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ORIGINAL ARTICLE

Correlation between NIHSS Score and Serum Ferritin Levels among Acute Ischemic Stroke Patients

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Abstract

Introduction: Stroke is a major cause of morbidity and mortality worldwide, with ischemic stroke accounting for the majority of cases. Serum ferritin, an iron-storage protein and acute-phase reactant, has been implicated in inflammation and oxidative stress, both of which play important roles in ischemic brain injury. This study was conducted to assess the association between serum ferritin levels and stroke severity among participants with acute ischemic stroke, using the National Institutes of Health Stroke Scale (NIHSS). **Materials and Methods:** This hospital-based cross-sectional analytical study was conducted among 106 participants with acute ischemic stroke admitted to a tertiary care teaching hospital. Participants aged more than 45 years, presenting within 48 hours of stroke onset and confirmed by neuroimaging, were included. After obtaining informed consent, demographic details, clinical history, vascular and lifestyle-related risk factors, and laboratory parameters were recorded. Stroke severity was assessed using the NIHSS score. Serum ferritin levels were measured and correlated with stroke severity and lipid profile parameters. Data were analysed using descriptive statistics, one-way ANOVA, independent samples t-test, and Pearson's correlation coefficient. **Results:** The majority of participants were males and belonged to the 51–70 years age group. Diabetes mellitus, hypertension, dyslipidemia, smoking, and alcohol consumption were common risk factors. Most participants had moderately severe neurological impairment based on NIHSS classification. Serum ferritin levels increased significantly with increasing stroke severity ($p < 0.001$). Higher serum ferritin levels and NIHSS scores were significantly associated with smoking, alcohol consumption, hypertension, diabetes mellitus, and dyslipidemia. Serum ferritin showed positive correlations with total cholesterol, triglycerides, and LDL cholesterol, and a negative correlation with HDL cholesterol. **Conclusion:** Elevated serum ferritin levels were significantly associated with increased stroke severity in acute ischemic stroke. Serum ferritin may serve as a useful biomarker of stroke severity and inflammatory burden.

Keywords: Acute ischemic stroke, Serum ferritin, NIHSS score, Stroke severity, Oxidative stress

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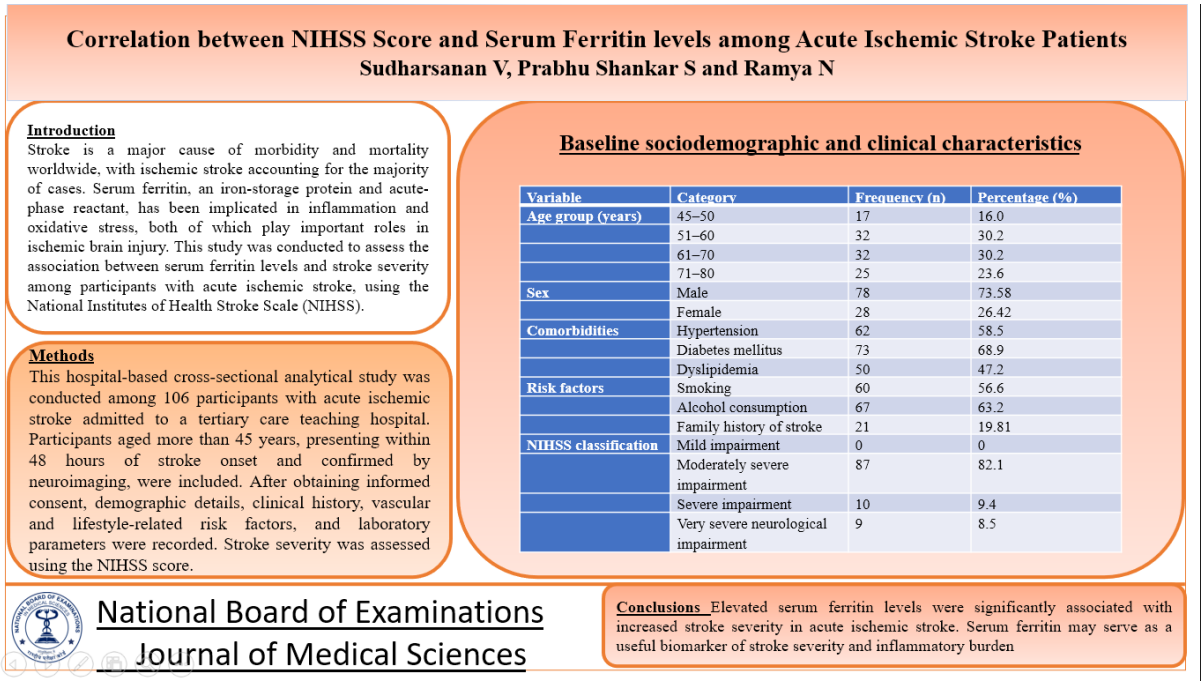
Graphical Abstract



Introduction

Stroke remains one of the leading causes of morbidity and mortality worldwide, with ischemic stroke accounting for nearly 85% of all stroke cases [1]. The clinical course and outcome of ischemic stroke vary widely among participants, depending on the extent of cerebral injury, associated comorbidities, inflammatory response, and the timeliness of clinical intervention. Therefore, identifying reliable and easily measurable biomarkers that can reflect stroke severity is important for early risk stratification, prognostication, and appropriate clinical management [2].

