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RESEARCH ARTICLE

Clinical Characteristics and Geriatric Nutritional Risk Index Levels in Elderly People with Dementia Living in A Nursing Home

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HIGHLIGHTS

> GNRI status of individuals with dementia were the highest rate in the "low risk" group, while those without dementia were the highest rate in the "no risk" group.

> Serum 25(OH)D levels were significantly lower in the with dementia group who did not use vitamin D supplements.

> Education level of the with dementia group was found lower than the without dementia group.

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ABSTRACT

Age, gender, family history, low education level, hypertension, diabetes, hyperlipidemia, smoking, alcohol and vitamin D deficiency are thought to be potential risk factors for patients with dementia. In addition, malnutrition is common among dementia patients. Therefore, we aimed to evaluate the clinical characteristics and Geriatric Nutritional Risk Index (GNRI) status of elderly individuals living in a nursing home diagnosed with dementia alongside those without dementia. A total of 150 elderly individuals aged 60 and over living in an Istanbul nursing home in were included in the study. Demographic characteristics, comorbidity status, and biochemical parameters were obtained from their own files. In addition, the GNRI status of elderly individuals were calculated. The mean age of patients with dementia is higher than those without ($p < 0.05$). The number of illiterate elderly (41.3%) was higher in those with dementia ($p < 0.05$). The mean Body Mass Index (BMI) and serum glucose, ALT, and albumin in the elderly were significantly lower in those with dementia ($p < 0.05$). When GNRI values were compared, those with dementia were at a higher risk than those without (70.7%, 33.3%, respectively). Findings call for a multidimensional assessment of the health status of elderly individuals living in nursing homes.

Contents

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1. Introduction

Dementia is classified as a severe neurocognitive disorder. It is considered to be one of the most important neurocognitive disorders of old age, and is characterized by a decline in cognitive and functional abilities. The disease results in loss of independence and eventually death [1]. Alzheimer's, Parkinson's disease, Lewy body, vascular and frontotemporal dementia types are found to be more common [2, 3]. Alzheimer's disease is the most common type of dementia and is responsible for 75% of all dementia cases [4]. Alzheimer's Disease International (ADI) predicts that there are more than 55 million people living with dementia worldwide, and that number is expected to increase to 78 million by 2030. In addition, ADI states that one person in the world develops dementia every three seconds, and that the annual cost of dementia is 1.3 trillion dollars, a number that could double by 2030 [5].

As the elderly population is growing rapidly and curative treatment of dementia is not yet available, it is important to identify the risk factors for dementia [6]. In an analysis of population-based data, it is thought that one third of Alzheimer's disease cases worldwide might be caused by potentially modifiable risk factors [7]. While age, gender and family history are accepted as unchangeable risk factors, other risk factors such as low education level, obesity, hypertension, diabetes, hyperlipidemia, depression, infrequent social contact, hearing impairment, smoking, alcohol, vitamin D deficiency and nutritional deficiencies are seen as modifiable risk factors that should be emphasized [8, 9]. Among these risk factors, malnutrition is common in dementia patients, regardless of their social situation, i.e. whether they such as live alone or reside in a nursing home [10]. Recent research has reported faster cognitive, neuropsychiatric, functional decline and greater impairment in activities of daily life in persons with dementia and malnutrition [11]. Therefore, health professionals should be aware of the risk of malnutrition in elderly individuals with dementia and develop preventive measures to offset this [5]. The GNRI, developed as a simple and objective tool by Bouillane et al., is one of the measures used to detect the risk of malnutrition in elderly individuals [12, 13].

The aim of our study is to evaluate the demographic characteristics, comorbidity status, laboratory parameters and GNRI levels of elderly individuals living in a nursing home diagnosed with dementia alongside those without dementia.

