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Demographic and Clinical Characteristics of Stroke Cases in Murtala Muhammed Specialist Hospital, Kano, Nigeria: A retrospective study

Sadiya Ibrahim Adam[1], Idris Abdu Tela,[1*]
Abdulrashid Sunusi[1], Abdullahi Yusuf Asuku[1]

[1]Anatomy Department,
Faculty of Basic Medical Sciences,
College of Health Science,
Bayero University Kano,
Nigeria.

Email: gwtel4u@gmail.com

Abstract
Stroke is a cerebrovascular disease that disturbs or damages the blood supply to the brain. This study aimed to evaluate the demographic and clinical characteristics of stroke cases in Murtala Muhammed Specialist Hospital, Kano, Nigeria. Five years of records of three hundred (300) stroke patients comprised of biodata and clinical data were collected. The data were expressed as mean±SD, while simple percentage and Chi-square (χ^2) tests were used to determine the incidence and association between the variables respectively using Minitab 17.0 software. The results showed an incidence of 182 (61%) males and 118 (39%) females, 265 (78%) and 65 (22%) for the above and below 40 years age groups respectively. The Hausa, Yoruba and Igbo ethnic groups have an incidence of 258 (86%), 24 (8%), and 18 (6%) respectively. The yearly incidence was 40 (13%), 50 (17%), 20 (7%), 56 (17%), and 134 (45%) for 2017 through 2021, respectively. The incidence of hemorrhagic, ischaemic, and transient ischaemic attack strokes were, 222 (74%), 63 (21%), and 15 (5%), while that of left, right, and both sides impairments were 144 (48%), 138 (46%), and 18 (6%), respectively. The common risk factors were hypertension (50%) and hypotension (20%), diabetes mellitus 54 (18%), and others 12 (4%) and 3 (1%) respectively. No association between sex and stroke types (P = 0.553). Conclusively, although intracerebral hemorrhagic stroke, right-side impairment, and hypertension were the most common stroke types, disabilities, and risk factors, respectively there was no association obtained between sex and the incidence of stroke type.

INTRODUCTION
Stroke is a cerebrovascular disease which damages the brain cells by impairing blood supply to the brain (Mozaffarian *et al*., 2015). It is the second leading cause of death next to ischemic heart disease worldwide (Katan and Luft, 2018). It is the major reason for neurological disability (Eze & Kalu, 2014) that accounts for about 25% cause of emergency and hospital admissions in Nigeria (Arabambi *et al*., 2021). Although the prevalence of stroke in Africa was said to be less compared to developed countries, the burden of stroke seems to be on the increase with serious consequences for society (Owolabi *et al*., 2015). The yearly incidence rate in Nigeria has been estimated to be 1.14 per 1000 persons/year (Vos *et al*., 2020) with a steady

*Author for Correspondence

rise in the global stroke burden from 10th to 9th in a decade (Thrift *et al*., 2016). Previous literature recognized the need for national clinical registries on stroke to monitor patients' characteristics, access to clinical care, health outcomes and provisions of reliable substitutes for epidemiological studies in countries with a large number of hospitalized populations (Thrift *et al*., 2013). Such records were poorly documented in Nigeria. Therefore, this study aimed to evaluate the demographic and clinical characteristics of stroke in patients that attended Murtala Muhammed Specialist Hospital, Kano, Nigeria.

METHODOLOGY

Study design and setting

This was a five years hospital-based retrospective study that evaluated all stroke cases of patients hospitalized in Murtala Mohammed Specialist Hospital Kano, Kano State, Nigeria between June 2017 to June 2021. The hospital is owned by the Kano State government. It has the highest patient usage in the area and is the largest state-owned hospital in northern Nigeria. It offers medical, surgical, obstetric, laboratory, radiology and physiotherapy services in the different departments of the hospital. The hospital was built primarily to serve Kano citizens, particularly those from the city. Patients from nearly all of Nigeria's northern states as well as its neighbours, the Niger Republic, Chad, and Mali, also use the facility. Ethical approval (NHREC/17/03/2018) was obtained from the Murtala Muhammed Specialist Hospital research ethics committee.

Study Participants

The records of all patients hospitalized in the Neurology Department of Murtala Mohammed Specialist Hospital Kano, Kano State, Nigeria and diagnosed with stroke between June 2017 to June 2021 were used in the study.

