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The relationship between malnutrition, diet quality and health-related quality of life among the elderly: A cross-sectional study

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Summary. *Introduction:* This study aims to evaluate the relationship between malnutrition, diet quality and health-related quality of life among the elderly in Famagusta, Cyprus. *Materials and Methods:* This study was conducted with 279 individuals aged 65 and over who were living in Famagusta, Cyprus between February 2017 and May 2018. Data was collected via one-to-one interviews using the following evaluation forms. The Mini Nutritional Assessment (MNA) evaluated demographic characteristics, nutritional habits, 24-hour retrospective food consumption records and risk of malnutrition. The Medical Outcome Study Short Form (SF-36) evaluated quality of life. In addition, participants' body weight, height, waist, hip, mid-upper arm and calf circumferences were measured using appropriate techniques. *Results:* Of the participants, 5.4% had malnutrition, and 9.3% were at risk of malnutrition. Participants over the age of 85 had the highest risk of malnutrition ($p < 0.05$). Males had a higher physical and mental quality of life and a lower risk of malnutrition than females ($p < 0.05$). Those without a risk of malnutrition had a higher mental and physical quality of life than those with a risk of malnutrition ($p < 0.001$). As diet quality increased, the physical quality of life increased. And as the quality of physical and mental life increased, the risk of malnutrition decreased ($p < 0.05$). *Conclusion:* Increased age is associated with increased risk of malnutrition. Males have a lower risk of malnutrition than females. As the quality of diet increases, the physical quality of life increases. And as the quality of physical and mental life increases, the risk of malnutrition decreases. Planning further cross-sectional, longitudinal and intervention studies with larger sample sizes to evaluate other factors that affect the relationship between malnutrition, diet and health-related quality of life in the elderly, is significant in terms of developing preventive public health policies.

Key words: malnutrition, diet, quality of life, elderly

Introduction

Life expectancy increases as quality of life increases. The World Health Organization (WHO), expects the elderly population to reach 1.2 billion by 2025 and 2 billion by 2050. Additionally, 80% of this elderly population will live in developing countries (1, 2). The WHO defines aging as the decline of an organism's ability to adapt to environmental factors. Aging is an inevitable process experienced by all living things and includes structural and functional changes that occur at the level of molecules, cells, tissues, organs and systems (1, 3).

Biological, social and psychological changes due to aging may increase the prevalence of malnutrition (4). A meta-analysis study determined the prevalence of malnutrition and the risk of malnutrition among the elderly as 5.8% and 31.9%, respectively (5). Other studies on the risk of malnutrition found the prevalence of malnutrition ranging from 49% to 67% (5-8). Malnutrition can be defined as lean body mass due to lack of nutrition or food intake, decline of physical and men-

tal functions and deterioration of clinical findings due to disease (6, 9). Malnutrition may increase the risk of falling, lead to inability to act independently, decrease quality of life, and increase number of hospitalizations, morbidity and mortality (7). These factors lead to difficulties in performing activities of daily living in the elderly, resulting in a need for caregiver support to maintain independent living (10). Malnutrition decreases health-related quality of life. Health-related quality of life includes physical, emotional, behavioral, cognitive and social functions. Various scales/tools have been developed to evaluate health-related quality of life. One of the most frequently used tools is the Medical Outcome Study Short Form (SF) -36 (11). Also, the Mini Nutritional Assessment (MNA) screening tool was developed in 1996 to determine and intervene in the risk of malnutrition in the elderly as earlier as possible (12). The European Society for Clinical Nutrition and Metabolism (ESPEN) suggest the MNA as an appropriate method for assessing and screening malnutrition among the elderly (13). Due to an increase in the awareness of malnutrition among elderly individuals in recent years, the MNA has become a scale frequently used in many studies and various countries (14). One study comparing three different screening tests, namely MNA, Subjective Global Assessment (SGA) and Nutritional Risk Screening-2002 (NRS-2002) used to assess nutritional status of the elderly living at home, found that the MNA was more sensitive and available than other tests to evaluate nutritional status of the elderly aged 65 and over who received care at home (15).

