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Risk factors and predictors among adult patients of ischemic and hemorrhagic stroke: A systematic review

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Abstract Stroke is a primary contributor to preventable mortality and enduring impairment globally, highlighting the necessity of comprehending its risk factors. Permanent disability affects 15-30% of stroke survivors, and twenty percent of survivors need institutional care three months after the stroke. This life-altering event impacts not only the individual but also their family and caregivers. Objectives of the study to identify and analyze risk factors associated with ischemic and hemorrhagic stroke. Utilizing PubMed, Embase, and the Cochrane Library, a comprehensive literature search was carried out on the years 2010 through 2024. All forms of experimental research, observational studies, and case series that have documented the results of the intervention programs indicated above were contained within the scope of the review.Studies examining risk factors for ischemic and hemorrhagic stroke were included. 18 studies (n=23,119 participants) reported hypertension (38.7-94%) as the most important factor in increasing the risk. Diabetes mellitus (12.4-80%) and dyslipidemia (12.8-73.36%) were commonly associated with ischemic stroke. Smoking (2.0-41.14%) and alcohol intake (12-37.9%) were linked to both stroke types. Elevated blood pressure, diabetes, abnormal lipid levels, tobacco use, and alcohol consumption are significant risk factors for stroke. The analysis highlights the crucial need to tackle modifiable risk factors in order to reduce the risk of stroke. To achieve this, healthcare professionals and researchers must focus on promoting lifestyle changes, investigating lesser-known risk factors, and conducting comprehensive meta-analyses to inform evidence-based conclusions. Future research should focus on lifestyle modifications, less common risk factors, and meta-analyses.

Keywords: hypertension, diabetes mellitus, dyslipidemia, alcohol intake, smoking

1. Introduction

Stroke, a medical emergency characterised by sudden brain cell death due to oxygen deprivation, this condition occurs when there is a disruption in the flow of blood to the brain as a result of an obstruction or a break in a blood vessel, resulting in symptoms lasting ≥24 hours with no apparent non-vascular cause (Johnson et al., 2016, Jowi and Mativo, 2003, Ekeh et al., 2015). The burden of stroke is substantial, encompassing not only high mortality and morbidity but also long-term disability (Greffi et al., 2015, Manorenj et al., 2016). As one of the most common medical emergencies, (Saha et al., 2016) among the many avoidable causes of mortality and disability, stroke ranks high on the global scale (Kortazar-Zubizarreta et al., 2019). This devastating condition exerts significant pressure on community healthcare systems (Patne & Chintale, 2016) and carries substantial socio-economic costs.

Permanent disability affects 15-30% of stroke survivors, and twenty percent of survivors need institutional care three months after the stroke. This life-altering event impacts not only the individual but also their family and caregivers (Siddiqui et al., 2013). Globally it is also the primary cause of chronic disability among adults. Notably, individuals aged 55 and above face a significant lifetime risk of stroke, with women having a 1 in 5 chance and men a 1 in 6 chance of experiencing a stroke (Banerjee & Das, 2016). Stroke occurs more frequently in metropolitan regions of India, with an annual incidence rate of 119–145 per 100,000 people (Das & Banerjee, 2008).

Furthermore, in developing countries like India, managing stroke patients is complicated by low socioeconomic status and limited education. Stroke requires prolonged care and financial support, yet many patients seeking treatment at tertiary government hospitals come from disadvantaged backgrounds and lack awareness about preventable risk factors (Siddiqui et al., 2013). The study of the factors that put a person at risk for having a stroke is therefore essential for avoiding and minimizing the catastrophic effects of stroke. To lessen the chances of having a stroke, people should take preventative actions by figuring out what variables are changeable. Early intervention and timely treatment can significantly improve outcomes, reducing stroke severity and the risk of recurrence. Moreover, understanding risk factors enables personalized treatment strategies, leading to better post-stroke recovery and enhanced overall well-being.

Examining risk factors fuels innovative research, yielding new treatments and informing policy decisions that optimize resource allocation. Raising public awareness about risk factors enables individuals to make informed choices, promoting a proactive approach to health. Ultimately, preventing strokes eases the strain on healthcare systems, minimizes socio-economic costs, and enhances overall well-being. By understanding and addressing risk factors, healthcare professionals and researchers can develop effective strategies to combat stroke, ultimately saving lives. Therefore, the purpose of this investigation was to investigate potential causes and indicators of ischemic and hemorrhagic stroke in adults.

2. Materials and Methods

Based on the PRISMA recommendations, which are internationally recognized, the inclusion criteria were developed using the PICOS framework:

Participants/population: The patients who were included in the trial were those who had been diagnosed with stroke and had been admitted to the hospital initially.

Intervention: Among patients who had suffered from ischemic stroke and hemorrhagic stroke, we wanted to find research that examined risk variables, or both, as well as studies that reported risk factors for stroke without distinguishing between the two types of strokes since these were the studies we were considering.

We considered studies that reported on or allowed for the examination of the link between stroke risk factors in a peer-reviewed journal. These studies might be cohort, case-control, or cross-sectional styles.

