Review

Relationship of Lipid Profiles to Stroke Patients: Systematic Review

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ABSTRACT

Background: *Stroke is the second leading cause of death and a major contributor to disability worldwide, with the highest prevalence in developing countries. Ischemic stroke is the most common type, caused by blood flow obstruction due to blood clots or fatty plaque accumulation (atherosclerosis). Hemorrhagic stroke, on the other hand, occurs due to blood vessel rupture and bleeding in the brain. This systematic review aims to explore the relationship between lipid profiles and stroke incidence.*
Methods: *This study employed a systematic review approach using the PRISMA methodology. Articles were sourced from databases including Google Scholar, PubMed, ScienceDirect, and Cochrane Library, focusing on publications from 2019 to 2024. Keywords used for the search included "lipid profile," "stroke," "ischemic stroke," and "hemorrhagic stroke." A total of 2,556 articles were identified, and after screening and selection, 9 relevant articles were included for review.*
Results: *The systematic review findings indicate a significant relationship between lipid profiles and the occurrence of stroke. Elevated lipid levels, particularly abnormal cholesterol and triglyceride levels, are associated with an increased risk of ischemic and hemorrhagic strokes.*
Conclusion: *This systematic review confirms a significant association between lipid profiles and stroke incidence. Elevated lipid levels increase the risk of both ischemic and hemorrhagic strokes. Early screening and management of lipid profiles through lifestyle changes and appropriate treatments are essential for stroke prevention. Further research should evaluate the effectiveness of targeted lipid-lowering strategies in reducing stroke risk.*

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Introduction

Strokes are disturbance-marked nerves with blockage of blood vessels. A blob forms in the brain and is annoying. Genre blood clogs arteries and causes vessels blood to break and cause bleeding. The rupture leads the artery to the brain during a resulting stroke, and death suddenly affects the brain Because of lack of oxygen. Strokes can happen too cause depression and dementia. Stroke is the second leading cause of death and a major contributor to disability worldwide. The prevalence of stroke is highest in developing countries, with ischemic stroke being the most common type. Ischemic and

hemorrhagic strokes are both dangerous. Ischemic stroke happens when clots of blood block Genre blood to the brain. Meanwhile, hemorrhagic stroke occurs when vessels have weak blood broken and bleeding in the brain. Ischemic stroke can happen when fatty plaque collects in the arteries and narrows the vessel's blood, the so-called atherosclerosis, slowing down Genre blood.

Prevalence disease No infectious the more increase mature This. This matter is caused by the pattern of life in the public in Indonesia, Which is experiencing modernization with fast food and awareness about sports. Non-communicable diseases that currently have quite a significant prevalence are stroke and diabetes mellitus. In 2013, data was obtained that the number of Stroke sufferers in the world amounted to 25.7 million, with 10.3 million new cases. There has been an increase in the prevalence of stroke from 7% in 2013 to 10.9% in 2018, And the disease diabetes mellitus went from 6.9% in 2013 to 8.5% in 2018 (Riskesdas, 2018)

WHO in 2014 estimated that 422 million people aged 18 years experience diabetes mellitus. The amount Asia, Southeast, and Pacific West donate is considerable, with 96 million in Southeast Asia and 161 million in the Western Pacific. Based on data obtained in the year 2000, it is estimated that 8.4 million residents in Indonesia are experiencing diabetes mellitus, and it is estimated that in 2030, it will increase drastically to 21.3 million. Diabetes mellitus is a metabolic disease marked by an enhanced blood sugar rate. A lack of secretions of insulin or interference with insulin sensitivity causes it. Diabetes mellitus is divided into diabetes mellitus type 1 and type 2 diabetes mellitus. In cases of type 2 diabetes mellitus, an abnormality from insulin causes sensitivity to insulin for work to decrease.

