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Research article

Incidence of first-time stroke in Taif, Saudi Arabia

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Abstract: Introduction: The majority of stroke survivors suffer from physical and mental disabilities. This causes social and economic burdens, and it is regarded as a major source of morbidity and the second leading cause of death worldwide. This study aims to quantify the incidence of cerebrovascular stroke in the Taif region, identify risk factors for CVA, and raise awareness about modifiable risk factors. **Methods:** Over 17 months period (February 2020 to June 2021), all first-stroke patients admitted to Alhada military hospital and King Faisal hospital in Taif region were included. Stroke patients from outside the Taif region were excluded from participating in the study. Age, gender, domicile, employment, history of hypertension, diabetes, cardiac diseases, smoking, previous history of stroke or transient ischemic episodes were all obtained from the patient's files. Also, a history of medications, particularly anticoagulants and contraceptive tablets if a female in childbearing age. **Results:** Overall, the study included 404 patients, 40.6% of whom were females and 59.4% of whom were males, with a mean age of 64.0 ± 14.9 years. The most common type of CVA was ischemic stroke (78.5%), followed by TIA (11.9%), and hemorrhagic stroke (7.2%). Slurred speech was the most commonly reported chief symptom among stroke survivors (23%), followed by dizziness (13.6%), left-sided weakness (10.9%), and right-sided weakness (10.9%). The incidence of stroke is increasing in patients who had chronic diseases like hypertension which is 62.6% survival had, and the second most common lead to stroke and decreased elasticity of vessels is diabetes mellitus 60.4% followed by ischemic heart disease 9.4% and smoking 5.4%. **Conclusions:** Finally, using a prospective clinical study, the incidence of first time CVA in Taif was higher in males (about 59.4%) than in females (40.6%). That indicates a strong relation between Diabetes which represents 60.4%, Hypertension was 62.6% and age 18–55. We suggest running campaigns that target people with these risk factors to reduce the possibility of CVA occurrence.

Keywords: stroke; incidence; TIA; ischemic; hemorrhagic; Taif; Saudi Arabia

1. Introduction

Stroke from cerebrovascular illness is one of the leading causes of death and disability in adults worldwide, particularly in industrialized countries [1].

The majority of stroke survivors suffer from physical and mental problems. This causes social and economic difficulties, and it is regarded as a major source of morbidity and the second leading cause of mortality worldwide, behind coronary heart disease and cancer [2,3].

According to current epidemiological data, 16.9 million people have a stroke each year, giving a global incidence of 258/100,000 people per year and accounting for 11.8% of total deaths worldwide [3,4].

As seen by studies conducted in Saudi Arabia, the hospital-based crude annual incidence rate of stroke is 15.1 per 100,000 people in Jizan [5], 29.8 per 100,000 people in the Eastern province [6], 43.8 per 100,000 people in Riyadh [7], and 57.64 per 100,000 people in Aseer [8] (Figure 1).

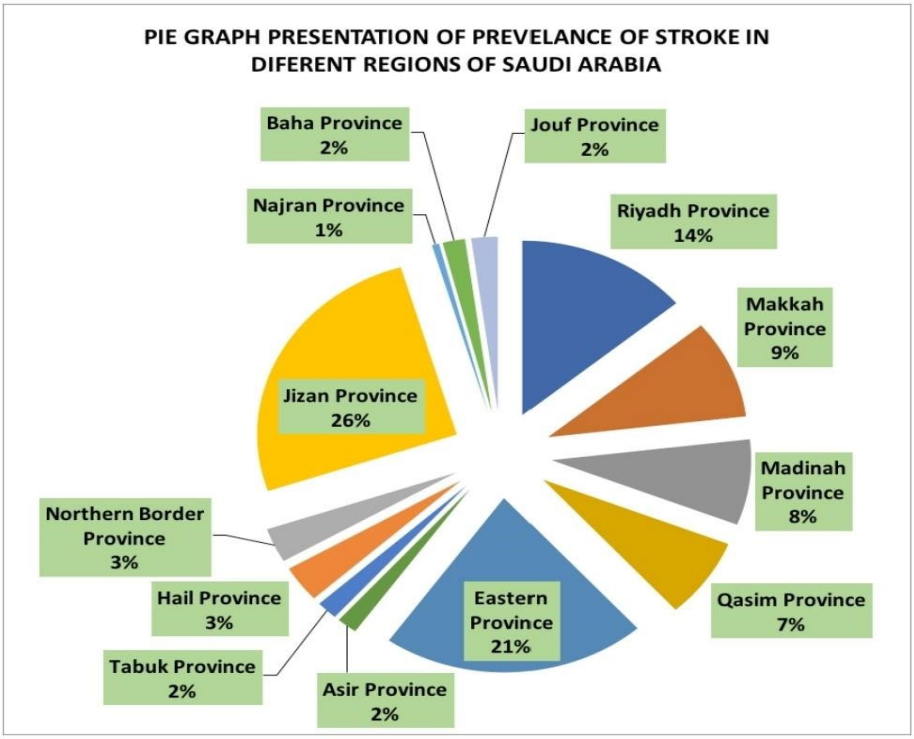

Figure 1. Stroke prevalence in Saudi provinces, 2016 [9].

