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Correlation between Blood Vitamin D Levels and Lipid Profiles in Post-Ischemic Stroke Patients

Santoso Jaeri[1]*, Retnaningsih[2], Amin Husni[3], Nani Maharani[4], Gemala Anjani[5]
[1] Department of Medical Biology and Biochemistry, Faculty of Medicine, Universitas Diponegoro, Indonesia
[2] Department of Neurology, RSUP Dr. Kariadi, Indonesia
[3] Department of Neurology, Faculty of Medicine Universitas Diponegoro, Indonesia
[4] Department of Pharmacology and Therapy, Faculty of Medicine, Universitas Diponegoro, Indonesia
[5] Department of Nutrition, Faculty of Medicine, Universitas Diponegoro, Indonesia

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***CORRESPONDENCE:**
santoso@fk.undip.ac.id

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Abstract: Dyslipidemia and vitamin D deficiency are the predisposing factors for stroke. It is also established that vitamin D contributes to cholesterol metabolisms. Unfortunately, there is no evidence regarding the correlation between blood vitamin D levels and lipid profiles in patients with post-ischemic stroke. Herewith, the authors determine the correlation between blood vitamin D levels and lipid profiles among patients with post-ischemic stroke. A cross-sectional approach among 40 patients with post-ischemic stroke was obtained consecutively. Demographic characteristics, as well as the history of other diseases and 24 24-hour recall diet, were recorded. Then, the measurement of blood vitamin D levels and lipid profiles, such as total, LDL, HDL cholesterol, and triglyceride levels, were performed. Their correlations were determined using the Spearman correlation test. Among 40 subjects, no significant correlation was revealed between blood vitamin D levels and the serum total, LDL, HDL cholesterol, and triglycerides levels (p=0.898, 0.560, 0.361, and 0.622 respectively, and r=0.021, -0.095, 0.080, and 0.080 respectively). To summarize, there is no significant correlation between blood vitamin D levels and all lipid profiles in patients with post-ischemic stroke.

Keywords: Dyslipidemia; Ischemic stroke; Lipid profiles; Vitamin D

INTRODUCTION

Stroke is the second rank of neurological disorders, leading to a mortality index of approximately five million per year with high morbidity resulting in disability among 50% of survivors with consequences on social and economic aspects.[1] Dyslipidemia is one of the predisposing factors for cardiovascular events, including ischemic heart attack, peripheral vascular disease, and stroke.[2] It is established that high levels of triglyceride, LDL cholesterol, and low levels of HDL cholesterol cause the incidence of atherosclerosis, resulting in several vascular diseases.[3]

On the other side, vitamin D deficiency is prevalent in the tropical area including in Indonesia. Vitamin D is associated with ischemic stroke risk and is involved in the pathogenesis of hypertension, dyslipidemia, diabetes mellitus, and heart disease.[4] According to prior studies, 86–89% of patients with stroke in rehabilitation care were found to have vitamin D insufficiency.[5] Furthermore, other studies have also reported an association between functional recovery after stroke and serum vitamin D levels.[6]

Previous studies have also demonstrated an association between Vitamin D and lipid profiles. Deficiency of Vitamin D is one of the predisposing factors for the occurrence of dyslipidemia.[7] Level of 25(OH)D3 negatively correlates with total, LDL cholesterol, and triglyceride levels and has a positive correlation with HDL cholesterol levels.[8,9] Furthermore, the addition of vitamin D resulted in a reduction of triglycerides, LDL, and total cholesterol levels and an elevation of HDL cholesterol level.[10]

Nevertheless, the mechanisms of vitamin D affect metabolisms of cholesterol remain unknown. One of its mechanical hypotheses through inhibition of secretion of parathyroid hormone resulted in a reduction

of VLDL and triglyceride levels.[7] Furthermore, vitamin D3 also contributes to the absorption of calcium and inhibits lipid deposition.[11, 12, 13, 14, 15]

Even though the correlation between vitamin D and lipid profiles is well established, there is also evidence that vitamin D influences the outcome of ischemic stroke,[16] and there is no evidence regarding this relationship among patients with post-ischemic stroke. Herewith, the authors provide evidence of this issue to get a better understanding of the correlation between vitamin D and lipid profiles among patients with post-ischemic stroke for the consideration of supplementation of vitamin D as secondary prevention for recurrency of stroke.