In stroke and diabetes, there are influencing factors, namely profile lipids. On the patient's stroke profile, lipids will affect the formation of blood vessel plaque and consequent damage to the lining of blood vessels, hardening, And loss of flexibility from vessels blood.High triglyceride levels can have a toxic effect on vessel walls blood, and high total cholesterol levels can trigger blood vessel blockages And lesion endothelium. Rate and rate HDL which has a low influence on the severity and mortality of non-hemorrhagic stroke due to LDL. HDL is also a significant factor in the formation of plaque atherosclerosis. High LDL and HDL low cause lipids to be high in the blood flow, making plaque easier to form. In the case of diabetes mellitus, lipid profile levels will experience changes, namely a decreased HDL enhancement rate of LDL And Triglycerides.High levels of the atherogenic index can increase the mortality of stroke patients Because its height rate index is a marker of atherogenicity in vessels blood; the mark index atherogenic is 0.71, which is significant for stroke patient mortality (Alogna et al., 2023; Chang et al., 2021).

A study about the connection of profile lipids to mortality patient stroke has been conducted, but the results obtained are still inconsistent. who state that rate LDL own connection significant to the incident, LDL levels have no relationship to events strokes. In addition, research examining the relationship between LDL levels, HDL levels, total cholesterol levels, atherogenic index, and triglyceride levels on mortality stroke patients with comorbid factors of type 2 diabetes mellitus has never been done. Therefore, researchers wish to do a study about matter (GDB, 2024; Wu & Qu, 2022).

Based on a study (Sari, Haroen, & Nursiswati, 2016), educational program-based foot care families effectively increase the behavior of foot care for DM patients, where the behavior of foot care after intervention in groups intervention higher compared with before intervention, while in the control group, there was decline score after measurement. Studies (Febrianti, Restuning Prihati, & Aini, 2024) show results that increase behavior after education foot care. A study (Setyaningsih & Maliya, 2018) shows results that there is an influence on education health Diabetic foot care with method demonstration in increase ability Diabetic foot care. A study (Ginting & Panjaitan, 2023) shows that there is an influence on giving homecare education towards *self-efficacy* the caregiver does maintenance wound simple diabetic ulcers. Besides that, the study (Magdalena & Purwanti Ningsih, 2016) shows that there is a difference before and after the intervention to level knowledge, efficacy self , and behavior foot care,

Methods

Study Design

Writing article: This uses a systematic review design with the first Systematic and Meta-Analysis (PRISMA) standard used For the first systematic. There are seven steps: write a review question, determine the criteria used, search comprehensively from various source information, identify source-relevant literature, select source-relevant literature, assess quality source-relevant literature, and synthesize source literature.

Criteria Appropriateness

Criteria used in writing the article This uses PICO (*Population, Intervention, Comparison, Outcome*) to develop criteria richness For criteria inclusion and exclusion from the first study in a random way. Following a number of the requirements that are:

P (*Population*): Diabetes mellitus sufferers
I (*Intervention*): *Foot care education* (foot care)
C (*Comparison*): Not using factor comparison
O (*Outcome*): *Self-efficacy* and change behavior (compliance foot care)

Search Strategy

The databases used for this systematic review are *Google Scholar, Pubmed, Science Direct,* and *the Cochrane Library*. Search article journal done in a way systematic from 5 years, namely 2019-2024, with the use of some keywords , namely " lipid profile," "stroke," " *ischemic stroke,"* or " *hemorrhagic stroke."* Search articles use Indonesian and languages English,

Study Selection and Synthesis

The feasibility study is done by ringing the review article with clear text. Articles considered proper by reviewers will used in the review literature. The process and results election article is served in PRISMA diagram 1. Based on the results, a search through the journal database obtained as many articles as possible from *Scholar* (1,287 articles), *Pubmed* (149 articles), *Science Direct* (1,111 articles), and *Cochrane Library* (9 articles). After selecting appropriate criteria inclusion and exclusion articles that are not in accordance, 9 articles were found to be reviewed.