Taif region is located in western Saudi Arabia and covers an area of 321 km^2. Located at an elevation of 1,879 m (6,165 ft) on the slopes of the Hejaz Mountains, which are part of the Sarawat Mountains.

Recent data on the incidence of first-time strokes in Saudi Arabia in general, and in the western region in particular, are limited.

The purpose of this study is to identify risk factors for CVA and discuss the first-time stroke incidence in the Taif region of western Saudi Arabia and raise awareness about modifiable risk factors.

2. Materials and methods

A cross-sectional study was conducted between February 2020 to June 2021 at 2 governmental hospitals: Al-Hada Military Hospital, King Faisal Hospital in Taif city. It was approved by the ethics and research committee IRB is HAP-02-T-067. The data were collected based on the hospital's archive system. Data was collected from Al-Hada hospital's database. And as for King Faisal hospital it was collected manually from the hospital archives. The used code for the nervous system diseases is G00–G99. Specifically, G45.9 for TIA and G46.4 for cerebral infarction.

Data included age that meets our criteria (over 18 years old), sex, residence, occupation, history of hypertension, diabetes, cardiac diseases, smoking, previous history of stroke or transient ischemic attacks confirmed by Computed Tomography (CT) scan or Magnetic Resonance Imaging (MRI).

History of medication especially anticoagulants, contraceptive pills if female in childbearing period. Data was coded, tabulated and analyzed using SPSS version 25. Qualitative data was expressed as numbers and percentages, and Chi-squared test ($\chi 2$) was applied to test the relationship between variables. ("Risk factors for CVA and raise awareness about modifiable risk factors.") Quantitative data was expressed as mean and standard deviation (Mean ± SD), the suitable statistical test was applied to assess the relationship between variables according to data normality.

3. Results

This study aimed to assess the first-time incidence of stroke cerebrovascular accident in Taif, Saudi Arabia. The study included 404 patients, which had 40.6% females and 59.4% males. The mean age of the CVA patients was found to be 64.0 ± 14.9 years. The age distribution showed that 71.5% were above 55 years, 18.1% were 45–55 years, 8.4% were 35–45 years, and 2% were less than 35 years old (Table 1).

Table 1. Baseline characteristics of the subjects.

		Frequency	Percent
Age	< 35 years	8	2.0
	35–45 years	34	8.4
	45–55 years	73	18.1
	> 55 years	289	71.5
Gender	Female	164	40.6
	Male	240	59.4
Marital status	Single	16	4.0
	Married	388	96.0

The analysis showed that the most common type of CVA was ischemic stroke (78.5%), whereas 11.9% had a transient ischemic attack (TIA), and 7.2% had hemorrhagic stroke (Figure 2).

When we evaluated the relationship of age of the patients with the type of stroke, it was found that ischemic shock was comparatively more frequent in subjects in the age group of 45–55 years and >55 years, whereas TIA was comparatively higher reported in subjects aged <35 years ($p = 0.024$).

Gender and marital status didn't show any statistically significant association with the type of stroke ($p > 0.05$) (Table 2).

Table 2. Relationship between patients sociodemographic characteristics and type of CVA.

		Cerebrovascular accident (CVA)				Total	Chisquare value	P value *
		Hemorrhagic	Ischemic	TIA	Others			
Age	< 35 years	0	4	3	1	8	19.203	0.024
		0.0%	50.0%	37.5%	12.5%	2.0%		
	35–45 years	2	22	9	1	34		
		5.9%	64.7%	26.5%	2.9%	8.4%		
	45–55 years	3	61	7	2	73		
		4.1%	83.6%	9.6%	2.7%	18.1%		
	> 55 years	24	230	29	6	289		
		8.3%	79.6%	10.0%	2.1%	71.5%		
Gender	Female	13	122	24	5	164	2.928	0.403
		7.9%	74.4%	14.6%	3.0%	40.6%		
	Male	16	195	24	5	240		
		6.7%	81.3%	10.0%	2.1%	59.4%		
Marital status	Single	1	10	5	0	16	6.234	0.101
		6.3%	62.5%	31.3%	0.0%	4.0%		
	Married	28	307	43	10	388		
		7.2%	79.1%	11.1%	2.6%	96.0%		