2. Materials and Methods

2.1. Study design

This study was carried out between August and September 2017 with 150 elderly individuals aged 60 and over, living in Istanbul living in a nursing home. 75 elderly individuals (49 females, 26 males) diagnosed with dementia according to DSM-5 diagnostic criteria and 75 dementia free elderly individuals (49 females, 26 males) were included in the study. Age, gender, education level, supplement intake, drug use and comorbidity status such as osteoporosis, hypertension, cardiovascular disease, hyperlipidemia, diabetes mellitus, chronic obstructive pulmonary disease (COPD) and gastrointestinal disease (GID) of the participants were obtained from their own files. Body weight and height measurements of the elderly individuals were recorded from the files of the individuals. BMI values were calculated by the researchers by dividing body weight by height squared (kg / m^2) [14]. Biochemical parameters such as glucose, total cholesterol, HDL cholesterol, LDL cholesterol, triglyceride, ALT, AST, albumin and 25(OH)D, analyzed in the nursing home medical center laboratory, were obtained from the subjects' own files. Serum 25(OH)D concentrations were categorized in three groups: sufficient levels (>20 ng/mL), insufficient levels (10-20 ng/mL), and deficient levels (<10 ng/mL) [15]. Blood samples of older individuals were taken by the institution nurse after 10 hours of fasting every 6 months. As an corporate policy, the blood values of elderly individuals were taken with an interval of at most 6 months. Since all individuals came to the corporate at different time intervals, all of the biochemical measurement results obtained from the files of the individuals were not equal in time and ranged from 0-6 months.

General information and blood findings were taken from the files of elderly individuals retrospectively.

2.2. Nutritional risk scoring

It is difficult to determine the ideal body weight of older individuals. For this reason, Bouillane et al. used the Lorentz weight (by height and sex) instead of the ideal body weight. Thus, they developed the GNRI screening tool, which includes the albumin level and the ideal body weight calculated according to the Lorentz formula (Table 1). The GNRI classifications are shown in Table 2. The nutritional risk degree of elderly individuals is determined by this classification [12]. In this study, the GNRI was used to determine the nutritional status of elderly individuals.

Table 1 Lorentz weight and GNRI calculation equations

Lorentz weight equation	
Ideal body weight for men	Height - 100- [(Height - 150) / 4]
Ideal body weight for women	Height - 100- [(Height -150) / 2.5]
The GNRI equation	
GNRI = (1.489 x albumin (g / L) + [41.7 x (body weight (W) / Lorentz weight (WLo)] *	

* Body weight (W) / Lorentz weight (WLo) = 1 (when the weight is more than WLo)

It is difficult to determine the ideal body weight in older individuals. Lorentz weight (by height and sex) is use instead of the ideal body weight. GNRI includes the albumin level and the ideal body weight calculated according to the Lorentz formula.

2.3. Statistical Analysis

All parameters were evaluated with the SPSS 24.0 statistical package program. The data were expressed as number (n), percentage (%), mean (X) and standard deviation (SD). One-Sample Kolmogorov-Smirnov test was used to determine whether numerical variables showed normal distribution. Student's-t independent test was used to compare normally distributed independent variables in two groups. The chi-square test was used to compare categorical variables. Parameters with a value of $p < 0.05$ were considered statistically significant [16].

Table 2 Classification of the GNRI risk rating

GNRI risk rating	Score range
Heavy risk	<82
Medium risk	82≤GNRI<92
Low risk	92≤GNRI≤98
No risk	>98

3. Results and Discussion

3.1. Demographic characteristics and comorbidity status

A total of 150 subjects were included in the study. Seventy-five subjects were diagnosed with dementia and 75 were without dementia.

