Galician medical journal 2021
Vol. 28, Issue 2, E202124
DOI: 10.21802/gmj.2021.2.4

Research Article | Internal Medicine

What Could Aid in Slowing Down Cognitive Function?

Azad Ilhan[1], Murat Varli[2], Pelin Bilgic[1*]

Abstract

The objective of this research was to assess the relationship between cognitive function, physical activity level, nutritional and depression status in the elderly.

Materials and Methods. A total of 200 individuals ($\geq$ 65 years) were included in the study. General characteristics of the individuals, biochemical findings, nutritional habits, 24-hour physical activity level and food consumption records were assessed. Cognitive function and depression status were screened by the Standardized Mini-Mental State Examination (S-MMSE) and Geriatric Depression Scale-Short Form (GDS-SF), respectively.

Results. Thirty-eight (19%) of the 200 individuals were diagnosed with dementia. On the evaluation of all the individuals, moderate and statistically significant negative correlation (r=-0.558, $p < 0.01$) was found between the S-MMSE and GDS-SF values. In addition, a moderate and statistically significant positive correlation was found between the S-MMSE and physical activity level values (r=0.553, $p < 0.01$). Vitamin B_1, vitamin B_2, vitamin B_3, vitamin B_6, and zinc intakes were lower in women than in men ($p < 0.05$). Moreover, it was observed that the vitamin B_3 and calcium intakes were below the recommended daily intake in both the genders.

Conclusions. Proper nutritional treatment and increasing the levels of physical activity may aid in slowing down the progression of dementia.

Keywords

Cognitive Function; Physical Activity; Depression; Nutritional Status

[1] *Department of Nutrition and Dietetics, Hacettepe University, Ankara, Turkey*
[2] *Department of Geriatric Medicine, Ankara University School of Medicine, Ankara, Turkey*
*__Corresponding author__: pbilgic@hacettepe.edu.tr

Problem statement and analysis of the latest research

Dementia is a syndrome in which one or more cognitive domains (learning and memory, language, executive function, or agnosia) are deficient, resulting in amnesia [1]. It is a rapidly growing global public health problem. Every year, there are nearly 10 million new cases. The total number of people with dementia is projected to reach 82 million in 2030 and 152 million in 2050 [2].

The probability of occurrence of age-related diseases and functional disorders is higher in older individuals than the younger ones, and maintenance of adequate nutritional status is an important factor governing the occurrence. Elderly individuals may face nutritional deficiencies due to number of medications they consume. The U.S. Department of Health and Human Services, considering the possible risks of malnutrition, has identified nutrition as the primary factor for the health goals of the country [3]. Diets of the elderly should be specific and meet their needs. Adequate and balanced nutrition, one of the basic conditions for a healthy life, depends on quality and quantity of the dietary intake of nutrients [4]. Moreover, elderly people should be encouraged to consume snacks as it allows a higher energy intake [5].

Furthermore, a high body mass index (BMI) in elderly individuals (overweight individuals) can be protective against cognitive flexibility, mobility, or disability [6]. In addition, a study on the relationship between high BMI and mortality in demented individuals suggested the obesity paradox, with an increased BMI being associated with a reduced mortality risk [7].

Physical activity affects the mental, spiritual, physical health [8]. In recent years, there has been a growing interest in the non-pharmacological intervention of the physical activity for dementia prevention and management [9, 10]. In recent studies, physical activity interventions in demented individ-

uals have been proven to improve movement and functional limitations [11, 12]. In a meta-analysis study on the relationship between the prevention of cognitive decline, dementia and physical activity, dementia was found to be correlated [13]. This situation boosts interest in the physical activity to delay and prevent dementia.

The objective of this research was to assess the relationship between the physical activity level, nutritional status, and cognitive function in the elderly.

Materials and Methods

Design and Participants

A sample of 200 functionally active patients (111 women and 89 men) at the age of 65 years or older (the mean age: 74.76 $\pm$ 7.5 years) was selected from the Ankara University School of Medicine. The functional activity status was determined according to the Katz Activities of Daily Living (ADL) scale [14], and the subjects who did not have a full score (ADL=6) on this scale were not included in the study. In addition, patients with advanced dementia, delirium, cancer, advanced visual and auditory impairment, fracture, scoliosis and kyphosis, orthopaedic disease hindering physical activity or relying on walking aids and those disabled or bedridden were excluded from the study. Considering the clinical history, daily activities and the Standardized Mini-Mental State Examination (S-MMSE) score, 38 individuals were identified by the specialist to be suffering from dementia.