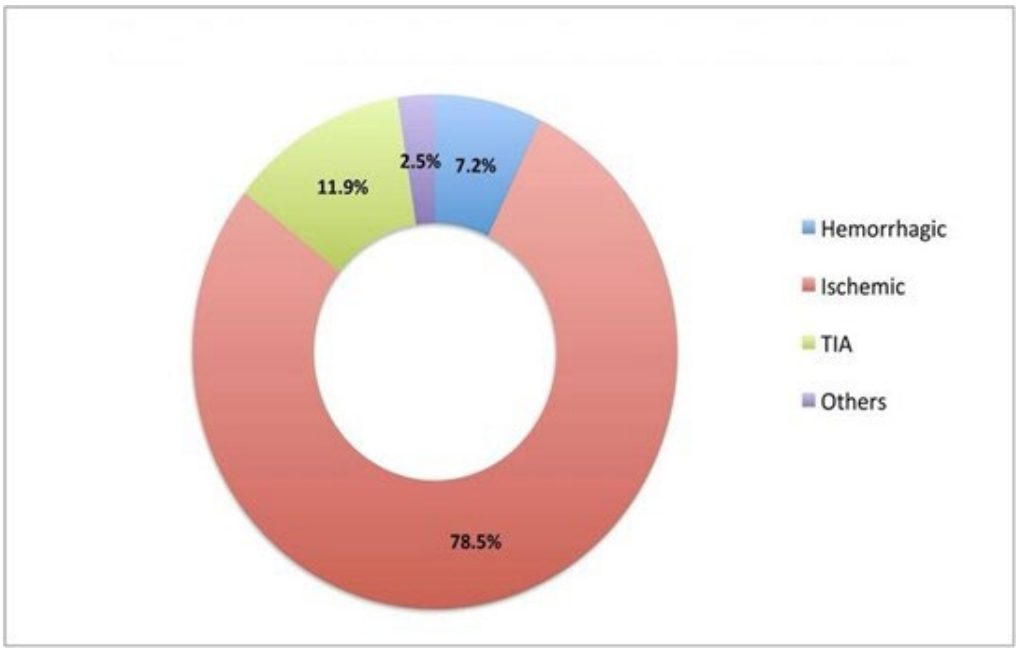

Figure 2. Pie chart representing relative frequency of cerebrovascular accidents (n = 404).

The assessment of the location of stroke showed that 23.8% of the strokes were in the basal ganglia, 9.4% were at the temporal lobe, and 8.9% at the frontal lobe in both sides (Figure 3).

The majority of episodes are ischemic, which represent 78.5% and the hemorrhagic is 7.2%. The most common site for hemorrhagic stroke was basal ganglia (17.2%) and occipital lobe (13.8%) in both sides. For ischemic stroke, it was basal ganglia (26.5%), and other sites (23.7%), and TIA occurred more frequently on other parts of the brain (68.8%), in the right occipital lobe, frontal lobe and basal ganglia. Which showed a statistically significant association ($p < 0.001$) (Table 3).

The most commonly reported chief impairment in stroke patients was slurred speech (23%) followed by dizziness (13.6%), weakness in the left side (10.9%), and weakness in the right side (Figure 4).

About 46% (n = 186) patients had multiple chronic diseases and 5.4% (n = 22) had no relevant medical history. It was found that 62.6% and 60.4% had hypertension and diabetes mellitus, respectively. Ischemic heart disease was reported in 9.4%, and chronic renal disease (CKD) was seen in 4.5% of the stroke patients (Figure 5).

A multivariate logistic regression showed that age >55 years TIA OR = 1.74 (1.15–2.61) and dyslipidemia OR = 1.89 (1.25–3.58) are independent risk factors for TIA. Whereas for ischemic stroke, hypertension showed an increased risk OR = 1.43 (0.97–2.71).

Table 3. Distribution of stroke based on site of stroke.

			Cerebrovascular accident (CVA)				Chisquare value	P value *
			Hemorrhagic	Ischemic	TIA	Others		
Site of stroke	Basal ganglia	N	5	84	7	0	77.736	< 0.001
		%	17.2%	26.5%	14.6%	0.0%		
	Frontal lobe	N	4	30	2	0		
		%	13.8%	9.5%	4.2%	0.0%		
	Occipital lobe	N	4	14	1	0		
		%	13.8%	4.4%	2.1%	0.0%		
	Parietal lobe	N	1	28	0	0		
		%	3.4%	8.8%	0.0%	0.0%		
	Temporal lobe	N	4	31	3	0		
		%	13.8%	9.8%	6.3%	0.0%		
	Thalamus	N	4	14	0	0		
		%	13.8%	4.4%	0.0%	0.0%		
	Carotid	N	0	11	1	0		
		%	0.0%	3.5%	2.1%	0.0%		
	Cerebellar	N	0	30	1	1		
		%	0.0%	9.5%	2.1%	10.0%		
	Others	N	7	75	33	9		
		%	24.1%	23.7%	68.8%	90.0%		