The mean age was 80.81±7.08 years in the dementia group and 74.45±9.28 years in the non-dementia group. Those with dementia were significantly older than those without (p <0.05). In both groups, 49 subjects (65.3%) were women and 26 were men (34.7%). Upon examination of the education levels of the two groups, it was found that 41.3% of the group with dementia was illiterate, whereas 38.7% of the non-dementia group had at least a secondary school education. The difference between the groups was statistically significant (p <0.05). The mean BMI was significantly higher in the non-dementia group (p=0.000), than in the dementia group. The level of supplement use was similar in both groups. The most commonly used supplements in both groups were vitamin D (dementia group=87.7%; non-dementia group=74.4%) and calcium (dementia group=75.4%; non-dementia group =46.8%), which was significantly higher in the dementia group (p <0.05). The presence of non-demented comorbidity was similar in both groups and had very high rates (dementia group=97.3%; non-dementia group=96.0%; p=1.000). Osteoporosis, hypertension, cardiovascular disease, hyperlipidemia, diabetes mellitus, chronic obstructive pulmonary disease (COPD) and gastrointestinal disease (GID) were common comorbidities in both groups and their incidence was similar for both (p >0.05). The most common comorbidity in the dementia group was osteoporosis and hypertension, while in the non-dementia group was hypertension and osteoporosis, respectively. The drug use status of the patients was questioned and it was seen that 69 people (92.0%) in both groups were using drugs. In the study, it was determined that 18 different drugs were used, each of which was used for a different type of disease. Excluding the drugs used for dementia, it was observed that the most used drugs were osteoporosis (36.0%) in those dementia group, and hypertension, heart disease and osteoporosis drugs, each of which was 28% in those who were non-dementia group.

The demographic characteristics and comorbidity status of the study population are shown in detail in Table 3.

Table 3 Demographic characteristics and comorbidity status of the study population

	With dementia (*n* = 75)	Without dementia (*n* = 75)	*p* value
Age (years), mean±SD	80.81±7.08	74.45±9.28	0.000*
Female, n (%)	49 (65.3)	49 (65.3)	1.000
Illiterate, n (%)	31 (41.3)	19 (25.3)	0.014*
Education (primary), n (%)	22 (29.3)	17 (22.7)	
Education (secondary), n (%)	12 (16.1)	29 (38.7)	
High school degree, n (%)	10 (13.3)	10 (13.3)	
BMI (kg/m^2), mean±SD	25.46±5.12	29.73±7.57	0.000*
Supplement intake (yes), n (%)	57 (76.0)	47 (62.7)	0.111
Vitamin D suppl. (yes), n (%)	50 (87.7)	35(74.4)	0.013*
Calcium suppl. (yes), n (%)	43 (75.4)	22 (46.8)	0.001*
Comorbidities (yes), n (%)	73 (97.3)	72 (96.0)	1.000
Osteoporoz, n (%)	51 (68.0)	40 (53.3)	0.066
Hypertension, n (%)	40 (53.3)	47 (62.7)	0.247
Diabetes mellitus, n (%)	15 (20.0)	17 (22.7)	0.690
Hyperlipidemia, n (%)	17 (22.7)	21 (28.0)	0.453
Cardiovascular disease, n (%)	26 (34.7)	29 (38.7)	0.611
COPD, n (%)	14 (18.7)	22 (29.3)	0.126
GID, n (%)	13 (17.3)	22 (29.3)	0.082

*p < 0.05 were considered statistically significant.

Statistics are reported as mean ± standard deviation for age and BMI; and as number and percentage for other variables. All parameters were evaluated with SPSS 24.0 statistical package program. One-Sample Kolmogorov-Smirnov test was used to determine whether numerical variables showed normal distribution. Student's-t independent test was used to compare normally distributed independent variables as two groups. The chi-square test was used to compare categorical variables.

3.2. Biochemical parameters

Among the biochemical parameters obtained from the file records of both groups in the study population, the glucose, ALT, albumin and serum 25(OH)D (Vitamin D suppl. (No)) values were significantly lower in the dementia group than in the non-dementia group (p=0.012, p=0.001, p=0.000, and p=0.006, respectively). The frequency of serum 25(OH)D deficiency and insufficiency in the dementia group was 12.0% and 41.3%, respectively. The prevalence of deficiency was higher in the group with dementia, and the serum 25(OH)D level of the majority of both groups was below normal range. The difference between the groups was not statistically significant. The two groups were similar with respect to all of the remaining parameters (p> 0.05) (Table 4).