The following types of studies were not considered for inclusion: case studies, reviews, studies without effect estimates in odds, rate, or risk ratios, studies without age adjustment, studies without mental health effects, anonymous reports, and duplicate reports on prior publications.

Comparator(s)/control: Research on any of the previously mentioned interventions was included, even those studies lacking a comparator group.

Outcome: The primary goals of the research were to determine the underlying age as reported in different research, alongside various modifiable and non-modifiable risk factors.

Study design: All forms of experimental research, observational studies, and case series that have documented the results of the intervention programs indicated above were contained within the scope of the review.

Inclusion criteria:For this study, we considered research carried out anywhere in the world as well as articles published in or after the year 2010 and up until September 2024. The review was limited to only those studies that were published in academic publications that were peer-reviewed and published in the English language.

Exclusion criteria: However, case studies were not included in the research. Studies that were carried out on animals were not included in the investigation.

Literature search:Three independent writers used a structured search approach to conduct a comprehensive literature search in the English language through September 2024. The search was conducted in PubMed, Embase, clinicaltrial.gov, and the Cochrane Library. To identify the articles that were not found in the search databases, the searches were screened using the references of the articles that were chosen. Due to the huge number of research, it was not possible to gather more references through a free internet search conducted by Google. The search approach for the details is presented in Table 1.

Table 1 The selected list for in-depth analysis of ischemic and the hemorrhagic stroke cases from 2010 to 2022, across various countries.

Author/Year	Country	Total Participants	Ischemic stroke case	Hemorrhagic stroke	Age Range/ Mean±SD:
Wong et al., (2022)	Taiwan	7589	-	7589	Without antiplatelet (n=5529):60.09±15.16 Antiplatelet (n=2060): 62.27±12.31
Kelly et al., (2022)	German	1,882,930	1,577,884	305,046	median age = 76 years, [IQR: 65–83 years]
Russell et al., (2022)	Sierra Leone	178	87 (48.8%)	27 (15.2%)	59.8 ± 14.0 years
Lakshmi et al., (2021)	Andhra Pradesh, India	210	171	39	18-90 years
Chen et al., (2021)	Taipai	670	304 (45%)	366 (55%)	16-45 years
Gadisa et al., (2021)	Ethiopia	111	89 (80.2%)	20 (18.0%	63.4 years (SD±12.6
Kortazar-Zubizarreta et al., (2019)	Spain	673	NM	NM	78 (interquartile range [IQR]:71-84)
Xia et al., (2019)	China	7078	NM	NM	60 -69 years :4113; 70-79 years: 2402;

					≥80 years:563
Habibi-Koolaee et al., (2018)	Iran	375	70.7%	29.3%	Men:66.4±14.2 Women:64..6±14.2
Owolabi et al., (2018)	Nigeria and Ghana	2112	1430	682	hemorrhagic stroke patients: 53·4±12·8 ischemic stroke: 61·6±13·5
Manorenj et al., (2016)	India	100	NM	NM	18-79 years; mean and median age of 54 years.
Riaz et al., (2015)	Bangladesh	175	105	70	hemorrhagic stroke patients: (60.4±12.3 years); ischemic stroke: (63.5±13 years
Ekeh et al., (2015)	Nigeria	120	NM	NM	18-85 years with a mean of 55±15.2 years
Kawle et al., (2015)	India	104	104	NM	NM
Raghuvanshi et al., (2014)	Bhopal, India	240	175 (72.9%)	65 (27.1%)	53.02 ± 14.38 years in ischemic stroke group and 52.84 ± 12.45 years in hemorrhagic stroke group
Siddiqui et al., (2013)	Bangladesh	100	53	47	21-90 years [maximum: (29%) 51-60 years followed by (22%)61-70 years age group]
Putaala et al., (2012)	Europe [15 Cities Young Stroke Study]	3944	3944	NM	median age; 43 years; IQR, 36–46
Barech et al., (2010)	Pakistan	156	156	NM	61 ± 9.7

Process of screening and selection of articles: A comprehensive analysis was performed on all of the citations, as well as the titles and abstracts of the research. The final list of articles that were to be evaluated for inclusion in the study was compiled by deleting any duplicates. To reduce the number of studies that are most likely to satisfy the inclusion criteria of the review, the following steps has been taken, three researchers thoroughly evaluated the papers by evaluating the titles and reading the abstracts in great detail. Attempts were made to acquire full-text papers for each of these studies that were under consideration for inclusion, and a comprehensive evaluation was carried out to determine whether or not the inclusion and exclusion criteria were met. Further exclusion was carried out for studies that did not meet the inclusion criteria under category of "Characteristics of Excluded Studies." A separate presentation was made of both the list of papers that were excluded from the analysis as well as the reasons for their exclusion. To provide a clear representation of the screening and selection process, a "PRISMA flow chart" was utilized (Figure 1).

Data extraction: The data extraction process was carried out manually using a standardized data extraction form after being carefully read through and extracted from the studies that were included. Therefore, the current effort was conducted to conduct additional analysis.

Risk of bias in individual studies: An evaluation of the level of methodological rigour that was present in the studies that were included in the systemic review was carried out with the use of the Fowkes and Fulton quality evaluation approach.