Method

From the five hundred (500) stroke patient files in the Neurology Unit of the hospital's Department of Medicine, records for three hundred (300) stroke patients—118 women and 182 men—were taken. Age, sex, race, date of admission, risk factors, and sides of impairment or disability are among the data gathered. Based on the hospital's recommendation, only cases that fit the World Health Organization's (1978) definition of a stroke were included, and files with missing data were left out of the final study.

Data Analyses

The age was expressed as mean ± standard deviation to determine the baseline. The minimum, maximum and interquartile ranges were calculated to determine the age distribution of the data. The age, sex, ethnicity, date of admission, risk factors and sides of impairment were expressed as either counts or percentages frequency to determine the prevalence. A chi-square (χ^2) test was performed to determine the association between sex and stroke types. The charts and figures were plotted in Microsoft word excel, 2019. All statistical analyses were performed using Minitab 17.0. software and values with a probability less than 0.05 were considered statistically significant.

RESULTS

The demographic and clinical variables of the stroke patients who attended MMSH Kano were presented in Table 1. The mean ages of the patients were 58.20±16.23 and 56.30±18.66 for the males and females respectively. Out of the 300 records of incidences of stroke overall over the studied period females constituted 118 (39%) and males 182 (61%) male of the cases. The

incidence by ethnicity indicated 257 (86%) were Hausa, 24 (8%) were Yoruba, and 18 (6%) were Igbo, primarily from south-eastern Nigeria. Also, 265 (78%) of the incidence was recorded in patients over 40 years old and 65 (22%) in patients with less than 40 years old. The Intracerebral hemorrhagic (ICH) stroke constituted 223 (74%), ischemic (IS), 63 (21%) and transient ischaemic attack (TIA), 15 (5%) of the incidence of the stroke types among the patients. The incidence of left impairment accounted for 144 (48%), while that of the right 138 (46%), and incidence of both sides (bilaterally) constituted 18 (6%) of the recorded cases.

Figure 1 depicted the annual incidence of stroke in MMSH from June 2017 to June 2021. In 2017, a record 40 (13.33%) instances were discovered. The record, however, rose to 50 (16.66%) in 2018, which surpassed the previous year's 3.33% of the population. The number of records dropped dramatically in 2019 to just 20 (6.66%) patients. The number of records, however, increased substantially in 2020 and 2021, peaking at 134 (44.66%) in 2021 and reaching 56 (18.88%) in 2020, respectively.

Table 1: Demographic and Clinical Variables of Stroke Patients Hospitalized at Murtala Muhammed Specialist Hospital Kano from June 2017 to June 2021

Variables		Incidence
Age (years)	Male	58.20±16.23
	Female	56.30±18.66
Sex	Male	182 (61%)
	Female	118 (39%)
Age group (years)	< 45	66 (22%)
	> 45	234 (78%)
Tribe		
	Hausa	257 (86%)
	Yoruba	23 (8%)
	Igbo	20 (7%)
Stroke Types	Hemorrhagic (HMG)	223 (74%)
	Ischemic (IS)	62 (21%)
	Transient ischaemic (TIA)	15 (5%)