Serum ferritin is an intracellular iron-storage protein which has gained attention as a potential biomarker in acute ischemic stroke due to its dual role as an indicator of body iron stores and also as an acute-phase reactant [3]. Elevated levels of ferritin are frequently associated with an inflammation and oxidative stress, both are central mechanisms in the ischemic brain injury pathophysiology [4]. During an acute ischemic event, the reduced cerebral blood flow initiates a cascade of events - cellular injury, blood–brain barrier dysfunction, inflammatory activation, and oxidative damage [5]. The ferritin levels may increase in such a situation as part of the systemic inflammatory response and thereby reflect the severity of tissue injury.

The Scientific relevance of ferritin in ischemic stroke is also linked with iron-mediated oxidative stress. Excessive iron can initiate in the generation of reactive oxygen species, thereby aggravating damage to neurons during and after ischemia [5]. Previous Literature have documented that increase in serum ferritin levels are associated with more extensive brain injury, greater neurological impairment, and poorer clinical outcomes in participants affected with ischemic stroke [6]. Erdemoglu et al. reported that elevated serum ferritin levels were

significantly linked with poor early prognosis among stroke participants [7] Similarly in a study done by Guo et al. the relationship between iron metabolism, oxidative stress, and ischemic stroke, supporting the possible role of ferritin as a marker of stroke-related injury is explained [8]. However, in spite of these evidences, the exact prognostic role of serum ferritin in acute ischemic stroke remains debatable.

The National Institutes of Health Stroke Scale (NIHSS) is a widely accepted clinical tool used for the standardized assessment and interpretation of neurological impairment in patients with acute stroke. It evaluates multiple domains of neurological function, including level of consciousness, motor function, sensory impairment, language, speech, and visual field and thereby provides a standardized measure for stroke severity [9]. Higher NIHSS scores generally indicate that more severe the neurological deficits, more poorer the clinical outcomes [10]. Hence, understanding the relationship between serum ferritin levels and NIHSS score may help in determining whether ferritin can serve as a useful biomarker for assessing stroke severity.

In addition to the biochemical markers, conventional vascular and lifestyle-related risk factors namely hypertension, diabetes mellitus, dyslipidemia, smoking, and alcohol consumption contribute significantly to the occurrence and severity of ischemic stroke. All these factors are significantly associated with inflammation, endothelial dysfunction, atherosclerosis, and oxidative stress, which may also influence both serum ferritin levels and neurological outcomes. Evaluating the ferritin levels and their relation to stroke severity and associated risk factors may therefore provide a more comprehensive understanding of its clinical relevance in acute ischemic stroke.

Hence, the present hospital-based cross-sectional study was conducted to assess serum ferritin levels in participants with acute ischemic stroke and to correlate them with stroke severity as measured by the NIHSS score. The study also aims to evaluate the association of serum ferritin and NIHSS score with selected clinical and lifestyle-related risk factors among participants with acute ischemic stroke.

Materials and Methods

This hospital-based cross-sectional analytical study was conducted in a tertiary care teaching hospital over a period of two years. The study population included participants aged more than 45 years who were admitted with acute ischemic stroke. Participants of both sexes who presented within 48 hours of onset of stroke and whose diagnosis was confirmed by neuroimaging were considered eligible for inclusion. Participants with known infectious diseases, connective tissue disorders, features of haemorrhagic stroke, and participants aged below 45 years were excluded from the study. A total of 106 eligible participants were included in the study.

Prior approval was obtained from the Institutional Ethics Committee. The study was conducted in accordance with laid down ethical principles, including respect for autonomy, beneficence, non-maleficence, and confidentiality. Eligible participants or their legally acceptable representatives were approached after an initial clinical stabilization. The purpose of the study, nature of participation, procedures involved, possible risks, benefits, and the right to withdraw from the study at any stage without affecting routine

treatment were explained in their local vernacular. Adequate space was provided to ask questions and clarify their doubts if any. Written informed consent was obtained before enrolment once they give their oral consent. For those eligible participants who were unable to provide consent due to neurological impairment or altered sensorium, consent was obtained from the legally acceptable representative as per ethical norms. No additional financial burden was imposed on the participants for study-related data collection.

Confidentiality of the information obtained was maintained throughout the study. Each participant was assigned a study identification number, and personal identifiers were not used during data entry or analysis to ensure confidentiality. Clinical and laboratory data were recorded in a structured proforma and all the data was stored securely. All procedures performed as part of the study were carried out with utmost consideration to patient safety, privacy, and dignity.

