Erciyes Med J 2021; 43(6): 566–73 • DOI: 10.14744/etd.2021.31799
ORIGINAL ARTICLE – OPEN ACCESS

Determining the Relationship between Food Consumption, Nutritional Status, and Cognitive Functions in the Elderly

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ABSTRACT

Objective: In this study, we aim to determine the relationship between food consumption, nutritional status, and cognitive functions among the elderly.

Materials and Methods: This cross-sectional and descriptive study was completed with 150 geriatric outpatients in Erciyes University Hospital. Demographic characteristics of the patients were collected, and the anthropometric measurements were made. Their 24-h food consumption was evaluated using the computer program BeBiS. The Mini Nutritional Assessment (MNA) and Nutritional Screening Index (NSI) were used to determine the malnutrition risk, whereas the Standardized Mini Mental Test was used to identify the cognitive functions. The obtained data were analyzed using Statistical Package for the Social Sciences 22.0; $p<0.05$ level was considered statistically significant.

Results: While 34.7% of the participants were at risk of malnutrition and 2.7% were malnourished according to MNA; in the NSI evaluation, these rates were determined to be 32.7% and 17.3%, respectively. It could be noted that with the decrease in malnutrition risk, language and orientation scores in cognitive function assessment increased. When the relationship between food consumption and cognitive function was analyzed, it was observed that participants with high protein, fat, phosphorus, iron, thiamine, riboflavin, niacin, and vitamin C consumption have normal cognitive function.

Conclusion: It has been determined that the various macro- and micronutrient consumption of the elderly can have substantial effects on their cognitive functions. Besides, the increasing risk of malnutrition was determined to be related to the decrease in cognitive functions. Therefore, it is essential to ensure adequate and balanced nutrient intake among the elderly and to determine the malnutrition risk with regular screenings, in order to make appropriate interventions when necessary.

Keywords: Elderly, malnutrition, cognitive function, food consumption, nutritional status

Cite this article as: Çalapkorur S, Küçükkatırcı H, Bakır B, Akın S. Determining the Relationship between Food Consumption, Nutritional Status, and Cognitive Functions in the Elderly. Erciyes Med J 2021; 43(6): 566–73.

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Submitted 24.11.2020

Accepted 21.02.2021

Available Online 30.09.2021

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INTRODUCTION

Old age is a process that needs to be addressed with its physical, social, and psychological dimensions; it needs to be focused on as it also includes variables such as genetics, lifestyle, and chronic diseases. Along with the aging process, a number of changes in the body and system functions of an individual are observed (1). Changes in gastrointestinal system functions and/or chronic diseases prevent adequate food intake in elderly individuals, resulting in the risk of malnutrition (2, 3). The European Society for Clinical Nutrition and Metabolism (ESPEN) defines malnutrition as "the decrease in physical and mental functions and deterioration of the clinical outcome of the disease resulting from the distortion of body composition and body cell mass caused by irregular nutrition" (4).

Among elderly individuals, along with physical changes, cognitive problems ranging from simple amnesia to dementia can affect the quality of life and the ability to live independently (5). The change in cognitive functions occurs due to factors such as decreased perception and cell renewal of individuals and increased physical and mental reaction time (6). In addition, malnutrition also plays an important role in individuals' cognitive functions. It has been reported that as the risk of malnutrition increases, cognitive function scores are also noted to decrease, and serious impairment is observed in the cognitive functions of the elderly with malnutrition (7). Food consumption is also among the modifiable factors that can lead to improved cognitive function. There is evidence that especially B vitamins, antioxidant vitamins/minerals, and omega-3 fatty acids play an important role in cognitive functions (8).

Studies in the literature have focused on the relationship between the frequency of consumption of food groups among elderly individuals or their malnutrition status and their cognitive functions (8, 9). There is yet no study evaluating the relationship between nutrient consumption, nutritional status, and cognitive functions together. Thus, in this study, we aim to evaluate these three parameters together and determine the direction of the relationship between them.