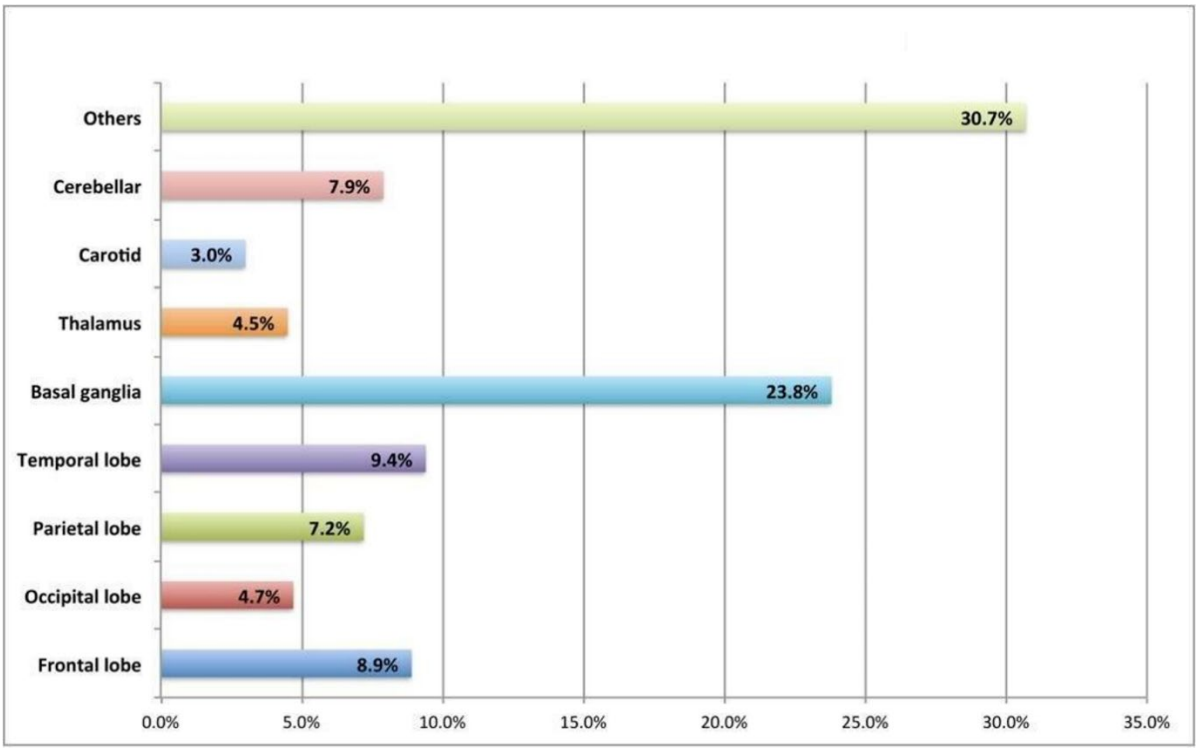

Figure 3. Bar chart representing relative frequency according to the site of stroke.