MATERIALS AND METHOD

This observational analytic study with a cross-sectional approach was conducted on patients with post-ischemic stroke in the setting of the outpatient department of Neurology RSUP Dr. Kariadi Semarang from July to September 2022. This study was conducted on forty patients with post-ischemic stroke obtained consecutively, with the inclusion criteria: 1) diagnosed with post-ischemic stroke and 2) aged approximately 18-60 years old and agreed to have participated in this study, and exclusion criterion: 1) history of vitamin D supplementation, 2) history of parathyroid hormone disorders, and 3) history of dyslipidemia or cholesterol-lowering drugs consumption.

Demographic characteristics such as age, gender, and history of prior diseases, including diabetes mellitus (DM), hypertension, and cardiovascular disorders, were recorded from medical records, and then the intake of energy, carbohydrate, protein, lipids, and cholesterol was assessed using 24-hour diet recall methods. Subjects were then asked to fast for 8 hours for examination of blood vitamin D levels and lipid profiles involving triglycerides, total, LDL, and HDL cholesterol levels, which were measured using the median cubital venous blood. Measurement of serum lipid profiles was performed in RSUP Dr. Kariadi Semarang, and examination of serum vitamin D levels was carried out at the *Gangguan Akibat Kekurangan Yodium* (GAKY) Laboratory using ELISA methods. The protocol of examination was performed according to the manufacture sheet obtained from Elabscience®.

Statistical analysis was performed utilizing SPSS for Windows version 23, divided into two phases. First, descriptive analyses were done to describe the characteristics of the subjects. Categorical data were presented in frequency with percentage, and numerical data were presented in the median, minimal, and maximal values because of abnormal data distribution. Then, analysis was continued using the Spearman correlation test to identify the correlation between the characteristics of subjects, serum vitamin D levels, and lipid profiles.

RESULTS

Characteristics of Subjects

The demographic, recall of diets, and laboratory findings data of the subjects are depicted in Table 1. Table 1 reveals that the age of subjects was approximately 57 years old, with 32 being the youngest and 71 being the oldest age, with the proportion of males being more than female subjects. Most of this study's subjects also had experience with prior stroke attacks. Unfortunately, there was no clear data for the type of stroke. Regarding the vascular risks of stroke, hypertension was the most often with or without diabetes Mellitus and cardiac problems.

Table 1. Demographic, Recall of Diets, and Laboratory Characteristics of Subjects

Variables	n	%	Median (min-max)
Age (Years)			57.5 (32 – 71)
Sex			
Male	23	57.5	
Female	17	42.5	
History of stroke			
No	35	87.5	
Yes	5	12.5	
History of hypertension			
No	8	20.0	
Yes	32	80.0	
History of DM			
No	26	65.0	
Yes	14	35.0	
History of cardiac problems			
No	25	62.5	
Yes	15	37.5	
Total energy recall diet			1482.3 (869.7 – 1921.3)
Protein recall diet			62.35 (33.20 – 156.80)
Lipid recall diet			41.75 (16.90 – 62.10)
Carbohydrate recall diet			221.6 (115.5 – 347.9)
Cholesterol recall diet			175.9 (66.1 – 400.1)
Blood vitamin D levels (mg/dL)			19.45 (7.30 – 49.90)
Blood total cholesterol levels (mg/dL)			208.5 (125 – 309)
Blood LDL cholesterol levels (mg/dL)			144 (67 – 363)
Blood Triglyceride levels (mg/dL)			132.5 (75 – 465)
Blood HDL cholesterol levels (mg/dL)			43 (26 – 94)

Correlation of Blood Vitamin D Levels and Characteristics of Subjects

The statistical analysis of the correlation of characteristics data of the subjects to serum vitamin D levels is demonstrated in Table 2. Table 2 displays that sex, intake of total energy, protein, and carbohydrate were correlated significantly with vitamin D levels but not for other characteristics.

Table 2. Correlation of Blood Vitamin D Levels and Demographic Characteristics of Subjects

Variables	Mean ± SD	p
Age (Years)		0.638
Gender		
Male	24.49 ± 8.56	0.002*
Female	17.97 ± 9.76	
History of stroke		
No	21.44 ± 9.62	0.698
Yes	23.68 ± 9.77	
History of hypertension		
No	22.05 ± 7.56	0.624
Yes	21.63 ± 10.08	
History of DM		
No	23.32 ± 10,90	0.288
Yes	18.74 ± 5.50	
History of cardiac problems		
No	21.30 ± 7.67	0.759
Yes	22.42 ± 12.32	
Total energy recall diet		0.001*
Protein recall diet		0.076
Lipid recall diet		0.397
Carbohydrate recall diet		<0.001*
Cholesterol recall diet		0.444

Correlation of Blood Total Cholesterol Levels and Characteristics of Subjects

The statistical analysis of the correlation of the characteristics data of the subjects to the blood total cholesterol levels is detailed in Table 3. Table 3 provides information that only gender was correlated with serum total cholesterol levels.