Table 1. The mean anthropometric measurements of participants

Anthropometric measurements	Male x̃ (Q1–Q3)	Female x̃ (Q1–Q3)	Total x̃ (Q1–Q3)	p	Test statistics
Body weight (kg)*	78 (44–106)	75 (52.8–130)	76.25 (44–130)	0.498	0.6791
BMI (kg/m²)*	27.3 (17.18–36.1)	31.8 (20.9–53.4)	29 (17.18–53.4)	**<0.001**	-5.5001
Waist circumference (cm)*	103 (68–127)	106 (72–139)	104 (72–139)	0.063	-1.8636
Hip circumference (cm)*	104 (85–119)	114 (97–156)	109 (85–156)	**<0.001**	-6.3619
Waist/height ratio*	0.60 (0.42–0.91)	0.69 (0.49–0.89)	0.63 (0.42–0.91)	**<0.001**	-5.2401
Upper middle arm circumference (cm)*	30 (24–39)	32 (25–48)	31.75 (24–48)	**0.004**	-2.8636
Calf circumference (cm)*	37 (15–45)	37 (28–61)	37 (15–61)	0.201	-1.2809

BMI: Body mass index; *: Mann–Whitney U test

MATERIALS and METHODS

Study Design

This cross-sectional and descriptive study was conducted in Erciyes University Hospital between November 2019 and February 2020. The prestudy sample size was determined as 59 people at 80% confidence level (effect size of the study 0.447; alpha value 0.05, and theoretical power 0.95); the study was completed with 150 people.

The population of the study consisted of individuals over the age of 65 who applied to the polyclinics in the geriatric department of Erciyes University. Individuals with Alzheimer's disease and/or dementia, patients with malignant tumors, patients with communication problems, as well as illiterate ones were not included in this study.

Prior to the study, the study permit and ethics committee approval (Decision No. date 2018/599 of 21.11.2019) were obtained from Erciyes University Medical Faculty Hospitals. In addition, all participating individuals were informed about the study, and their written and verbal consents were obtained.

Data Collection

The demographic information of the individuals was obtained via face-to-face interview method in questionnaire form. Individuals' body weight, height, waist, hip, upper and middle arm, and calf circumference measurements were measured by the researchers in accordance with their technique. Body mass index (BMI) [weight (kg)/height (m)l] was calculated from the weight and height measurement values (10).

In order to determine the food consumption, 24-hour food consumption was recorded via a retrospective recall method, and after determining the amount of nutrients they consumed daily, energy and macro- and micronutrient intake was determined using the Nutrition Information Systems Package Program (BeBiS).

Mini Nutritional Assessment (MNA) and Nutritional Screening Index (NSI) forms were used to screen the nutritional status of the patients. MNA is described as a screening tool used to assess the nutritional status of patients aged 65 and over, which consists of two parts, e.g., screening and assessment. A maximum of 30 points can be obtained from a total of 14 questions. A score of 24 and above indicates normal nutritional status, a score of 17–23.5 points indicates the risk of malnutrition, and a score below 17 points indicates malnutrition (11). NSI, on the other hand, consists of three stages, including diet assessment, general assessment, and social assessment. In addition, being over 80 years of age is defined as a major risk factor for malnutrition. If the obtained score is between 0 and 2, they are grouped as low risk for malnutrition, 3–5 points as medium risk, and 6 and above as high risk (12).

Cognitive functions were assessed using the Standardized Mini Mental Test (SMMT). The total score that can be obtained from the test in which orientation, memory, attention, calculation, recall, language, motor function and perception, visuospatial abilities are addressed is 30, and a score below 24 points indicates dementia, 24–26 points indicate mild cognitive impairment, and 26 points and above indicate normal cognitive functions. Validity and reliability of the test in the Turkish language was ensured by Güngen et al. (13).

Statistical Analysis of Data

The data obtained in this study was analyzed using Statistical Package for the Social Sciences Windows 22.0 program. The normality of data was tested using Shapiro–Wilk test. The information collected from patients was interpreted as frequency (n), percentage (%), median (x̃), and quartile 1 and quartile 3 from descriptive statistics. The independent sample t-test was used to compare the averages of the data with normal distribution, while the Mann–Whitney U test was used to compare the averages of data without normal distribution. The chi-square analysis was used for comparisons of categorical variables. Frequency and percentage values for categorical variables, median, and quartile 1 and quartile 3 values were used for continuous variables. Kruskal–Wallis test was used to compare the variables that are not normally distributed. Dunn's method multiple comparison test was applied in cases where there is a difference between groups for variables showing nonparametric distribution. The relationship between MNA and NSI total score and other scores was evaluated using Pearson correlation analysis. $P<0.05$ level was considered to be statistically significant.