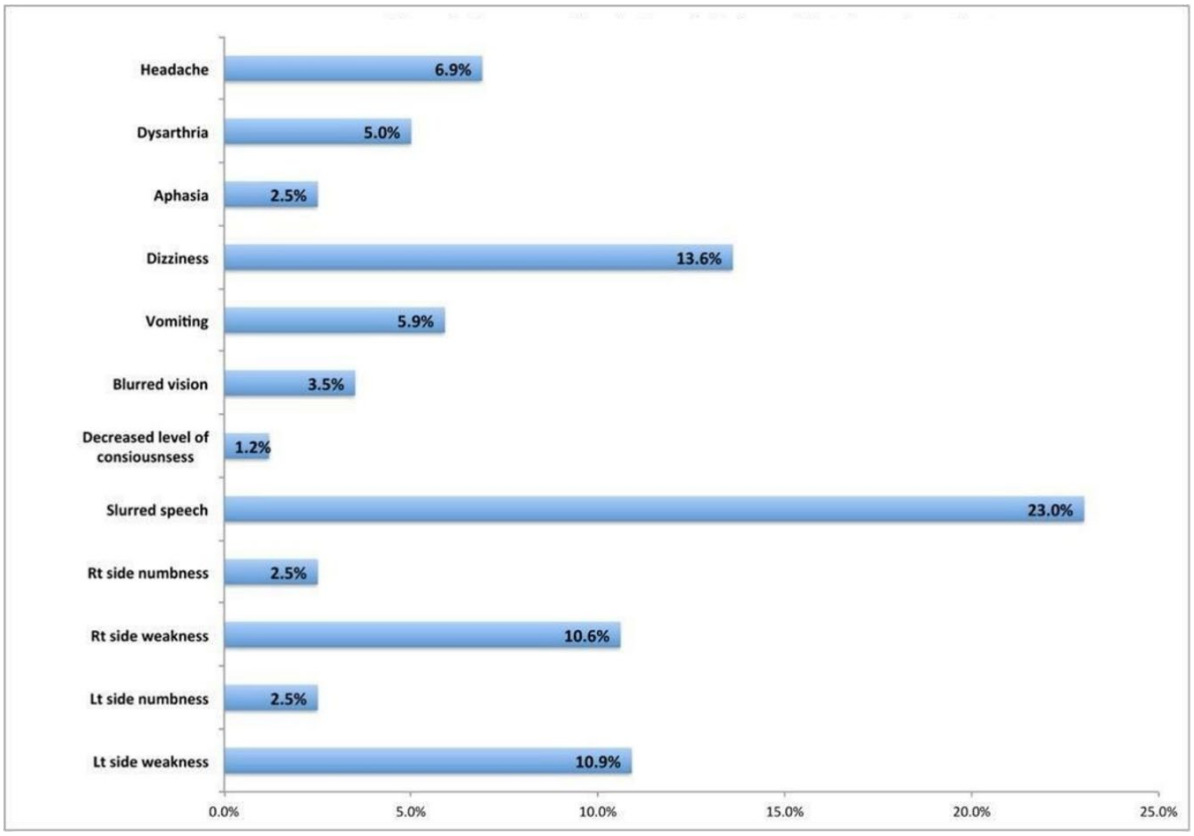

Figure 4. Bar chart representing relative frequency of chief complaints in stroke patients.

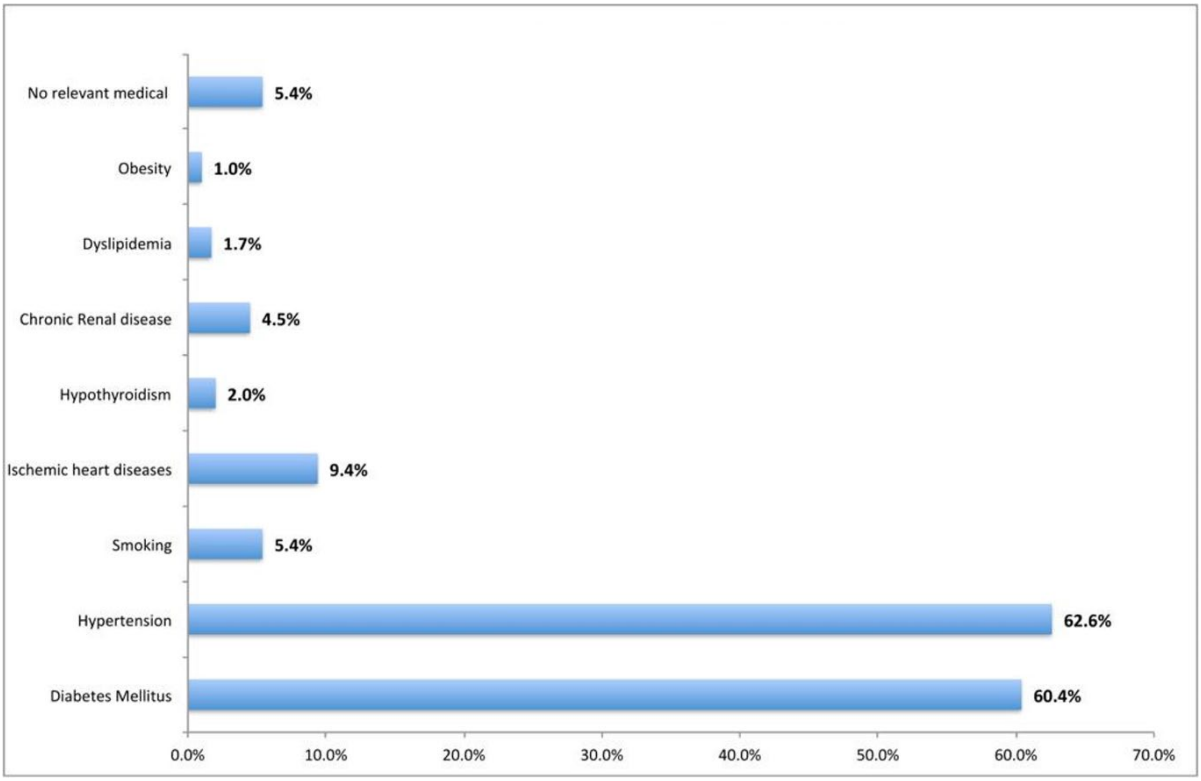

Figure 5. Bar chart representing relative frequency of medical history.