Table 4 The laboratory parameters of the study population.

	With dementia (*n* = 75)	**Without dementia (*n* = 75)**	***p* value**
Glucose (mg/dl), mean±SD	87.70±17.49	97.60±28.60	0.012*
Total cholesterol (mg/dl), mean±SD	176.09±35.68	185.81±34.86	0.094
HDL cholesterol (mg/dl), mean±SD	54.20±16.23	56.61±17.03	0.378
LDL cholesterol (mg/dl), mean±SD	100.63±27.70	101.81±28.16	0.795
Triglyceride (mg/dl), mean±SD	110.58±48.76	127.22±64.50	0.077
ALT (U/L), mean±SD	15.94±6.59	20.24±8.78	0.001*
AST (mg/dl), mean±SD	17.84±6.38	19.05±5.94	0.231
Albumin (g/dl), mean±SD	3.66±0.36	4.03±0.41	0.000*
25(OH)D (ng/mL), mean±SD	19.21±6.84	20.88±5.47	0.101
Vitamin D suppl. (yes)/ 25OHD (ng/mL), mean±SD	20.35±7.34	20.85±5.24	0.712
Vitamin D suppl. (No)/ 25OHD (ng/mL), mean±SD	16.93±5.11	20.89±5.72	0.006*
Deficient (25OHD <10 ng/mL), n (%)	9 (12.0)	2 (2.7)	0.087
Insufficient (25OHD=10-20 ng/mL), n (%)	31 (41.3)	36 (48.0)	
Sufficient (25OHD >20 ng/mL), n (%)	35 (46.7)	37 (49.3)	

*p < 0.05 were considered statistically significant.

Statistics are reported as number and percentage for 25OHD deficient, insufficient and sufficient; and as mean ± standard deviation for other variables. All parameters were evaluated with SPSS 24.0 statistical package program. One-Sample Kolmogorov-Smirnov test was used to determine whether numerical variables showed normal distribution. Student's-t independent test was used to compare normally distributed independent variables as two groups. The chi-square test was used to compare categorical variables.

3.3. GNRI status.

When GNRI assessment was performed 70.7% of patients with dementia were found to be at a risky group for malnutrition, whereas 66.4% of the non-dementia group was found to be risk free. The difference between the groups was statistically significant (p <0.05) (Table 5).

Studies show that the elderly population is increasing in Turkey and in the world. As a consequence, dementia, one of the most prominent diseases of the old age, is thought to be on the rise [17, 18]. It is important to identify risk factors, as the currently applied treatments are not yet sufficient to cure dementia.

According to the researches, although there are many factors associated with the onset of dementia, clinical features and nutritional status are seen as important risk factors that should be considered [19, 20].

Table 5 GNRI status of the study population.

GNRI grades of risk	**GNRI cutoff values**	**With dementia (*n* = 75),(n, %)**	**Without dementia (*n* = 75),(n, %)**	***p* value**
Moderate risk	82≤GNRI<92	20 (26.7)	6 (8.0)	0.000*
Low risk	92≤GNRI≤98	33 (44.0)	19 (25.3)	
No risk	>98	22 (29.3)	50 (66.7)	

*p < 0.05 were considered statistically significant.

All parameters were evaluated with SPSS 24.0 statistical package program. Student's-t independent test was used to compare normally distributed independent variables as two groups. The chi-square test was used to compare categorical variables.

This study provides data on demographic characteristics, comorbidity status, laboratory parameters and GNRI status of elderly individuals with without dementia.

In our study, the average age of individuals with dementia was found to be higher. Laboratory parameters as well as education levels were lower in individuals with dementia. While those without dementia were not in any risk group for GNRI, most of the elderly people with dementia were in the "low risk" group.