Due to the physiological changes caused by aging; a decreased sense of taste and loss of appetite may occur as well as problems with chewing and swallowing. Acute/chronic diseases due to these changes may negatively affect food consumption, decreasing diet quality and causing malnutrition (11, 16). The Healthy Eating Index-1995 (HEI-1995), developed for the first time in 1995, is based on the U.S. Dietary Guidelines for Americans and is considered an appropriate tool for measuring the quality of diet (17). The HEI has been updated according to the updates in the U.S. Dietary Guidelines for Americans, and thus the HEI-2015 scale has been developed (18). The HEI is an effective measurement tool for determining the quality of diet and is also used frequently for different populations and age groups outside the United States (19). Therefore, determining the relationship between risk of malnutrition, diet quality and health-related life quality among the elderly is important to protect the health of the growing elderly population and to develop necessary protective public health policies. Therefore, this study aims to evaluate the relationship between malnutrition, diet quality and health-related quality of life among the elderly in Famagusta, Cyprus

Materials and Methods

This study was conducted with 279 individuals aged 65 and over who were living in Famagusta, Cyprus between February 2017 and May 2018. The sample size was determined using the sample selection method with unknown population and accepting a 95% confidence interval and 5% error margin. Native Turkish speakers who were not bedridden and without Alzheimer's disease were included in the study. In a one-to-one interview method with the participants the Mini Nutritional Assessment (MNA) was used to evaluate demographic characteristics, nutritional habits, 24-hour retrospective food consumption records, and the risk of malnutrition. The Medical Outcome Study Short Form (SF-36) was used to evaluate quality of life. In addition, participants' body weight, height, waist circumference, hip circumference, mid-upper arm and calf circumferences were measured using appropriate techniques.

HEI-2015

The energy and nutrients were calculated using the data obtained from the participants' 24-hour food consumption records that were uploaded to the Nutrition Information System (BEBIS). In addition, the information on food groups were grouped according to 13 components of the Healthy Eating Index-2015 (intake of total fruit, whole fruit, total vegetables, dark green vegetables, legumes (beans and peas), whole grains, dairy, total protein foods, seafood and plant proteins, fatty acids, refined grains, sodium, calories from added sugars, and saturated fatty acids). The lowest and highest total scores to be obtained on these components were 0 and 100, respectively. A total score

over 80 referred to "high quality diet', scores of 51-80 were considered "needs improvement" and scores under 51 indicated "poor diet quality" (20, 21).

Mini Nutritional Assessment (MNA)

The Mini Nutritional Assessment (MNA) was developed by Guigoz et al. (12) to determine and intervene early in the risk of malnutrition in the elderly (22-24). The Turkish validity and reliability study of the MNA, which is recommended by ESPEN for nutritional screening of the elderly, was performed by Sarıkaya (13, 25). The MNA consists of 18 questions and a total of four subscales, including anthropometric measurements, nutritional habits, general assessment and personal assessment. Anthropometric measurements included four questions about body weight loss, body mass index (BMI), mid-upper arm circumference and calf circumference. Nutritional habits included six questions about the number of daily meals, types of food consumed, liquid intake and independent nutrition. General assessment included six questions about mobility, medications regularly used, stress, dementia or depression and presence of serious illness in the last three months. Personal assessment included questions about one's own health and nutrition status. The scale consisted of two stages; the Mini Nutritional Assessment-Short Form (MNA-SF) was administered in the first stage, and if there was a risk of malnutrition (that is, if the individual had a score 11 or lower out of 14) then the second stage (assessment) was continued. The lowest and highest total score on the scale were 0 and 30, respectively. A total score of >24 referred to normal nutritional status, a score between 17-23.5 points indicated a malnutrition risk and a score of <17 showed malnutrition (12).

SF-36

SF-36 is a frequently used measure of health-related quality of life, developed in 1992 and validated in Turkish in 1999. SF-36 has 36 items in eight dimensions: physical function (PF), physical role limitation (PRL), emotional role limitation (ERL), vitality (VT), mental health (MH), social functioning (SF), pain (PA) and general health perception (GHP) (26, 27). For each quality of life dimension tested, item scores were coded, summed, and transformed into a scale from 0 (worst) to 100 (best) using the standard SF-36 scoring algorithms described by the developers. Then the physical and mental summary component scale scores were calculated (28).

Anthropometric Measurements

Body weight was measured with a 0.1 kg sensitive digital scale. Height, hip, waist, mid- upper arm and calf circumference were measured by using non-streching tape. The height was measured with the head, back, hips and heels touching a wall. The waist and hip circumference were measured by standing with legs together and hands down at the side. The waist circumference was measured at the point between the iliac crest and the rib cage. The hip was measured at the broadest section of the hip. The body mass index (BMI) was calculated as weight (kg)/height $(m)^2$. The results were classified as <18.5 kg/m^2 underweight; 18.5-24.9 kg/m^2 normal; 25-29.9 kg/m^2 overweight; and ≥30.0 kg/m^2 obese (29). Waist circumference was classified as ≥94 cm in males and ≥80 cm in females were defined as under risk≥102 cm in males and ≥88 cm in females were defined as high risk for cardiometabolic diseases. A waist to hip ratio >1.0 in men and > 0.85 in women was determined as under risk for cardiometabolic diseases Mid-upper arm circumference was measured at midpoint between acromion and olecranon by standing with legs together and arm bent at 90 degrees. Calf circumference was measured at the broadest section in the plane perpendicular to the longitudinal line of the calf by standing with feet 20 cm apart (30). Waist to height ratio ≥0.5 for Turkish adults was associated with increased risk (31).

