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ASSOCIATION BETWEEN LOW VITAMIN B12 LEVELS AND COGNITIVE IMPAIRMENT IN ELDERLY AT THE NAVAL MEDICAL CENTER OF PERU

ASOCIACIÓN ENTRE EL BAJO NIVEL DE VITAMINA B12 Y DETERIORO COGNITIVO EN ADULTOS MAYORES DEL CENTRO MÉDICO NAVAL DEL PERÚ

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ABSTRACT

Introduction: Older adults are susceptible to malnutrition and vitamin deficiency. **Objective:** To determine the association between the low level of vitamin B12 and cognitive deterioration in older adults from the Naval Medical Center, located in Lima-Peru, in the period 2010-2015. **Methods:** An analytical cross-sectional study was carried out, based on a secondary analysis of the Texas-Cemena UTMB 2010-2015 database of the Center for Research on Aging (CIEN) of the University of San Martín de Porres. To quantify the cognitive impairment variable, the MiniMental Test was used. To analyze the association, the Chi-square test and Poisson regression were performed. **Results:** 57.6% of the patients were male and the mean age was 78 ± 8.4. 41.2% presented cognitive deterioration and 9.5% of the patients presented vitamin B12 deficiency. The factors independently associated with cognitive impairment were a history of cerebrovascular disease (PR= 1.38 95% CI [1.24-1.53]), depression (PR= 1.88 95% CI [1.80-1 .97]) and vitamin B12 deficiency (PR = 1.10 95% CI [1.01-1.20]). **Conclusions:** In the present study, an association was found between a low level of vitamin B12 and cognitive deterioration in older adults.

Keywords: Elderly, Cognitive impairment, Naval Medicine, Geriatrics, Peru. (Source: MESH-NLM)

RESUMEN

Introducción: Los adultos mayores son suscepctibles a la malnutrición y el déficit de vitaminas. **Objetivo:** Determinar la asociación entre el bajo nivel de vitamina B12 y el deterioro cognitivo en adultos mayores del Centro Médico Naval, ubicado en Lima-Perú, en el periodo 2010-2015. **Métodos:** Se realizó un estudio transversal analítico, a partir de un análisis secundario de la base de datos Texas-Cemena UTMB 2010-2015 del Centro de Investigación del Envejecimiento (CIEN) de la Universidad de San Martín de Porres. Para la cuantificación de la variable de deterioro cognitivo se utilizó el MiniMental Test. Para analizar la asociación, se realizó la prueba de Chi cuadrado y la regresión de Poisson. **Resultados:** El 57,6% de los pacientes fueron de sexo masculino y la edad promedio fue de 78 ± 8,4. El 41,2% presentó deterioro cognitivo y el 9,5% de los pacientes presentó déficit de vitamina B12. Los factores independientemente asociados al deterioro cognitivo fueron el antecedente de enfermedad cerebro vascular (RP= 1,38 IC 95% [1,24-1,53]), depresión (RP = 1,88 IC 95% [1,80-1,97]) y déficit de vitamina B12 (RP = 1,10 IC 95% [1,01-1,20]). **Conclusiones:** En el presente estudio se encontró asociación entre un bajo nivel de vitamina B12 y el deterioro cognitivo en adultos mayores.

Palabras clave: Anciano, Deterioro cognitivo, Geriatría, Medicina Naval, Perú. (Fuente: DeCS- BIREME)

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INTRODUCTION

The population of elderly has increased worldwide in recent decades, and it is estimated that this growth will continue in the coming years. According to the World Health Organization (WHO), in the year 2000, older adults accounted for 10% of the global population[1]. In Peru in 2020, older adults represented 11% of the population, corresponding to approximately 3,613,000 individuals. The increase in this population is attributed to the demographic transition taking place in Peru [2]. Elderly are highly susceptible to malnutrition and specific nutritional deficiencies. Vitamin B12 deficiency is caused by decreased absorption due to age-related factors such as hypochlorhydria or intrinsic factor deficiency [3].

Cobalamin or vitamin B12 plays an important role in the development and maturation of the central nervous system, neurotransmitter metabolism, and red blood cell formation. Cobalamin deficiency in older adults is associated with neurological manifestations, metabolic disorders, megaloblastic anemia, cardiovascular diseases, and mental disorders [3-6].

In Peru, there is a lack of information regarding the association between vitamin B12 deficiency and cognitive impairment, despite the negative impact of this deficiency on the quality of life of older adults. The information obtained in this study aims to raise awareness about this issue and contribute to addressing this public health problem. Based on the above, the following research is proposed with the objective of determining the association between low vitamin B12 levels and cognitive impairment in elderly at the Naval Medical Center of Peru, Lima, 2010-2015.

METHODS

Design and Study Area

A cross-sectional analytical study was conducted based on the secondary analysis of a database from Texas-Cemena UTMB 2010-2015, obtained from the Center for Aging Research at Universidad San Martin de Porres.