The frequency of dementia increases with aging. Many studies have shown that age is one of the most important risk factors associated with dementia [9]. This is explained by irregularities in brain energy metabolism that occur with age and cause neuro-degeneration [21]. Our study is consistent with the literature, since the average age of the dementia group is higher than that of the non-dementia group. Due to the longer life span of women, many studies have found that the geriatric age group consists mostly of women. Therefore, the incidence of dementia increasing with age is considered to be higher in women [22, 23]. In addition, some studies have reported that the pathology of dementia begins decades before clinical symptoms appear. Thus, there is an opinion that the higher risk in women compared to men is not related to their longer life span but rather

to menopausal transition, which is a midlife neuro-endocrine transitional state unique to females [24, 25]. Similarly, in our study, the number of females was higher in both the dementia and non-dementia groups (F=49, M=26). In this study, the education level of the dementia group was found to be lower than that of the non-dementia group, and similar results were obtained in parallel studies [26, 27]. In a meta-analysis conducted by Xu et al., it was found that each year of extra education reduces the risk of dementia by 7% [28]. In our study, the mean BMI for both groups was in the overweight grade, but was significantly lower in the dementia group than in the non-dementia group. It was observed in other studies that elderly individuals with dementia had lower BMI values [29, 30], which is consistent with our findings. In a meta-analysis, the risk of all-cause dementia was found to be higher among underweight individuals [31]. This was associated with undernourishment. As for higher average age, this was correlated with physical changes like the decrease in the muscle formation in the body along with the increase in fat [30]. Chronic diseases and absorption problems, which endanger nutritional status, are frequently seen in elderly individuals. Therefore, many nutrient deficiencies occur and supplement use is widely needed [32]. In this study, it was determined that supplement intake was high in both groups, and the most commonly used supplement was vitamin D. It has been observed in many studies that vitamin D supplements are used at high rates in elderly individuals [33, 34]. According to the Office of Dietary Supplements, vitamin D is found in few naturally occurring foods. Therefore, sunlight exposure is important to meet adequate serum 25(OH)D levels [35]. The deficiency can be attributed to less exposure to the sun or a decrease in the vitamin D synthesis capacity of the skin with old age. In such cases, it is recommended to take vitamin D supplements to prevent health problems [36]. In our study, it was observed that the presence of comorbidity was higher in the dementia group ($p > 0.05$), similar to the studies conducted [37, 38]. However, in our study osteoporosis, one of the comorbidity types, was found to be higher in the dementia group, while the other disease types were lower. In addition to studies that are consistent with our study, there are also studies that are not [37–39]. The low availability of comorbidities in the dementia group is associated with a lack of diagnosis, since patients with dementia did not receive adequate follow up [37]. Furthermore, the true association may have been obscured by not controlling the potentially protective effects of medications [27]. Studies with high comorbidities in the dementia group explain this situation with the effect of some chronic diseases such as diabetes, hypertension and heart diseases. These comorbidities have been associated with the development of dementia as a result of causing vascular damage, disrupting the blood-brain barrier and inducing decreased cerebral blood flow [9, 39].

In addition to using biochemical measurements in the diagnosis of many diseases, the abnormal levels of some biochemical parameters such as cholesterol, lipid, insulin activity and glucose are accepted as potential indicators responsible for the development of dementia [40]. In our study, glucose and ALT were significantly lower in the group with dementia. Total cholesterol, HDL cholesterol, LDL cholesterol, triglyceride and AST were also lower in the dementia group, although not significantly so. In the literature, in addition to the studies that yield results similar to ours, there are also some with different results [40–42]. It is thought that these differences between studies may result from changes in nutritional and disease states that affect the biochemical measurements of the individuals participating in the study [40, 43]. Malnutrition is considered an important risk factor due to the common nutritional problems in individuals with dementia [44]. Low levels of albumin are considerd to be one of the biochemical indicators of malnutrition, and studies confirm the relationship between dementia and low albumin levels [43]. In our study, the albumin values of individuals with dementia were found to be lower, finding consistent with the other studies we investigated [42, 43]. Serum 25(OH)D, which is often seen to be deficient among older individuals, is considered to be an important marker that needs to be looked at in serum, as it is found to be associated with cognitive performance [45, 46]. In this study, no significant difference was found between the groups in mean serum 25(OH)D levels. However, serum 25(OH)D levels were significantly lower in those members of the dementia group who did not use vitamin D supplements. In a similar study, the use of vitamin D supplements was significantly associated with the serum 25(OH)D status of participants with a dose-response relationship [46]. In our study, although serum 25(OH)D deficiency and insufficiency were high in both groups, serum 25(OH)D deficiency was found to be higher in the dementia group. Other studies confirm that serum 25(OH)D levels were lower in elderly individuals with dementia, mild cognitive impairment (MCI) and Alzheimer's disease compared to the control group [41, 45]. Studies have associated low serum 25(OH)D status to poorer cognitive function. In addition, elderly individuals with higher serum 25(OH)D levels were found to have higher mini mental status assessment scores and cognitive function [42, 45]. In a 12-year follow-up study with 916 participants over age 65 who had no dementia at baseline, individuals who initially had a deficiency of serum 25(OH)D level were found to have 3 times higher risk of Alzheimer's dementia than individuals with adequate serum 25(OH)D levels [46].

