risk Factors	No. of Patients	Male	Females
Hypertension	81	34(41.98%)	47(58.02%)
Diabetes Mellitus	56	16(28.75%)	40(71.43%)
Malaria	22	14(63.64%)	8 (36.6%)
Pneumonia	20	9 (45.00%)	11 (55.00%)
Heart Disease	24	5 (20.83%)	19 (79.17%)
Chronic Anemia	5	5(100.00%)	0 (0.00%)

While other risk factors listed in the structured questionnaire had only one or two recorded cases in the medical records of the studied population.
In Table 3, hypertension and diabetes mellitus, were found to have the highest recorded risk factors for stroke patients in the studied population, which is consistent with previous studies (Mulugeta et al., 2020; Ojo et al., 2024). The results in Table 3 also indicate that heart disease, malaria, and pneumonia were the second-highest recorded infectious risk factors. Malaria was observed more frequently in males (63.64%) while pneumonia was more commonly observed in females (55.00%). Previous studies have linked severe complications of malaria caused by Plasmodium falciparum and pneumonia as possible infectious risk factors associated with stroke (Carod-Artal, 2007; Leopoldino et al., 1999; Warren-Gash et al., 2018; Periyasamy et al., 2023).
To determine if the predominant risk factors listed in Table 3 are significantly associated with different types of strokes, we used multinomial logistic regression. In this analysis, the risk factors were used as the multinomial response variable, while the stroke types were used as the predictor variables.

Table 4: Multinomial logistic regression model for stroke types and risk factors

Risk factor	β	S.E	Wald	df	Sig	Exp(β)	[95% C.I]
Hypertension							
Intercept	19.735	0.880	503.013	1	0.000		
TIS	-18.348	1.423	166.314	1	0.000	1.075E-8	[6.613E-10; 1.748E-7]
IS	-17.687	0.746	562.131	1	0.000	2.083E-8	[4.827E-9 ; 8.988E-8]
AS	0.159	0.867	0.033	1	0.856	1.173	[0.211; 6.523]
HS	0.957	11763.256	0.000	1	1.000	2.603	[0.000; .[b]]
LHS	0.598	13002.555	0.000	1	1.000	1.818	[0.000; .[b]]
LHIS	0.038	7431.315	0.000	1	1.000	1.039	[0.000; .[b]]
RHS	0.673	12079.281	0.000	1	1.000	1.961	[0.000; .[b]]
RHIS	0[c]	.	.	0	.	.	.
Diabetes mellitus							
Intercept	19.378	0.904	459.557	1	0.000		
TIS	-18.279	1.466	155.379	1	0.000	1.152E-8	[6.504E-10; 2.040E-7]
IS	-17.720	0.784	510.782	1	0.000	2.016E-8	[4.336E-9; 9.372E-8]
AS	0.110	0.923	0.014	1	0.905	1.117	[0.183; 6.812]
HS	0.466	11763.56	0.000	1	1.000	1.594	[0.000; .[b]]
LHS	0.954	13002.55	0.000	1	1.000	2.597	[0.000; .[b]]
LHIS	0.395	7431.315	0.000	1	1.000	1.484	[0.000; .[b]]
RHS	0.807	12079.218	0.000	1	1.000	2.241	[0.000; .[b]]
RHIS	0[c]	.	.	0	.	.	.
Malaria							
Intercept	18.818	0.961	383.155	1	0.000		
TIS	-18.818	1.710	121.101	1	0.000	6.719E-9	[2.354E-10;1.918E-7]
IS	-17.566	0.864	413.786	1	0.000	2.352E-8	[4.329E-9;1.278E-7]
AS	-1.409	1.354	1.083	1	0.298	0.244	[0.017; 3.471]
HS	-17.337	13031.610	0.000	1	0.999	2.956E-8	[0.000; .[b]]
LHS	-17.337	14404.533	0.000	1	0.999	2.956E-8	[0.000; .[b]]
LHIS	-0.298	7431.315	0.000	1	1.000	0.742	[0.000; .[b]]
RHS	-17.337	13381.713	0.000	1	0.999	2.956E-8	[0.000; .[b]]
RHIS	0[c]	.	.	0	.	.	.
Pneumonia							
Intercept	18.818	0.961	383.155	1	0.000		
TIS	-36.244	6079.164	0.000	1	0.995	1.818E-16	[0.000; .b]
IS	-18.007	0.886	412.891	1	0.000	1.512E-8	[2.662E-9; 8.587E-8]
AS	-0.023	1.041	0.000	1	0.982	0.977	[0.127; 7.515]
HS	-17.483	13220.58	0.000	1	0.999	2.553E-8	[0.000; .[b]]
LHS	-17.483	14613.08	0.000	1	0.999	2.553E-8	[0.000; .[b]]
LHIS	-0.298	7431.315	0.000	1	1.000	0.742	[0.000; .[b]]
RHS	-17.483	13575.942	0.000	1	0.999	2.553E-8	[0.000; .[b]]
RHIS	0[c]	.	.	0	.	.	.
Heart disease							
Intercept	18.531	0.584	1007.259	1	0.000		
TIS	-16.921	1.241	185.817	1	0.000	4.479E-8	[3.932E-9; 5.103E-7]
IS	-17.519	0.000	.	1	.	2.464E-8	[2.464E-8; 2.464E-8]
AS	-0.265	0.000	.	1	.	1.303E-8	[1.303; 1.303]
HS	-16.962	12930.666	0.000	1	0.999	4.300E-8	[0.000;.b]
LHS	-16.962	14292.954	0.000	1	0.999	4.300E-8	[0.000; .b]
LHIS	-0.704	7431.315	0.000	1	1.000	0.495	[0.000; .b]
RHS	-16.962	13278.057	0.000	1	0.999	4.300E-8	[0.000; .b]
RHIS	0[c]	.	.	0	.	.	.

