

Malnutrition is Associated with Cognitive Function, Tiredness and Sleep Quality in Elderly Living Nursing Home

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ABSTRACT

Background: The last studies have shown that aging is associated with an increase in the risk of malnutrition and related complications. The aim of this study was to investigate the relationship between malnutrition and cognitive function, tiredness and sleep quality in the elderly living in nursing home.

Methods: The subjects of this study were 119 elderly people over the age of 65 living in nursing homes in Tehran. The demographic characteristics of the subjects were collected and recorded. Then, body composition and anthropometric indices including weight, body mass index [BMI], height and calf circumferences [CC], waist circumferences [WC] and hip circumferences were measured using a digital scale of OMRON and meter tape. nutritional status, cognitive function, sleep quality and level of tiredness were measured by Mini Nutritional Status, Mini-Mental State Examination, Pittsburgh Sleep Quality Index and FACIT-Fatigue scale, respectively.

Results: The results of statistical analysis of the data showed a positive relationship between malnutrition with dementia [$p < 0.024$], fatigue [$p < 0.000$] and sleep quality [$p < 0.008$].

Conclusion: Taken together, the use of strategies to improve the nutritional status of the elderly in nursing homes can play an important role in preventing the symptoms of geriatric syndrome and increasing the level of health in the elderly.

Keywords: Aging; Nutritional status; Sleep quality; Geriatric syndrome; Health; Dementia; Fatigue; Disability; Older adults; Malnutrition

INTRODUCTION

Aging is usually associated with the progressive decline in the body's physiological, biological and functional capacities, all of which increase the risk factors for various diseases [1,2]. Numerous studies have indicated the increase in the elderly population throughout the world, with the number projected to reach 2 billion by 2050 [3]. It is also estimated that by 2050, Iran's elderly population will reach over 26 million and will constitute 26% of the country's total population of elderly, making it one of the world's oldest countries [4]. On the other hand, the number of elderly people referring to nursing homes is increasing in Iran, and according to the studies, problems such as malnutrition, fatigue, depression, memory loss and dementia,

changing sleep patterns and the like are more common among these people than other elderly.

Geriatric syndrome is one of the most important problems in the elderly that is used to describe a set of common conditions in this age group. In fact, geriatric syndrome is a multifactorial condition that includes dementia, malnutrition, sleep disorder, delirium, falls, dizziness, syncope, fatigue, urinary incontinence and frailty, which is common among the elderly and is associated with a decline in quality of life and disability in performing daily activities and in severe cases, leads to death [5,6].

According to the WHO, dementia is a disorder that encompasses several diseases related to memory, cognitive and behavioral abilities, and disrupts the normal course of life. Aging

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is the strongest risk factor for dementia. The prevalence of dementia is increasing rapidly throughout the world, with an estimated 50 million people worldwide suffering from the disease, and the number is projected to reach 135 million by 2050. More importantly, about 60 percent of these people live in low-to middle-income countries such as Iran [7]. Also, the prevalence of dementia in Iran was estimated at 7.9% in 2016 [8]. It is well-established that, in addition to its multiple effects on individual and community health, the disease results in heavy costs in the health care section [9].

On the other hand, sleep disorders are among the factors affecting the quality of life of the elderly that can be caused by various factors such as anxiety, medication and biological changes. Since the ability to concentrate, think, and perform daily activities is largely dependent on adequate sleep, sleep disorders can cause many problems for the elderly [10,11]. It has been well established that a decrease in sleep quality in the elderly leads to memory problems and an increased risk of dementia. In addition, it has been reported that decreased sleep quality affects the circadian rhythm of the body, which leads to an increased risk of cardiovascular and metabolic diseases [12,13]. So, identifying healthy strategies to improve the sleep quality of the elderly is of high importance to their health and lifespan.

Another problem faced by the elderly is a frailty syndrome that is associated with physiological changes as they age and endangers the health of the elderly [14]. One of the most important symptoms of frailty syndrome is fatigue. To put it simply, fatigue is a frequent and chronic feeling of energy shortage that in addition to aging, is influenced by factors such as genetics, malnutrition, sedentary lifestyles, illnesses, alcohol consumption and smoking [15]. Studies have shown a positive association between fatigue and cognitive impairment in the elderly [16].

