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Original Article

The Relationship between Serum Folic Acid Levels with The Cognitive Function of The Elderly

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Abstract

Background : Cognitive decline is a common condition that occurs in the elderly. One of the early indicators of senility is a decrease in cognitive function. Folic acid is thought to protect the arteries from damage because of homocysteine by converting homocysteine into cysteine and then excreted in the urine. Increased levels of homocysteine can interfere with vascular function and cause toxic effects on neurons thereby increasing the risk of cognitive decline. The objectives of this study was to determine the relationship between serum folic acid levels and cognitive function of the elderly.
Methods : Analytical descriptive research with a cross-sectional approach. The research subjects were the elderly who met the inclusion criteria and did not have exclusion criteria. The research was conducted from May to July 2022 at the Pucang Gading Nursing Home, Semarang. Serum folic acid levels were examined using the ELISA (Enzyme-linked immunosorbent assay) method. Cognitive function was assessed using the Indonesian version of the Montreal Cognitive Assessment (MoCA) simultaneously on the subject. Cognitive function is normal if the MoCA-INA value is ≥ 26 and it is said to be cognitive dysfunction if the MoCA-INA value is < 26. Data were analyzed using the Spearman test. Results are considered significant if the value of p <0.05.
Results : There is a strong positive correlation between serum folic acid levels and cognitive function in the elderly (r=0.914, p<0.001). There is a relationship between educational level and cognitive function (r=0.922, p<0.001) where higher education correlates with increased cognitive function in the elderly.
Conclusion : There is a significant positive correlation between serum folic acid levels and cognitive function in the elderly.

Keywords : Cognitive function, MoCA-INA, Serum Folic Acid Levels

INTRODUCTION

The elderly are aged > 60 years, at which age it generally occurs a degenerative aging process that triggers a decrease in various body functions, one of the consequences is a decline in cognitive function. The progressive decline in cognitive function can affect the social function and daily life of the elderly. In Indonesia, the number of elderly tends to increase from 7.6% in 2010 to 8.03% in 2014. Central Java is the province with the second highest number of elderlies after the Special Region of Yogyakarta. In 2015, the number of elderly in Central Java reached 11.7% and increased in 2017 to 12.59%. This shows an increase in the Life Expectancy (UHH) of the world population including Indonesia.[1–3]

According to the Indonesian Ministry of Health in 2009, the age categories of the elderly are divided into early elderly (46–55 years old), late elderly (56–65 years old), and elderly period (≥65 years old). The Delphi Consensus published that there is a 10% increase in the prevalence of cognitive impairment compared to previous publications. In Southeast Asia, the number is expected to increase from 2.48 million in 2010 to 5.3 million in 2030.[2]

The lack of folic acid intake is one of the factors leading to decreased cognitive function. Folic acid is a nutrient needed to maintain homocysteine levels in normal conditions. The increased amount of homocysteine levels will disrupt vascular function and cause toxicity to neurons, so it can increase the risk of cognitive decline.[4]

Until now, checking folic acid levels is not a routine test in health facilities. This may be due to the limited examination services and high cost. Therefore, there is no data on folic acid levels in the elderly, especially in Semarang City.

Although many studies have discussed the relationship between serum folic acid levels and cognitive function in the elderly, the results vary. In addition, there is not enough data on folic acid levels in the elderly community in Semarang City. Therefore, the researcher was interested in conducting a study of the problem. This study aims to determine the relationship between serum folic acid levels and cognitive function in the elderly in Semarang City. Especially in Pucang Gading nursing home in Semarang.

METHODS

This study is an analytical descriptive study with a cross-sectional approach that was conducted at Pucang Gading Wredha Home Semarang from May–July 2022. The research subject is elderly who meet the inclusion criteria (elderly people over 56 years of age who can read and write, can speak Indonesian, conscious and cooperative subjects) and had no exclusion criteria (subjects with depressive disorders, disturbed diet due to impaired intake, impaired absorption, patients with a history of stroke, history of tumor/carcinoma, dementia, and a history of taking drugs).

This study assessed serum folic acid levels with the cognitive function of the elderly. Examination of cognitive function by using MoCA-INA instrument. The confounding factors in this study were age, gender, education level, cholesterol level, BMI, history of diabetes mellitus, and high blood pressure. Examinations are carried out by general practitioners who have understood and received instructions regarding how to collect data.

This research has received approval from the Medical Research Ethics Commission of FK UNDIP/RSDK with No. 30/EC/KEPK-RSDK/II/2022. Statistical analysis using the "SPSS for Windows version 26" program. Data analysis included descriptive analysis and statistical analysis. The first stage was a univariate analysis of descriptive statistics to determine the basic characteristics of the research subjects. While statistical analysis is to see correlation and comparison. Comparative tests used the Chi-Square and Spearman correlation tests for numerical data. Meanwhile, to determine the significance of the strength of the relationship after controlling for confounding variables using the partial correlation test.

RESULTS

This study required a minimum number of samples of 30 research subjects. This study involved 35 subjects, most of whom were > 65 years old as many as 25 subjects (71.4%). The education level of the research subjects was found to be mostly elementary school 12 subjects (34.3%). Most of the subjects were female, namely 22 subjects (62.9%). Most subjects had normal cholesterol levels (71.4%), normal BMI (77.1%), no DM (22.9%), and no hypertension (68.6%).

The analysis was carried out between the variables of folic acid levels on the cognitive function of the elderly, there was a significant correlation between the two variables with a strong positive correlation level. This means that increased folic acid levels are associated with increased cognitive function in the elderly.

Based on the risk factor analysis, there was a relationship between the MoCA-INA score on gender ($p=0.019$) and level of education ($p=0.001$). Women tend to experience cognitive dysfunction compared to men. Subjects without education up to junior high school education had a higher incidence of cognitive dysfunction than high school subjects.