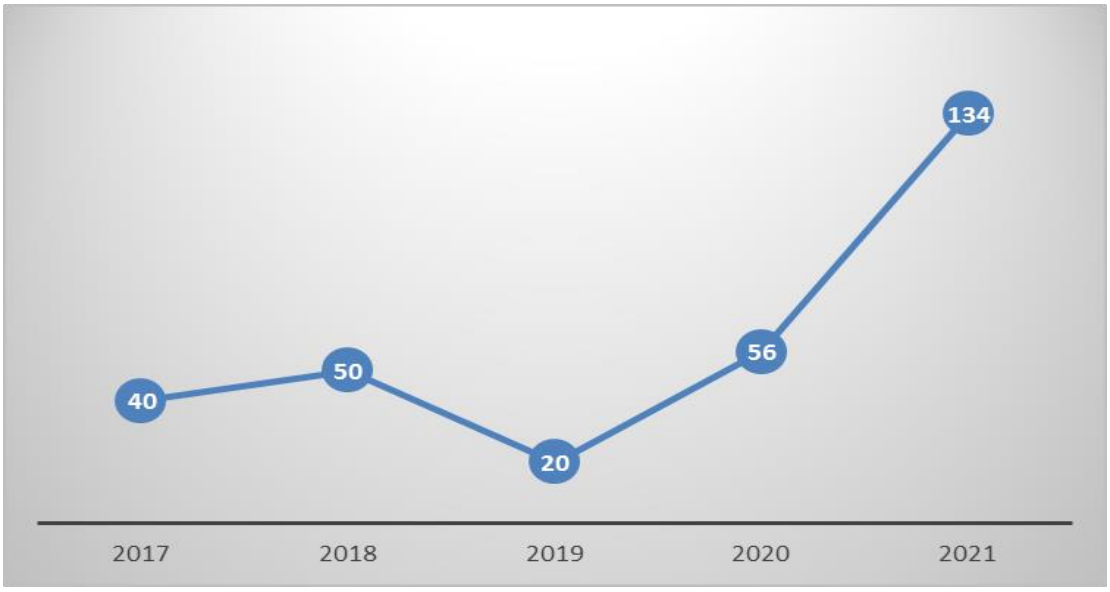

Figure 1. The incidence of stroke cases of patients hospitalized at MMSH from June 2017 to June 2021.

Table 2 provides the common stroke risk factors of patients hospitalized in MMSH from June 2017 to June 2021. The stroke caused by hypertension (HYP) contributed the most, with an incidence rate of 150 (50%) of the records obtained. This was followed by 60 (20%), hypotension (HyP), and 54 (18%) cases of diabetes mellitus. Accidents (ACD) and peptic ulcer diseases (PUD) each contributed 12 (4%) respectively. Similarly, cardiovascular diseases (CVD), hereditary (HRD) or genetic factors, sickle cell diseases (SCD), and transient ischaemic attack (TIA) each contributed 3 (1%) respectively.

Table 3 shows the association between sex and stroke types in patients hospitalized at MMSH. This included ICH stroke, ischaemic stroke (IS), and transient ischaemic attack (TIA). There was no statistically significant association ($\chi 2 = 1.186$, DF = 2, p-value = 0.553) between sex and the stroke types.

Table 2 The common stroke risk factors of patients hospitalized at MMSH from June 2017 to June 2021.

Cause	Count	Per cent
ACD	12	4.0
CVD	3	1.0
DM	54	18.0
HRD	3	1.0
HYP	150	50.0
HyP	60	20.0
PUD	12	4.0
SCD	3	1.0
TIA	3	1.0

ACD: Accident; **CVD**: Cardiovascular Diseases; **DM**: Diabetes Mellitus; **HRD**: Hereditary (Genetic); **HYP**: Hypertension; **HyP**: Hypotension; **PUD**: Peptic Ulcer Disease; **SCD**: Sickle Cell Disease; **TIA**: Transient Ischaemic Attack.

Table 3. Association between sex and stroke types of patients hospitalized at MMSH from June 2017 to June 2021

Sex	Test	HMG	IS	TIA	Total	*p*-value
Male	Observed	135	36	11	182	0.553
	Expected	135.29	37.61	9.1		
	χ^2 contribution	0	0.07	0.4		
Female	Observed	88	26	4	118	
	Expected	87.71	24.39	5.9		
	χ^2 contribution	0	0.11	0.61		
Total		**223**	**62**	**15**	**300**	

HMG: Hemorrhagic stroke, **IS**: Ischaemic stroke, **TIA**: Transient Ischaemic Attack
Pearson Chi-Square = 1.186, DF = 2, P-Value = 0.553.

DISCUSSION

In the present study, we evaluated the incidence of stroke by age, sex, and ethnicity among the major Nigerian ethnic populations: Hausa, Yoruba, and Igbo admitted to MMSH Kano. The mean age of stroke in our study was 58.20 for males and 56.30 for females, respectively. This was consistent with the 57.0-year African mean age of onset of the first stroke (Cadilhac *et al*., 2015). In other studies, the mean age of stroke patients in sub-Saharan Africa was 58.0 years, which was almost a decade and a half younger than patients in developed countries (Owolabi *et al*., 2009).

We observed higher stroke incidence recorded in patients above 40 years old and lower incidence recorded in patients below 40 years old. The incidence of stroke among young adults in Nigeria was reported and is mostly associated with sickle cell disease, cervical trauma, and cocaine abuse (Feigin *et al*., 2014). A previous study also reported a lower incidence of 12.3% in the 40-year age group in Nigeria, which differed from our finding of reported 16% incidence cases (i.e., 2% in the 0–19 and 14% in the 20–39 age groups), which signifies an increase in stroke burden among the youth.