Measurements

With the help of a prepared questionnaire, general characteristics, such as age, marital status, educational status, place of residence, diagnosed health problems, medication use, diet history, daily food consumption records, nutritional status, anthropometric measurements and smoking and alcohol drinking habits were individually recorded. For the questions that demented individuals could not answer, their relatives were consulted. To assist the respondents in gauging the actual quantity of the foods, a Turkish food photograph catalogue was used. The dietary data were analyzed using BEBIS-7 (Nutrition Information Systems Software), and the total intake of energy, carbohydrates, proteins, fats, fibers, vitamins A, E, C, B_1, B_2, B_3, B_6, B_{12}, folic acid, calcium, magnesium, iron and zinc was calculated. Dietary intake was individually compared with the gender and age groups, and the recommendations about daily required amount of nutrients were referred from the nutritional guide specific to Turkey [15]. The exact Recommended Daily Intake (RDI) values were used as the cut-off values to categorize dietary intake.

Anthropometrical assessment consisted of weight (kg) and height (cm) measurements. Height was measured with a clinical stadiometer, with the individuals standing barefoot with the head in the Frankfort plane. Body weight was measured using the TESS MB-300 model scale, with the individuals wearing light clothes and no shoes. BMI (kg/m^2) was calculated as weight/height^2 and was classified according to the World Health Organization (WHO) classification.

Cognitive functions were assessed by the S-MMSE [16]. The cut-off score for possible dementia in Turkish population was 23/24 [17]. The S-MMSE was conducted and interpreted by a specialist (medical doctor) in the field of geriatrics. Daily activities related to independent living were evaluated with the Instrumental Activities of Daily Living (IADL) scale [18]. The Geriatric Depression Scale-Short Form (GDS-SF) [19] and 24-hour physical activity records were used to assess the depression status and physical activity levels (PAL), respectively. The basal metabolic rate (BMR) was calculated according to the Schofield Equations determined by the age group and sex. For individuals having more than 25% of ideal body weight, the adjusted body weight was used in the equation. The individuals' PALs were calculated by dividing the total energy consumption to the BMR. Individuals were classified as sedentary, low-active, active and very active according to the PAL values.

Statistical Analysis

The data were analyzed with the SPSS 23 package software. The normality of data distribution was tested using histogram and detrended plot graphics, kurtosis and skewness coefficients, variation coefficient and the Kolmogorov-Smirnov or the Shapiro-Wilk test, considering the amount of data. Descriptive statistics were expressed using mean (Mean) and standard deviation (SD) if the data were normally distributed and median and interquartile range [IQR], if not. The Student's t-test (under parametric conditions) or the Mann-Whitney U and the Chi-Square tests (under non-parametric conditions) were used for comparison of data between demented and non-demented individuals. Pearson correlation test examined the relationships between the S-MMSE, GDS-SF, PAL and BMI scores.

Results

A sample of 200 functionally independent individuals (111 women and 89 men) at the age of 65 years or older was included in the study, and 38 of them were diagnosed with dementia. The individuals were divided into two groups, those with dementia and without dementia. The mean age of demented individuals was 78.97 $\pm$ 6.52 years; the mean age of non-demented individuals was 73.77 $\pm$ 7.38 years ($p < 0.001$).

Table 1 summarizes the S-MMSE, GDS-SF and PAL scores of the individuals who participated in the study. The difference between the S-MMSE scores of the two groups was statistically significant ($p < 0.001$). Mild depression was found in 15.8% and moderate depression in 39.5% of demented individuals; 44.4% and 11.7% of non-demented individuals were diagnosed with mild and moderate depression, respectively. The difference between the mean scores of the GDS-SF of the two groups was statistically significant ($p < 0.001$). It was observed that 86.8% of non-demented individuals and 40.7% of demented individuals were seden-

Table 1. General characteristics of the individuals and the S-MMSE, GDS-SF and PAL score information.