RESULTS

In total, 150 participants, including 69 males and 81 females, were included in this study. The mean age of the individuals was 70.28±5.70 years.

Table 1 indicates the mean anthropometric measurements of patients. As per our findings, it was determined that there was a

Table 2. Nutritional status of participants

	Male (n=69)	Female (n=81)	Total (n=150)	p	Test statistics
MNA x̃ (Q1–Q3)*					
Screening score	13 (6-14)	12 (8-14)	12 (6-14)	**0.018**	2.3697
Assessment score	13 (9-16)	12.5 (8-15.5)	12.5 (8-16)	**0.015**	2.4282
Total score	26 (15-30)	24 (16.5-29)	25 (15-30)	**0.003**	2.9761
MNA nutritional status n %**					
Normal (>23.5)	51 (73.9)	43 (53.1)	94 (62.7)		
At risk of malnutrition (23.5–17)	16 (23.2)	36 (44.4)	52 (34.7)	**0.024**	7.4609
Malnourished (<17)	2 (2.9)	2 (2.5)	4 (2.7)		
NSI x̃ (Q1–Q3)*					
Total score	2 (0-10)	3 (1-12)	3 (0-12)	**0.006**	-2.7298
NSI nutritional status n %**					
Low risk (0–2)	41 (59.4)	34 (42.0)	75 (50.0)		
Malnutrition risk (3–5)	18 (26.1)	31 (38.3)	49 (32.7)	0.102	4.5561
Malnutrition (>6)	10 (14.5)	16 (19.8)	26 (17.3)		

MNA: Mini nutritional assessment; NSI: Nutritional screening index; *: Mann–Whitney U test; **: Pearson chi-square test

Table 3. Cognitive functions of participants

	Male (n=69) x̃ (Q1–Q3)	Female (n=81) x̃ (Q1–Q3)	Total (n=150) x̃ (Q1–Q3)	p	Test statistics
SMMT score					
Orientation score*	10 (7–10)	9 (2–10)	9 (2–10)	<**0.001**	4.9196
Record memory*	3 (1–3)	3 (1–3)	3 (1–3)	0.395	0.8539
Attention and calculation*	3 (0–6)	1 (0–5)	1 (0–6)	<**0.001**	6.0434
Recall score*	2 (0–3)	2 (0–3)	2 (0–3)	0.978	-0.0297
Language score*	8 (6–9)	8 (4–9)	8 (4–9)	0.100	1.6462
Total score*	25 (19–30)	22 (14–230)	23 (14–230)	<**0.001**	5.0604
SMMT evaluation**, n (%)					
Normal	45 (65.2)	21 (25.9)	66 (44.0)		
Mild dementia	22 (31.9)	52 (64.2)	74 (49.3)	<**0.001**	23.681
Severe dementia	2 (2.9)	8 (9.9)	10 (6.7)		

SMMT: Standardized mini mental test; *: Mann–Whitney U test; **: Pearson chi-square test

significant difference between the measurements of height, BMI, hip, and upper middle arm circumference of male and female patients (p<0.05).

According to MNA, 34.7% of the patients were at risk of malnutrition, while 2.7% were found with malnutrition, while these rates were determined as 32.7% and 17.3%, respectively, in the NSI assessment. It was found out that the MNA total score of male patients was higher than that of female patients and that there was a difference between genders in terms of the assessment of nutritional status according to MNA (p<0.05). In the NSI assessment, which indicates that high scores increase the risk of malnutrition, it was found that the scores of female were higher compared to that of male (p<0.05) (Table 2).

In the assessment of the cognitive functions of participants, the total SMMT score of male was found to be higher than that of female, and it was determined that SMMT assessment varied between genders (p<0.05) (Table 3).

The macronutrient intake levels according to the cognitive functions are given in Table 4. It was observed that the individuals with normal cognitive function had higher protein consumption than those with mild and severe dementia (p<0.05). Fat consumption was found to be less in people with severe dementia than individuals with normal cognitive function (p<0.05).