There was a higher incidence of stroke cases in males (61%) than females (39%). This is consistent with the previous finding that reported a higher stroke rate in men than in women (Nwosu, *et al*., 1992). A higher incidence of stroke in men has been attributed to established risk factors for stroke, such as hypertension, cigarette smoking, and ischemic heart disease (Nwosu *et al*., 1992). The lower incidence of females could be linked to the genetic factor (Appelros *et al*., 2009), the effects of estrogen on cerebral circulation (Touzé *et al*., 2008), and higher blood pressure in men than in women of similar ages.

The incidence of Hausa patients was higher than that of other ethnic groups. This is to be expected because Kano is a Hausa state, therefore the patients were mostly Hausa. To our knowledge, this is the first study to document an ethnic comparative disparity of stroke incidence among the major Nigerian tribes. However, previous findings have reported a significant racial/ethnic disparity in stroke incidence in the United States population (Krause *et al*., 2006). The black population was reported to double in mortality and stroke risk when compared to the white population.

Stroke is the second-leading cause of death and disability worldwide, with over 13 million new cases annually (Morgenstern & Kissela, 2015). According to the latest WHO data published in 2020, stroke deaths in Nigeria reached 57,744, or 3.90% of total deaths. It has been reported that the overall incidence rates decreased from 1990 to 2016, largely due to prevention and better control of risk factors (Johnson *et al*., 2019). However, we observed an increase in stroke cases, with at least a 10% increase in the yearly admission of stroke patients between 2017 and 2018. We also observed a decrease in about 60% of the records in 2019 when compared to the previous years. The cause of the decline could be attributed to increasing awareness and preventive measures taken by the general population. However, unlike the immediate past years, we observed a double increase in the records of stroke cases in the facility both in 2020 and 2021, respectively. This upsurge might not be a surprise consequent to the global COVID-19 and post-COVID-19 pandemic local and global ease policies, where many patients were rendered helpless as a result of the inability to access hospitals and diagnostic centres due to global lockdown policies adopted by many countries to curb the menace and spread of the pandemic. Due to a lack of standard treatments and vaccines to treat the pandemic, measures that banned public gatherings, international flights, and social distancing were adopted. Other measures taken to mitigate the pandemic include general

lockdown, obligatory home quarantine, and public awareness campaigns on proper handwashing, hygiene, and sanitation (Feigin *et al*., 2022). During the early outbreak in Kano State, several mysterious deaths were reported that were not related to COVID-19 but its complications (Bruinen de Bruin *et al*., 2020). Although several studies reported a reduction in stroke admissions during the pandemic's acute phase (Brennen et al., 2020), there have been reports of acute cerebrovascular disease (CVD) that include both acute ischemic stroke (AIS) and intracerebral haemorrhage (ICH), as well as stroke risk factors (Beyrouti et al., 2020). The COVID-19 pandemic disrupted communities, countries, and indeed, the global healthcare workforce (Dogra *et al*., 2020). This led to untold physical, economic, and emotional stresses, all of which are potential stroke risk factors.

In the current study, intracerebral hemorrhagic stroke (ICH) accounted for 74% of all stroke cases in the hospital. This differed from the previous finding, which reported an 87% incidence of ischemic stroke (IS) cases (Mozaffarian *et al*., 2015). Other risk factors might be linked to epidemiologic and demographic transitions driven partly by rural-urban drift, rapid economic development, population growth, ageing, physical inactivity, and consumption of processed foods high in cholesterol and salt (Ripp *et al*., 2020) that lead to hypertension and associated cardiovascular diseases. Hypertension has been reported to occupy a prime position as a risk factor among the black race (Adeloye, 2014). Other documented risk factors for intracerebral hemorrhagic stroke in the black population include advanced age, diabetes mellitus (DM), and smoking (Guo *et al*., 2012).

The incidence of ischemic stroke (IS) and transient ischemic attack (TIA) was recorded in 21% of all total stroke cases. According to a Global Burden of Disease (GBD) study in 2010, more than 11 million ischemic strokes occurred, 63% of them in low- and middle-income countries (Feinstein *et al*., 2012). It has also been reported that IS constitutes approximately 80% of stroke cases (Tramacere *et al*., 2019). The disparity observed might not be unconnected with the study design, as we used a retrospective hospital-based design. Racial diversity, lifestyle, consumption, and genetic differences might be responsible factors. Previous literature reported a higher number of patients with hemorrhagic stroke in the Caucasian population (Kamiya-Matsuoka *et al*., 2015).