After obtaining informed consent, a detailed history was collected from each participant, including the demographic details, time of onset of stroke symptoms, presenting complaints, past medical history, and about the history of vascular and lifestyle-related risk factors such as hypertension, diabetes mellitus, dyslipidemia, smoking, alcohol consumption, and also family history of stroke. Blood pressure at the time of admission was recorded, and relevant clinical findings were documented.

Neuroimaging was done as a routine to confirm the diagnosis of acute ischemic stroke and to exclude haemorrhagic stroke. Non-contrast computed tomography of the brain was used for confirmation wherever applicable, and imaging findings were interpreted by qualified personnel as part of routine clinical care. Only participants with imaging-confirmed acute ischemic stroke were included in the final analysis.

Stroke severity was assessed using the National Institutes of Health Stroke Scale. The NIHSS score was recorded after clinical evaluation by assessing neurological domains including level of consciousness, gaze, visual field, facial palsy, motor function, limb ataxia, sensory function, language, speech, and neglect. Based on the NIHSS score, participants were classified according to the degree of neurological impairment. The NIHSS score was used as the clinical measure of stroke severity for correlation with serum ferritin levels.

Blood samples were collected from all study participants under aseptic precautions after enrolment. Serum ferritin levels were measured using standard laboratory methods. In addition, relevant hematological and biochemical investigations were recorded, including complete blood count, liver function tests, renal function tests, thyroid profile, lipid profile, random blood sugar, systolic blood pressure, and diastolic blood pressure. All laboratory procedures were usual routing followed for the patients, and the results were entered into the study proforma for analysis.

The data collected were compiled, coded, and was entered into a spreadsheet, and statistical analysis was performed. Descriptive statistics was used to summarize demographic variables, clinical characteristics, risk factors, NIHSS scores, serum ferritin levels, and laboratory parameters. Continuous variables were expressed as mean and standard deviation, while categorical variables were expressed as frequency and percentage. The

association between serum ferritin levels and the stroke severity categories was performed using one-way analysis of variance. Comparisons of serum ferritin levels and NIHSS scores between groups based on the presence or absence of selected risk factors were evaluated using the independent samples t-test. The correlation between serum ferritin levels and lipid parameters was assessed using Pearson's correlation coefficient. A p value of less than 0.05 was considered statistically significant.

Results

The study included 106 participants with acute ischemic stroke. The majority of participants belonged to the 51–60 years and 61–70 years age groups, with each group contributing 32 participants (30.2%). Participants aged 71–80 years constituted 25 cases (23.6%), while those aged 45–50 years accounted for 17 cases (16.0%). Male predominance was observed, with 78 males (73.58%) and 28 females (26.42%). Among the comorbidities, diabetes mellitus was the most common, present in 73 participants (68.9%), followed by hypertension in 62 participants (58.5%) and dyslipidemia in 50 participants (47.2%). With regard to lifestyle-related risk factors, alcohol consumption was reported by 67 participants (63.2%) and smoking by 60 participants (56.6%). Family history of stroke was present in 21 participants (19.81%). Based on NIHSS classification, most participants had moderately severe neurological impairment, accounting for 87 cases (82.1%), followed by severe impairment in 10 participants (9.4%) and very severe neurological impairment in 9 participants (8.5%). None of the participants had mild impairment. These findings indicate that the study population predominantly consisted of middle-aged to elderly males with a high burden of vascular and lifestyle-related risk factors (Table 1).

Table 1. Baseline sociodemographic and clinical characteristics of the study population

Variable	**Category**	**Frequency (n)**	**Percentage (%)**
Age group (years)	45–50	17	16.0
	51–60	32	30.2
	61–70	32	30.2
	71–80	25	23.6
Sex	Male	78	73.58
	Female	28	26.42
Comorbidities	Hypertension	62	58.5
	Diabetes mellitus	73	68.9
	Dyslipidemia	50	47.2
Risk factors	Smoking	60	56.6
	Alcohol consumption	67	63.2
	Family history of stroke	21	19.81
NIHSS classification	Mild impairment	0	0

	Moderately severe impairment	87	82.1
	Severe impairment	10	9.4
	Very severe neurological impairment	9	8.5

Note: Total study population = 106. NIHSS: National Institutes of Health Stroke Scale.

Serum ferritin levels showed a statistically significant association with stroke severity. The mean serum ferritin level was lowest among participants with moderately severe neurological impairment and increased progressively among participants with severe and very severe neurological impairment. Participants with moderately severe impairment had a mean serum ferritin level of 135.76 ± 13.68, while those with severe impairment had a mean level of 236.15 ± 49.51. The highest mean serum ferritin level was observed among participants with very severe neurological impairment, measuring 288.17 ± 41.67. The difference between the groups was statistically significant on one-way analysis of variance ($F = 27.885$, $p < 0.001$). This suggests that increasing serum ferritin levels are significantly associated with increasing stroke severity in participants with acute ischemic stroke (Table 2).