a. The reference category is: chronic anemia b. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing. c. This parameter is set to zero because it is redundant.

Table 4 displays the SPSS output of the multinomial logistic regression analysis for the stroke types and risk factors as presented in Equation (2.2). A cursory look at Table 4 reveals that transient ischemic stroke (TIS) and ischemic stroke (IS) have a significant relationship with hypertension (p=0.000), diabetes mellitus (p=0.000), and malaria (p=0.000), respectively. Table 4 also reveals that IS has a significant relationship with pneumonia (p=0.000), and TIS has a significant relationship with heart disease (p=0.000). Column 2 of Table 4 presents

the Wald statistic for TIS and IS, corresponding to their coefficient values for the five predominant risk factors. The observed substantially large Wald statistic presents strong evidence that TIS and IS coefficient values are significantly different from zero. Additionally, in columns 2 and 3 of Table 4, we also observed that the standard errors (SE) are much smaller than the absolute values of the coefficients for TIS and IS for the five predominant risk factors, which is typically good, and a confirmation that TIS and IS have a very significant relationship with the predominant risk factors.

This result not only confirms our earlier assertion on Table 3 results, but further reveals that all the identified predominant risk factors have a significant relationship with ischemic stroke. This suggests that among all stroke types, ischemic stroke (whether TIS or IS) has the highest prevalence in this study, which is consistent with previous studies (Mulugeta et al., 2020; Osuegbu et al., 2021). In addition to the commonest risk factors such as hypertension, diabetes mellitus, and heart disease identified in this study, the significant relationship of malaria and pneumonia with ischemic stroke in Table 4 suggests the two infectious risk factors as significant emerging risk factors for stroke in Nigeria. This finding is corroborated by previous studies and presentations outside Nigeria that have linked severe complications of malaria caused by plasmodium falciparum and pneumonia as possible infectious risk factors associated with stroke, and others that even suggested they could have a direct causal role (Carod-Artal, 2007; Leopoldino et al., 1999; Warren-Gash et al., 2018; Periyasamy et al., 2023).

4. Conclusion

This study found that ischemic stroke was a common indication for medical admissions, in particular for the age group 61-80, with hypertension and diabetes mellitus as the leading risk factors, followed by heart disease, malaria, and pneumonia. Therefore, there is a need to step up measures aimed at increasing public awareness of emerging infectious risk factors (such as malaria and pneumonia) associated with stroke and providing effective preventive measures. Prioritizing interventions directed towards cost-effective treatment of hospitalized stroke patients is imperative, as this will hopefully improve the overall outcomes in resource-constrained settings such as Nigeria.

This study, being a retrospective review of records, had some limitations. Many of the case files had substantial missing data and could not be included in the data analysis. This low yield of data may distort the accurate picture of stroke presentations at the hospital. Also, the measured risk factors were likely underreported as they were absent in some of the case files reviewed. A multi-centered prospective and retrospective, registry-based study that will provide more representative and reliable data regarding stroke types with current associated risk factors in Nigeria will, without doubt, help establish this study result.

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