When micronutrient intakes were examined, it was found that phosphorus intake was higher in individuals with normal cognitive function than individuals with mild and severe dementia, while iron

Table 4. Macronutrient intake according to the cognitive functions of the participants

	Male (n=69)			**Female (n=81)**			**Total (n=150)**		
	Normal (n=45) x̃ (Q1–Q3)	**Mild dementia (n=22) x̃ (Q1–Q3)**	**Severe dementia (n=2) x̃ (Q1–Q3)**	**Normal (n=21) x̃ (Q1–Q3)**	**Mild dementia (n=52) x̃ (Q1–Q3)**	**Severe dementia (n=8) x̃ (Q1–Q3)**	**Normal (n=66) x̃ (Q1–Q3)**	**Mild dementia (n=74) x̃ (Q1–Q3)**	**Severe dementia (n=10) x̃ (Q1–Q3)**
Energy	1310.95	1148.57	1300.78	1100.24	1074.96	751.95	1209.11	1100.935	804.935
kcal)*	(1012.71–1719.09)	(879.22–1497.49)	(821.42–1780.15)	(816.25–1421.59)	(838.09–1309.63)	(569.00–968.37)	(438.53–2679.73)	(310.57–2565.02)	(508.4–1780.41)
z		1.2575			4.3681			7.8217	
Protein	**54.61**	**42.18**	35.99	**47.03**	39.79	**26.61**	**50.68**	**41.57**	**29.23**
(g)*	**(42.16-69.82)**[a]	**(27.68–52.05)**[a]	(31.37–40.61)	**(28.7–59.39)**[b]	(31.43–59.58)	**(24.96–55.60)**[b]	**(17.55–121.91)**[a,b]	**(8.58–92.45)**[b]	**(23.57–75.45)**[a]
z		8.012			**2.2531**			**10.0658**	
Fat	39.72	36.86	33.98	**40.72**	**38.56**	**329.54**	**40.55**	37.24	**29.54**
(g)*	(26.68–61.80)	(26.63–41.22)	(28.10–39.86)	**(31.84–64.70)**[c]	**(28.82–50.79)**[b]	**(21.80–43.78)**[b,c]	**(27.09–62.60)**[a]	(28.63–49.54)	**(23.30–42.09)**[a]
z		2.7671			**2.4254**			**4.5061**	
Carbohydrate	160.65	148.88	206.69	130.38	124.09	107.18	139.66	134.69	107.18
(g)*	(111.47–238.40)	(128.67–238.67)	(82.08–331.3)	(77.09–168.96)	(93.59–163.21)	(64.97–249.40)	(103.92–214.04)	(104.69–173.34)	(76.03–295.58)
z		0.0444			0.2509			1.4903	
Fiber	17.5	14.99	16.51	**14.93**	**15.62**	**12.52**	15.37	15.57	13.21
(g)*	(12.33–24.91)	(11.01–28.89)	(12.85–20.17)	**(10.76–19.78)**[c]	**(10.45–19.77)**[b]	**(10.01–22.77)**[b,c]	(11.84–23.02)	(10.49–21.06)	(10.55–21.24)
z		0.1383			**0.2816**			0.7986	
Carbohydrate	51	63	59	**49**	**49.5**	**55**	50.5	52.5	55
(E%)*	(45–59)	(51–64)	(41–77)	**(40–52.5)**[c]	**(41.5–57.75)**[b]	**(43.5–65.75)**[b,c]	(44–58)	(44–61.25)	(42.75–68.75)
z		5.2984			**2.5222**			1.5038	
Protein	**16**	**14**	12.5	**17**	**16**	**17**	16	15	16
(E%)*	**(14–21)**[a]	**(13–15.5)**[a]	(9–16)	**(14–19)**[c]	**(14–19)**[b]	**(11.75–21)**[b,c]	(14–19.25)	(13–18.25)	(11–21
z		**8.5628**			**0.1732**			2.6587	
Fat	31	25.5	28.5	**34**	**33**	**35.5**	32	31	35.5
(E%)*	(24–35.5)	(20.75–30.75)	(14–43)	**(30–43)**[c]	**(26.25–40.75)**[b]	**(22.5–40.5)**[b,c]	(26.75–38.25)	(25–39)	(20.5–41.5)
z		2.9572			**1.0551**			0.4345	

Kruskal-Wallis test was used to compare the variables those are not normally distributed. Dunn's Method multiple comparison test was applied in cases where there is a difference between groups for variables showing non-parametric distribution.*a, b, c Post–Hoc test Dun-Bonferonni; $p<0.05$; a, there is a significant difference between groups with the same letter on the same line intake was found to be lesser in individuals with severe dementia than those with normal cognitive function ($p<0.05$) (Table 5). Thiamine and riboflavin intake was found to be lesser in women with severe dementia than that in women with normal cognitive function and mild dementia ($p<0.05$). It was determined that vitamin C intake was higher in women with normal cognitive function than women with severe dementia ($p<0.05$). Niacin intake was found to be higher in all individuals with normal cognitive function than people with mild and severe dementia ($p<0.05$).