Table 2. Association between serum ferritin levels and stroke severity

NIHSS classification	**n**	**Serum ferritin, Mean**	**SD**	**F value**	**p value**
Moderately severe impairment	87	135.76	13.68	27.885	<0.001
Severe impairment	10	236.15	49.51		
Very severe neurological impairment	9	288.17	41.67		

Note: Statistical test used: One-way ANOVA. SD: Standard deviation.

Serum ferritin levels were significantly higher among participants with selected vascular and lifestyle-related risk factors. Smokers had higher mean serum ferritin levels compared with non-smokers, and this difference was statistically significant. Similarly, participants with alcohol consumption, hypertension, diabetes mellitus, and dyslipidemia showed significantly higher serum ferritin levels compared with their respective comparison groups. The mean difference in serum ferritin was highest for smoking, followed by alcohol consumption, hypertension, diabetes mellitus, and dyslipidemia. These findings suggest that the presence of conventional stroke risk factors is associated with higher serum ferritin levels, possibly reflecting increased inflammatory and oxidative stress burden among these participants (Table 3).

Table 3. Comparison of serum ferritin levels with selected risk factors

Risk factor	Absent, Mean	Absent, SD	Present, Mean	Present, SD	Mean difference	t value	p value
Smoking	204.66	49.03	251.35	55.81	46.68	-4.496	<0.001
Alcohol consumption	227.37	57.82	257.49	57.48	30.124	2.592	0.011
Hypertension	218.94	55.58	249.12	60.90	30.18	2.647	0.009
Diabetes mellitus	222.90	58.24	248.16	56.49	25.261	2.087	0.039
Dyslipidemia	223.17	51.12	248.16	62.48	24.99	2.237	0.027

Note: Statistical test used: Independent samples t-test. Serum ferritin values are expressed as mean ± SD. For smoking, the negative t value reflects the direction of group comparison in the original analysis. The p value 0.000 has been presented as $p < 0.001$. The mean difference for dyslipidemia has been corrected mathematically as 24.99.

NIHSS scores were also significantly higher among participants with major vascular and lifestyle-related risk factors. Participants with smoking habit had higher NIHSS scores compared with non-smokers. Similarly, participants with alcohol consumption, hypertension, diabetes mellitus, and dyslipidemia had significantly higher NIHSS scores than their respective comparison groups. Among these risk factors, hypertension showed the highest mean difference in NIHSS score, followed by diabetes mellitus, smoking, alcohol consumption, and dyslipidemia. These findings indicate that the presence of these risk factors is associated with greater neurological impairment and increased stroke severity in participants with acute ischemic stroke (Table 4).

Table 4. Comparison of NIHSS score with selected risk factors

Risk factor	Absent, Mean	Absent, SD	Present, Mean	Present, SD	Mean difference	t value	p value
Smoking	20.16	5.365	24.93	6.04	4.76	-4.136	<0.001
Alcohol consumption	22.43	6.36	26.60	6.23	4.166	3.28	0.001
Hypertension	22.64	5.99	29.16	6.78	6.52	5.226	0.001
Diabetes mellitus	21.42	6.24	26.82	6.51	5.398	4.07	<0.001
Dyslipidemia	21.88	5.52	25.73	6.87	3.850	3.156	<0.001

Note: Statistical test used: Independent samples t-test. NIHSS: National Institutes of Health Stroke Scale; SD: Standard deviation. The smoking absent SD was written as 5365 in the original table and has been corrected to 5.365.

Serum ferritin levels showed significant correlations with lipid profile parameters. A strong positive correlation was observed between serum ferritin and total cholesterol, indicating that higher ferritin levels were associated with higher total cholesterol levels. Serum ferritin also showed a moderate positive correlation with triglycerides and a strong positive correlation with LDL cholesterol. In contrast, HDL cholesterol showed a weak but statistically significant negative correlation with serum ferritin, suggesting that higher ferritin levels were associated with lower HDL cholesterol levels. Overall, these findings indicate that elevated serum ferritin levels are associated with a more atherogenic lipid profile in participants with acute ischemic stroke (Table 5).

Table 5. Correlation between serum ferritin levels and lipid profile parameters

Lipid parameter	Correlation coefficient (r)	p value
Total cholesterol	0.718	0.001
Triglycerides	0.682	0.035
HDL cholesterol	-0.262	0.045
LDL cholesterol	0.735	0.015

Note: Statistical test used: Pearson's correlation coefficient. HDL: High-density lipoprotein; LDL: Low-density lipoprotein.