Results

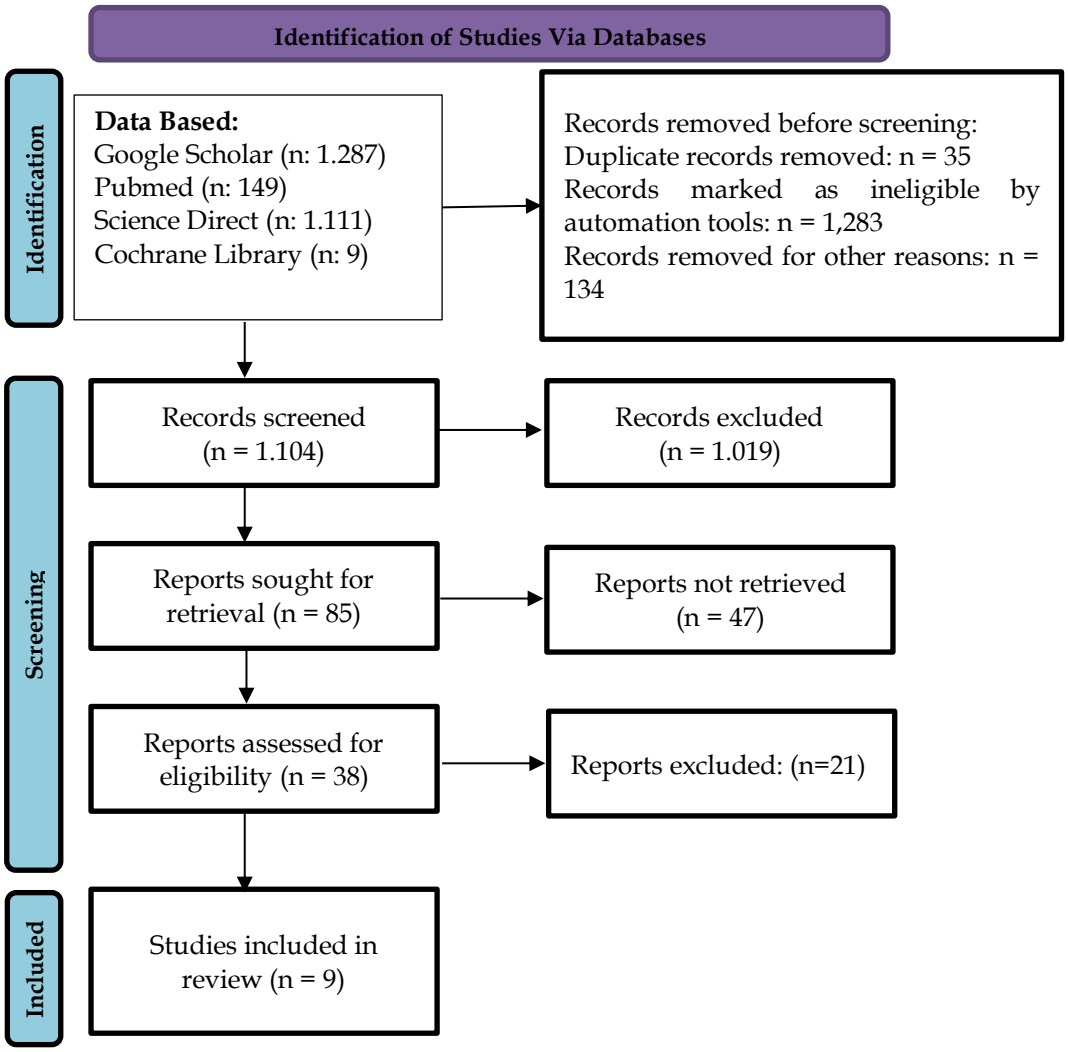

Figure 1. PRISMA diagram

Table 1. Characteristic of study

No.	Journal	Method	Results
1.	The Relationship Of Triglyceride Levels In The Blood To Clinical Outcomes Of Acute Ischemic Stroke Patients (Ö Tekir & Özsezer, 2023).	**Design:** descriptive analytic with method cut latitude. **Sample:** 73 people **Variables :** Independent: Triglyceride Levels Dependent: Ischemic stroke **Instruments :** Modified Rankin Scale (mRS). **Analysis :** Mann-Whitney	Of the 73 subjects, 41 (56.2%) were male, averaging 60.73 years. Additionally, 16 subjects (32.7%) had hyperglycemia at the time of admission, 42 subjects (57.5%) had hypertension upon entry, 22 subjects (30.1%) Had ypercholesterolemia at the time of admission, and 24 subjects (32.9%) had hypertriglyceridemia upon entry. There is a connection backward between the rate of triglycerides in blood ischemic stroke sufferers in women or without increased blood sugar levels fast moment enter to outer clinical ischemic stroke I.
2.	Lipid Profile And Incident Of Hypertension (Yarnita, Rayasari, & Kamil, 2023).	**Design:** Cross-sectional. **Sample:** 100 respondents **Variables :** Independent: Lipid profile Dependent: Hypertension **Instruments :** Sediment analyzer **Analysis :** chi-square test	Research results show that from 100 data samples, respondents were primarily based on type sex: men (26.0%) and women (74.0%). The chi-square test results show a connection between the rate of cholesterol and triglycerides with incident hypertension (p-value = 0.000). In contrast, with incident hypertension, BMI status, cholesterol, HDL, and LDL levels are insignificant. That incident hypertension relates to the rate of triglycerides and does not relate to BMI status, cholesterol levels, HDL levels, and LDL levels.
3.	Comparison Of Lipid Profile Levels In Ischemic Stroke Patients With Hemorrhagic Stroke At Budhi Asih Hospital, East Jakarta.	**Design:** Analytic comparative with approach quantitative, **Sample:** 104 people **Variables :** Independent: lipid profile Dependent: ischemic and hemorrhagic stroke **Instruments :** Quota sampling technique. **Analysis :** Mann-Whitney - U	The research results show that, based on age range, the highest number of ischemic stroke cases were found in individuals aged 51-60 years and those older than 60 years, with 18 cases (17.3%) in each group. In contrast, most cases of hemorrhagic stroke were found in individuals older than 60 years, with 19 cases (18.3%). In terms of gender, the highest prevalence was observed in male patients. For ischemic stroke, 30 male patients (28.8%) were affected, while for