	Demented group (n=38)		Non-demented group (n=162)		p value
	n	%	n	%	
Gender					0.291[a]
Male	14	36.8	75	46.3	
Female	24	63.2	87	53.7	
Marital status					**0.025[a]**
Married	14	36.8	101	62.4	
Divorced	3	7.9	10	6.1	
Widow	21	55.3	51	3.5	
Educational status					**0.04[a]**
Illiterate	17	44.7	39	24.1	
Literate	15	39.5	56	34.5	
Secondary	3	7.9	27	16.7	
High school	1	2.6	18	11.1	
University	2	5.3	22	13.6	
Medication use					**0.039[a]**
<4	8	21.1	64	39.5	
≥ 4	30	78.9	98	60.5	
Skipping meal					**0.002[a]**
Yes	16	42.1	30	18.5	
No	22	57.9	132	81.5	
Age (years)	78.97±6.52		73.77±7.38		**<0.001[b]**
Educational level (years)	2.00 [5.25]*		6.00 [8.25]*		**<0.001[c]**
IADL	6.00 [5.50]		9.00 [10.00]		**0.003[c]**
Main meal consumption	2.55±0.5		2.8±0.41		**0.002[b]**
Snack meal consumption	0.50 [1.00]		1.00 [2.00]		0.53[c]
S-MMSE (n, %)					**<0.001[a]**
>24 (normal)	3	7.9	108	66.7	
≤ 24 (possible dementia)	35	92.1	54	33.3	
S-MMSE score	17.63±3.93		25.62±3.41		**<0.001[b]**
GDS-SF (n, %)					**<0.001[a]**
0-4 (no depression)	6	15.8	65	40.1	
5-8 (mild depression)	6	15.8	72	44.4	
9-11 (moderate depression)	15	39.5	19	11.7	
12-15 (severe depression)	11	28.9	5	3.1	
GDS-SF score	8.81±3.41		5.36±2.9		**<0.001[b]**
PAL (n, %)					**<0.001[a]**
1.0 - <1.4 (sedentary)	33	86.8	66	40.7	
1.4 - <1.6 (low activity)	5	13.2	41	25.3	
1.6 - <1.9 (active)	-	-	44	27.2	
1.9 - <2.5 (very active)	-	-	11	6.8	
PAL score	1.2±0.14		1.49±0.26		**<0.001[b]**

Notes: BMI: Body Mass Index; IADL: Instrumental Activities of Daily Living; GDS-SF: Geriatric Depression Scale-Short Form; PAL: Physical Activity Level; S-MMSE: Standardized Mini Mental State Examination;
* - Median [IQR]; p[a] - Chi square test; p[b] - Independent samples t-test; p[c] - Mann-Whitney U test ($p<0.05$).

tary, and the difference between the PAL scores of the two groups was statistically significant ($p < 0.001$).

Table 2 shows the relationship of the tests with each other. When evaluating all the individuals, the S-MMSE values were found to be negatively correlated with the GDS-SF and BMI values and positively correlated with the PAL values. There was a moderate and statistically significant negative relationship between the S-MMSE and GDS-SF values (r=-0.558, $p < 0.01$) and a positive statistically significant relationship between the S-MMSE and PAL values (r=0.553, $p < 0.01$). In addition, there was a moderate and statistically significant negative relationship between the GDS-SF and BMI (r=-0.404, $p < 0.01$).

Table 2. Relationship between the tests applied to the individuals (r).

	S-MMSE	GDS-SF	PAL	BMI
Demented participants (n=38)				
S-MMSE	-	-0.224	**0.413***	-0.039
GDS-SF	-0.224	-	-0.145	-0.074
PAL	**0.413***	-0.145	-	**-0.382***
BMI	-0.039	-0.074	**-0.382***	-
Non-demented participants (n=162)				
S-MMSE	-	**-0.476****	**0.416****	-0.01
GDS-SF	**-0.476****	-	**-0.31***	-0.036
PAL	**0.416****	**-0.31***	-	**-0.224****
BMI	-0.01	0.036	**-0.224****	-
All participants (n=200)				
S-MMSE	-	**-0.558****	**0.553****	**-0.15***
GDS-SF	**-0.558****	-	**-0.404****	0.044
PAL	**0.553****	**-0.404****	-	**-0.293****
BMI	**-0.15***	0.044	**-0.293****	-

Notes: BMI: Body Mass Index; GDS-SF: Geriatric Depression Scale-Short Form; PAL: Physical Activity Level; S-MMSE: Standardized Mini Mental State Examination; * - $p < 0.05$; ** - $p < 0.01$; Pearson correlation analysis was applied to all groups.