Study Outcome: After an indepth examination of all the available literature 18 research papers have been selected as study outcomes enlisted in Table 1. Further for extensive analysis of the targeted goal of risk factors and the predictors among adult patients of ischemic and hemorrhagic stroke, the accorded data was displayed in tabular form in Table 2.

These 18 studies reported in Table 1, observed between 2010 and 2022, investigated ischemic and hemorrhagic stroke cases across various countries, including Taiwan, Germany, Sierra Leone, India, Taipei, Ethiopia, Spain, China, Iran, Nigeria, Ghana, Bangladesh, and Pakistan. There was a total of 23,119 people who participated in the investigations, and the sample sizes ranged from 100 to 1,882,930. The average age of the participants varied from one study to the next, ranging from 43 years (Putaala et al.,2012) to 78 years (Kelly et al., 2022). The age ranges vary significantly across studies, from 16-90 years to more focused ranges like 60-69 years. Mean ages range from 43 to 78 years, with standard deviations indicating variability within each study's population. Ischemic stroke cases accounted for 45-80.2% of total stroke cases, while hemorrhagic stroke cases comprised 15.2-55% of total cases. Notably, the studies identified varying risk factors and demographics associated with stroke types, including age, gender, antiplatelet use, and comorbidities.

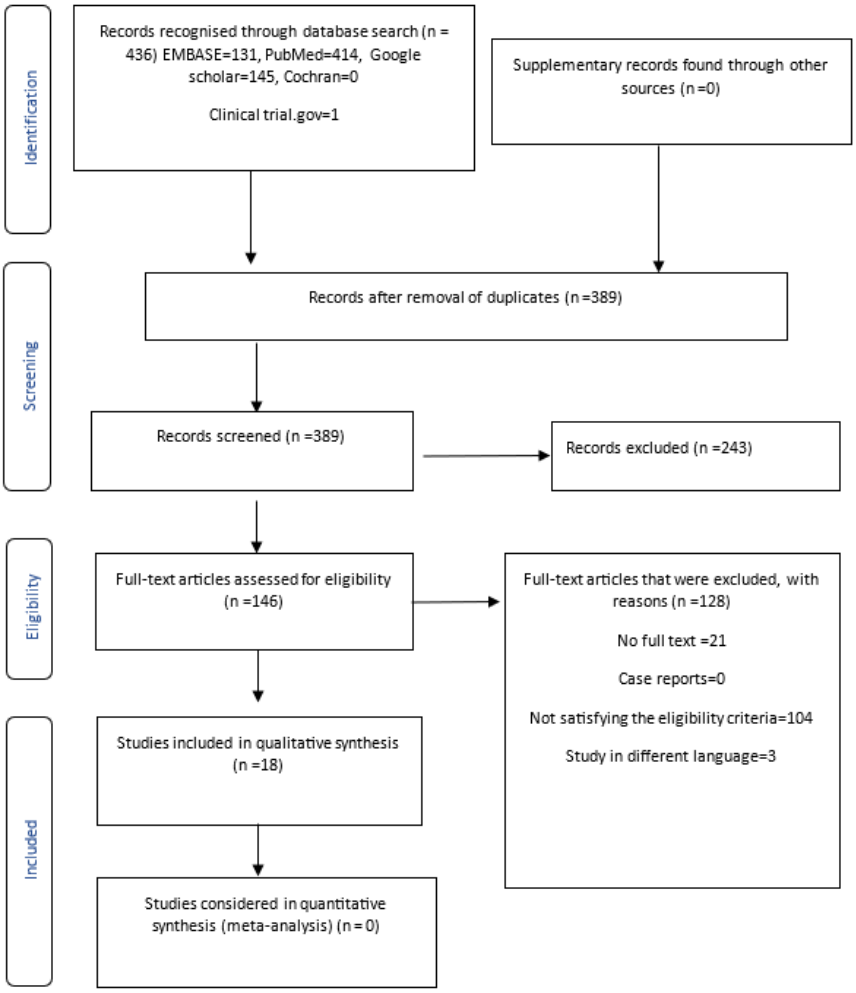

Figure 1 Search Strategy ensuring PRISMA 2009 flow Diagram.

A review of the provided studies reveals varying age ranges for hemorrhagic and ischemic stroke patients. Hemorrhagic stroke patients exhibited age ranges spanning from 18-90 years (Lakshmi et al., 2021), with a median age of 53.4 ± 12.8 years (Owolabi et al., 2018). The oldest age range recorded was 60.4 ± 12.3 years (Riaz et al., 2015), while other studies reported similar age ranges, including 52.84 ± 12.45 years (Raghuvanshi, 2014) and 55-85 years (Ekeh et al., 2015).

In contrast, ischemic stroke patients displayed age ranges from 16-45 years (Chen et al., 2021), with a median age of 61.6 ± 13.5 years (Owolabi et al., 2018). The oldest age range documented was 78 years, with an interquartile range of 71-84 (Kortazar-Zubizarreta et al., 2019). Additional studies reported age ranges of 60.09 ± 15.16 years to 62.27 ± 12.31 years (Wong et al., 2022), and 63.5 ± 13 years (Riaz et al., 2015).

