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The Effect of Micronutrient Intake on Cognitive Function and Physical Activity of the Elderly

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Abstract

Objectives: The purpose of this research was to investigate the effect of micronutrient intake on cognitive function and physical activity of the elderly.

Methods: The subjects included all elderly people over 60 years of age in Robat Karim city in 2018. Ninety elderly males participated voluntarily in the research after signing the informed consent form. The short form of Beck questionnaire of physical activity and MMSE test were respectively used to measure the levels of physical activity and cognitive status of participants. Pearson correlation test was used to analyze the data.

Results: The results indicated that there was a significant relationship between each of the micronutrients and cognitive performance of the elderly ($P \leq 0.05$). Additionally, there was a significant relationship between each of the micronutrients with the level of physical activity of the elderly ($P \leq 0.05$).

Conclusions: Conclusively, micronutrients intake could be of much importance for cognitive function and physical activity of the elderly.

Keywords: Micronutrients, Cognitive Function, Physical Activity, Elderly

1. Background

The elderly population often suffers from malnutrition due to aging, physiological changes and lifestyle changes. the aging process is associated with a number of physiological, economic and social factors that affect physical and mental performance (1, 2). Evidence suggest that global population of older people will be more than1.4 billion by 2030 (3-5). In addition, diseases that have neurological roots, such as Alzheimer's and memory disorders, appear to be on the rise, so all countries should be aware of the costs of these disorders occurring in the elderly (6). To address this global challenge, much research has been conducted around the world to study the mechanisms associated with cognitive impairment and brain aging in the elderly (7). The Cognitive processes include learning, attention, memory, language, reasoning, and decision making which are all possibly affected by aging process (8, 9). Evidence shows that cognitive processes decline from adulthood to old ages (10, 11). These degenerative changes usually begin in the third decade of life and affect the cognitive function of individuals (11). Normal cognitive processes are clearly present in two stages of life. One stage is from puberty to adulthood, which occurs automatically, and the second stage is from adulthood to old age, which requires environmental issues affecting cognitive function to be considered (10-12). There are some evidences suggesting that micronutrients such as vitamins, antioxidants, and B vitamins play a role in nerve protection. For example, vitamin B12 is an essential micronutrient found only in foods of animal origin and is necessary for healthy nerve tissue and brain function (13). Vitamin A also regulates most nerve growth pathways that can reasonably affect cognition (14). Nutrient deficiencies is not only associated with body composition and physical fitness (muscle atrophy, etc.), but also affects the brain health leading to cognitive disturbances in the elderly (15). The recommended micronutrients in diet for the elderly in France is as follows: daily intake of 15 to 10 mg of zinc, 80 mg of selenium, 15 to 50 mg of vitamin E, 120 mg of vitamin C and 400 mg of folate. An insufficient intake of theses micronutrients in older people has been reported in several studies (16, 17). There are other factors that can affect the cognitive function of the elderly (e.g., Smell and taste disorders, as well as tooth decay and digestive disorders) (18). In addition, environmental problems (loneliness, economic conditions, depression, substance abuse) may reduce essential nutrient intake leading to clinical side effects and vitamin deficiencies (19). Hence, it is important to follow a diet plan for people over the age of 50. For example, diets recommended for the treatment of obesity, dyslipidemia, osteoporosis or constipation may lead to changes in the intake and absorption of micronutrients (20). It was found in a study that 8.3% of Korean aged people 65 had cognitive impairment. At the same time, it was reported that they often had problems with micronutrient intake (21). As noted, aged persons are at risk for low energy and protein intake and deficiency of some micronutrients such as vitamin C, vitamin B12, vitamin A, folate and zinc (22). Studies show that the world's population is rapidly growing over the world and this process is increasing in developing countries at the beginning of the 21st century. This is also the case in our country. On the other hand, responsibility for families where the elderly live is another cost to the family and society, so it is necessary to adopt strategies that prevent cognitive impairment (23). reported that physical activity is an effective strategy in preventing and the progression of Alzheimer's disease. It has also been reported that aerobic exercise and yoga affect the memory and dynamic balance of elderly men (24). Research results showed that physical activity has a significant effect on improvement of memory in aged female (25). exercise can improve cognitive function by improving cerebral blood flow, increasing hippocampal volume, and improving neurogenesis (26). The obtained results in this study can be useful for all those who are in contact with the elderly. On the other hand, there is a research gap regarding the consumption of micronutrients and motor and cognitive function of the elderly.