After controlling the variables of gender and level of education, there was still a correlation between serum folic acid levels on cognitive function in the elderly ($p<0.001$; $r= 0.862$ (controlling for sex) and $r= 0.922$ (controlling for level of education)).

TABLE 1
Relationship between serum folic acid levels and cognitive function in the elderly

Variable	Elderly Cognitive Function	
	r	p
Folic Acid Levels	0.914	<0.001$^{\$*}$

Description: * p < 0.05 significant, $^{\$}$ SpearmanTest

TABLE 2
Relationship between confounding variables and cognitive function in the elderly

Variable		MoCA-INA			
		Normal (≥26)	Disturbed (<26)	P	OR (95% CI)
Age	56–65 years	1 (10%)	9 (90%)	0.436$^{\&}$	0.444 (0.45–4.37)
	> 65 years	5 (20%)	20 (80%)		
Level of education	No school Junior High School	0 (0.0%)	25 (100%)	0.001$^{*!}$	–
	Senior High School	6 (60%)	4 (40.0%)		
Gender	Man	5 (38.5%)	8 (61.5%)	0.019$^{*\&}$	13.125 (1.321–130.424)
	Woman	1 (4.5%)	21 (95.5%)		
Cholesterol Levels	Normal	4 (16.0%)	21 (84.0%)	0.564$^{\&}$	0.762 (0.116–5.006)
	Tall	2 (20.0%)	8 (80.0%)		
BMI	Underweight	0 (0.0%)	5 (100%)	0.200$^{!}$	–
	Normal	5 (18.5%)	22 (81.5%)		
	Overweight	0 (0.0%)	1 (50.0%)		
	Obese	1 (50.0%)	1 (50.0%)		
History DM	Yes	1 (12.5%)	7 (87.5%)	0.580$^{\&}$	0.629 (0.062–6.328)
	No	5 (18.5%)	22 (81.5%)		
History of Hypertension	Yes	1 (9.1%)	10 (90.9%)	0.371$^{\&}$	0.38 (0.393–0.713)
	No	5 (20.8%)	19 (79.2%)		

Description: * p < 0.05 significant, $^{\$}$ Chi-Square Test, $^{\&}$ Fisher's Exact Test, $^{!}$Kruskal-Wallis

DISCUSSION

The mean serum folic acid level of the 35 study participants was 7.09 ± 2.55 mg/mL. The minimum value is 2.40 mg/mL, and the maximum value is 9.62 mg/mL. The average was 8.09 mg/mL. 3 mg/mL is the normal serum folic acid level. There was no discrimination between men and women.[5–7]

Only 5 (17.2%) of the 35 study participants had a decrease in serum folic acid levels. This could be because the study was conducted on the elderly in nursing homes, where the residents' health and psychological factors, as well as their dietary patterns, are likely to be well maintained. Morris *et al* (2010) research found that low folate levels and high homocysteine levels are risk factors for depression and dementia, including Alzheimer's disease and vascular dementia.[7] High homocysteine levels can impair cognitive performance via a variety of mechanisms such as oxidative stress, apoptosis, and senile plaque.[8,9] Increased plasma homocysteine causes faster shrinkage of the medial temporal lobe, resulting in.[8,9]

The Moca-INA score obtained an average of 21.4 ± 4.6 on the Moca-INA examination, with the lowest score being 14 and the highest score being 30. The median value is 22. Folic acid deficiency has been linked to

TABLE 3
Correlation test for the relationship between serum folic acid levels and cognitive function in the elderly with control over gender and education

Variable	Correlation between serum folic acid levels and cognitive function in the elderly	
	Rho	P
Gender	0.862	<0.001$
Education	0.922	<0.001$

Description: p <0.05 significant, $Partial Correlation Test

neurological disorders such as depression and dementia, as well as demyelinating myelopathy. Folic acid is a nutrient that is required to maintain normal homocysteine levels. Increased homocysteine levels will disrupt vascular function and cause neurotoxicity, increasing the risk of cognitive decline.[4,10,11,12]

The subjects in this study had a lower-than-normal MoCA-INA score (26), indicating that their serum folic acid levels were low. As a result, cognitive function suffers. This is according to Mengyue L *et al* (2020) found a significant relationship between folic acid intake and cognitive function. The correlation value (r) is positive, indicating that taking folic acid for 6 months can improve cognitive function significantly.[13]

The strength of the relationship between serum folic acid levels and cognitive function in the elderly was discovered in this study. After controlling for gender, no significant changes with the same correlation strength were found; this is consistent with a study that stated menopause is a natural part of aging. Menopause and the loss of ovarian hormones are two factors that contribute to memory loss. As a trophic agent, the hippocampus secretes hormones such as estrogen in adults. However, a lack of estrogen during menopause causes neurons to become more fragile, resulting in memory loss.[14] After controlling for education, changes in the strength of the relationship between serum folic acid levels and cognitive function in the elderly revealed changes in the strength of the correlation. This is consistent with the findings of Yao *et al* (2009) who discovered that "changes in the shape and function of the post-maturity brain are primarily the result of experience and education"[15] routine and continuous cognitive skill development such as logic and reasoning, abstract thinking, and the ability to prevent and enhance neuronal connections.[16]

This study has several limitations, including the fact that it was only conducted in one elderly home, so the results do not represent the general population; brain structural abnormalities were not excluded by supporting examinations; and no further follow-up on folic acid serum levels and cognitive function was performed. examined in the elderly.

CONCLUSION

There is a significant relationship between serum folic acid levels and cognitive function in the elderly. Higher educational status in the elderly is associated with better cognitive function.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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