When the correlation between the cognitive function scores of the patients and the MNA and NSI scores was examined, it was seen that there was a positive correlation between the orientation and language score and the MNA score, and a negative correlation with the NSI score ($p<0.05$). Moreover, a positive correlation was noted between the total SMMT score and NSI scores of all participants in the study ($p<0.05$) (Table 6).

DISCUSSION

In old age, malnutrition may occur due to decreased sense of taste and smell and appetite, deterioration in chewing function, and changes in the gastrointestinal system (dysphagia, gastric atrophy, malabsorption, etc.) (14, 15). In addition, decline in cognitive functions becomes evident with aging (5). In our study, food consumption, nutritional status, cognitive functions of the elderly, and the relationship between these three parameters were examined.

As per our findings, it was determined that there was a significant difference between the measurements of height, BMI, hip, and upper middle arm circumference of male and female patients examined in this study. When the nutritional status was considered, it was determined that 34.7% of the individuals according to MNA and 32.7% according to NSI were at risk of malnutrition. The rate of individuals with malnutrition was 2.7% according to the MNA form and 17.3% according to the NSI form. As we have utilized NSI assessment form to increase awareness of the risk of malnutrition, the form has demonstrated a significant number of people at risk (16, 17). The difference in the rate of individuals with malnutrition between the two forms was attributed to this reason. In a study evaluating the nutritional status of elderly individuals using Mini Nutritional Assessment-Short Form (MNA-SF), it was determined that 40.4% of the individuals were at risk of malnutrition and 29.9% were determined to have malnutrition (2). In another study, the nutritional status of elderly individuals was assessed with NSI, and the malnutrition rate was determined as 16.8% (16). Studies in the literature (2, 16) and our study reveal that the risk of malnutrition and malnutrition rates are high in elderly individuals.

In the assessment of cognitive functions, the total SMMT score of male was found to be higher than that of female. There is limited data showing that changes in cognitive functions with aging are related to food consumption of individuals (9, 18). In this context, the relationship between food consumption of individuals and their cognitive functions was examined in our study. According to these results, it was seen that individuals with high protein and fat consumption had normal cognitive function. Similar results have been obtained in studies on the subject, and it has been reported that individuals with normal cognitive function have higher dietary protein and fat intake than individuals with mild and moderate dementia (18, 19). One of the important roles of dietary protein in the development of cognitive function is that it provides a source of amino acids for the production of neurotransmitters such as catecholamines and serotonin. For example, the precursor to serotonin, which is a neurotransmitter involved in cognitive functions, is tryptophan, an essential amniocyte. Since it is known that the level of serotonin may decrease with aging and this situation can negatively affect cognitive functions, adequate protein intake is deemed important (20, 21). Since dietary fat is necessary for the nervous membrane structure, it is identified as an important macronutrient for the brain. In addition, it activates neuronal stages and affects memory-related processes; therefore, it plays an important role in cognitive functions (20).

When micronutrient intakes of the individuals were examined, it was observed that the intake of phosphorus, iron, thiamine, riboflavin, niacin, and vitamin C was higher in individuals with normal cognitive function. Vitamin C has been identified to be vital in neurodevelopment as it can affect neuronal differentiation and myelin formation. The important roles of vitamin C in the central nervous system have also highlighted its effects on cognitive functions (22). The role of thiamine, one of the group B vitamins, on brain function has been known for many years, and it is emphasized that adequate intake of riboflavin and niacin can improve multidimensional cognitive function in elderly individuals (23–25). The results of our study also support this data. When the relationship between dietary iron intake and cognitive function is assessed, different results have been found in the literature (26–29). In various studies conducted on the subject, it has been stated that high iron intake is associated with a decrease in cognitive functions. In these studies, it has been stated that iron accumulation in the brain increases with aging, and this accumulation constitutes a risk factor for diseases such as Alzheimer's disease, in which cognitive function is affected (26, 27). However, anemia is a very common health problem in the elderly, and this condition is associated with a decrease in functional capacity (28). In our study, iron intake was found to be higher in individuals with normal cognitive function. In light of all this data, it was concluded that excessive iron intake may cause damage to brain tissues; on the other hand, iron deficiency, which may cause anemia, may also lead to a decrease in cognitive functions. Therefore, it is important to ensure the recommended level of iron intake in elderly individuals is followed.