Table 3 lists the nutritional status of the individuals assessed by daily food consumption records. The mean total energy intake of all the individuals was 1635.95 ± 628.61 kcal and showed statistically significant difference between the demented and non-demented individuals ($p < 0.001$). Thirty-two percent of the individuals did not meet the RDI levels with respect to the energy intake. Daily intakes of carbohydrates, proteins and fats were 214.87 ± 90.72 g, 68.86 ± 28.39 g, and 52.84 ± 23.8 g, respectively. The mean fiber intake was 21.53 ± 9.72 g and 29.5% of the individuals could not meet the RDI for fiber. The mean percentages of the individuals meeting the RDI were the lowest for calcium ($49.01 \pm 23.3\%$) and magnesium ($64.95 \pm 27.94\%$). Daily water consumption was found to be 660.26 ± 270.04 mL in demented individuals and 906.11 ± 399.91 mL in non-demented individuals. There was a statistically significant difference between the two groups regarding water consumption ($p < 0.001$).

Discussion

One of the main conditions for maintaining a healthy life is adequate and balanced nutrition daily, and it can be provided by eating regular meals [4]. It is important for elderly people not to skip meals to meet their daily nutritional requirements. Snack consumption is associated with higher energy intake and should be encouraged in the elderly [5]. However, it was observed that the number of snack meals were insufficient in both the groups of the individuals (Table 1). This could be because elderly individuals prefer medication treatment for their illnesses, and their caregivers are ignorant about the importance of nutrition and consumption of snacks.

There are many studies in the literature that evaluate the relationship between the S-MMSE and cognitive functions [20, 21]. According to the present study, 92.9% of the elderly diagnosed with dementia had S-MMSE scores of 24 and below (Table 1). This indicated that S-MMSE score has a strong relationship ($p < 0.001$) with cognitive impairment. The results of the study also showed that 24 as a cut-off point for the diagnosis of dementia for Turkish society is appropriate for this study.

Lerche and colleagues [22] have found the association of the level of physical activity with cognitive function as 62.2% of the individuals were inactive, 32.5% of the individuals were minimally active and 5.3% of the individuals were very active. In the present study, 86.8% of demented individuals and 40.7% of non-demented individuals were sedentary (Table 1). A lack of physical activity is common in older individuals. In the present study, physical activity status was evaluated by the PAL scores. The mean value of the PAL scores was 1.2 ± 0.14 in demented individuals and 1.49 ± 0.26 in non-demented individuals and the difference between the two groups was statistically significant ($p < 0.001$). In general, the study population was found to be sedentary. This could be attributed to a decrease in the physical activity with age and a geriatric population being the sample for the study.

Kim and colleagues [23] have found that there was a relationship between the daily intake of energy, protein and folic acid in the group of individuals with cognitive dysfunction and the control group. In addition, in the group with cognitive dysfunction, there was a positive correlation between the intake of vitamin B_2, vitamin B_6, vitamin B_{12}, folic acid and the mini-mental state test. In another study, participants were followed for 13 years, and at the end of the study, the decrease in cognitive function was associated with the total fiber, soluble fiber, omega-3 fatty acid, β-carotene and retinol intake [24]. In the present study, while the intake of vitamin A, vitamin E and vitamin C was similar in both the groups ($p > 0.05$), other macro- and micronutrient intake levels were statistically significantly lower in demented individuals ($p < 0.05$) (Table 3). This may be related to the undesirable effects of dementia medications, such as loss of appetite, nausea, vomiting and diarrhea.

Adequate hydration is required for adequate digestion, removal of toxins from the body, regulation of body temperature, energy production and a series of biochemical reactions. However, the feeling of thirst is known to reduce due to ageing. To prevent dehydration, it is recommended for elderly individuals to drink approximately 2,250 mL of water daily [25]. In this study, daily water consumption by demented individuals and non-demented individuals was found to be 660.26 ± 270.04 mL and 906.11 ± 399.91 mL, respectively. There was a statistically significant difference between the two groups regarding water consumption ($p < 0.001$) (Table 3). Furthermore, it was found that water consumption was below the recommended amounts in both the groups. This

Table 3. Energy and nutrient intakes of the individuals assessed by daily food consumption records.