In the entire set of records studied, we found a 5% incidence of TIA. This was slightly higher compared with the previous study (Alawneh *et al*., 2020). Although the TIA is poorly recognized and underreported by the patients (Lioutas *et al*., 2021), retrospective evaluation of the TIA in patients occurs only if this is followed by a stroke. The study design and sample size for the study could have also accounted for the disparity observed.

Numerous studies have explored the differences between left and right hemispheric strokes. In the present study, we observed 48% left and 46% right contralateral impairments. This signifies the right hemispheric propensity over the left. The left cerebral hemispheric infarctions have been reported to be more common than the right, especially among young adults (Chandratheva *et al*., 2010), on account of the tunica intima-media complex and flow velocity in the left carotid artery, which could induce atherosclerotic changes that can lead to severe left hemispheric ischemia (Matakas *et al*., 2020) than the right. The impact of contralateral hemispheric motor control, study design, and the study population could have caused the variability observed. The study also observed 6% cases of bilateral impairments when compared to the total number of cases recorded. This was consistent with the previous findings (Hernández *et al*., 2003). Generally, bilateral stroke is relatively rare and uncommon

in the population and is often reported to be associated with a cardio-embolic cause, myocardial infarction, or coronary valve disease (Behera & Mohanty, 2019).

The identification of risk factors for stroke is complicated by the fact that strokes come in many varieties (Arboix & Alioc, 2010). According to the latest WHO data published in 2020, hypertension-related deaths in Nigeria reached 10,692, or 0.72% of total deaths. In this study, 50% of stroke cases were attributed to hypertension. This was in tune with the previous hospital-based prevalence studies in Kano (Boehme *et al*., 2017), which reported that hypertension was the most common stroke risk factor among the studied patients. In Nigeria, like many black nations, hypertension among stroke patients has been reported to occupy a prime position (Chandratheva *et al*., 2010).

The role of hypotension as a risk factor for stroke was found to be associated with watershed infarctions (Femi & Mansur, 2013) of the cerebral blood vessels, which can cause transient ischemia attacks (Okokhere *et al*., 2013) that reduce blood flow to the brain. Hypotension accounted for 20% of the stroke risk factors observed in this study. Although no previous records of similar cases were reported in the literature, it has been suggested that strokes caused by decreased perfusion can be secondary to the low flow of the blood itself or caused by impaired clearance of microemboli in the setting of decreased cerebral blood flow, which could lead to stroke (Boon *et al*., 2008).

Diabetes mellitus as a risk factor for stroke has already been well-established as an independent, modifiable risk factor for both ischemic and hemorrhagic stroke (Arboix, 2015). According to the latest WHO data published in 2020, diabetes-related deaths in Nigeria reached 22,497, or 1.52% of total deaths (Arboix & Alioc, 2010). We observed 18% of the recorded cases of diabetes mellitus (DM) that were associated with the incidence of stroke. A previous study reported a similar finding (Boehme *et al*., 2017; Femi and Mansur, 2013). Diabetes mellitus triggers stroke due to vascular endothelial dysfunction, atherosclerosis, systemic inflammation, and thickening of the capillary basement membrane.

Cardiovascular diseases (CVDs) include any disorder, abnormality, or failure to function well relating to the heart, blood vessels or circulation (Okokhere *et al*., 2013). This involves dilated myocardiopathy, heart valve disease, left ventricular hypertrophy, atrial myxoma, congenital heart diseases and coronary syndromes that cause minor cardioembolism (Boon *et al*., 2008). According to the latest WHO data published in 2020, coronary heart disease deaths in Nigeria reached 61,374 or 4.14% of total deaths (Feinstein *et al*., 2012). Of all the recorded cases, only 1% were caused by cardiovascular disease. Cardioembolic infarction was reported as one of the most severe stroke subtypes, with negligible records of symptom-free patients at hospital discharge, but non-negligible risk of early recurrent embolic events and higher mortality in the acute stroke phase (Boon *et al*., 2008).