Population and Sample

The population consisted of older adults registered in the database, including clinical and epidemiological data of individuals aged 60 and above, who received outpatient care and attended the Day Clinic (outpatient service) from June 2010 to December 2015 at the Geriatrics Service of the Center. For this study, no sampling was performed, and all registered patients in the database were included. The study included older adults from the Naval Medical Center of Peru, including non-military patients, retired military personnel, and family members of the Naval Medical Center of Peru. Records with incomplete or incorrect data were excluded, as well as those meeting criteria for hospitalization and home visits. Ultimately, 1,553 records were included.

Variables and Instruments

Cognitive impairment was considered as the dependent variable, and sociodemographic characteristics were considered as independent variables. These characteristics included: age (senior (60-74 years), elderly (75-90 years), and oldest-old (above 91 years)) [7], sex (male and female), years of education (less than 11 years and more than 11 years), and pathological history including: diabetes (yes and no), hypothyroidism (yes and no), and cerebrovascular disease (yes and no). This measurement was previously used in a published research with the same study population[8].

The Mini-Mental State Test (MMST) was used for the quantification of cognitive impairment, which ranges from 0 to 30 points, and it was measured using the adapted version validated in Spain. A cutoff score of 24 points was used as a screening for cognitive impairment, classifying scores below 24 as cognitive impairment [9].

The Geriatric Depression Scale by Yesavage was used for assessing depression, which has been previously used in the Peruvian population. This scale consists of 5 closed-ended questions that inquire about the presence or absence of depression in older adults, and it was considered positive if patients obtained a score greater than or equal to 2. This classification was previously used in a published research with the same study population[9]. On the other hand, the variable "vitamin B12" was quantified as <150 pmol to define

low levels, compared to individuals with normal levels of vitamin B12. This classification was used in a previous study (10).

Procedures

A secondary analysis of the Texas-Cemena UTMB 2010-2015 database from the Center for Aging Research at Universidad de San Martín de Porres was conducted. The database was derived from a structured instrument developed by the researchers of the original study.

Statistical Analysis

The SPSS V20.0 software was used for data processing. Descriptive statistics were performed, including the calculation of frequencies, percentages, dispersion, and measures of central tendency. The association between variables was assessed using the chi-square test.

To identify independently associated factors with cognitive impairment, a Poisson regression with robust variance was conducted, calculating crude and adjusted prevalence ratios (PR). The calculations were performed with a 95% confidence level. Regarding statistical power, it was measured using Epidat software version 4.2, assuming a frequency of vitamin B12 deficiency in individuals with cognitive impairment of 87.8% and 7.6% in individuals without cognitive impairment, with a 95% confidence interval. The calculated power was 100%.

Ethical Considerations

Approval was obtained from the Research Ethics Committee of the Faculty of Medicine at Universidad San Martin de Porres.

RESULTS

The majority of patients seen were male, accounting for 57.6% of the sample, and the average age was 78 ± 8.4 years. Most patients were classified as elderly (75-90 years), representing 64.4% of the sample. Additionally, the majority had more than 11 years of education, accounting for 72.5%. Finally, the main pathologies observed in the study among the older adult patients are described. Diabetes mellitus was present in 18.3% of cases. Hypothyroidism was present in only 11% of all patients. Cerebrovascular disease was observed in 4.4% of the patients. Depression was present in 25.2% of the patients. As for the Mini-Mental State Test, 41.2% showed cognitive impairment. Regarding vitamin B12 levels, 90.5% of the patients did not have a vitamin B12 deficiency (Table 1).

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Table 1. General characteristics of elderly.

Variables	N	%
Sex		
Female	659	42.40%
Male	894	57.60%
Age		
Senior	445	28.70%
Elderly	1 000	64.40%
Oldest Old	108	7.00%
Education		
≤11 years	427	27.50%
>11 years	1 126	72.50%
Diabetes Mellitus		
No	1 269	81.70%
Yes	284	18.30%
Hypothyroidism		
No	1 392	89.00%
Yes	171	11.00%

	Cerebrovascular Disease		
	No	1 484	95.60%
	Yes	69	4.40%
	Depression		
	No	1 162	74.80%
	Yes	391	25.20%
	Cognitive Impairment		
	Yes	640	41.20%
	No	905	58.30%
	Vitamin B12 Levels		
	Deficiency	147	9.50%
	No Deficiency	1 406	90.50%
	Total	1 553	100%

Table 2 describes the variables in relation to MMSE ≤ 24, showing an association between hypothyroidism (p<0.001), cerebrovascular disease (p<0.001), depression (p<0.0001), and vitamin B12 (p=0.003) with cognitive impairment.

Table 2. General characteristics of patients in relation to cognitive impairment.