4. Discussion

Stroke is a significant public health problem, identification and treating high-risk individuals is the key to minimizing its magnitude. The prevalence of stroke and the economic burden on the aging population are rising [10]. Epidemiologic studies on stroke help researchers, physicians, and public health policymakers to critically analyze the risk factors and develop effective prevention and control strategies.

According to the 2020 census report, the Kingdom of Saudi Arabia (KSA) has a population of over 35 million, of which nearly 14% are above the age of 50 years [11]. According to Saudi Arabia General Authority for Statistics, in 2019 Taif city population was 682,959 [12]. The Kingdom has witnessed a drastic increase in life expectancy compared to other countries, which has risen from 69 years in 1990 to 75 years in 2020 [13]. According to the reports of the World Health Organization, stroke was the second leading cause of death in KSA in 2020 [14]. In our study, the most common type of stroke was ischemic stroke (78.5%), followed by hemorrhagic stroke (7.2%). According to the American Heart Association, ischemic stroke accounts for the majority of stroke cases (87%), followed by intracerebral hemorrhage (10%) and subarachnoid hemorrhage (3%) [15].

A study from KSA reported that the mean age of the first stroke was 63 years [7].

Age is a non-modifiable risk factor for stroke, especially ischemic stroke, and incidence doubles every ten years after the age of 55 [16]. However, recent evidence shows that the incidence of stroke is also rising in the younger population [17], which reflects the increased diagnostic tastings and greater sensitivity for its detection among people with minor symptoms [18]. With aging, many structural and functional changes in cerebral vasculature may lead to microvascular injury, and also

the prevalence of other risk factors such as hypertension, diabetes, coronary diseases, peripheral artery disease, and atrial fibrillation increases with age [19,20]. It was reported that the incidence of hemorrhagic stroke increases after the age of 45 years [21]. The gender differences in stroke are not well established; however, females at younger ages are likely to have a higher risk than males, though the risk is higher for males at older ages [22]. The higher risk in younger females could be due to pregnancy and hormone-related changes. It is also postulated that stroke occurs more in females than males due to the longer lifespan of females compared to males [17]. In our study, there were no significant gender differences seen between different types of stroke.

Another most important modifiable risk factor for stroke is hypertension, and our study showed a strong association with ischemic stroke. A previous meta-analysis of 147 clinical trials reported that a decrease of systolic blood pressure of 10 mm Hg and diastolic 5 mm Hg were associated with a 40% reduction in the incidence of stroke risk [23]. Our findings imply that hypertension has a major effect on stroke risk and are consistent with many studies [20,24]. Diabetes is considered an independent risk factor incidence of stroke, and studies show a 2-fold increase in diabetic patients compared to nondiabetic patients [25,26]. The risk is also found to be higher in pre-diabetic patients [27]. Hyperlipidemia is a crucial risk factor for stroke, and evidence shows a reduction in cholesterol level significantly reduces the incidence of ischemic stroke [28,29]. Increased total cholesterol is found to show an increased risk of ischemic stroke incidence, whereas decreased risk is seen with elevated HDL cholesterol levels [30,31]. Sedentary behavior and physical inactivity is a risk factor for many morbidities including stroke. Diet studies are complex and have several limitations, such as recall bias and sampling errors, but some specific diets such as high salt and potassium intake are found to have an increased association with stroke [32,33]. Alcohol consumption and smoking are also found to have a direct effect on the incidence of ischemic and hemorrhagic stroke [34,35].

The current study findings showed that ischemic stroke and hemorrhagic stroke were more seen in the basal ganglia, whereas TIA was found to be more in other parts of the brain. Evidence shows that the middle cerebral artery (MCA), which supplies a large area of basal ganglia and lateral surface of the brain, is the commonly involved artery for ischemic stroke [36]. Hemorrhagic stroke occurs as a result of bleeding into the brain by rupture of blood vessels, which may be subdivided into intracerebral hemorrhage (ICH) and subarachnoid hemorrhage (SAH). The former type is bleeding into the brain parenchyma, whereas for SAH, it is bleeding into the subarachnoid space [37]. In ischemic stroke, the occlusion of arteries impedes perfusion of oxygenated blood to brain parenchyma causing cerebral edema and necrosis of parenchyma. Understanding anatomic variation of the site of lesion is an important consideration for vascular surgery, and this will help vascular surgeons to decide the best surgical approach.

Our study poses certain limitations. First, this is a hospital bases study and may have been subjected to referral bias. Second, we used convenience sampling, which might not have reflected the actual prevalence of different types of stroke in the reference population. Third, there may have many variables that were not matched or controlled, resulting in confounding bias. Fourth, the clinical way of diagnosis rather than imaging methods might have distorted the accuracy and reliability of the data. Finally, due to the short recruitment period, our sample size was comparatively small, and this might lead to poor identification of certain risk factors.