Comparing these age ranges suggests that ischemic stroke patients tend to be older than hemorrhagic stroke patients. However, some studies reported overlapping age ranges. Notably, Putaala et al., (2012) found a median age of 43 years for ischemic stroke patients, significantly younger than other studies. Similarly, Chen et al., (2021) reported a younger age range of 16-45 years for ischemic stroke patients. These findings indicate that ischemic stroke can occur in younger patients, but further research is necessary to confirm this trend.

The analysis (table 2) research has consistently identified hypertension as the most significant risk factor for both ischemic and hemorrhagic strokes. The prevalence of hypertension ranges from 38.7-94% across the course of these investigations. Diabetes mellitus and dyslipidemia are more commonly associated with ischemic stroke, with prevalence ranges of 12.4-80% and 12.8-73.36%, respectively. Family history and cardiac disease are also important risk factors. Moderately associated risk factors include smoking, alcohol intake, obesity, atrial fibrillation, and cardiac disease. In addition to being connected to both ischemic and hemorrhagic strokes, smoking and alcohol consumption are also associated with obesity, according to the findings of recent research, which has been identified as a risk factor. Less commonly associated risk factors include hematological disorders, poor diet, physical inactivity, migraine/headache, psychological stress, and traumatic head injury. Key observations highlight the significance of hypertension, diabetes mellitus, and dyslipidemia in stroke risk. Additionally, family history and cardiac disease play crucial roles. The analysis acknowledges limitations, including variability in study design, population, and sample size, as well as inconsistent reporting of risk factors across studies.

Table 2 Risk factors and the predictors data of ischemic and hemorrrhagic stroke among adult patients of selective cases from 2010 to 2022 across various countries.

Author/Year	Type of stroke	Hypertension	Smoking	Alcohol intake	Diabetes mellitus	Obesity	Dyslipidemia	Family history	Heart Failure	Atrial fibrillation	Hematological disorder	Poor diet	Physical inactivity	Migraine/Headache	Psychological stress	Traumatic head injury	Ischemic heart disease	Transient ischemic attack
Wong et al., (2022)	Ischemic stroke case	Not mentioned (NM)																
	Hemorrhagic stroke	6747	NM	NM	2338	NM	2339	NM	3425	320	NM	NM	NM	NM	NM	NM	NM	NM
Russell et al., (2022)	Stroke	150 (84.3%)	64 (35.9%)	56 (31.4%)	37 (20.7%)	NM	32 (17.9%)	NM	NM	11 (6.1%)	NM	NM	NM	NM	NM	NM	NM	NM
Adnyana et al., (2022)	Ischemic stroke case	NM												Present			NM	
Kelly et al., (2022)	Ischemic stroke case	1,196,720 (75.8%)	70,557 (4.5%)	NM	442,222 (28.0%)	76,731 (4.9%)	633,558 (40.2%)	NM	172,525 (10.9%)	NM	NM	NM	NM	NM	NM	NM	251,407 (15.9%)	NM
	Hemorrhagic stroke	203,473 (66.7%)	6,037 (2.0%)	NM	52,006 (17.1%)	10,905 (3.6%)	39,144 (12.8%)	NM	21,013 (6.9%)	NM	NM	NM	NM	NM	NM	NM	32,376 (10.6%)	NM
Chen et al., (2021)	Stroke	259 (38.7%)	254 (37.9%)	170 (25.4%)	83 (12.4%)	NM	139 (20.7%)	104 (15.5 %)	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Lakshmi et al., (2021)	Stroke	100 (17%)	63 (11%)	70 (12%)	51 (9%)	NM	170 (29%)	NM	Cardiac disease: 20 (4%)		NM	NM	NM	NM	NM	NM	NM	NM

Xia et al., (2019)	Stroke	80.18%	27.26%	15.45%	23.24%	38.14%	73.36%	NM	NM	8.80%	NM	NM	50.01%	NM	NM	NM	NM	NM
Kortazar-Zubizarreta et al., (2019)	Stroke (n=673)	469 (69.69%)	225 (33.43%)	NM	157 (23.33%)	NM	236 (35.07%)	NM	NM	191 (28.38%)	NM	NM	NM	NM	NM	NM	NM	NM
Habibi-Koolaee et al., (2018)	Ischemic stroke case	174	18	NM	108	NM	61	NM	NM	NM	NM	NM	NM	NM	NM	NM	57	6
	Hemorrhagic stroke	77	12	NM	27	NM	22	NM	NM	NM	NM	NM	NM	NM	NM	NM	20	4
Owolabi et al., (2018)	Ischemic stroke case	1329 (94%)	36 (3%)	NM	612 (43%)	NM	1147 (80%)	NM	NM	NM	NM	NM	117 (5%)	NM	NM	NM	NM	NM
	Hemorrhagic stroke	664 (98%)	33 (5%)	NM	185 (27%)	NM	509 (75%)	NM	NM	NM	NM	NM	40 (4%)	NM	NM	NM	NM	NM
Manorenj et al., (2016)	Stroke	83	43	61	32	21	59	NM	Cardiac disease:13		NM	NM	28	NM	NM	NM	NM	NM
Riaz et al., (2015)	Ischemic stroke case	NM	NM	NM	NM	Odds ratio (OD): 6.92	NM	NM	NM	NM	NM	NM	OD: 1.81	NM	OD: 3.51	NM	NM	NM
	Hemorrhagic stroke	OD:42.87	NM	NM	NM	OD: 3.74	NM	NM	NM	NM	NM	OD:2.2 (fatty diet)	NM	NM	OD :4. 14	NM	NM	NM
Ekeh et al., (2015)	Stroke	94(78.3%)	NM	NM	38(36.7%)	73(60.8%)	NM	NM	NM	NM	2(1.7 %)	NM	NM	NM	NM	NM	NM	NM