Discussion

The present study evaluated the relationship between serum ferritin levels and stroke severity among participants with acute ischemic stroke, with stroke severity assessed using the National Institutes of Health Stroke Scale. The study also examined the association of serum ferritin and NIHSS score with selected vascular and lifestyle-related risk factors. The findings demonstrated that higher serum ferritin levels were significantly associated with increasing stroke severity. In addition, participants with smoking habit, alcohol consumption, hypertension, diabetes mellitus, and dyslipidemia had significantly higher serum ferritin levels and NIHSS scores compared with their respective comparison groups. Serum ferritin also showed significant positive correlations with total cholesterol, triglycerides, and LDL cholesterol, and a significant negative correlation with HDL cholesterol.

In the present study, most participants belonged to the 51–60 years and 61–70 years age groups, indicating that acute ischemic stroke was more common among middle-aged and elderly individuals. This finding is consistent with the established association between advancing age and increased stroke risk. Age is one of the most important non-modifiable risk factors for stroke, and the risk of stroke increases substantially with advancing age due to progressive vascular changes, atherosclerosis, endothelial dysfunction, and accumulation of comorbidities. Yousufuddin and Young highlighted the close relationship between aging and ischemic stroke, emphasizing that age-related vascular and metabolic alterations contribute significantly to cerebrovascular events [11]. Similarly, the American Heart Association has reported that stroke risk increases with age, particularly after middle age [12].

Male predominance was observed in the present study, with males constituting nearly three-fourths of the study population. This finding is comparable with previous studies reporting a higher incidence of ischemic stroke among males, especially in younger and middle-aged groups. Sex-related differences in stroke risk may be influenced by hormonal factors, lifestyle exposures, smoking, alcohol intake, and the higher burden of vascular risk factors among men. Rexrode et al. described the influence of sex and gender on stroke epidemiology and outcomes, while Norman et al. also reported sex differences in ischemic stroke among younger participants [13,14]. However, it should be noted that the sex difference in stroke risk may narrow with advancing age, particularly after menopause in women, as described in population-based studies [15].

The study population had a high burden of conventional stroke risk factors. Diabetes mellitus was the most common comorbidity, followed by hypertension and dyslipidemia. Smoking and alcohol consumption were also frequent among the participants. These findings reflect the well-established contribution of vascular and lifestyle-related risk factors to ischemic stroke. Hypertension remains the most important modifiable risk factor for stroke, mainly through its effects on endothelial injury, arterial stiffness, atherosclerosis, and small vessel disease. Even modest blood pressure reduction has been shown to reduce stroke risk significantly [16]. Diabetes mellitus contributes to ischemic stroke through endothelial dysfunction, accelerated atherosclerosis, chronic inflammation, and increased platelet activation [17]. Dyslipidemia promotes atherogenesis and vascular occlusion, thereby contributing to ischemic cerebrovascular disease. The high prevalence of these comorbidities in the present study emphasizes the need for early identification and aggressive control of modifiable risk factors among high-risk individuals.

Smoking was reported by more than half of the study participants. Smoking is a well-known risk factor for ischemic stroke because it promotes oxidative stress, endothelial dysfunction, platelet activation, thrombosis, and atherosclerotic plaque instability. Gallucci et al. described the cardiovascular risk associated with smoking and the benefits of smoking cessation [18] Hackshaw et al. also demonstrated that even low levels of cigarette consumption are associated with an increased risk of coronary heart disease and stroke. [19]. In the present study, smokers had significantly higher serum ferritin levels and NIHSS scores compared with non-smokers. This suggests that smoking may be associated not only with stroke occurrence but also with greater inflammatory burden and more severe neurological impairment. The higher ferritin levels among smokers may reflect increased oxidative stress and systemic inflammation, which can aggravate ischemic neuronal injury.

Alcohol consumption was also common among the study participants and was significantly associated with higher serum ferritin levels and higher NIHSS scores. The relationship between alcohol and stroke is complex and depends on the pattern and quantity of intake. Heavy alcohol consumption has been associated with hypertension, arrhythmias, dyslipidemia, inflammation, and increased stroke risk. Chung et al. reported that cumulative alcohol consumption burden is associated with increased stroke risk,

particularly among young adults [20] O'Donnell et al. also identified alcohol intake as one of the potentially modifiable risk factors associated with acute stroke in the INTERSTROKE study [21]. The present findings suggest that alcohol consumption may be linked to higher inflammatory and oxidative stress activity, as reflected by increased ferritin levels, and may also be associated with more severe neurological presentation.

NIHSS classification showed that most participants had moderately severe neurological impairment, followed by severe and very severe impairment. The mean NIHSS score in the study population indicated a clinically significant burden of neurological deficit. NIHSS is widely used for quantifying stroke severity and has strong prognostic value in acute ischemic stroke. Higher NIHSS scores are associated with larger infarct burden, poorer functional outcome, and increased mortality. Farooque et al. emphasized the importance of NIHSS in assessing stroke severity and predicting clinical outcomes [22]. In the present study, NIHSS score was significantly higher among participants with smoking, alcohol consumption, hypertension, diabetes mellitus, and dyslipidemia, suggesting that these risk factors may contribute to greater neurological impairment at presentation.