2. Objectives

The purpose of this study was to investigate the effect of micronutrient intake on cognitive function and physical activity of the elderly.

3. Methods

3.1. Participants

The subjects included all elderly people over 60 years of age in Robat Karim city in 2018. Ninety elderly males participated voluntarily in the research after signing the informed consent form. The first call for research was made through social networks as well as relevant organizations, and finally ninety elderly people announced their readiness to participate in this research, and 70 of them who met the eligibility criteria were included in the study. Inclusion criteria were age over 65, ability to answer questions, alertness, no history of falls in the last 6 months, no memory or forgetfulness disorders, and having functional independence such as walking.

3.2. Measurement

The short form of Beck questionnaire of physical activity and MMSE test were used respectively to measure the levels of physical activity and cognitive status of aged individuals.

Before carrying out the work, all stages of their research were explained. The MMSE consists of seven domains, each with an assigned point value totaling 30: (1) orientation to time (5 points); (2) orientation to place (5 points); (3) three word registration (3 points); (4) attention and calculation (5 points); (5) three word recall (3 points); (6) language (8 points); and (7) visual construction (pentagon copying, 1 point). An MMSE score greater or equal to 24 were considered normal cognitive function, while scores less than 24 indicated cognitive impairment. The reliability of MMSE has been reported to be 79%.

3.3. Procedure

The common dietary intakes of participants over the past year were assessed using a valid food frequency questionnaire consisting of 168 food items. The amount of micronutrients and energy intake of each person was calculated via N4 software. A short version of the questionnaire of Beck (27) was used to measure the amount of physical activity. It includes 16 questions in three components of workplace, leisure time and sports (see Equation 1). Questions 1 to 8 refers to physical activity at work and questions 9 to 16 are related to exercise in leisure time and home. The reliability of this questionnaire was calculated to be 0.79 (28). Calculation of physical activity level is as follow:

$$Labor\ Index : \left[\frac{I_1 + (6 - I_2) + 13 + 8}{I_4 + I_5 + I_6 + I_7 + I_8}\right] \quad (1)$$

$$Sport\ Index : \frac{I_9 + I_{10} + I_{11} + I_{12}}{4} \quad (2)$$

$$leisure\ Time\ Index : \frac{(6 - I_{13}) + I_{14} + I_{15} + I_{16}}{4} \quad (3)$$

$$Total\ Index : Labar\ Index + Sport\ Index + Leisure\ Time\ Index \quad (4)$$

3.4. Statistical Analysis

Pearson correlation test was used to analyze the data using the SPSS v21.0 software (SPSS Inc., Chicago, IL). Data were presented as mean ± SD in the table and the text.

4. Results

General information and descriptive variables of the research are reported in Tables 1 and 2.

Table 1. Demographic Characteristics of Participants

Demographic Characteristic	Mean ± SD
Age	68.8 ± 5.3
Weight (kg)	75.9 ± 10.9
Height (m)	1.70 ± 0.3

As seen in Table 3, Shapiro Wilk test was used to check the normality of data distribution. The test results show that the data distribution was normal.

According to Table 4, the results of Pearson correlation test showed that there was a significant relationship between each of the micronutrients with cognitive function in the elderly ($P \geq 0.05$).

As shown in Table 5, the results of Pearson correlation test showed that there was a significant relationship between each of the micronutrients with motor function in the elderly ($P \geq 0.05$).