Identifying the factors that influence the development of symptoms of frailty syndrome can play an important role in preventing, controlling and treating this syndrome, promoting health and reducing the health care costs of the elderly. Our previously studies shown that physical activity and exercise can prevent cardiovascular and metabolic diseases and related risk factors [17,18]. The safest ways to improve seniors' health include exercising and good diet. Dorner et al. reported that nutrition plays an important role in the health of the elderly, preventing and ameliorating the symptoms of frailty syndrome [19]. As defined by the World Health Organization, malnutrition is the result of nutrient deficiencies or imbalances between calorie intake and calorie burn [20]. It has also been well established that malnutrition in the elderly is associated with decreased functional capacity and fatigue, reduced muscle mass, immune system disorders, cognitive decline, and sleep disorders [21]. It has been proven that malnutrition in the elderly is associated with the decrease in the functional capacity and fatigue, reduced muscle mass, immune system impairment, reduced cognitive performance and sleep disorders and it is estimated that between 2 and 16% of seniors are short of daily required nutrients and calories for a variety of reasons, reaching 35% in terms of the absence of minerals and vitamins.

As far as we know, few studies have examined the relationship between nutritional status, indicators of frailty syndrome in rest home residents. Also, given the literature reviews and the increased risk of symptoms of geriatric syndrome including dementia, fatigue and decreased sleep quality in the elderly living in nursing homes, we hypothesized that malnutrition is one of the factors related to sleep quality, cognitive function, and fatigue in the elderly. This study was to investigate the relationship between malnutrition and cognitive function, tiredness and sleep quality in the elderly living in nursing home.

MATERIAL AND METHODS

Subjects

The subjects of this study were elderly people who lived in the ten rest homes in the different areas of Tehran city. We included elderly who were older than 65 years, without severe dementia and Alzheimer as well as living in the rest home for more than 90 days. Before the sampling the full scoping review protocol was written and agreed by the nurses and subjects. The sample size using the Cochran formula was set to 130 with confidence level of 95%, $p=0.05$. At first, 142 elderly participated in this research voluntarily, gave informed consent and completed the demographic questionnaire. After that, 119 elderly [33 men, 86 women] qualified following the interview. The exclusion criteria were, Inability to interview, having infectious or communicable diseases and BMI less than 17 kg/m².

Demographic questionnaire

Demographic characteristics included age, gender, educational level, marital status, residency [nursing home], birth place, job status and the number of children.

Anthropometric indices

Height and weight were measured by measuring tape to the nearest 0.1 cm and OMRON digital scale to the nearest 0.1 kg respectively, as well as, BMI was calculated as weight [kg]/height squared [m²]. In addition, Waist circumference and hip circumferences were measured with non-stretching tape to the nearest 0.1 cm, and Waist-hip ratio [WHR] was calculated by dividing WC [in cm] by hip circumference [cm].

Nutritional status

To assess the risk of malnutrition in the subjects we used the Mini Nutritional Assessment [MNA] tool. The MNA is a simple, low-cost, non-invasive method that can be performed at the bedside. It is a useful screening tool for diagnosing malnutrition and the risk of malnutrition in the elderly. The MNA questions are divided into four categories of anthropometric indices, general condition, eating patterns, and self-perceived nutrition/health. In this research, screening questions were used to distinguish subjects who are malnourished [<7 points] or at the risk of malnutrition [8-11 points] or well nourished [>12 points]. The validity and reliability of the questionnaire in the Iranian population have been confirmed [22].

Sleep quality

In current research, The PSQI questionnaire was used for the purpose of assessing sleep quality and recognizing sleep disorders. The PSQI is a 19-item self-report measure of sleep quality over the last month. It consists of seven component scores, each rated on a 0 to 3 scale, with higher scores implying greater difficulties. A PSQI score of 5 or less shows good quality, while more than 5 shows a weak sleep. PSQI has been translated and validated in several languages and is being used in Iranian population [23].

Tiredness

For this study, we used the FACIT-fatigue questionnaire, as it is brief, with 13 items, and an easy-to-administer, symptom-specific tool that is more suitable for clinicians interested only in measuring fatigue. The level of fatigue was assessed on a four-point Likert scale [4=not at all fatigued to 0=very much fatigued] with higher scores detecting less fatigue. Internal consistency was measured using Cronbach's α [0.891] [24].