Peptic ulcer disease (PUD) is an infectious gastrointestinal disease associated with *Helicobacter pylori* (Arboix, 2015). The World Health Organization (WHO) data on Peptic Ulcer Disease deaths in Nigeria in 2020 was reported to reach 5,846 or 0.39% of total deaths (Arboix & Alioc, 2010). We observed that 4% of records of stroke cases were due to PUD. The PUD can be caused by both acute and chronic stressors (NIH, 1994). This triggers the increase of circulatory catecholamines, corticotropins, and cortisol to increase heart rate, blood pressure, hemostatic factors, and blood viscosity (Ellard *et al*., 1990), which could lead to cardioembolism and ischemic stroke.

Road traffic injury is a major public health problem, with death records of 1.3 million people annually in road accidents worldwide (Feinstein *et al*., 2012). The WHO published data on road traffic accidents in 2020. Deaths in Nigeria were reported to reach 41,693, or 2.82% of total deaths (Feinstein *et al*., 2012). Ischemic stroke and traumatic brain injury (TBI) are common and leading causes of severe disability in adults (Bacon *et al*., 2006). We observed a 4% incidence of the studied records to be due to automobiles and related traumatic brain injuries (TBI). TBI has been identified as a potential stroke risk factor that is often ignored. This is because trauma to the head and neck increases the risk of stroke through vascular dissection (Roger *et al*., 2012), microvascular injury, or abnormal coagulation (Fullerton *et al*., 2001).

The previous literature reported higher cases of stroke in adults with sickle cell disease (SCD) compared to the non-SCD population (Lu *et al*., 2004). Our records revealed that only 1% of cases of stroke were attributable to SCD. This differed from the incidence rate of 3.75% of stroke patients with SCD earlier reported (Talahma *et al*., 2014). SCD is a genetic disease caused by a substitution mutation in the beta-globulin of the haemoglobin chain. The valine amino acids are substituted for glutamic acid in the 6^{th} position of the chain. This makes the deoxygenated haemoglobin poorly soluble, polymerizes it, and occludes the blood vessels (Ohene-Frempong *et al*., 1998).

Genetic factors are nonmodifiable stroke risk factors that increase with both parental and family histories (Switzer *et al*., 2006). It also varies by age, sex, and race (Seshadri *et al*., 2010). We observed that 1% of the recorded incidence of stroke in our study was due to heritability. Generally, genetic risk factors are associated with a very small proportion of strokes, probably less than 1 per cent, which is higher among younger stroke patients (Boehme *et al*., 2017).

A transient ischemic attack (TIA) is a brief neurologic disturbance caused by focal brain, spinal cord, or retinal ischemia without acute neuronal degeneration (Leys *et al*., 2002). It is a major sign of stroke (Panuganti *et al*., 2022). We observed a 1% record case of stroke incidence due to TIA during the study period, which signifies a low incidence. Previous research has estimated the incidence of TIA in various populations around the world, with varying results (Kleindorfer et al., 2005). This ranged from 0.2% in western Japanese towns (n = 24) to 9.7% in the older populations of the Pakistan community (Kokubo, 2013). We observed differences in the population, risk factor prevalence, and criteria used to define TIA that contributed to the disparity in our study.

The current study compared the incidence of stroke cases with sex. No association between sex and stroke was observed in the present study. Previous findings have reported sex differences in stroke incidence on account of differences in body physiology (Kamal *et al*., 2009). that oestradiol promotes endothelial dilation and blood flow, whereas testosterone has the opposite effects (Yu *et al*., 2015). The fact that no sex difference was observed in the stroke types probably signifies the influence of age, as the ages recorded were mostly postmenopausal. Oestradiol concentrations were found to drop dramatically during menopause (Barton, 2016). Hence, vasoconstriction in older women is due to the testosterone-like behaviour of oestradiol decline.

CONCLUSION

This study retrospectively evaluated the age, sex, ethnicity, date of admission, stroke types, risk factors, and sides of the impairment from the medical records of stroke patients who attended MMSH, Kano, from 2017 through 2021. The incidence of stroke was higher in males

than in females, but it did not associate significantly with sex. Intracerebral hemorrhagic (ICH) stroke was the most common type, just as right-side impairment and hypertension were the most common disabilities and risk factors, respectively. Our study was based on the available registered records obtained in the hospital stroke patients register, and we did not participate in the assessment or evaluation of the neuroimages. Such definitions of the ICH, classification of the stroke subtypes, and definition of hypertension or hypotension solely relied on what was obtained in the hospital register. Therefore, the result obtained from this article should be treated with caution before application.

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