Variables	MMSE* ≤ 24 (Cognitive Impairment) N	%	MMSE* >24 (No Cognitive Impairment) N	%	P value
Sex					0.318
Female	263	41.10%	395	43.60%	
Male	377	58.90%	510	56.40%	
Age					0.691
Senior	177	29.10%	254	28.10%	
Elderly	406	63.40%	591	65.30%	
Oldest Old	48	7.50%	60	6.60%	
Education					0.951
≤11	177	27.70%	249	27.50%	
>11 years	463	72.30%	656	72.50%	
Diabetes Mellitus					0.711
No	520	81.30%	742	82.00%	
Yes	120	18.80%	163	18.00%	
Hypothyroidism					<0.0001
No	519	81.10%	855	94.50%	
Yes	121	18.90%	50	5.50%	

Cerebrovascular Disease					<0.0001
No	579	90.50%	897	99.10%	
Yes	61	9.50%	8	0.90%	
Depression					<0.0001
No	289	45.20%	895	95.60%	
Yes	351	54.80%	40	4.40%	
Vitamin B12					0.003
No Deficiency	78	12.20%	836	92.40%	
Deficiency	562	87.80%	69	7.60%	

*MMSE: Mini-Mental Test Examination

The factors independently associated with cognitive impairment were a history of cerebrovascular disease (PR = 1.375, 95% CI [1.239-1.527]), depression (PR = 1.881, 95% CI [1.796-1.971]), and vitamin B12 deficiency (PR = 1.102, 95% CI [1.012-1.200]) (Table 3).

Table 3. Factors associated with cognitive impairment in older adults.

Variable	Crude Model P value	PR [Ci95%]	Adjusted Model P value	PR [Ci95%]
Male sex	0.318	1.11[0.90-1.63]	0.269	1.03[0.98-1.08]
Age				
Oldest Old	0.684	1.02[0.92-1.13]	0.879	1.01[0.91-1.11]
Elderly	0.583	0.99[0.93-1.04]	0.525	0.98[0.93-1.04]
Education >11 years	0.951	1.00[0.91-1.10]	0.327	1.03[0.98-1.08]
Diabetes Mellitus	0.711	1.02[0.94-1.14]	0.645	1.01[0.96-1.08]
Hypothyroidism	<0.0001	2.13[1.68-2.70]	0.748	0.99[0.91-1.06]
Cerebrovascular Disease	<0.0001	5.24[2.73-10.07]	<0.0001	1.80[1.24-1.53]
Depression	<0.0001	7.33[5.45-9.85]	<0.0001	1.88[1.80-1.98]
Vitamin B12 Deficiency	0.003	1.28[1.07-1.52]	0.025	1.10[1.01-1.20]

DISCUSSION

Ethe present study found an association between low levels of vitamin B12 and cognitive impairment. Additionally, an association was found between a history of cerebrovascular disease (CVD) and depression with cognitive impairment. Vitamin B12 and folic acid are crucial in the methylation processes of the central nervous system, and their deficiency can lead to neuropsychiatric disorders and vascular cognitive impairment due to hyperhomocysteinemia and excitotoxic mechanisms [11]. Previous studies have also described the association between cobalamin levels and cognitive function. Meertens et al. conducted a study in a nursing home in Venezuela [12], Vogel et al. conducted a longitudinal study in Spain [13], and Aguilar et al. conducted a study in outpatient patients at a hospital in Mexico [14], all finding a significant relationship between low cobalamin levels and cognitive function. Silva et al. [15] also found that vitamin B12 deficiency is common in older individuals and can lead to reversible dementia. In older adults aged 60 years and above with dementia, the prevalence of

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vitamin B12 deficiency has been determined to be 7.5%. Significant improvement in the median MMSE score was observed at 6 weeks and 12 weeks after vitamin B12 supplementation [16]. This is explained by the fact that vitamin B12 deficiency leads to elevated homocysteine levels, which are a risk factor for vascular disease and cause DNA damage in the brain[17].

Finally, this study found an association between cognitive impairment and a history of cerebrovascular disease (CVD). In Japan, the prevalence of cognitive impairment after a 3-year follow-up following a stroke increased with advanced age. Previous studies have also reported that the prevalence of cognitive impairment following a stroke ranges from 20% to 80% [18]. Therefore, as a result of the high rates of mortality and disability associated with stroke occurrence, managing significant risk factors is of utmost importance in older adults [19].

Similarly, vitamin B12 supplementation could be beneficial in reversing these symptoms in older adults. A case presented by Behres et al. at a hospital in Chile showed that treatment with parenteral cobalamin and vitamin B9 reversed the symptoms, leading to normal results in neuropsychological tests and consequently reintegrating the individual into their work [20]. Additionally, vitamin B supplements have been found to delay or maintain cognitive decline in older adults [21].However, it is indicated that higher dietary intake of folate, but not B12 or B6, is associated with a reduced risk of dementia in the elderly population without dementia, thus requiring further studies[22]. Among the limitations of the present study, it was found that some variables could not be measured due to missing data in the original database or were unrelated to the patient. Additionally, this study was conducted at a military hospital in Peru, which may have some differences compared to findings in public hospitals under the Ministry of Health or the Social Health Insurance (EsSalud). However, these older adults represent a significant percentage of patients living in middle-class areas of Lima, where there is a considerable increase in the elderly population. Therefore, the results are important for obtaining an approximation of the influence of vitamin B12 on cognitive impairment in this population.

CONCLUSIONS

In this population, an association was found between low levels of vitamin B12 and cognitive impairment. These findings may indicate the influence of cobalamin on cognition in geriatric patients, as well as the potential usefulness of vitamin supplementation in slowing the progression of cognitive disorders in older adults.

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