Statistical Evaluation

For the MNA classification frequency and percentage were calculated for each qualitative variable, while arithmetic mean and standard deviation were calculated for MNA, HEI-2015, and SF-36 according to demographic characteristics and anthropometric measurement classifications. For parametric assumptions Student's t test was used to compare quantitative variables between the two independent groups and one-way ANOVA post-hoc Tukey's test was used to compare the differences between the three independent groups. For correlation analysis between MNA, HEI-2015 and SF-

36, Pearson test of correlation was used. The p value less than 0.05 was accepted as statistically different. Statistical Package for the Social Sciences (SPSS) 18.0 was used for the statistical data analysis.

Results

Out of the participants, 5.4% obtained a MNA score of <17.0, 9.3% between 17.0-23.5 and 85.3% between 24.0-30.0.

Males had higher MNA, SF-36 MCS and SF-36 PCS scores than females (p <0.05). Those aged > 85 years had lower MNA scores as compared to those in other age groups, and those aged 65-74 had higher SF-36 MCS and SF-36 PCS scores as compared to those in other age groups (p <0.05). There was no statistically significant differences between the participants' HEI-2015, MNA, SF-36 MCS and SF-36 PCS scores with respect to BMI, waist circumference, waist/hip ratio and waist/height ratio (p> 0.05) (Table 1).

Table 1. Participants' HEI-2015, MNA, SF-36 scores according to demographic characteristics and anthropometric measurements of participants.

	HEI-2015 $\bar{\chi}$±S **(Min-Max)**	**MNA** $\bar{\chi}$±S **(Min-Max)**	**SF-36 MCS** $\bar{\chi}$±S **(Min-Max)**	**SF-36 PCS** $\bar{\chi}$±S **(Min-Max)**
Gender				
Male (M)	56.2±11.45 (31.1-83.1)	24.9±2.43 (13.0-26.0)	51.5±7.47 (29.9-72.2)	52.8±8.21 (32.0-67.1)
Female (F)	52.3±13.17 (18.1-83.9)	24.1±3.14 (13.0-26.0)	48.8±9.00 (22.0-72.8)	48.0±9.75 (29.2-68.7)
p	0.155	**0.012***	**0.048***	**0.004***
Age (year)				
65-74	55.7±12.59 (18.1-83.9)	24.8±2.70 (13.0-26.0)	52.0±7.62[b] (34.6-72.8)	53.3±7.97[c] (30.7-67.5)
75-84	52.6±12.63 (24.6-83.1)	24.4±2.77 (13.0-26.0)	48.8±8.83 (22.0-72.3)	48.5±9.63 (29.4-68.7)
≥85	52.4±12.12 (30.7-73.3)	22.7±3.76[a] (13.0-26.0)	46.9±8.70 (28.4-63.5)	42.6±8.65 (29.2-58.8)
p	0.119	**0.004**	**0.002**	**<0.001**
BMI (kg/m²)				
18.5-24.9	53.4±11.37 (31.6-78.2)	24.0±3.29 (13.0-26.0)	50.4±9.29 (22.0-72.8)	50.3±9.59 (31.6-64.1)
25.0-29.9	53.6±12.16 (26.0-80.1)	24.6±2.64 (13.0-26.0)	49.8±8.87 (22.1-67.7)	50.9±9.22 (29.4-68.7)
≥30.0	54.1±13.36 (18.1-83.9)	24.4±2.94 (13.0-26.0)	49.8±8.07 (28.4-72.2)	49.4±9.53 (29.2-67.5)
p	0.851	0.709	0.963	0.478
Waist circumference (cm)				
M: <94 F: <80	58.7±9.75 (43.3-75.3)	23.6±3.84 (13.0-26.0)	50.4±6.91 (34.0-63.4)	51.4±8.24 (39.4-63.6)
M: 94-102 F: 80-88	56.8±12.43 (31.3-80.1)	25.3±1.04 (21.0-26.0)	50.8±8.40 (22.1-67.8)	52.6±9. 39 (31.6-64.1)
M: >102 F: >88	53.0±12.74 (18.1-83.9)	24.4±2.99 (13.0-26.0)	49.8±8.56 (22.0-72.8)	49.5±9.36 (29.2-68.7)
p	0.055	0.070	0.744	0.124
Waist/Hip Ratio				
M: <1.0 F<0.8	57.8±11.00 (31.1-80.1)	24.7±2.73 (13.0-26.0)	51.2±7.45 (34.0-72.2)	51.7±8.30 (35.6-64.1)
M: ≥ 1.0 F: ≥0.8	53.0±12.83 (18.1-83.9)	24.4±2.91 (13.0-26.0)	49.7±8.63 (22.0-72.8)	49.7±9.53 (29.2±68.7)
p	0.208	0.533	0.269	0.227
Waist/Height Ratio				
<0.5	55.0±9.45 (45.3-66.3)	23.7±4.11 (16.5-26.0)	54.5±3.51 (50.0-58.5)	54.4±9.27 (40.3-63.6)
≥0.5	53.9±12.69 (18.1-83.9)	24.5±2.85 (13.0-26.0)	49.9±8.47 (22.0-72.8)	50.0±9.33 (29.2±68.7)
p	0.570	0.285	0.130	0.709
Total	53.9±12.62 (18.1-83.9)	24.4±2.89 (22.0-72.8)	50.0±8.49 (22.0-72.8)	50.0±9.44 (29.2-68.7)