Table 3. Correlation of Blood Total Cholesterol Levels and Demographic Characteristics of Subjects

Variables	Mean ± SD	p
Age (Years)		0.796
Gender		
Male	196.13 ± 31.47	0.035*
Female	223.35 ± 47.38	
History of stroke		
No	209.54 ± 42.20	0.457
Yes	194.80 ± 29.34	
History of hypertension		
No	229.13 ± 56.09	0.232
Yes	202.34 ± 35.17	
History DM		
No	207.04 ± 40.74	0.891
Yes	208.93 ± 42.45	
History of cardiac problems		
No	201.12 ± 37.53	0.192
Yes	218.67 ± 44.92	
Total energy recall diet		0.085
Protein recall diet		0.200
Lipid recall diet		0.221
Carbohydrate recall diet		0.191
Cholesterol recall diet		0.428

Correlation of Blood LDL Cholesterol Levels and Characteristics of Subjects

The statistical analysis of the correlation of the characteristics data of the subjects to the serum LDL cholesterol levels is shown in Table 4. It is revealed that a history of hypertension, intake of total energy, and lipids were correlated with the serum LDL cholesterol levels.

Table 4. Correlation of Blood LDL Cholesterol Levels and Characteristics of Subjects

Variables	Mean ± SD	p
Age (Years)		0.852
Gender		
Male	144.43 ± 55.99	0.345
Female	146.59 ± 30.85	
History of stroke		
No	139.91 ± 31.73	0.638
Yes	183.40 ± 102.14	
History of hypertension		
No	182.50 ± 76.72	0.048*
Yes	136.06 ± 30.71	
History DM		
No	138.73 ± 31.19	0.600
Yes	157.64 ± 66.02	
History of cardiac problems		
No	145.08 ± 55.28	0.520
Yes	145.80 ± 27.88	
Total energy recall diet		0.023*
Protein recall diet		0.058
Lipid recall diet		0.015*
Carbohydrate recall diet		0.199
Cholesterol recall diet		0.588

Correlation of Blood Triglyceride Levels and Characteristics of Subjects

The statistical analysis of the correlation of the characteristics data of the subjects to the serum triglyceride levels is presented in Table 5. Table 5 depicts no significant association between the subject's characteristics and the serum triglyceride levels.

Table 5. Correlation of Serum Triglyceride Levels and Characteristics of Subjects

Variables	Mean ± SD	p
Age (Years)		0.239
Gender		
Male	167,65 ± 98,40	0.547
Female	148,47 ± 65,20	
History of stroke		
No	162,29 ± 87,86	0.526
Yes	140,00 ± 70,63	
History of hypertension		
No	139,25 ± 39,92	0.906
Yes	164.56 ± 93.21	
History of DM		
No	162.23 ± 78.36	0.487
Yes	154.43 ± 100.21	
History of cardiac problems		
No	163.52 ± 92.94	0.615
Yes	152.80 ± 73.79	
Energy recall diet		0.473
Protein recall diet		0.221
Lipid recall diet		0.133
Carbohydrate recall diet		0.624
Cholesterol recall diet		0.862

Correlation of Blood HDL Cholesterol Levels and Characteristics of Subjects

The result of the analysis of the correlation of characteristics data of the subjects to the serum HDL cholesterol levels is displayed in Table 6. It is uncovered that there was a significant correlation between age and intake of lipids with the serum HDL cholesterol levels.

Table 6. Correlation of Serum HDL Cholesterol Levels and Characteristics of Subjects

Variables	Mean ± SD	p
Age (Years)		0.001*
Gender		
Male	42.83 ± 11.34	0.059
Female	53.76 ± 17.85	
History of stroke		
No	47.23 ± 15.80	0.499
Yes	49.20 ± 12.22	
History of hypertension		
No	48.38 ± 23.87	0.648
Yes	47.25 ± 12.83	
History of DM		
No	47.31 ± 16.91	0.427
Yes	47.79 ± 12.22	
History of cardiac problems		
No	46.12 ± 15.34	0.484
Yes	49.73 ± 15.42	
Energy recall diet		0.180
Protein recall diet		0.437
Lipid recall diet		0.032*
Carbohydrate recall diet		0.372
Cholesterol recall diet		0.498

Correlation of Blood Vitamin D Levels and Lipid Profiles

The statistical analysis results of the correlation of blood vitamin D levels and the profile of lipids are exhibited in Table 7. Table 7 provides information that there was no significant correlation between serum vitamin D levels and the serum total, LDL, HDL cholesterol, as well triglycerides levels among subjects.