The central finding of this study was the significant association between serum ferritin levels and stroke severity. Serum ferritin levels increased progressively with worsening NIHSS severity category, and the association was statistically significant. Participants with very severe neurological impairment had the highest mean ferritin levels, while those with moderately severe impairment had the lowest mean ferritin levels. This finding supports the possible role of ferritin as a marker of stroke severity. Ferritin is not only a marker of iron stores but also an acute-phase reactant that increases in response to inflammation and tissue injury. In acute ischemic stroke, ischemia-induced neuronal injury, inflammatory activation, blood–brain barrier disruption, and oxidative stress may contribute to increased ferritin levels [23].

The biological plausibility of this association is supported by the role of iron in oxidative injury. Excess iron can participate in the generation of reactive oxygen species, which may worsen lipid peroxidation, mitochondrial dysfunction, and neuronal cell injury during ischemia. Kell and Pretorius discussed the role of ferritin and iron metabolism in inflammatory and oxidative processes [24]. Wang et al. also suggested that elevated ferritin in acute stroke may reflect inflammatory response and oxidative stress rather than body iron stores alone [25]. Thus, in acute ischemic stroke, serum ferritin may represent a combined marker of iron metabolism, inflammation, and oxidative injury.

The findings of the present study are consistent with earlier studies that reported an association between elevated ferritin levels and poor stroke outcomes. Millerot et al. examined serum ferritin in stroke and discussed whether it reflects increased body iron stores or stroke severity [6]. Erdemoglu and Ozbakir reported that serum ferritin levels were associated with early prognosis in stroke participants [7]. Similarly, other studies have suggested that higher serum ferritin levels are associated with larger infarct size, poorer functional outcome, and increased mortality among participants with acute ischemic stroke [26]. The present study adds to this evidence by showing that ferritin levels are significantly associated with NIHSS-based

stroke severity in a hospital-based population.

The study also found that serum ferritin levels were significantly higher among participants with hypertension, diabetes mellitus, and dyslipidemia. These conditions are closely linked to chronic vascular inflammation, endothelial dysfunction, oxidative stress, and atherosclerosis, all of which may contribute to ferritin elevation. Hypertension causes vascular injury and promotes atherosclerosis, while diabetes mellitus accelerates endothelial dysfunction and inflammatory vascular damage [16,17]. Dyslipidemia contributes to plaque formation and vascular occlusion, which are central mechanisms in ischemic stroke. The coexistence of these risk factors with elevated ferritin levels may indicate a higher inflammatory and metabolic burden among participants with more severe stroke.

Serum ferritin showed significant correlations with lipid profile parameters in the present study. A strong positive correlation was observed with total cholesterol and LDL cholesterol, while triglycerides showed a moderate positive correlation. HDL cholesterol showed a significant negative correlation with serum ferritin. These findings suggest that elevated ferritin levels are associated with an atherogenic lipid profile. Dyslipidemia is an important contributor to atherosclerotic disease and ischemic stroke. Elevated LDL cholesterol and total cholesterol promote plaque formation, while low HDL cholesterol reduces reverse cholesterol transport and vascular protection. Grundy et al. described the importance of lipid management for cardiovascular and cerebrovascular risk reduction [27]. The SPARCL study also demonstrated the role of aggressive cholesterol reduction in reducing recurrent stroke risk [28].

The negative correlation between serum ferritin and HDL cholesterol is clinically relevant because HDL has anti-inflammatory, antioxidant, and endothelial protective effects. Lower HDL levels may therefore indicate reduced vascular protection in participants with elevated ferritin. In contrast, the positive correlation of ferritin with LDL cholesterol and total cholesterol suggests that ferritin elevation may coexist with a pro-atherogenic and pro-inflammatory metabolic state. These findings support the concept that ferritin may be linked not only to acute stroke severity but also to underlying vascular risk burden.

In the present study, family history of stroke was present in a smaller proportion of participants compared with those without family history. However, family history remains an important non-modifiable risk factor for stroke, as it may reflect genetic predisposition as well as shared environmental and lifestyle factors. Bevan et al. reported that family history contributes to stroke risk independent of traditional vascular risk factors [29]. Although family history was not the major risk factor observed in this study population, it remains relevant in comprehensive stroke risk assessment.

The present study has important clinical implications. Serum ferritin is a relatively accessible laboratory parameter and may be useful as an adjunct marker for assessing stroke severity in participants with acute ischemic stroke. Its association with NIHSS score suggests that ferritin may reflect the biological severity of ischemic injury, particularly through inflammatory and oxidative stress pathways. However,

serum ferritin should not be interpreted in isolation, as it can be influenced by infection, inflammation, liver disease, iron metabolism disorders, and other systemic conditions. In clinical practice, ferritin may be considered along with NIHSS score, imaging findings, and vascular risk profile to improve risk stratification.