In our study, we also evaluated the correlation of cognitive function scores with MNA and NSI scores. In both tests, it was determined that the language and orientation scores increased with a decrease in malnutrition risk. In similar studies conducted on the subject, it has been reported that there is a significant relationship between MNA score and SMMT score of elderly individuals, and cognitive function scores were noted to decrease as the risk of malnutrition increases (29, 30). This data, which reveals the importance of the relationship between cognitive function and nutritional status, also highlights the need for routine nutritional screening in elderly individuals. No study assessing the relationship between NSI score and cognitive function scores has been found in the literature. The data of our study has become the first data used for this purpose.

Table 5. Micro nutrient intake according to the cognitive functions of the participants

	Male (n=69)			Female (n=81)			Total (n=150)		
	Normal (n=45) x̃ (Q1–Q3)	Mild dementia (n=22) x̃ (Q1–Q3)	Severe dementia (n=2) x̃ (Q1–Q3)	Normal (n=21) x̃ (Q1–Q3)	Mild dementia (n=52) x̃ (Q1–Q3)	Severe dementia (n=8) x̃ (Q1–Q3)	Normal (n=66) x̃ (Q1–Q3)	Mild dementia (n=74) x̃ (Q1–Q3)	Severe dementia (n=10) x̃ (Q1–Q3)
Calcium	579.4	565.36	419.23	612.3	516.22	504.34	608.30	541.86	482.97
(mg)*	(446.23–889.22)	(417.24–787.28)	(410.19–428.28)	(385.23–716.12)	(398.28–753.35)	(353.55–690.54)	(437.22–818.96)	(403.24–769.57)	(385.47–640.72)
z		2.6493			0.2161			2.6242	
Phosphorus	787.83	745.37	540.19	**796.57**	660.71	**452.78**	**792.2**	**665.40**	**473.57**
(mg)*	(614.7–1131.44)	(491.25–834.10)	(471.45–608.93)	**(555.32–940.95)**[b]	(502.91–930.39)	**(379.28–681.55)**[b]	**(609.29–1016–94)**[a,b]	**(504.43–876.13)**[b]	**(385.45–635.56)**[a]
z		5.6197			**6.4758**			**14.3891**	
Iron	6.77	7.17	6.60	**6.67**	**5.67**	**4.34**	**6.70**	5.76	**5.34**
(mg)*	(5.84–9.65)	(3.73–9.38)	(5.62–7.58)	**(5.33–7.68)**[c]	**(5.05–8.23)**[b]	**(2.75–6.86)**[b,c]	**(5.75–8.89)**[a]	(4.86–8.80)	**(2.79–7.29**)a
z		2.1974			**3.2111**			**7.0571**	
Vitamin A	567.82	475.10	407.46	442.2	491.44	325.89	541.12	480.52	325.89
(µg)*	(395.35–914.52)	(309.22–725.89)	(205.37–609.55)	(298.39–612.93)	(347.62–747.87)	(163.19–640.3)	(362.57–887.65)	(338.93–725.98)	(178.11–636.02)
z		3.1483			2.8763			4.4743	
Thiamine	0.7	0.55	0.59	**0.59**	**0.57**	**0.33**	0.63	0.57	0.34
(mg)*	(0.47–0.83)	(0.34–0.69)	(0.35–0.84)	**(0.42–0.71)**[c]	**(0.42–0.68)**[b]	**(0.23–0.68)**[b,c]	(0.44–0.78)	(0.40–0.69)	(0.24–0.75)
z		4.4931			**2.5851**			6.6771	
Riboflavine	0.90 (0.63–1.25)	0.81	0.60	**0.89**	**0.77**	**0.55**	0.89	0.77	0.55
(mg)*		(0.46–1.00)	(0.44–0.77)	**(0.48–1.06)**[c]	**(0.54–1.03)**[b]	**(0.33–0.98)**[b,c]	(0.61–1.12)	(0.52–1.00)	(0.40–0.86)
z	7.43	6.4834			**1.5106**			6.9903	
Niacin	(6.17–9.58)	5.32	4.20	**5.49**	**5.92**	**4.93**	**83.84**	**82.87**	**99.49**
(mg)*		(3.05–7.55)	(3.27–5.14)	**(3.75–10.98)**[c]	**(4.24–8.29)**[b]	**(3.56–5.87)**[b,c]	**(36.85–143.51)**[a,b]	**(47.41–141.84)**[b]	**(40.44–157.57)**[a]
z	88.58	10.602			**0.8766**			**0.2012**	
Vitamin C	(36.34–153.95)	78.45	100.02	**77.43**	85.39	**86.73**	6.81	5.65	4.93
(mg)*		(27.83–123.87)	(96.63–103.41)	**(36.83–117.86)**[b]	(49.49–157.94)	**(28.66–182.70)**[b]	(5.71–9.83)	(3.84–8.05)	3.24–5.51)
z		1.1064			**0.5748**			10.281	