Table 7. Correlation of Blood Vitamin D Levels and Lipid Profiles

Lipid Profiles	p	r
Total cholesterol	0.898	0.021
LDL cholesterol	0.560	-0.095
Triglyceride	0.622	0.080
HDL cholesterol	0.361	-0.148

DISCUSSION

Dyslipidemia is one of the predisposing factors for cardiovascular events, such as ischemic heart attack, peripheral vascular disease, as well as stroke.[2] It is established that high levels of triglyceride and LDL cholesterol and low levels of serum HDL cholesterol are associated with the incidence of atherosclerosis, resulting in several vascular diseases.[3]

Previous studies have demonstrated an association between vitamin D and lipid profiles in the general population. Deficiency of vitamin D is one of the predisposing factors for the occurrence of dyslipidemia.[7] Level of 25(OH)D3 negatively correlates with total, LDL cholesterol, and triglyceride levels and has a positive correlation with HDL cholesterol levels.[8,9] Furthermore, giving vitamin D resulted in a decrease of triglycerides, LDL, and total cholesterol levels and an increase in HDL cholesterol level.[10]

Vitamin D deficiency is also now a well-known risk factor in some health problems, including stroke.[17] Furthermore, it is also in the rehabilitation process of patients with post-stroke as well as dyslipidemia.[18] Herewith, the authors provide evidence of a correlation between blood vitamin D levels and lipid profiles to reconsider the supplementation of vitamin D among patients with post-ischemic stroke. This research's results provide information that there was no significant correlation between blood vitamin D levels and the total LDL, HDL cholesterol, as well as triglyceride levels among patients with post-ischemic stroke. These findings are controversial with a previous study, which demonstrated that in patients with ischemic stroke, the elevation of vitamin D levels is associated with the increase of atherogenic lipids.[19] In that study, the subjects were classified into two groups, which are control groups with vitamin D levels less than 30 ng/dL and case group with vitamin D levels more than 30/dL; it differs from this study, which used numerical data to determine the correlation of vitamin D levels with the lipid profiles. Furthermore, that study also adjusted the confounding factors, having the risk of bias for the results.[19]

The mechanisms of vitamin D affect metabolisms of cholesterol remain unknown. One of its mechanical hypotheses through inhibition of secretion of parathyroid hormone resulted in a reduction of VLDL and triglyceride levels.[3] Furthermore, vitamin D3 also contributes to the absorption of calcium and inhibits lipid deposition.[10,11,12,13,14] Vitamin D contributes to the elevation of calcium in the blood by promoting the absorption of calcium in the intestine,[11] resulted in the decrease of serum triglycerides through reduction of hepatic triglyceride formation and its secretion.[12] Calcium also binds lipids in the gut, resulting in reduced lipid absorption.[13] Vitamin D also controls metabolisms of triglyceride by altering the VLDL cholesterol receptors expressed in some types of cells.[14] Even though these hypothetical mechanisms are available, again, this study failed to demonstrate the correlation between vitamin D and lipid profiles among patients with post-ischemic stroke.

Several factors contribute to vitamin D and lipid metabolisms in the human body, such as age, gender, or maybe genetics.[20] Even though this research's results provide evidence that there are several confounding factors associated with the particular lipid profiles and vitamin D in the bivariate analysis, such as total cholesterol level that had a correlation with gender, LDL cholesterol levels versus hypertension, total energy, and lipid diet, the authors did not continue the analysis to the multivariate. In addition, this study did not categorize vitamin D levels and lipid profiles based on clinical categorization of these parameters, including which levels are pathogenic, which may interfere with clinical decisions in patient management. Hence, this study only presented the statistical importance of these findings.

CONCLUSION

There is no significant correlation between blood vitamin D levels and the total, LDL, HDL cholesterol, and triglyceride levels among patients with post-ischemic stroke. Several factors associated with the lipid profiles among patients with post-ischemic stroke should be investigated further.

ETHICAL CONSIDERATIONS

Study protocols were approved by the Health Research Ethical Committee RSUP Dr. Kariadi Semarang Indonesia with the number of ethical clearance No 993-1/EC/KEPK-RSDK/2022.

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CONFLICT OF INTEREST

Nil.

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