Kawle et al., (2015)	Ischemic stroke case	70 (67%)	8 (8%)	11 (11%)	29 (28%)	NM	NM	NM	Cardiac diseases: 3 (3%)		NM	NM	NM	NM	NM	5 (5%)	NM
Raghuvanshi et al., (2014)	Ischemic stroke case	92 (52.57%)	72 (41.14%)	NM	51 (29.14%)	NM	110 (62.86%)	NM	NM	6 (3.43%)	NM	NM	NM	NM	NM	NM	24 (13. 71%)
	Hemorrhagic stroke								NM								
Siddiqui et al., (2013)	Ischemic stroke case	(40/100) 51.94%	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
	Hemorrhagic stroke	(37/100) 48.05%	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
	Total cases of stroke	77	NM	NM	22%	NM	20%	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Putaala et al., (2012)	Ischemic stroke case	3939	3665	NM	3929	NM	3317	3094	2970	39333	NM	NM	NM	NM	NM	NM	NM
	Hemorrhagic stroke								Not mentioned (NM)								
Barech et al., (2010)	Ischemic stroke case	75 (62.9%)	26 (16.6%)	NM	17 (26.3%)	NM	8 (14.1%)	20 (12.8 %)	NM	NM	(2.05 %)	NM	NM	NM	NM	7 (12.2%)	NM
	Hemorrhagic stroke								NM								

Future research directions include investigating lifestyle modifications' impact on stroke risk, exploring less common risk factors, and conducting meta-analyses to strengthen conclusions.

In general, this research helps to shed light on the risk variables that are related to ischemic and hemorrhagic strokes. In addition, it emphasizes the need to address risk factors that can be altered to lessen the possibility of experiencing a stroke.

Hypertension: A significant risk factor for both ischemic and hemorrhagic strokes is hypertension, also known as high blood pressure. This is a finding that has been made repeatedly. Individuals who have hypertension have a higher risk of developing a stroke, with the prevalence ranging from 38.7-94%, according to studies which have been conducted. A considerable reduction in the risk of stroke can be achieved by the management of hypertension through changes in lifestyle and medication.

Smoking: There is a moderate association between smoking and the chance of having an ischemic stroke as well as a hemorrhagic stroke. Multiple studies have found that the proportion of smokers among stroke patients ranges from 2.0 to 41.14%. Therefore, smoking is a significant risk factor because It causes damage to the blood arteries, produces an increase in blood pressure, and it reduces the amount of blood that goes to the brain.

Alcohol Intake: There is a correlation between excessive alcohol consumption and an increased risk of hemorrhagic stroke. Studies show a prevalence range of 12-37.9% of alcohol intake among hemorrhagic stroke patients. Moderate alcohol consumption may also contribute to stroke risk.

Diabetes Mellitus: A prevalence range of 12.4% to 80% is connected with ischemic stroke, which is a condition that is usually associated with diabetes mellitus. Because diabetes causes damage to blood arteries and neurons, because of this, the likelihood of getting a stroke is raised.

Obesity: In several studies, obesity has been identified as a risk factor, and the prevalence of obesity ranges from 3.6-60.8%. There is a correlation between having a higher body mass index (BMI) and having a greater possibility of developing hypertension, diabetes, and other aspects that are risk factors for stroke.

Dyslipidemia: Dyslipidemia, or abnormal cholesterol levels, is commonly linked to ischemic stroke, with a prevalence range of 12.8-73.36%. In addition to having high levels of low-density lipoprotein (LDL) cholesterol, having low levels of high-density lipoprotein (HDL) cholesterol is related to an increased risk of having a stroke.

Family History: In several investigations, the presence of a family history has been found as a risk factor. It is more likely that an individual will suffer a stroke themself if there is a history of stroke in their family.

Heart Failure: There is a correlation between heart failure and an increased risk of brain stroke. It has been demonstrated through research that persons who suffer from heart failure have a higher risk of experiencing a stroke due to decreased cardiac output and elevated blood pressure.

Atrial Fibrillation: A higher risk of ischemic stroke is associated with atrial fibrillation, according to research. This heart condition causes irregular heartbeats, increasing the risk of blood clots and stroke.

Hematological Disorder: Hematological disorders, such as sickle cell disease or blood clotting disorders, are identified in a few studies as risk factors for stroke.

Poor Diet: It has been found that a poor diet, which includes a high intake of sugar and sodium, is connected with an increased risk of stroke.

Physical Inactivity: Physical inactivity is linked to stroke risk. Regular exercise reduces blood pressure, improves cardiovascular health, and lowers stroke risk.