	Demented group (n=38) Mean±SD	Non-demented group (n=162) Mean±SD	p	Total (n=200) Mean±SD
Energy (kcal)	1297.29±428.41	1715.39±642.51	**<0.001***	1635.95±628.61
RDI (%)	65.14±33.52	85.51±42.94	**<0.001***	84.62±31.12
<RDI	20 (52.6)	45 (27.8)	**0.003***	65 (32.5)
Carbohydrate (g)	175.54±60.85	224.09±94.19	**0.003***	214.87±90.72
Protein (g)	54.08±21.18	72.33±28.8	**<0.001***	68.86±28.39
Fat (g)	40.01±16.72	55.85±24.24	**<0.001***	52.84±23.8
Fiber (g)	17.45±7.46	22.49±9.97	**0.004***	21.53±9.72
RDI (%)	72.84±50.72	83.17±45.65	**0.022***	88.82±40.22
<RDI	15 (39.5)	44 (27.2)	0.134	59 (29.5)
Vitamin A (mcg)	636.17±563.28	816.25±642.84	0.114	782.04±631.14
RDI (%)	52.57±94.39	78.02±71.3	**0.015***	99.99±80.64
<RDI	23 (60.5)	59 (36.4)	**0.007***	82 (41.0)
Vitamin E (mg)	10.71±6.9	12.84±7.21	0.1	12.43±7.18
RDI (%)	66.26±71.28	84.27±61.48	0.082	82.91±47.9
<RDI	19 (50.0)	64 (39.5)	0.237	83 (41.5)
Vitamin C (mg)	80.44±62.47	99.81±64.45	0.095	96.13±64.38
RDI (%)	89.38±69.41	110.9±71.61	0.093	106.81±71.53
<RDI	14 (36.8)	46 (28.4)	0.306	60 (30.0)
Vitamin B_1 (mg)	0.64±0.21	10.71±6.9	**<0.001***	0.82±0.31
RDI (%)	58.63±23.51	73.03±35.76	**<0.001***	72.06±27.35
<RDI	26 (68.4)	63 (38.9)	**0.001***	89 (44.5)
Vitamin B_3 (mg)	9.17±5.74	12.1±7.22	**0.021***	11.54±7.04
RDI (%)	54.84±34.56	66.38±51.21	**0.006***	77.36±46.64
<RDI	27 (71.1)	82 (50.6)	**0.023***	109 (54.5)
Vitamin B_6 (mg)	0.95±0.34	1.33±0.48	**<0.001***	1.25±0.48
RDI (%)	58.33±33.38	79.07±42.98	**<0.001***	79.07±29.31
<RDI	24 (63.2)	54 (33.3)	**0.001***	78 (39.0)
Folic acid (mcg)	252.39±106.19	310.58±143.45	**0.02***	299.53±138.82
RDI (%)	60.37±35.06	70.34±32.84	**0.012***	74.88±34.7
<RDI	23 (60.5)	69 (42.6)	**0.046***	92 (46.0)
Vitamin B_{12} (mcg)	2.09±1.32	2.99±1.67	**0.002***	2.82±1.65
RDI (%)	63.4±76.36	120±92.29	**0.002***	117.49±68.82
<RDI	20 (52.6)	37 (22.8)	**<0.001***	57 (28.5)
Calcium (mg)	484.69±246.09	612.39±282.22	**0.011***	588.13±279.68
RDI (%)	37.16±28.49	47.73±29.39	**0.013***	49.01±23.3
<RDI	34 (89.5)	129 (79.6)	0.16	163 (81.5)
Magnesium (mg)	182.92±66.16	247.18±103.02	**<0.001***	234.97±100.2
RDI (%)	50.72±29.99	64±34.02	**0.001***	64.95±27.94
<RDI	29 (76.3)	90 (55.6)	**0.019***	119 (59.5)
Omega 3 (g)	0.78±0.36	1.19±0.69	**<0.001***	1.11±0.66
RDI (%)	61.9±30.01	90.56±53.61	**<0.001***	85.11±51.18
<RDI	25 (65.7)	65 (40.1)	**<0.001***	90 (45.0)
Omega 6 (g)	12.21±5.92	16.05±8.31	**0.006***	15.32±8.04
RDI (%)	102.44±51.18	130.1±66.89	**0.018***	124.84±65.01
<RDI	11 (28.9)	24 (14.8)	**<0.001***	35 (17.5)
Water (mL)	660.26±270.04	906.11±399.91	**<0.001***	859.4±390.25