Kruskal-Wallis test was used to compare the variables those are not normally distributed. Dunn's Method multiple comparison test was applied in cases where there is a difference betweengroups for variables showing non-parametric distribution. *a, b, c Post–Hoc test Dun-Bonferonni; $p<0.05$; a, there is a significant difference between groups with the same letter on the same line

Table 6. Correlation of cognitive function score with MNA and NSI scores

	Male (n=69)		Female (n=81)		Total (n=150)	
	MNA	NSI	MNA	NSI	MNA	NSI
Orientation score						
r	0.0445	-0.2793	0.2350	-0.1509	0.2371	-0.1819
p	0.716	**0.020**	**0.010**	0.100	**0.003**	**0.026**
Record memory						
r	-0.0018	-0.2251	-0.0852	0.0996	-0.0438	-0.0236
p	0.988	0.063	0.355	0.279	0.594	0.775
Attention and calculation						
r	-0.0315	-0.2057	0.1511	-0.1940	0.1265	-0.2023
p	0.797	0.090	0.099	**0.034**	0.123	**0.013**
Recall score						
r	-0.1841	0.2029	-0.1205	0.1481	-0.1525	0.1693
p	0.130	0.094	0.190	0.107	0.062	**0.038**
Language score						
r	0.1194	-0.2670	0.2367	-0.2565	0.1876	-0.2489
p	0.328	**0.027**	**0.009**	**0.005**	**0.022**	**0.002**
Total score						
r	-0.0186	-0.2644	0.0155	0.2914	0.0105	0.2440
p	0.879	**0.028**	0.866	**0.001**	0.898	**0.003**

MNA: Mini nutritional assessment; NSI: Nutritional screening index; *: Pearson correlation analysis

CONCLUSION

In our study, it was determined that the malnutrition risk and malnutrition status of elderly individuals were high. As per our findings, it was determined that as the risk of malnutrition increased in these individuals, decreases were observed in various steps of cognitive function assessment. For this reason, it is important to perform malnutrition screening of these individuals regularly and to make appropriate interventions when necessary.

In our study, it was seen that individuals' intake of various dietary macro- and micronutrients had positive effects on cognitive functions. The sufficient intake of nutrients, which are determined to have positive effects on the cognitive function score, is important to protect and improve the cognitive functions of individuals. For this reason, an adequate and balanced diet should be created by dieticians for these individuals, and their food consumption should be monitored, and the insufficient nutrients should be supported.

Limitation of the study: Food consumption records were taken for only 1 day, assuming that elderly individuals would experience problems with recall.

Acknowledgements: We would like to thank Bahar Şavlı, Nursima Kocataş, Simge Kartallı, Sümeyye Göktaş, Ayşenur Gürsoy 4th grade students of Erciyes University Faculty of Health Sciences Department of Nutrition and Dietetics for their support during the data collection process.

Ethics Committee Approval: The Erciyes University Clinical Research Ethics Committee granted approval for this study (date: 21.11.2019, number: 2018/599).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – SÇ, HK, BB, SA; Design – SÇ, HK, BB, SA; Supervision – SÇ, HK, BB, SA; Resource – SÇ, BB, SA; Materials – SÇ, BB, SA; Data Collection and/or Processing – SÇ, HK, SA; Analysis and/or Interpretation – SÇ, HK; Literature Search – SÇ, BB; Writing – SÇ, HK; Critical Reviews – SÇ, BB, HK, SA.

Conflict of Interest: The authors have no conflict of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

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