Table 2. Participants' HEI-2015 and SF-36 scores by MNA classification

	MNA<17.0 (n=15)	MNA 17.0-23.5 (n=26)	MNA >23.5 (n=238)	p
HEI-2015	50.7±10.22 (26.2-73.8)	51.6±10.91 (35.9-73.3)	54.3±12.91 (18.1-83.9)	0.354
SF-36 MCS	42.6±11.85 (22.0-63.1)	44.2±6.51 (34.6-58.3)	51.0±7.97[a] (22.1-72.8)	**<0.001**
SF-36 PCS	45.9±9.50 (31.5-58.8)	42.2±8.14[b] (29.2-59.0)	51.1±9.12[b] (29.4-68.7)	**<0.001**

[a]: Statistically different than others (p<0.05); [b]: Statistically different than others (p<0.05)

Those with a MNA score > 23.5 had higher SF-36 MCS scores than those with other MNA scores (p <0.001). Those with a MNA score > 23.5 had higher SF-36 MCS scores than those with a score of 17.0-23.5 (p <0.001) (Table 2).

There was a weak positive correlation between HEI-2015 and SF-36 PCS scores (r=0.135, =0.024). There was a moderate positive correlation between MNA, SF-36 MCS and SF-36 PCS scores (r=0.323, p<0.001; r=0.284, p<0.001, respectively) (Figure 2).

There was a weak negative correlation between HEI-2015 scores, waist/hip and waist/height ratios (r= -0.183, p=0.023; r= -0.124, p=0.042, respectively). There was a weak negative correlation between SF-36 PCS scores and waist/height ratio (r= -0.243, p<0.001), and a moderate positive correlation with body muscle mass (r=0.314, p=0.011). There was a weak positive correlation between lean body mass, SF-36 PCS and MNA scores (r=0.224, p=0.001; r=0.128, p=0.049, respectively) (Table 3).

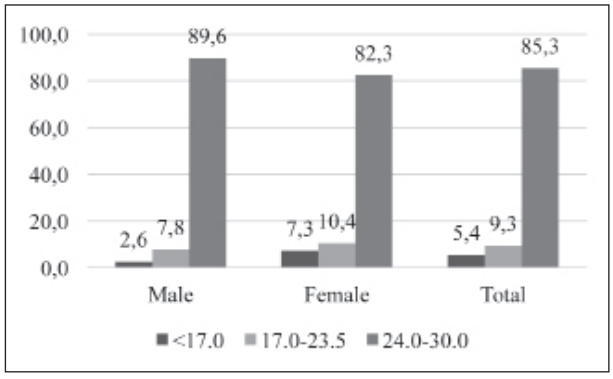

Figure 1. Distribution of participants by MNA classification

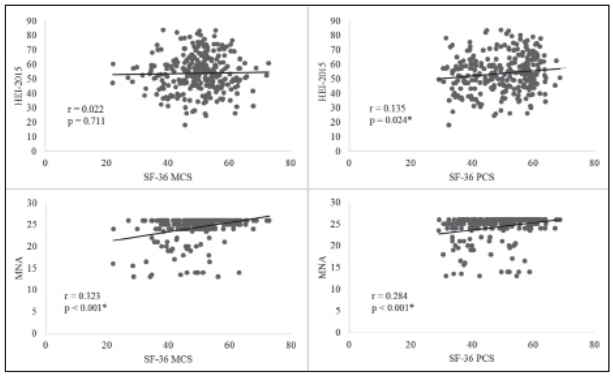

Figure 2. The relationship between participants' SF-36, HEI-2015 and MNA scores (* p<0.05)