Notes: Values indicating the number of patients with food consumption below RDI (<RDI) are shown as number and percentage (%) in parenthesis. RDI: Recommended daily intake. Mann-Whitney U test ($p<0.05$).

was probably due to lack of anticipation of thirst and a lack of awareness about the importance of water for vital functions.

Conclusions

Dementia is a progressive disease that seriously threatens elderly individuals. Nutritional status is closely related to the cognitive function level. Therefore, proper nutritional supplementation should be an important component of multidisciplinary treatment of dementia. Furthermore, increasing the levels of physical activity may slow down the progression of the disease and should be considered equally important while treating the demented elderly.

Ethical Statement

The study protocol complied with the principles laid down in the Declaration of Helsinki and was approved by the Hacettepe University Ethics Committee (GO 16/504-16).

Informed Consent

Written informed consent was obtained from all the individuals.

Conflict of Interest

The authors declare that no conflicts exist.

Financial Disclosure

There is no funding from any sources. All expenses were borne by the researchers.

Acknowledgement

Thank you to all the participants that participated in this research.

References

[1] Duong S, Patel T, Chang F. Dementia. Canadian Pharmacists Journal [Internet]. 2017;150(2):118–129. Available from: https://doi.org/10.1177/1715163517690745

[2] WHO. Risk reduction of cognitive decline and dementia: WHO guidelines. Geneva: World Health Organization; 2019.

[3] U.S. Department of Health and Human Services. Healthy People 2010. With understanding and improving health and objectives for improving health. 2 vols. 2nd ed. Washington, DC: U.S. Government Printing Office;2000.

[4] Muñoz Fernández SS, Lima Ribeiro SM. Nutrition and Alzheimer disease. Clinics in Geriatric Medicine [Internet]. 2018;34(4):677–697. Available from: https://doi.org/10.1016/j.cger.2018.06.012

[5] Rakıcıoğlu N, Aksoy B, Tamer F, Yıldız EA, Samur G, Pekcan G, et al. Nutritional status and eating habits of the institutionalised elderly in Turkey: a follow-up study. Journal of Human Nutrition and Dietetics [Internet]. 2015;29(2):185–195. Available from: https://doi.org/10.1111/jhn.12320

[6] Skinner JS, Abel WM, McCoy K, Wilkins CH. Exploring the "Obesity Paradox" as a correlate of cognitive and physical function in community-dwelling black and white older adults. Ethnicity & Disease [Internet]. 2017;27(4):387. Available from: https://doi.org/10.18865/ed.27.4.387

[7] De Souto Barreto P, Cadroy Y, Kelaiditi E, Vellas B, Rolland Y. The prognostic value of body-mass index on mortality in older adults with dementia living in nursing homes. Clinical Nutrition [Internet]. 2017;36(2):423–428. Available from: https://doi.org/10.1016/j.clnu.2015.12.009

[8] Klimova B, Dostalova R. The impact of physical activities on cognitive performance among healthy older individuals. Brain Sciences [Internet]. 2020;10(6):377. Available from: https://doi.org/10.3390/brainsci10060377

[9] Zucchella C, Sinforiani E, Tamburin S, Federico A, Mantovani E, Bernini S, et al. The multidisciplinary approach to Alzheimer's disease and dementia. A narrative review of non-pharmacological treatment. Frontiers in Neurology [Internet]. 2018 13;9:1058. Available from: https://doi.org/10.3389/fneur.2018.01058

[10] Meyer C, O'Keefe F. Non-pharmacological interventions for people with dementia: a review of reviews. Dementia [Internet]. 2018;19(6):1927–1954. Available from: https://doi.org/10.1177/1471301218813234

[11] Brasure M, Desai P, Davila H, Nelson VA, Calvert C, Jutkowitz E, et al. Physical activity interventions in preventing cognitive decline and alzheimer-type dementia. Annals of Internal Medicine [Internet]. 2017;168(1):30-38. Available from: https://doi.org/10.7326/M17-1528