No.	Journal	Method	Results
			hemorrhagic stroke, there were 28 male patients (26.9%). Based on the results of the independent t-test and Mann-Whitney U test, significant differences were found in the lipid profile levels between ischemic stroke and hemorrhagic stroke patients. The p-values for the different lipid parameters were as follows: total cholesterol ($p < 0.002$), HDL ($p < 0.002$), LDL cholesterol ($p < 0.007$), and triglycerides ($p < 0.006$). Since all p-values are less than 0.05, the study concludes that there is a significant difference in the lipid profile levels between the two groups of stroke patients.
4.	Lipid Profile Levels in Ischemic Stroke Sufferers at Pasar Rebo Hospital, Jakarta.	**Design:** Quasi experiment **Sample:** 45 people **Variables :** Independent: lipid profile Dependent: ischemic stroke **Instruments :** Record data medical **Analysis :** Wilcoxon test	The research results show that in ischemic stroke patients, there was an increase in total cholesterol levels in 43 patients (95.6%) and LDL cholesterol levels in 37 patients (82.2%). The most normal results were found for triglycerides, with 33 patients (73.3%) showing normal levels and 25 patients (55.6%) showing normal HDL cholesterol levels. Based on gender, ischemic stroke was most common in men, with 30 patients (66.7%). The most affected age group was 56-65, with 17 patients (37.8%). There was a notable change in the lipid profile of ischemic stroke patients, particularly in total cholesterol and LDL cholesterol, where an increase in cholesterol levels was observed, surpassing the normal range. However, the levels of HDL cholesterol and triglycerides remained within normal limits.
5.	Nonlinear relationship between triglycerides and cognitive function after acute ischemic stroke among older adults.	**Design:** observational cross-sectional **Sample:** 221 patients **Variables :** Independent: level triglycerides and function cognitive Dependent: ischemic stroke	In this study, a total of 221 patients (mean ± SD: 70.64 ± 7.43 years) with acute ischemic stroke (AIS) were recruited sequentially, of whom 144 (65.16%) were male. Among these 221 patients, 102 (46.15%) experienced cognitive