Dementia

MMSE was used to screen and evaluate dementia and cognitive impairment. It measures orientation, registration, attention, recall, language, and visuospatial functions. The MMSE included 10 questions with a total score of 30 and regarded as one of the most common tools to measure the general cognitive function. Its scores range from 0 to 30, the higher scores show better cognition, and scores below 23 show cognitive dysfunction. The validity and reliability of Persian version of MMSE has been confirmed [25].

Statistical analysis

At first, in order to determine normality of data distribution we used the Kolmogorov-Smirnov test. Subjects' characteristics were analyzed using means \pm standard deviations for continuous variables, and frequencies and percentages for categorical variables. Pearson correlation coefficient was used to determine the relationship between variables and nutritional status. After that, 1-way ANOVA was used to determine the difference between FACIT-f score, MMSE score and sleep quality in three nutritional status groups [malnourished, at risk and well nourished]. Statistical analyses were conducted by SPSS version 21, and a p value of <0.05 was considered to be statistically significant.

RESULTS

Demographic characteristics, blood pressure, education, marital status, and nutritional status (normal, risk of malnutrition, and malnutrition), shown in Table 1. Elderly mean age was 74.17 years; Also, the mean BMI, SBP and DBP of the subjects were 26.82 kg/m², 135.22 mmHg and 82.59 mmHg respectively. A total 38 [31.93%] were married, 19 [15.97%] were single and 62 [52.10%] were widow or divorced. Of the total, 42 [35.29%] of subjects had middle school or diploma and 28 [about 24%] were

illiterate. Also, the prevalence rates of malnutrition and the risk of malnutrition were about 16% and 48%, respectively (Table 1).

Table 1: Demographic, anthropometric characteristics, and the malnutrition prevalence of the subjects.

Variables	Mean \pm SD	N [%]
Age [year]	74.17 \pm 8.67	-
Height [cm]	154.75 \pm 10.53	-
Weight [kg]	62.03 \pm 13.23	-
BMI [kg/m ²]	26.82 \pm 6.41	-
Education	Not literate	- 28 [23.53%]
	Primary school	- 31 [26.05%]
	Middle school/ diploma	- 42 [35.29%]
	bachelor	- 13 [10.92%]
Marriage	Master/PHD	- 5 [4.20%]
	Single	- 19 [15.97%]
Marriage	Married	- 38 [31.93%]
	Widow/Divorced	- 62 [52.10%]
MNA	Malnourished	- 19 [15.97%]
	Men	- 5 [4.2%]
MNA	Women	- 14 [11.76%]
	At risk	- 57 [47.90%]
MNA	Men	- 16 [13.45%]
	Women	- 41 [33.45%]
MNA	Well nutrition	- 43 [36.13%]
	Men	- 12 [10.08%]
MNA	Women	- 31 [26.05%]

BMI: Body Mass Index; CV: Cardiovascular; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure

The correlation between different variables are shown in Table 2. There was a significant and negative relationship between age with weight [$p < 0.034$], educational status [$p < 0.034$], dementia [$p < 0.008$], and fatigue [$p < 0.011$].

Whilst we observed an indirect and significant relationship between age and sleep quality [$p < 0.003$]. Also, there was direct significant relationship between malnutrition with dementia

[p<0.024] and fatigue [p<0.000], but there was an inverse significant correlation between malnutrition with weight [p<0.000], BMI [p<0.000], and sleep quality [p<0.008] (Table 2).

Table 2: The Correlation between nutritional status, general and physiologic variables.

		Age	Weight	BMI	Education	MNA	Dementia	Fatigue	SQ
Age	R	1	-0.195*	-0.148	-0.195*	-0.119	-0.240**	-0.231*	0.272**
	P	-	0.034	0.109	0.034	0.198	0.008	0.011	0.003
weight	R	-	1	0.568**	0.085	0.396**	0.299**	0.276**	-0.113
	P	-	-	0	0.356	0	0.001	0.002	0.223
BMI	R	-	-	1	-0.228*	0.373**	0.373**	0.08	-0.047
	P	-	-	-	0.013	0	0	0.387	0.609
Education	R	-	-	-	1	0.078	0.605**	0.391**	-0.114
	P	-	-	-	-	0.397	0	0	0.217
MNA	R	-	-	-	-	1	0.207*	0.410**	-0.241**
	P	-	-	-	-	-	0.024	0	0.008
Dementia	R	-	-	-	-	-	1	0.381**	-0.12
	P	-	-	-	-	-	-	0	0.194
Fatigue	R	-	-	-	-	-	-	1	-0.403**
	P	-	-	-	-	-	-	-	0
SQ	R	-	-	-	-	-	-	-	1
	P	-	-	-	-	-	-	-	-

SQ: Sleep Quality; Edu: Education; BMI: Body Mass Index,

*. The mean difference is significant at the 0.05 level.