5. Conclusions

Our study found relations between the risk factors and the different types of strokes, and we found that the incidence of first CVA in Taif was higher in age 18 to 55. And it was higher in males at about 59.4% meanwhile in females it was 40.6%. Significantly, we noticed that it was higher among married people. That indicates a strong relation between diabetes which represent 60.4%, hypertension was 62.6%. We suggest running campaigns that target people with these risk factors to reduce the possibility of CVA occurrence, one of the campaigns could be to increase the awareness of these risk factors by getting screened for early detection and control.

Conflict of interest

The authors declare no conflict of interest.

References

1. Murray CJ, Vos T, Lozano R, et al. (2013) Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990–2010: a systematic analysis for the global burden of disease study 2010. *Lancet* 380: 2197–2223. https://doi.org/10.1016/S0140-6736(12)61689-4
2. Ovbiagele B, Nguyen-Huynh MN (2011) Stroke epidemiology: advancing our understanding of disease mechanism and therapy. *Neurotherapeutics* 8: 319–329. https://doi.org/10.1007/s13311-011-0053-1
3. Thrift AG, Thayabaranathan T, Howard G, et al. (2017) Global stroke statistics. *Int J Stroke* 12: 13–32. https://doi.org/10.1177/1747493016676285
4. Benjamin EJ, Blaha MJ, Chiuve SE, et al. (2017) Heart disease and stroke statistics—2017 update: a report from the American Heart Association. *Circulation* 135: e146–e603. https://doi.org/10.1161/CIR.0000000000000485
5. Ayoola AE, Banzal SS, Elamin AK, et al. (2003) Profile of stroke in Gazan, kingdom of Saudi Arabia. *Neurosciences (Riyadh)* 8: 229–232.
6. Robert AA, Zamzami MM (2014) Stroke in Saudi Arabia: a review of the recent literature. *Pan Afr Med J* 17: 14. https://doi.org/10.11604/pamj.2014.17.14.3015
7. Al Rajeh S, Awada A, Niazi G, et al. (1993) Stroke in a Saudi Arabian National Guard community. Analysis of 500 consecutive cases from a population-based hospital. *Stroke* 24: 1635–1639. https://doi.org/10.1161/01.STR.24.11.1635.
8. Alhazzani AA, Mahfouz AA, Abolyazid AY, et al. (2018) Study of stroke incidence in the Aseer region, southwestern Saudi Arabia. *Int J Environ Res Public Health* 15: 215. https://doi.org/10.3390/ijerph15020215
9. Alahmari K, Paul SS (2016) Prevalence of stroke in Kingdom of Saudi Arabia—Through a physiotherapist diary. *Mediterr J Soc Sci* 7: 228–233. https://doi.org/10.5901/mjss.2016.v7n1s1p228
10. Béjot Y, Delpont B, Giroud M (2016) Rising stroke incidence in young adults: more epidemiological evidence, more questions to be answered. *J Am Heart Assoc* 5: e003661. https://doi.org/10.1161/JAHA.116.003661