Table 2. Research Variables

Variables	Mean ± SD
Cognitive function	23.3 ± 4.58
Physical activity	2.25 ± 1.34
Micronutrients (mg)	
EPA	Very little
Iron	15.55 ± 18.34
Sodium	12456.16 ± 1029.48
Manganese	2.45 ± 1.44
Zinc	9.78 ± 128.19
Magnesium	2.44 ± 3.35
Iodine	6.85 ± 1.52
Vitamin A	729.29 ± 11.75
Vitamin E	30.64 ± 13724.62
Thiamine	1.4 ± 0.5
Niacin	19.65 ± 11.15
Folate	298.49 ± 327.42
Pantothenic acid	3.45 ± 1.59
Vitamin C	169.53 ± 12.74
Vitamin K	79.95 ± 201.33
Cholesterol	182.75 ± 125.49
DHA	Very little
Calcium (mg/d)	729.15 ± 498.34
Potassium	2987.98 ± 1725.09
Phosphorus	1986.44 ± 982.44
β-carotene	1542.48 ± 4236.24
α-tocopherol	6.24 ± 15.32
Riboflavin	1.56 ± 0.68
Pyridoxine	1.55 ± 0.66
Cobalamin	6.68 ± 15.42
Biotin	10.77 ± 7.65
Vitamin D	0.68 ± 1.01

5. Discussion

As shown in result section, a significant relationship was found between each of the micronutrients with cognitive function in the elderly. This result is consistent with the results of GU (29) and Gustaw-Rothenberg (30). They stated that a healthy diet pattern that is positively correlated with the consumption of fruits (fresh and dried), whole grains, Fresh dairy products, vegetables, breakfast cereals, tea, vegetable fats, nuts and fish, and inversely related to consumption of red meat and poultry, refined grains, animal fats and processed meats (31).

On the other hand, the obtained results aren't consistent with the results of (21, 32). In another study, protein intake was higher in active people than in people with lower levels of physical activity (33). There are several facts suggesting beneficial effects of polyunsaturated fatty acids (PUFAs) fats such as fish and MUFA fatty acids. Another study found that omega-3 fatty acids are beneficial for brain health through their anti-inflammatory, antioxidant and antithrombotic properties (34). Vitamin B12 and folate can affect Alzheimer's disease by lowering circulating homocysteine levels. Since, the elderly is at risk for low energy and protein intake and deficiency of some micronutrients, it's necessary to consider some interventions such as training and prescribing nutritional supplements. It was also observed in a study that there was a positive and significant relationship between calorie intake and dietary pattern indicators and micronutrient intake with sedentary behaviors (32). Evidence has shown that tooth decay and musculoskeletal disorders reduce self-esteem in the elderly and ultimately reduce their

Table 3. Results of Shapiro-Wilk Test

Variables	Shapiro-Wilk	
	Z	P
Cognitive function	0.842	0.312
Physical activity	0.645	0.315
EPA (mg)	0.742	0.641
Iron (mg)	0.771	0.316
Sodium (mg)	0.312	0.841
Manganese (mg)	0.735	0.153
Zinc (mg)	0.678	0.398
Magnesium (mg)	0.835	0.088
Iodine (mg)	0.543	0.648
Vitamin A (mg)	0.902	0.314
Vitamin E (mg)	0.443	0.658
Thiamine (mg)	0.523	0.148
Niacin (mg)	0.779	0.348
Folate (mg)	0.684	0.648
Pantothenic acid (mg)	0.463	0.348
Vitamin C (mg)	0.341	0.487
Vitamin K (mg)	0.503	0.187
Cholesterol (mg)	0.901	0.981
DHA (mg)	0.664	0.476
Calcium (mg/d)	0.387	0.682
Potassium (mg)	0.663	0.079
Phosphorus (mg)	0.778	0.641
β-carotene (mg)	0.870	0.099
α-tocopherol (mg)	0.992	0.248
Riboflavin (mg)	0.416	0.516
Pyridoxine (mg)	0.648	0.551
Cobalamin (mg)	0.764	0.271
Biotin (mg)	0.441	0.334
Vitamin D (mg)	0.310	0.684