The findings also emphasize the importance of aggressive management of modifiable stroke risk factors. Smoking, alcohol consumption, hypertension, diabetes mellitus, and dyslipidemia were associated with higher serum ferritin levels and greater NIHSS scores. This highlights the need for comprehensive preventive strategies, including smoking cessation, alcohol risk reduction, blood pressure control, glycemic control, and lipid management. Such interventions may reduce both the risk of stroke and the severity of neurological outcomes.

Conclusion

The present study demonstrated a significant association between elevated serum ferritin levels and increased stroke severity among participants with acute ischemic stroke. Serum ferritin levels were also significantly associated with major vascular and lifestyle-related risk factors and showed significant correlation with lipid profile parameters. These findings suggest that serum ferritin may serve as a useful biomarker of stroke severity and inflammatory burden in acute ischemic stroke. However, as this was a cross-sectional study, causality cannot be established. Further longitudinal and multicentric studies are required to validate the prognostic value of serum ferritin and to determine whether it can independently predict stroke outcomes after adjusting for potential confounding factors.

Statements and Declarations

Conflicts of interest

The authors declare that they do not have conflict of interest.

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References

1. Virani SS, Alonso A, Aparicio HJ, Benjamin EJ, Bittencourt MS, Callaway CW, et al. American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee. Heart Disease and Stroke Statistics-2021 Update: A Report From the American Heart Association. Circulation. 2021 Feb 23;143(8):e254-e743. doi: 10.1161/CIR.0000000000000950.
2. Goldstein LB, Samsa GP, Matchar DB, Horner RD. Charlson Index comorbidity adjustment for ischemic stroke outcome studies. Stroke. 2004 Aug;35(8):1941-5. doi: 10.1161/01.STR.0000135225.80898.
3. Garg R, Aravind S, Kaur S, Singh Chawla SP, Aggarwal S, Goyal G. Role of serum ferritin as a prognostic marker in acute ischemic stroke: A preliminary observation. Ann Afr Med. 2020 Apr-Jun;19(2):95-102. doi: 10.4103/aam.aam_35_19.
4. Emsley HC, Hopkins SJ. Acute ischaemic stroke and infection: recent and emerging concepts. Lancet Neurol. 2008 Apr;7(4):341-53. doi: 10.1016/S1474-4422(08)70061-9.
5. Dhondge RH, Agrawal S, Kumar S, Acharya S, Karwa V. A Comprehensive Review on Serum Ferritin as a Prognostic Marker in Intensive Care Units: Insights Into

Ischemic Heart Disease. Cureus. 2024 Mar 31;16(3):e57365. doi: 10.7759/cureus.57365.

6. Millerot E, Prigent-Tessier AS, Bertrand NM, Faure PJ, Mossiat CM, Giroud ME, Beley AG, Marie C. Serum ferritin in stroke: a marker of increased body iron stores or stroke severity? J Cereb Blood Flow Metab. 2005 Oct;25(10):1386-93. doi: 10.1038/sj.jcbfm.9600140.
7. Erdemoglu AK, Ozbakir S. Serum ferritin levels and early prognosis of stroke. Eur J Neurol. 2002 Nov;9(6):633-7. doi: 10.1046/j.1468-1331.2002.00472.x.
8. Guo J, Tuo Q zhang, Lei P. Iron, ferroptosis, and ischemic stroke. J Neurochem. 2023 May;165(4):487–520.
9. Kasner SE. Clinical interpretation and use of stroke scales. Lancet Neurol. 2006 Jul;5(7):603-12. doi: 10.1016/S1474-4422(06)70495-1.
10. Adams HP Jr, Bendixen BH, Kappelle LJ, Biller J, Love BB, Gordon DL, Marsh EE 3rd. Classification of subtype of acute ischemic stroke. Definitions for use in a multicenter clinical trial. TOAST. Trial of Org 10172 in Acute Stroke Treatment. Stroke. 1993 Jan;24(1):35-41. doi: 10.1161/01.str.24.1.35.
11. Yousufuddin M, Young N. Aging and ischemic stroke. Aging (Albany NY). 2019 May 1;11(9):2542-2544. doi: 10.18632/aging.101931.
12. Benjamin EJ, Muntner P, Alonso A, Bittencourt MS, Callaway CW, Carson AP, et al Heart Disease and Stroke Statistics-2019 Update: A Report From the American Heart Association. Circulation. 2019 Mar 5;139(10):e56-e528. doi: 10.1161/CIR.0000000000000659. Erratum in: Circulation. 2020 Jan 14;141(2):e33. doi: 10.1161/CIR.0000000000000746.
13. Rexrode KM, Madsen TE, Yu AYX, Carcel C, Lichtman JH, Miller EC. The Impact of Sex and Gender on Stroke. Circ Res. 2022 Feb 18;130(4):512–28. Available from: https://www.ahajournals.org/doi/10.1161/CIRCRESAHA.121.319915
14. Norman K, Eriksson M, von Euler M. Sex Differences in Ischemic Stroke Within the Younger Age Group: A Register-Based Study. Front Neurol. 2022 Feb 14;13:793181. doi: 10.3389/fneur.2022.793181.
15. Gall SL, Donnan G, Dewey HM, Macdonell R, Sturm J, Gilligan A, et al. Sex differences in presentation, severity, and management of stroke in a population-based study. Neurology. 2010 Mar 23;74(12):975-81. doi: 10.1212/WNL.0b013e3181d5a48f.
16. Lawes CM, Bennett DA, Feigin VL, Rodgers A. Blood pressure and stroke: an overview of published reviews. Stroke. 2004 Apr;35(4):1024.
17. Maida CD, Daidone M, Pacinella G, Norrito RL, Pinto A, Tuttolomondo A. Diabetes and Ischemic Stroke: An Old and New Relationship an Overview of the Close Interaction between These Diseases. Int J Mol Sci. 2022 Feb 21;23(4):2397. doi: 10.3390/ijms23042397.
18. Gallucci G, Tartarone A, Lerose R, Lalinga AV, Capobianco AM. Cardiovascular risk of smoking and benefits of smoking cessation. J Thorac Dis 2020;12(7):3866-3876. doi: 10.21037/jtd.2020.02.47
19. Hackshaw A, Morris JK, Boniface S, Tang JL, Milenković D. Low cigarette consumption and risk of coronary heart disease and stroke:

meta-analysis of 141 cohort studies in 55 study reports. BMJ. 2018 Jan 24;360:j5855. doi: 10.1136/bmj.j5855. Erratum in: BMJ. 2018 Apr 11;361:k1611. doi: 10.1136/bmj.k1611. Erratum in: BMJ. 2018 Nov 28;363:k5035. doi: 10.1136/bmj.k5035.

20. Chung JW, Lee SR, Choi EK, Park SH, Lee H, Choi J, et al. Cumulative Alcohol Consumption Burden and the Risk of Stroke in Young Adults: A Nationwide Population-Based Study. Neurology. 2023 Jan 31;100(5):e505-e515. doi: 10.1212/WNL.0000000000201473.
21. O'Donnell MJ, Chin SL, Rangarajan S, Xavier D, Liu L, Zhang H, et al. Global and regional effects of potentially modifiable risk factors associated with acute stroke in 32 countries (INTERSTROKE): a case-control study. Lancet. 2016 Aug 20;388(10046):761-75. doi: 10.1016/S0140-6736(16)30506-2.
22. Farooque U, Lohano AK, Kumar A, Karimi S, Yasmin F, Bollampally VC, Ranpariya MR. Validity of National Institutes of Health Stroke Scale for Severity of Stroke to Predict Mortality Among Patients Presenting With Symptoms of Stroke. Cureus. 2020 Sep 5;12(9):e10255. doi: 10.7759/cureus.10255.
23. Xia X, Liu J, Fang W, Chen Z, Wang J, Xu H. The association between ferritin levels and all-cause mortality in stroke patients. Front Neurol. 2024 Jun 26;15:1386408. doi: 10.3389/fneur.2024.1386408.
24. Kell DB, Pretorius E. Serum ferritin is an important inflammatory disease marker, as it is mainly a leakage product from damaged cells. Metallomics 2014 Mar;6(4):748–73.
25. Wang W, Knovich MA, Coffman LG, Torti FM, Torti SV. Serum ferritin: Past, present and future. Biochim Biophys Acta. 2010 Aug;1800(8):760-9. doi: 10.1016/j.bbagen.2010.03.011.
26. Millan M, Sobrino T, Castellanos M, Nombela F, Arenillas JF, Riva E, et al. Increased Body Iron Stores Are Associated With Poor Outcome After Thrombolytic Treatment in Acute Stroke. Stroke. 2007 Jan 1;38(1):90–5. Available from: https://doi.org/10.1161/01.STR.0000251798.25803.e0
27. Grundy SM, Stone NJ, Bailey AL, Beam C, Birtcher KK, Blumenthal RS, et al. 2018 AHA/ACC/AACVPR/AAPA/ABC/ACPM/ADA/AGS/APhA/ASPC/NLA/PCNA Guideline on the Management of Blood Cholesterol: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. J Am Coll Cardiol. 2019 Jun;73(24):e285–350.
28. Amarenco P, Bogousslavsky J, Callahan A 3rd, Goldstein LB, Hennerici M, Rudolph AE, et al. High-dose atorvastatin after stroke or transient ischemic attack. N Engl J Med. 2006 Aug;355(6):549–59.
29. Bevan S, Traylor M, Adib-Samii P, Malik R, Paul NL, Jackson C, et al. Genetic heritability of ischemic stroke and the contribution of previously reported candidate gene and genomewide associations. Stroke. 2012 Dec;43(12):3161-7. doi: 10.1161/STROKEAHA.112.665760.