No.	Journal	Method	Results
		Instruments : Mini-Mental State Examination (MMSE) **Analysis :** ANOVA	disturbances. After controlling for potential confounders, the study found a nonlinear relationship between triglyceride levels and mental disorders, with a turning point at 0.8 mmol/L. Below the turning point, triglyceride levels were positively correlated with the Mini-Mental State Examination (MMSE) score (β = 14.11, 95% confidence interval [CI] = 2.33–25.89, P = 0.020). However, above the turning point, the correlation between MMSE scores and triglyceride levels was insignificant (β = 1.04, 95% CI = -1.27 to 3.34, P = 0.380). This study suggests that there is a nonlinear relationship between triglyceride levels and cognitive function after acute ischemic stroke in older adults, indicating that the impact of triglycerides on cognitive outcomes may vary depending on the level of triglycerides. Triglycerides relate positively to cognitive function when lacking 0.8 mmol/L.
6.	Acute-Phase Stroke Outcome and Lipids.	**Design:** Pre- experiment **Sample:** 698 patients **Variables :** Independent: lipid profile Dependent: stroke **Instruments :** Rankin Scale and Glasgow Coma Score. **Analysis :** Mann–Whitney U-test	In a follow-up study of 698 patients, 64 patients died during the follow-up period. The average levels of triglycerides (TG), the triglyceride-to-HDL cholesterol ratio (TG/HDL-C), and the total cholesterol-to-HDL cholesterol ratio (TC/HDL-C) were significantly lower in the mortality group compared to the survival group. Receiver operating characteristic (ROC) analysis revealed the following cutoff values and areas under the curve (AUC) for the lipid parameters associated with short-term stroke mortality: TG: 100.2 mg/dL (AUC = 0.648) TG/HDL-C: 2.52 (AUC = 0.650)

No.	Journal	Method	Results
			TC: 170.50 mg/dL (AUC = 0.598) TC/HDL-C: 4.32 (AUC = 0.640) In the Cox regression model, TG and TG/HDL-C were identified as independent variables for predicting short-term mortality based on their ROC cutoff values. Specifically: TG ≤ 100.2 mg/dL was associated with a hazard ratio (HR) of 2.413 (95% CI: 1.345–4.327, P = 0.004) TG/HDL-C ≤ 2.56 was associated with a hazard ratio (HR) of 2.720 (95% CI: 1.389–5.359, P = 0.003) This suggests that lower levels of TG and TG/HDL-C are significant predictors of short-term mortality in stroke patients. Dyslipidemia is known to be a risk factor for stroke. However, this study focuses on the estimation that higher triglyceride (TG) levels and a higher TG/HDL-C ratio may serve as predictors of short-term mortality within one month after a stroke attack, which differs from the factors associated with long-term stroke risk. Serum TG levels may be a more accurate indicator of mortality in conditions involving hypercatabolic trauma, such as a stroke. This suggests that lipid profiles, particularly TG levels and the TG/HDL-C ratio, can provide valuable insights into short-term mortality risk following a stroke.
7.	The impact of triglyceride-glucose index on ischemic stroke: a systematic review and meta-analysis.	**Design:** Systematic review **Sample:** 18 journals **Variables :** Independent: ischemic stroke Dependent: index triglycerides **Instruments :** Cochrane, Embase, Medline, Web of Science, PubMed **Analysis :** Meta Packages in STATA	A total of 18 studies involving 592,635 patients were included in our analysis. The combined effect value for all types of stroke showed that a higher TyG index is associated with an increased risk of ischemic stroke (IS) in the general population (OR 1.37; 95% CI 1.22-1.54) based on a total sample of 554,334 cases, with high heterogeneity (P = 0.000, I^2 =