Migraine/Headache: Migraines and headaches are identified as risk factors in some studies. It is not quite understood what the specific mechanism is, however, it may be connected to the constriction of blood vessels.

Psychological Stress: There is a correlation between psychological stress and the likelihood of developing coronary heart disease is higher. Over time, persistent stress can lead to several negative outcomes, including a rise in blood pressure and damage to blood vessels.

Traumatic Head Injury: Traumatic head injury is linked to stroke risk. The injury can cause blood vessel damage and increase stroke risk.

Ischemic Heart Disease: Ischemic heart disease is not consistently associated with stroke risk. However, it may contribute to stroke risk in some individuals.

Transient Ischemic Attack (TIA): A transient ischemic attack, also referred to as a "mini-stroke," is a warning sign that serves as an indication that a stroke is imminent. In terms of transient ischemic attack (TIA) as a risk factor, there is a dearth of data.

3. Discussion

Because it is responsible for a significant amount of mortality and disability, stroke is a major public health concern in every region of the world. Stroke is the second leading cause of mortality across the world, according to the World Health Organization (WHO), which estimates that it will account for around 11% of all deaths that occur by the year 2020 (WHO, 2020). Both ischemic and hemorrhagic strokes are most likely to be caused by hypertension, which is the most major risk factor, according to the current analysis, which found that the prevalence range for hypertension was between 38.7-94%. In addition,

diabetes mellitus and dyslipidemia are significantly linked to ischemic stroke, whereas smoking, alcohol use, obesity, atrial fibrillation, and heart disease are moderately linked to the condition. Hematological problems, poor diet, physical inactivity, migraines and headaches, psychological stress, and severe head injuries are some of the less prevalent risk factors known to be associated with this condition. Family history is also an important component. The significance of hypertension is highlighted by the fact that controlling it can significantly minimize the chance of having a stroke. Both smoking and drinking an excessive amount of alcohol are risk factors that contribute to the impairment of blood vessels and the worsening of hypertension. These two conditions, diabetes mellitus and dyslipidemia, both contribute to the risk of stroke by causing damage to the blood vessels and neurons. The likelihood of acquiring hypertension, diabetes, and other stroke risk factors is increased by obesity, although there is no evidence that obesity is directly linked to these conditions.

According to Kearney et al. (2004), on a global scale, hypertension is a significant risk factor for acute ischemic stroke (AIS), and it is a condition that affects both developing countries and wealthy countries of the world. The findings of a study that was carried out by the Indian Council of Medical Research provide credence to this assertion. The study discovered that hypertension, diabetes, tobacco use, and low haemoglobin levels are among the most significant risk factors for acute ischemic stroke (Dalal et al., 1989). In addition, research has identified diabetes, hypertension, heart disease, current smoking, and high alcohol consumption over an extended time as the key risk factors for stroke in young individuals (You et al., 1997).

These investigations are consistent with our findings, which emphasize hypertension as a key risk factor for acute ischemic syndrome (AIS) across all age groups. However, our results diverge from previous research in two notable aspects: diabetes was more prevalent among older AIS patients and smoking was more common among young AIS patients.

According to the findings of Owolabi et al., (2018), ischemic stroke (IS) was responsible for 61.7% (174 cases) of all stroke events. It is important to note that characteristics such as gender, alcohol intake, smoking, homocysteine levels, C-reactive protein, anthropometric measurements, and carotid parameters did not reveal significant relationships with the type of stroke ($p > 0.05$). The patients who had IS, on the other hand, had a tendency to have lower blood pressure, were older, and more frequently had comorbidities such as diabetes mellitus, heart illness, or a history of transient ischemic attacks in comparison to those who had hemorrhagic stroke (HS). In the multivariate regression analysis, three independent predictors of IS were found to accurately predict 69% of stroke types. These predictors were age 62 years or older (odds ratio: 4.0, 95% confidence interval: 2.0-7.9), a history of transient ischemic attack (odds ratio: 4.3, 95% confidence interval: 1.2-15.7), and a systolic blood pressure that is lower than 140 mmHg (odds ratio: 0.4, 95% confidence interval: 0.2-0.9).

