What Could Aid in Slowing Down Cognitive Function?

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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 (≥ 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 B₁, vitamin B₂, vitamin B₃, vitamin B₆, and zinc intakes were lower in women than in men (p < 0.05). Moreover, it was observed that the vitamin B₃ 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

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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 independent patients (111 women and 89 men) at the age of 65 years or older (the mean age: 74.76 ± 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, 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, B1, B2, B3, B6, B12, 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 Frankfurt plane. Body weight was measured using the TESS MB-300 model scale, with the individuals wearing light clothes and no shoes. BMI (kg/m²) was calculated as weight/height² 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 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 ± 6.52 years; the mean age of non-demented individuals was 73.77 ± 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 |
|------------------------|-----------------------|-----------------------------|---------|
| **Gender**             |                       |                             |         |
| Male                   | 14 (36.8)             | 75 (46.3)                   | 0.291*  |
| Female                 | 24 (63.2)             | 87 (53.7)                   |         |
| **Marital status**     |                       |                             | 0.025*  |
| 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*   |
| 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*  |
| <4                     | 8 (21.1)              | 64 (39.5)                   |         |
| ≥4                     | 30 (78.9)             | 98 (60.5)                   |         |
| **Skipping meal**      |                       |                             | 0.002*  |
| Yes                    | 16 (42.1)             | 30 (18.5)                   |         |
| No                     | 22 (57.9)             | 132 (81.5)                  |         |
| **Age (years)**        | 78.97±6.52            | 73.77±7.38                  | <0.001b |
| **Educational level (years)** | 2.00 [5.25]*        | 6.00 [8.25]*                | <0.001c |
| **IADL**               | 6.00 [5.50]           | 9.00 [10.00]                | 0.003c  |
| **Main meal consumption** | 2.55±0.5              | 2.8±0.41                    | 0.002b  |
| **Snack meal consumption** | 0.50 [1.00]           | 1.00 [2.00]                 | 0.53c   |
| **S-MMSE (n, %)**      |                       |                             | <0.001a |
| >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                  | <0.001b |
| **GDS-SF (n, %)**      |                       |                             | <0.001a |
| 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                    | <0.001b |
| **PAL (n, %)**         |                       |                             | <0.001a |
| 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                   | <0.001b |

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* - Chi square test; pb - Independent samples t-test; pc - Mann-Whitney U test (p<0.05).

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).
There was a statistically significant difference between the two groups regarding water consumption (p < 0.001). Thirty-two percent of the participants 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 were minimally active and 5.3% of the individuals were very active. 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 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).

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 were minimally active and 5.3% of the individuals were very active. 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 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).

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

| Energy and Nutrient | Demented group | Non-demented group | P       | Total       |
|---------------------|----------------|--------------------|---------|-------------|
|                     | (n=38)         | (n=162)            |         | (n=200)     |
|                     | Mean±SD        | Mean±SD            |         | Mean±SD     |
| Energy (kcal)       | 1297.2±428.41  | 1715.3±642.51      | <0.001* | 1635.9±628.61 |
| RDI (%)             | 65.1±33.52     | 85.5±42.94         | <0.001* | 84.6±31.12  |
| <RDI                | 20 (52.6)      | 45 (27.8)          | 0.003*  | 65 (32.5)   |
| Carbohydrate (g)    | 175.5±60.85    | 224.0±94.19        | 0.003*  | 214.8±90.72 |
| Protein (g)         | 54.0±21.18     | 72.3±23.8          | <0.001* | 68.9±28.39  |
| Fat (g)             | 40.0±16.72     | 55.8±24.24         | <0.001* | 52.8±23.8   |
| Fiber (g)           | 17.4±7.46      | 22.4±9.97          | 0.004*  | 21.5±9.72   |
| RDI (%)             | 65.1±33.52     | 85.5±42.94         | <0.001* | 84.6±31.12  |
| Protein (g)         | 54.0±21.18     | 72.3±23.8          | <0.001* | 68.9±28.39  |
| Fat (g)             | 40.0±16.72     | 55.8±24.24         | <0.001* | 52.8±23.8   |
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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.

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