The needs of the elderly, such as maintaining health, protection from diseases, independence and quality of life, depend on an adequate and balanced diet. Since nutritional deficiency is an important risk factor in elderly individuals, it requires careful monitoring. The GNRI, which is a simple and accurate tool for this purpose, has been developed as a nutritional risk index in elderly individuals [13]. In our study, it was observed that the GNRI status of individuals with dementia were the highest rate in the "low risk" group, while those without dementia were the highest rate in the "no risk" group. As a result of the literature study, research evaluating the GNRI on elderly individuals with and without dementia has not been found. In a study evaluating the difference in nutritional risk among elderly individuals with normal cognitive function and MCI, MCI was associated with moderate and high nutritional risk [47]. In studies conducted on individuals living in nursing homes, akin to our study, nutritional risk was increased in the presence of dementia [48]. In addition, in a study conducted to determine the relationship between cognitive impairment and nutritional risk in elderly individuals, it was revealed that moderate or high nutritional risk was associated with increased cognitive impairment [49]. Since our study is retrospective, it is not clear whether dementia was caused by an increased nutritional risk or whether the existing dementia led to an increased nutritional risk condition. This situation can be explained by prospective cohort studies.

The strength of this study is that dementia was diagnosed according to a rigorous clinical procedure using published criteria. In addition to clinical features, the GNRI status assessment, which has not been used before to compare individuals with and without dementia, is another strength of the study. This knowledge could provide a better understanding of the relationship between risk factors and dementia.

The limitations of our study were it being a retrospective study, having a limited sample size, and not performing dementia staging. Other potential limitations of this study were that the information received from individuals with dementia was determined based on system records, not face-to-face evaluations, and the fact that the research was conducted in a single institution and may not be generalizable to other settings.

4. Conclusions

The average age of elderly individuals with dementia included in the study was higher. Their educational status was lower, and the use of supplements was more. Biochemical parameters of elderly individuals with dementia such as glucose, blood fats (total cholesterol, HDL and LDL cholesterol), liver enzymes (ALT, AST), albumin and vitamin D were lower than in those without dementia. In addition, BMI and GNRI values were found to be lower in the dementia group than the non-dementia group. It is known that low education level is an important risk factor for dementia. For this reason, the cognitive capacities of these individuals should be followed for early diagnosis of dementia. In addition, individuals with undesired low or high biochemical parameter levels and comorbidity status should be carefully monitored, and quality of life should be increased by reducing the progression and severity of the disease. As for BMI and GNRI values of individuals aged 65 years and older, especially those with dementia, those should be calculated and controlled regularly to prevent malnutrition.

Declaration of Conflict of Interest

Authors declare that they have no conflict of interest with any person, institution, or company.

Ethics Approval

The study was approved by the Non-Interventional Clinical Research Ethics Committee of Istanbul Medipol University, Turkey (Date: 31.05.2017, No: 10840098-604.01.01-E.12584).

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