Table 4. Relationship Between Micronutrients and Cognitive Function of the Elderly

Variables (Micronutrients)	Cognitive Function	
	R	P
Iron (mg)	0.551	0.001
Sodium (mg)	0.208	0.024
Manganese (mg)	0.654	0.001
Zinc (mg)	0.532	0.001
Magnesium (mg)	0.622	0.001
Iodine (mg)	0.395	0.018
Vitamin A (mg)	0.648	0.001
Vitamin E (mg)	0.335	0.001
Thiamine (mg)	0.415	0.016
Niacin (mg)	0.553	0.001
Folate (mg)	0.598	0.001
Pantothenic acid (mg)	0.328	0.025
Vitamin C (mg)	0.234	0.045
Vitamin K (mg)	0.415	0.012
Cholesterol (mg)	0.637	0.001
Calcium (mg/d)	0.263	0.024
Potassium (mg)	0.248	0.011
Phosphorus (mg)	0.325	0.028
β-carotene (mg)	0.601	0.001
α-tocopherol (mg)	0.622	0.001
Riboflavin (mg)	0.334	0.028
Pyridoxine (mg)	0.429	0.001
Cobalamin (mg)	0.550	0.001
Biotin (mg)	0.325	0.034
Vitamin D (mg)	0.228	0.041

presence in physical activity, and this is one of the issues that can directly affect their cognitive function (18). However, the relationship between motor function and cognitive function in lower age groups such as adolescence has not always been positive (21). For example, a study found that there is no significant relationship between physical and cognitive function in adolescents. It seems that the differences in the findings of the present study with other studies would be related to differences in lifestyle, socio-economic and cultural status. In general, the results showed that there is a significant relationship between each of the micronutrients with the cognitive function of the elderly. On the other hand, the results showed that there is a significant relationship between each of the elements of micronutrients with the motor function of the elderly. There are several limitations in the study, including low number of participants, different levels of economic status and education. The lack of precise control of the participants' motivation to answer the research questions was another limitation of this research, so, it is suggested to study more samples to study with more certainty.

Table 5. Relationship Between Micronutrients and Motor Function of the Elderly

Variables (Micronutrients)	Motor Function	
	R	Sig.
Iron (mg)	0.445	0.001
Sodium (mg)	0.625	0.001
Manganese (mg)	0.458	0.001
Zinc (mg)	0.553	0.001
Magnesium (mg)	0.601	0.001
Iodine (mg)	0.435	0.001
Vitamin A (mg)	0.556	0.015
Vitamin E (mg)	0.412	0.001
Thiamine (mg)	0.556	0.001
Niacin (mg)	0.326	0.024
Folate (mg)	0.601	0.001
Pantothenic acid (mg)	0.446	0.001
Vitamin C (mg)	0.401	0.022
Vitamin K (mg)	0.558	0.001
Cholesterol (mg)	0.789	0.001
Calcium (mg/d)	0.635	0.001
Potassium (mg)	0.432	0.001
Phosphorus (mg)	0.226	0.033
β**-carotene (mg)**	0.712	0.001
α**-tocopherol (mg)**	0.552	0.001
Riboflavin (mg)	0.618	0.001
Pyridoxine (mg)	0.213	0.042
Cobalamin (mg)	0.569	0.001
Biotin (mg)	0.378	0.004
Vitamin D (mg)	0.369	0.009

Footnotes

Authors' Contribution: A.A developed the original idea and the protocol, abstracted and analyzed data, wrote the manuscript, and is a guarantor. M.A, S.T and F.M contributed to the development of the protocol, abstracted data, and prepared the manuscript.

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Informed Consent: Ninety elderly males participated voluntarily in the research after signing the informed consent form.

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