In terms of the influence that they have on the economy and the public's health, neurovascular disorders such as migraines and strokes are examples of conditions that are a big reason for concern. Numerous studies have concluded that migraines are linked to an elevated risk of stroke. These findings are in line with the findings of the extensive study that has been carried out on the relationship between migraines and stroke. Using a hazard ratio (HR) of 1.205 and a 95% confidence interval (CI) ranging from 1.151 to 1.262, with a p-value of 0.0001, Adnyana et al., (2022) did a meta-analysis that revealed that there is a statistically significant link between migraines and ischemic strokes. An example of this would be the fact that migraines that were accompanied by auras were linked to an increased risk of ischemic stroke (hazard ratio: 1.442, 95% confidence interval: 1.241-1.675, p=0.0001). A significant connection was also found between migraines that did not involve auras (hazard ratio: 1.126, 95% confidence interval: 1.048-1.211, p=0.001), as opposed to migraines that did contain auras. Even though the precise mechanisms that underlie migraine-related strokes are not fully understood, several hypotheses have been put up. Several potential causes could contribute to migraine headaches, including hemodynamic alterations, endothelial dysfunction, cervical artery dissection, vascular reactivity, hypercoagulability, and the use of medications that kill migraines. Particularly noteworthy is the fact that endothelial dysfunction brought on by cortical spreading depression is regarded to be the fundamental pathophysiological mechanism of ischemic stroke in migraine syndrome. According to the findings of another study conducted by Saddik et al. (2022), there is a substantial connection between migraine attacks and the risk of stroke, particularly ischemic strokes, in female clients. In addition, several factors significantly increase the likelihood of this happening. Women under the age of 45 who smoke and consume oral contraceptives daily have an increased risk of experiencing a stroke. The utilization of nonsteroidal anti-inflammatory medicines (NSAIDs), genetic susceptibility, and metabolic dysfunction are a few additional risk factors that are contributing to the rise in the occurrence of hemorrhagic strokes. Hemorrhagic strokes are significantly less prevalent than ischemic strokes; yet, they are characterized by more severe underlying pathophysiologies, which results in a disproportionately high proportion of fatalities. A further analysis conducted by Chen et al., (2014) evaluated 22 prospective cohort studies and found that there were substantial differences in the risk variables for stroke between populations from the Western world and cultures from Asia. Particularly noteworthy is the fact that smoking and alcohol drinking exhibited different prevalence rates. Western populations demonstrated a higher smoking risk (2.05, 95% CI: 1.68-2.49), whereas Asian populations demonstrated a higher alcohol consumption risk (1.28, 95% CI: 1.07-1.53). At the same time, a body mass index (BMI) of 18.5-21.9 kg/m2 was found to be significantly associated with the risk of having a stroke, but this was only found to be the case in Western countries (0.96, 95% confidence interval: 0.93-0.99). In contrast, a systolic blood pressure (SBP) of 120-139 mmHg was discovered to be a significant risk factor only among Asian people (2.29, 95% confidence interval: 1.04-5.09). This was established by a statistical analysis. Given these findings, which suggest that ethnic differences affect the factors that increase the likelihood of having a stroke, it is of the utmost importance that populations in the Western

and Asian regions that are at a high risk of having a stroke have access to preventative measures that are precisely designed to meet their requirements. The findings highlight the significance of the implementation of population-specific measures to address distinct risk factor profiles and reduce the morbidity associated with stroke attacks.

Literature has also reported the role of genetic factors in stroke. Research has identified specific genetic risk loci associated with ischemic stroke and its subtypes, linked to various underlying mechanisms. These include atrial fibrillation (involving PITX2 and ZFHX3 genes), coronary artery disease (involving ABO, chr9p21, HDAC9, and ALDH2 genes), blood pressure regulation (involving ALDH2 and HDAC9 genes), and vascular development (involving FOXF2 gene). Additionally, genetic factors contributing to coagulation (HABP2 gene), carotid plaque formation (MMP12 gene), and neuro-inflammation (TSPAN2 gene) have been implicated. For hemorrhagic stroke, two distinct risk loci have been identified: APOE and PMF1 (Chauhan & Debette, 2016).

Another factor that has been lately associated with stroke is migraine. Migraine and stroke exhibit distinct epidemiological, clinical, and prognostic profiles, and require different treatment approaches (Ophaff et al., 1996). Despite these differences, research suggests a potential link between the two conditions (Mckinley et al., 2021). This association has significant implications, posing a substantial burden on society (Linstra et al., 2021).

Even for neurologists with years of experience, it can be challenging to differentiate between migraine aura and transient ischemic attack (TIA). This difficulty is more obvious in patients who are over the age of sixty, as transient ischemic attacks (TIAs) are more prevalent in this age group, and migraine auras frequently manifest in an atypical manner, without being accompanied by a migraine headache. The quick onset of symptoms associated with transient ischemic attack (TIA) and the presence of vascular risk factors have been identified as the key distinguishing feature between TIA and migraine aura. Migraine aura symptoms, on the other hand, often manifest themselves more progressively. A headache that is accompanied by transitory neurological symptoms does not necessarily indicate that a migraine aura is present. Ischemic vascular events can produce migraine-like attacks, regardless of whether or not they are accompanied by an aura. It has been suggested by research that people who suffer from migraine aura (MA) may be at a higher risk of transient ischemic attack (TIA), whereas people who suffer from migraine without aura (MO) do not share this risk. According to Oie et al.'s research from 2020, a misdiagnosis of migraine aura as a transient ischemic attack (TIA) can impede an accurate investigation of this association (Oie et al., 2020).

According to Silberstein and Lipton (1993), a misdiagnosis of hemorrhagic or ischemic stroke with migraine as migraine with aura might result in grave repercussions. This is an important point to keep in mind.