** The mean difference is significant at the 0.01 level.

The result of 1-way ANOVA showed there was a significant difference in BMI [F=11.550, p<0.000] and fatigue [F=11.453, p<0.000] between all three groups of MNA score [malnutrition

status]. Also, there was a significant difference in sleep quality between malnutrition and well nutrition groups (Table 3).

Table 3: ANOVA results of nutritional status, regarding BMI, dementia, fatigue, sleep quality and education.

Dependent variables	SS	MS	F	Sig.			p
BMI	804.17	402.085	11.55	0.000**	malnourished		0.003**
					At risk	well	
					At risk	well	

						mal	0.003**
						Well	0.013**
						At risk	0.000**
					Well nutrition	mal	0.013**
						malnourished	
						At risk	0.401
						well	0.156
					At risk	mal	0.401
						Well	0.706
						At risk	0.156
Dementia	114.124	57.062	1.858	0.161	Well nutrition	mal	0.706
						malnourished	
						At risk	0.014*
						well	0.000**
					At risk	mal	0.014*
						Well	0.011*
						At risk	0.000**
Fatigue	3405.226	1702.613	11.453	0.000**	Well nutrition	mal	0.011*
						malnourished	
						At risk	0.424
						well	0.029*
					At risk	mal	0.424
						Well	0.463
						At risk	0.029*
Sleep Quality	41.186	20.593	1.809	0.168	Well nutrition	mal	0.463
						malnourished	
						At risk	0.857
						well	0.546
					At risk	mal	0.857
						Well	0.29
						At risk	0.546
Education	1.406	0.703	0.582	0.561	Well nutrition	mal	0.29

Independent variable: MNA

** . The mean difference is significant at the 0.01 level.

* . The mean difference is significant at the 0.05 level

DISCUSSION

The high prevalence of geriatric syndrome increases the risk of various diseases and their associated complications, which lead to lower health status of the community. Malnutrition is one of the influential factors in the development of the frailty syndrome, especially in developing and low-income countries. The attention of researchers to overweight and obesity and related diseases has led to the neglect of malnutrition, especially among the elderly, which can be effective in the high prevalence of malnutrition-related frailty syndrome. The syndrome is also widespread in the elderly living in nursing homes and with devastating effects on people's lives may ultimately lead to their death. As far as we know, this was the first study to investigate the relationship between malnutrition and cognitive function, fatigue and sleep quality in elderly living in rest homes in Tehran.

Prevalence of malnutrition

In the present study, 15.97% of subjects had malnutrition, 47.9% were exposed to malnutrition and 36.13% had normal nutritional status. Studies in this area have reported a worldwide prevalence of malnutrition between 13 and 54% among the elderly [26]. On the other hand, Nazemi et al. [2014] reported 10.3% prevalence of malnutrition in the elderly living in the rest home in Tehran [27]. There are several factors that contribute to the development of malnutrition in the elderly, which generally fall into three groups of medical factors, such as loss of appetite, oral and dental problems, problems with chewing and swallowing due to decreased saliva secretion, diseases and infections, and medication, numerous social and lifestyle factors including the loss of loved ones, loneliness, as well as economic problems and, ultimately, psychological factors such as depression, anxiety and dementia [28]. The present study indicates a growing trend of malnutrition in the elderly in the elderly living in the rest homes in Tehran, which may indicate an inappropriate diet. It has been reported that deficiencies in vitamins D and B12, zinc, protein, and dehydration are the most important malnutrition causes in the elderly [27]. In this study, there was a significant inverse relationship between weight [$p < 0.000$] and BMI [$p < 0.000$] with malnutrition. Lack of proper nutrition in the elderly due to various mechanisms such as impaired metabolism and endocrine function, as well as reduced bone and muscle density can lead to weight loss and BMI decrease, which eventually results in numerous problems such as frailty, falls, fractures and other movement restrictions [29,30].