No.	Journal	Method	Results
			74.10%). Additionally, when compared to IS patients with a lower TyG index, those with a higher TyG index had a significantly higher risk of stroke recurrence (OR 1.50; 95% CI 1.19-1.89) and increased mortality risk (OR 1.40; 95% CI 1.14-1.71). However, no significant correlation was found between the TyG index and poor functional outcomes (OR 1.12; 95% CI 0.88-1.43) or worsening neurological status (OR 1.76; 95% CI 0.79-3.95) in a total sample of 38,301 cases, with high heterogeneity (P = 0.000; I^2 = 77.20%). The TyG index shows potential in optimizing IS risk stratification in the general population. Moreover, again, there is a significant relationship between index high TyG and various bad results from stroke, especially stroke recurrence, and high mortality. Future research must focus on multi-center and multi-regional design to explore more carry-on connections between IS and index TyG.
8.	Triglyceride-glucose index and common carotid artery intima-media thickness in patients with ischemic stroke.	**Design:** Quasi experiment **Sample:** 1523 patients **Variables :** Independent: ischemic stroke Dependent: index triglycerides and atherosclerosis carotid **Instruments :** Mercury sphygmomanometer **Analysis :** Mann Whitney U	Adjusted odds ratio with multivariable (95% CI) in quartile 4 versus quartile 1 of the index TyG is 1.56 (1.06-2.28) for The mean cIMT was abnormal and was 1.46 (1.02-2.08) for cIMT abnormal maximum. There is a linear relationship between the index Abnormal mean TyG and cIMT (P for linearity = 0.005) and the cIMT maximum abnormality (P for linearity = 0.027). Additionally, index TyG already gives capacity predictive extra outside factor risks , shown with enhancement reclassification clean and upgrade discrimination integrated (all P<0.05). Index More TyG is linked to atherosclerosis. The carotid is measured with cIMT in patients with ischemic stroke, showing that TyG can become a

No.	Journal	Method	Results
			marker promising atherosclerosis.
9.	Triglyceride and Total Cholesterol Level as the Predictor of Mortality in Stroke Patients: Literature Review.	**Design:** Systematic review **Sample:** 18 journals **Variables :** Independent: ischemic stroke Dependent: triglycerides and total cholesterol **Instruments :** Google Scholar, Pubmed, Springer, European Society Of Cardiology (ESC), Elsevier, and Circulation. **Analysis :** Systematic review	From the literature review, 18 journals were analyzed, revealing that triglycerides and total cholesterol levels are significant predictors of prognosis and mortality in stroke patients. High triglyceride levels (>200 mg/dL) and high total cholesterol levels (160-240 mg/dL) play a crucial role in the formation of atherosclerosis, leading to blood vessel blockages, particularly in ischemic stroke patients. On the other hand, low triglyceride levels (<150 mg/dL) and low cholesterol levels (<120-180 mg/dL) may indicate potential malnutrition, which can worsen the condition of stroke patients. Low triglyceride and cholesterol levels influence the integrity of membrane cells and resilience to broken membrane cells, resulting From analysis. It can concluded that high or low rate triglycerides and total cholesterol have an effect on prognosis and mortality in stroke patients based on the pathophysiology that occurs.

Discussion

Triglycerides are one of the suspected components role a factor in the occurrence of a stroke. That matter supported through research by Freiberg et al. against 13,956 subjects, where 1529 subjects were obtained suffered from ischemic and related strokes with enhancement rate triglycerides in blood without fasting (log-rank trend, p-value <0.001).

A study cohort conducted by Huang et al. on elderly with hypertension also shows that the rate of triglycerides in blood independently influences stroke attack. However, the effect of triglycerides in blood on outer clinical stroke is still controversial. Several studies support that the rate of triglycerides in low blood pressure will be influential to outer clinical ischemic stroke. In a follow-up study conducted by Ryu et al ., Rate found triglycerides in low blood pressure associated tightly with enhancement risk mortality in ischemic stroke, especially in non-cardioembolic stroke and vascular death. This matter was strengthened by research conducted by Pikija et al., where triglycerides in high blood pressure relate to the possibility of taller obtained more clinically well, possibly small happening worse, and lower mortality

risk. Study It also concludes that the rate of triglycerides in high blood pressure is related to a higher survival rate compared to the rate triglycerides in blood pressure is low in cases of noncardioembolic stroke, but not in cases of cardioembolic stroke, so allegedly, the rate triglycerides in blood influential to certain types of stroke.