Our study has not analysed gender disparity; however, literature has also reported menopause as an associated risk factor for stroke. Menopause marks a significant turning point in women's health, as it is associated with an escalation of multiple stroke risk factors. Research has shown that during the menopausal transition, healthy women experience a range of unfavorable changes, including increased abdominal obesity, elevated triglycerides, total cholesterol, and LDL cholesterol, alongside decreased HDL cholesterol (Matthews et al., 2001). Additionally, fasting glucose levels rise, indicating heightened insulin resistance, while BMI and blood pressure also increase. This surge in cardiovascular risk factors is thought to be driven by the dramatic 60% decline in endogenous estrogen levels during menopause, leading to a relative excess of androgens. It is considered that this hormonal shift is a substantial contributor to the increased risk of stroke and cardiovascular disease that women experience throughout this crucial period of their lives (Lisabeth & Bushnell, 2012).

The risk of stroke and death associated to stroke is greatly reduced by engaging in regular physical exercise, but the risk of stroke and mortality linked to stroke is increased by leading a sedentary lifestyle (Zhou et al., 2007). Physical activity's beneficial effects on stroke risk can be attributed to its role in lowering blood pressure, managing diabetes, and maintaining a healthy weight (Boehme et al., 2017). A study by Manorenj et al., (2016) revealed a significant gender disparity in physical activity levels, with women exhibiting substantially higher rates of inactivity compared to men. This disparity may be attributed to occupational factors, as men tend to engage in more physically demanding work and often serve as primary breadwinners, necessitating greater physical exertion. Another research conducted by Azevedo et al., (2007) which similarly observed this gender-based difference in physical activity levels.

Additionally, dietary habits play a crucial role in stroke prevention, influencing not only stroke risk but also related factors such as diabetes, hypertension, and dyslipidemia (Appel et al., 2006). Adopting a Mediterranean-style diet or consuming a diet high in fruits and vegetables can substantially reduce stroke risk (He et al., 2006). Furthermore, a diet rich in potassium has been shown to lower stroke risk (Larsson et al.,2011). On the other hand, according to Nagata et al., (2004), excessive salt consumption was found to dramatically increase the risk of both hypertension and stroke symptoms.

Riaz et al., (2015) were able to identify separate predictors for each subtype of stroke by conducting a multivariate logistic regression analysis on patients who had suffered from hemorrhagic stroke (HS) and ischemic stroke (IS). There were several major predictors for ischemic stroke, including decreased fruit consumption (odds ratio: 4.6), excessive table salt intake (odds ratio: 8.15), psychosocial stress (odds ratio: 3.5), abnormal electrocardiogram (odds ratio: 3.6), and increased waist-to-hip ratio (WHR) (odds ratio: 6.9)). Less fruit consumption (odds ratio: 5.0), high table salt intake (odds ratio: 9.9), stress (odds ratio: 4.1), a family history of cardiovascular disease death (odds ratio: 11.3), hypertension (odds ratio: 43), aspirin intake (odds ratio: 4.5), and WHR (odds ratio: 3.7) were all predictors of hemorrhagic stroke. According to Riaz et al. (2015), these findings highlight the significance of lifestyle factors, family history, and cardiovascular health in predicting the risk of stroke.

Furthermore, by gaining an awareness of these risk factors, focused interventions can be devised to reduce the risk of stroke and enhance public health outcomes.

It was shown that the risk of stroke was substantially connected with increasing age in a matching review conducted by Tabrizi et al., (2021) among the Iranian population. However, it was interesting to note that gender did not have any influence on the risk of stroke. An increased risk of stroke is associated with several factors, including elevated systolic and diastolic blood pressure, diabetes mellitus, and high fasting blood glucose levels. Insulin resistance was yet another component that demonstrated a substantial role. Additionally, dyslipidemia, which is defined by high triglycerides, low-density lipoprotein cholesterol, total cholesterol, and low high-density lipoprotein cholesterol, has also been recognized as a substantial risk factor. This condition has been a contributing role in the development of cardiovascular disease. Furthermore, cigarette smoking, opioid addiction, and an increased waist circumference were identified as three other key characteristics that were found to be independent drivers of stroke.

The current study emphasizes the significance of the modification of risk variables that can be altered to lessen the likelihood of having a stroke. Modifications to one's lifestyle, such as exercising regularly, maintaining a healthy diet, and learning to handle stress, can dramatically lower the chance of having a stroke. Future research should delve deeper into the impact of these modifications, explore lesser-known risk factors, and conduct meta-analyses to solidify findings. This study provides valuable insights into the risk factors linked to stroke susceptibility, emphasizing the need for comprehensive risk factor management to mitigate stroke risk. When healthcare providers have a thorough grasp of these risk factors, they are better able to devise focused therapies and educate patients about how it is possible to reduce the chance of having a stroke by making adjustments to one's lifestyle.

4. Conclusion

This systematic review highlights the significance of hypertension, diabetes mellitus, dyslipidemia, smoking, as well as consumption of alcohol as potential risk factors for both ischemic and hemorrhagic stroke. The analysis emphasizes the importance of addressing modifiable risk factors to mitigate stroke risk. Healthcare professionals and researchers should prioritize lifestyle modifications, explore less common risk factors, and conduct meta-analyses to strengthen conclusions. By understanding and addressing these risk factors, we can develop effective strategies to combat stroke and ultimately save lives.

Ethical Considerations

Not applicable.

Conflict of Interest

The authors declare no conflicts of interest.

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