Dementia

In the present study, a positive and significant relationship between malnutrition and dementia was found [$p < 0.024$]. There was also a significant positive relationship between age and dementia [$p < 0.008$]. It is well established that age is the strongest known risk factor for dementia. On the other hand,

numerous studies have suggested a direct relationship between malnutrition and the development of cognitive dysfunctions in the elderly [31,32], while other studies have shown that malnutrition has little to do with the incidence of dementia, and that patients with cognitive dysfunction develop malnutrition for a variety of reasons, such as amnesia [33,34]. On the other hand, interestingly, longitudinal studies in this area show that the elderly with cerebral palsy had poor nutritional status in the years prior to developing these disorders and most of them were malnourished [35,36]. In addition, Wang et al. showed that proper nutrition in the elderly helps prevent cognitive dysfunction after having various diseases associated with aging such as falls and bone fractures [37].

Tiredness

In the present study, a significant and positive relationship was found between malnutrition and fatigue [$p < 0.000$]. There was also a significant positive correlation between age and fatigue [$p < 0.011$]. In addition, there was a significant difference in level of fatigue [$F = 11.453$, $p < 0.000$] between all three groups of MNA score [malnutrition status]. The mechanisms underlying fatigue in the elderly have not yet been fully elucidated, but factors such as chronic inflammation, mitochondrial and musculoskeletal dysfunction, malnutrition and sleep disorders may play a role in the development of fatigue [38]. More importantly, malnutrition, which is generally associated with an imbalance in the synthesis and decomposition of proteins in the body, dramatically reduces the levels of proteins involved in metabolism, including peptide hormones and enzymes, which generally decrease chronic function and fatigue [15]. On the other hand, a direct relationship between malnutrition and the musculoskeletal disorders such as atrophy, sarcopenia and osteoporosis has been reported in previous studies, which has an effective role in reducing mobility, sedentary lifestyle and fatigue [39].

Sleep quality

In the present study, there was a significant inverse relationship between sleep quality and malnutrition [$p < 0.008$]. The relationship between nutritional status and sleep quality has been demonstrated in various studies [40]. Also, in the well-nourished group, sleep quality was significantly better than the malnutrition group [$p < 0.029$]. Zhou et al. reported that protein intake of less than 20% of total daily calorie intake had a negative effect on neural function and circadian rhythm of the body in the elderly, leading to decreased sleep quality [41]. On the other hand, malnutrition and reduced absorption of vitamins lead to a decrease in the body's antioxidant function and problems such as energy deficiency, which is associated with increased fatigue and decreased sleep quality in the elderly [27,42]. In the present study, a significant and inverse relationship was observed between age and sleep quality

[$p < 0.003$]. Physiological and neurochemical changes that involve stimulation of the cortex, thalamus, hypothalamus, and various areas of the cortex have been implicated in aging-related sleep disorders [10]. In addition, a range of factors such as medication, urinary incontinence, age-related hormonal changes, and diseases play an effective role in reducing the quality of sleep in the elderly [43].

Education

In the present study, there was a significant inverse relationship between education level with dementia [$p < 0.000$] and fatigue [$p < 0.000$]. Recent findings suggest that in developing and low-income countries, higher education levels are generally associated with increased interest in learning and participation in cognitive processes, leading to higher cognitive performance and prevention of dementia over time [44].

CONCLUSION

According to the results of this study, it can be stated that proper nutrition under the supervision of sports physiology experts and nutritionists can greatly prevent or control elderly syndromes and malnutrition-related diseases in the elderly living in the nursing homes.

LIMITATIONS OF THE STUDY

The study was restricted to Tehran's nursing homes and was conducted in only 10 nursing homes, reducing the generality of the results. Also, due to physical and mental problems [severe dementia and Alzheimer's disease], many elderly failed to participate in the project and the number of subjects decreased. In addition, because of the cross-sectional design, this study cannot properly illustrate cause-and-effect relationships.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The researcher ensured that participants' identity and what they said or did during research were maintained confidential. In addition, they were given a detailed explanation about the study's purpose and methods. The research protocol was approved by the Health Committee of the Information Services Corporation [Iran].

CONSENT FOR PUBLICATION

Informed consent has been obtained from all the participants.

AVAILABILITY OF DATA AND MATERIALS

The authors confirm that the data supporting the findings of this study are available within the article.

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In this study, there was no funding source.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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