11. Saudi Arabia General Authority for Statistics, Population characteristics surveys, 2020. Available from: https://www.stats.gov.sa/en/43.
12. World Population Review, Taif Population 2022. Available from: https://worldpopulationreview.com/world-cities/taif-population.
13. Al-Subaie AS, Al-Habeeb A, Altwaijri YA (2020) Overview of the Saudi national mental health survey. *Int J Methods Psychiatr Res* 29: e1835. https://doi.org/10.1002/mpr.1835
14. World Health Organization, Saudi Arabia Country Statistics, 2014. Available from: http://www.who.int/countries/sau/en/.
15. Mozaffarian D, Benjamin EJ, Go AS, et al. (2015) Heart disease and stroke statistics—2015 update: a report from the American Heart Association. *Circulation* 131: e29–e322. https://doi.org/10.1161/CIR.0000000000000152
16. Roger VL, Go AS, Lloyd-Jones DM, et al. (2012) Executive summary: heart disease and stroke statistics—2012 update: a report from the American Heart Association. *Circulation* 125: 188–197. https://doi.org/10.1161/CIR.0b013e3182456d46
17. Anderlini D, Wallis G, Marinovic W (2020) Incidence of hospitalization for stroke in Queensland, Australia: younger adults at risk. *J Stroke Cerebrovasc Dis* 29: 104797. https://doi.org/10.1016/j.jstrokecerebrovasdis.2020.104797
18. George MG, Tong X, Kuklina EV, et al. (2011) Trends in stroke hospitalizations and associated risk factors among children and young adults, 1995–2008. *Ann Neurol* 70: 713–721. https://doi.org/10.1002/ana.22539
19. O'Donnell MJ, Xavier D, Liu L, et al. (2010) Risk factors for ischaemic and intracerebral haemorrhagic stroke in 22 countries (the interstroke study): a case-control study. *Lancet* 376: 112–123. https://doi.org/10.1016/S0140-6736(10)60834-3
20. Yousufuddin M, Bartley AC, Alsawas M, et al. (2017) Impact of multiple chronic conditions in patients hospitalized with stroke and transient ischemic attack. *J Stroke Cerebrovasc Dis* 26: 1239–1248. https://doi.org/10.1016/j.jstrokecerebrovasdis.2017.01.015
21. van Asch CJ, Luitse MJ, Rinkel GJ, et al. (2010) Incidence, case fatality, and functional outcome of intracerebral haemorrhage over time, according to age, sex, and ethnic origin: a systematic review and meta-analysis. *Lancet Neurol* 9: 167–176. https://doi.org/10.1016/S1474-4422(09)70340-0
22. Kapral MK, Fang J, Hill MD, et al. (2005) Sex differences in stroke care and outcomes: results from the registry of the Canadian Stroke Network. *Stroke* 36: 809–814. https://doi.org/10.1161/01.STR.0000157662.09551.e5
23. Moon JR, Capistrant BD, Kawachi I, et al. (2012) Stroke incidence in older US hispanics: is foreign birth protective? *Stroke* 43: 1224–1229. https://doi.org/10.1161/STROKEAHA.111.643700
24. Stansbury JP, Jia H, Williams LS, et al. (2005) Ethnic disparities in stroke: epidemiology, acute care, and postacute outcomes. *Stroke* 36: 374–386. https://doi.org/10.1161/01.STR.0000153065.39325.fd
25. Banerjee C, Moon YP, Paik MC, et al. (2012) Duration of diabetes and risk of ischemic stroke: the Northern Manhattan Study. *Stroke* 43: 1212–1217. https://doi.org/10.1161/STROKEAHA.111.641381

26. Sui X, Lavie CJ, Hooker SP, et al. (2011) A prospective study of fasting plasma glucose and risk of stroke in asymptomatic men. *Mayo Clin Proc* 86: 1042–1049. https://doi.org/10.4065/mcp.2011.0267
27. Utsumi H, Elkind MM (1986) Potentially lethal damage, deficient repair in X-ray-sensitive caffeine-responsive Chinese hamster cells. *Radiat Res* 107: 95–106. https://doi.org/10.2307/3576853
28. Amarenco P, Labreuche J (2009) Lipid management in the prevention of stroke: review and updated meta-analysis of statins for stroke prevention. *Lancet Neurol* 8: 453–463. https://doi.org/10.1016/S1474-4422(09)70058-4
29. Heart Protection Study Collaborative Group (2002) MRC/BHF Heart Protection Study of cholesterol lowering with simvastatin in 20,536 high-risk individuals: a randomised placebo-controlled trial. *Lancet* 360: 7–22. https://doi.org/10.1016/S0140-6736(02)09327-3
30. Horenstein RB, Smith DE, Mosca L (2002) Cholesterol predicts stroke mortality in the women's pooling project. *Stroke* 33: 1863–1868. https://doi.org/10.1161/01.STR.0000020093.67593.0B
31. Kurth T, Everett BM, Buring JE, et al. (2007) Lipid levels and the risk of ischemic stroke in women. *Neurology* 68: 556–562. https://doi.org/10.1212/01.wnl.0000254472.41810.0d
32. Nagata C, Takatsuka N, Shimizu N, et al. (2004) Sodium intake and risk of death from stroke in japanese men and women. *Stroke* 35: 1543–1547. https://doi.org/10.1161/01.STR.0000130425.50441.b0
33. Ascherio A, Rimm EB, Hernan MA, et al. (1998) Intake of potassium, magnesium, calcium, and fiber and risk of stroke among US men. *Circulation* 98: 1198–1204. https://doi.org/10.1161/01.CIR.98.12.1198
34. Gill JS, Zezulka AV, Shipley MJ, et al. (1986) Stroke and alcohol consumption. *N Engl J Med* 315: 1041–1046. https://doi.org/10.1056/NEJM198610233151701
35. Foerster M, Marques-Vidal P, Gmel G, et al. (2009) Alcohol drinking and cardiovascular risk in a population with high mean alcohol consumption. *Am J Cardiol* 103: 361–368. https://doi.org/10.1016/j.amjcard.2008.09.089
36. Maulaz AB, Bezerra DC, Bogousslavsky J (2005) Posterior cerebral artery infarction from middle cerebral artery infarction. *Arch Neurol* 62: 938–941. https://doi.org/10.1001/archneur.62.6.938
37. Rymer MM (2011) Hemorrhagic stroke: intracerebral hemorrhage. *Mo Med* 108: 50–54.

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