[12] Jia R, Liang J, Xu Y, Wang Y. Effects of physical activity and exercise on the cognitive function of patients with Alzheimer disease: a meta-analysis. BMC Geriatrics [Internet]. 2019;19(1):181. Available from: https://doi.org/10.1186/s12877-019-1175-2

[13] Blondell SJ, Hammersley-Mather R, Veerman JL. Does physical activity prevent cognitive decline and dementia?: A systematic review and meta-analysis of longitudinal studies. BMC Public Health [Internet]. 2014;14(1):510. Available from: https://doi.org/10.1186/1471-2458-14-510

[14] Katz S. Assessing self-maintenance: activities of daily living, mobility, and instrumental activities of daily living. Journal of the American Geriatrics Society [Internet]. 1983;31(12):721–727. Available from: https://doi.org/10.1111/j.1532-5415.1983.tb03391.x

[15] Besler HT, Rakıcıoğlu N, Ayaz A. Food and nutrition guide specific to Turkey. 1st edition. Ankara: Merdiven Reklam Tanıtım; c2015.

[16] Molloy DW, Alemayehu E, Roberts R. Reliability of a standardized mini-mental state examination compared with the traditional mini-mental state examination. American Journal of Psychiatry [Internet]. 1991;148(1):102–105. Available from: https://doi.org/10.1176/ajp.148.1.102

[17] Güngen C, Ertan T, Eker E, Yaşar R, Engin F. Reliability and validity of the standardized Mini Mental State Examination in the diagnosis of mild dementia in Turkish population. Turk Psikiyatri Derg. 2002;13(4):273-281.

[18] Lawton MP, Brody EM. Assessment of older people: self-maintaining and instrumental activities of daily living. The Gerontologist [Internet]. 1969;9(3 Part 1):179–186. Available from: https://doi.org/10.1093/geront/9.3_Part_1.179

[19] Lesher EL, Berryhill JS. Validation of the geriatric depression scale-short form among inpatients. Journal of Clinical Psychology [Internet]. 1994;50(2):256–260. Available from: https://doi.org/10.1002/1097-4679(199403)50:2<256::AID-JCLP2270500218>3.0.CO;2-E

[20] Mitchell AJ. The mini-mental state examination (MMSE): update on its diagnostic accuracy and clinical utility for cognitive disorders. In: Larner A, editor. Cognitive Screening Instruments [Internet]. Cham: Springer International Publishing; 2017. p. 37–48. Available from: https://doi.org/10.1007/978-3-319-44775-9_3

[21] Rosli R, Tan MP, Gray WK, Subramanian P, Mohd Hairi NN, Chin A-V. How can we best screen for cognitive impairment in Malaysia? A pilot of the idea cognitive screen and picture-based memory impairment scale and comparison of criterion validity with the mini mental state examination. Clinical Gerontologist [Internet]. 2017;40(4):249–257. Available from: https://doi.org/10.1080/07317115.2017.1311978

[22] Lerche S, Gutfreund A, Brockmann K, Hobert MA, Wurster I, Sünkel U, et al. Effect of physical activity on cognitive flexibility, depression and RBD in healthy elderly. Clinical Neurology and Neurosurgery [Internet]. 2018;165:88–93. Available from: https://doi.org/10.1016/j.clineuro.2018.01.008

[23] Kim H, Kim G, Jang W, Kim SY, Chang N. Association between intake of B vitamins and cognitive function in elderly Koreans with cognitive impairment. Nutrition Journal [Internet]. 2014;13(1):118. Available from: https://doi.org/10.1186/1475-2891-13-118

[24] Vercambre M-N, Boutron-Ruault M-C, Ritchie K, Clavel-Chapelon F, Berr C. Long-term association of food and nutrient intakes with cognitive and functional decline: a 13-year follow-up study of elderly French women. British Journal of Nutrition [Internet]. 2009;102(3):419–427. Available from: https://doi.org/10.1017/S0007114508201959

[25] Armstrong L, Johnson E. Water intake, water balance, and the elusive daily water requirement. Nutrients [Internet]. 2018;10(12):1928. Available from: https://doi.org/10.3390/nu10121928

Received: 2020-12-25

Revised: 2021-02-14

Accepted: 2021-02-19