In research Mahendrakrisna, 2021. Of the 73 subjects, 41 subjects (56.2%) were male with an average age of 60.73 years, 16 subjects (32.7%) had hyperglycemia moment admission, 42 subjects (57.5%) with hypertension moment entered, and 22 subjects (30.1%). With hypercholesterolemia moment entered, 24 subjects (32.9%) were obtained hypertriglyceridemia moment enter. There is a connection backward between the rate of triglycerides in blood ischemic stroke sufferers in women or without increased blood sugar levels fast moment enter to outer clinical ischemic stroke I.

The enhancement rate of total cholesterol or hypercholesterolemia is essential to ischemic stroke because the enhancement of total cholesterol results in internal blockage of blood vessels. This matter is by research conducted by (Rahayu et al., 2023). The lipid profile analysis in patients with ischemic stroke revealed an increase in total cholesterol levels in 43 patients (95.6%) and LDL cholesterol levels in 37 patients (82.2%). Most patients showed expected triglyceride results, with 33 patients (73.3%) presenting within the normal range, and HDL cholesterol was normal in 25 patients (55.6%). In terms of demographics, the male gender was predominant, with 30 patients (66.7%), and the most common age group was 56-65 years, comprising 17 patients (37.8%). These findings indicate notable alterations in lipid profiles among ischemic stroke patients, particularly in total and LDL cholesterol levels, with a significant increase observed compared to typical values. Meanwhile, other lipid parameters, such as HDL cholesterol and triglycerides, remained within normal limits.

High-density lipoprotein Is a lipoprotein that acts as cleaner excess cholesterol. High-density lipoprotein takes excess cholesterol from cells and tissues in the body and returns it to the heart. Low HDL levels increase the risk of freezing blood and can cause stroke. Low HDL levels The same is dangerous with high LDL levels. If HDL levels are too high low and high levels of LDL, plaque can build up in the arteries and block them Genre blood to all organs and brain

Excessive LDL levels will settle in wall vessels and blood arteries and create plaque, triggering fat accumulation and atherosclerosis (hardening and blockage, making fat deposits thick and stiff The range of triglyceride values in ischemic stroke patients was 80–601 mg/dl, with a mean of 192 mg/dl, while in hemorrhagic stroke patients, the range was 53–172 mg/dl, with a mean of 124 mg/dl. The Mann-Whitney U test yielded a p-value of <0.001. Triglycerides constitute approximately 90% of dietary fats, but elevated levels can negatively affect blood vessels and arteries. Uncontrolled diabetes, diuretics, corticosteroids, or excessive alcohol consumption may influence high triglyceride levels. Elevated triglycerides are stored under the skin and contribute to the formation of LDL cholesterol in the liver, which then enters the bloodstream. Based on the study results, This rate Lipid profile in ischemic stroke sufferers obtained increased total cholesterol and LDL cholesterol levels. Research shows this is also the most found in men aged 56-65.

Conclusion

Based on the literature review conducted, a systematic review involves a series of methods used to identify, evaluate, and interpret research evidence to address the research problem. From the collected articles, a selection process was carried out, resulting in a set of studies meeting the criteria. The reviewed articles demonstrate a connection between lipid profiles and the incidence of stroke. Future research is recommended to explore the impact of specific lipid-lowering interventions on stroke prevention and recovery. Additionally, studies focusing on the interaction of lipid profiles with other risk factors, such as genetics, lifestyle, and comorbidities, can provide a more comprehensive understanding of stroke prevention strategies.

Authors Contributions

In this literature review endeavor, each author played a pivotal role in shaping the narrative and depth of analysis: one author spearheaded the identification of research gaps, conceptualized the study framework, and meticulously curated the literature; another author critically evaluated the quality and relevance of selected sources, conducted a meta-analysis, and contributed to the theoretical synthesis; while a third author meticulously revised the manuscript, ensured alignment with research objectives, and polished the language for clarity and coherence.

Conflicts of Interest

We certify that this research was conducted free from any conflicts of interest, with no external influence from funding bodies, personal relationships, or organizational affiliations that could have compromised the validity of our results.

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