Discussion

Chewing-swallowing problems, decreased sense of taste, anorexia, malnutrition and chronic diseases increase the risk of malnutrition in the elderly. A Turkish study has found that 5.8% of the elderly had malnutrition, and 49.2% were under the risk of malnutrition (32). Another study of different regions in Turkey has found that 4.2% of the elderly had malnutrition, and 21.9% were under the risk of malnutrition (33). One study, conducted in 2015 in the same region of Cyprus where the present study was conducted, has found no elderly individuals with malnutrition, but determined that 16.7% of them were at risk of malnutrition (34). The present study found that 5.4% of the elderly had malnutrition, and 9.3% were under the risk of malnutrition. Accordingly, although these studies were carried out with different samples, the present study results suggest that the rate of malnutrition has increased in this region. Socioeconomic status, age and lifestyle behaviors affect the quality of life in the elderly (35). Risk of malnutrition increases with aging, a factor affecting quality of life and malnutrition (36). The present study found that those aged > 85 years had the highest risk of malnutrition and those aged 65-74 had the highest physical and mental quality of life

Table 3. Participants' HEI-2015, MNA and SF-36 scores according to energy and macro nutrient intake and anthropometric measurements.

		HEI-2015	MNA	SF-36 MCS	SF-36 PCS
BMI (kg/m2)	r	-0.017	-0.072	-0.021	-0.102
	p	0.782	0.231	0.723	0.091
Waist circumference (cm)	r	-0.053	-0.027	0.016	-0.095
	p	0.385	0.655	0.788	0.119
Waist/Hip	r	**-0.183**	0.066	-0.014	0.083
	p	**0.023***	0.411	0.863	0.307
Waist/Height	r	**-0.124**	-0.091	-0.056	**-0.243**
	p	**0.042***	0.137	0.359	**<0.001***
Body fat	r	-0.082	-0.018	0.011	-0.084
	p	0.206	0.783	0.870	0.200
Lean body mass	r	0.125	**0.128**	0.105	**0.224**
	p	0.055	**0.049***	0.106	**0.001***

* p<0.05

(p<0.05). In addition, males had higher physical and mental quality of life and lower risk of malnutrition than females (p <0.05). However, other studies have found that males had a higher risk of malnutrition and lower quality of life (33, 37).

Studies of elderly individuals found an inverse relationship between malnutrition and health-related quality of life (32, 38-41). The present study found that those without a risk of malnutrition had higher mental and physical quality of life than those with a malnutrition risk (p <0.001). Malnutrition affects physical, mental and social functions, and is associated with decreased enjoyment of eating and anorexia (42). In addition, increased diet quality is associated with increased health-related quality of life, but also was affected by factors such as mood, appetite and anorexia (43). The present study also found that as the quality of diet increased, the physical quality of life increased, and that as the physical and mental quality of life increased, the risk of malnutrition decreased (p <0.05). One meta-analysis study has determined that malnourished individuals had a lower quality of life, and that interventions to improve nutritional status in these individuals increased their physical and mental quality of life (11). An increase in diet quality decreases the risk of cardiovascular diseases, type 2 diabetes, cancer and all types of mortality (44). An increase in diet quality is associated with a decrease in waist circumference, which is considered a risk for these diseases (45). Similarly, the present study found that as diet quality increased waist/hip and waist/height ratios decreased. One study of the elderly has found that increased waist circumference and waist/height ratio was associated with decreased cardiovascular disease risk (46). Another study of middle-aged and elderly individuals in China has determined that increased BMI, waist circumference and waist/height ratio was associated with increased mortality risk (47). One other study has reported that increased waist circumference was associated with decreased physical quality of life (48). The present study also found that as the waist/height ratio decreased and the lean tissue mass increased, and the physical quality of life increased. In addition, as the lean tissue mass increased, the risk of malnutrition decreased (p <0.05). Studies report that being underweight or overweight/obese is associated with increased risk of malnutrition and decreased quality of life (16, 49). Taking into account limitations of this study will be useful in obtaining more comprehensive data. These limitations can be summarized as follows. Firsty, only anthropometric measurements and relevant scales/tools were used in this study to evaluate malnutrition, diet quality and quality of life. However, in addition to anthropometric measurements, measuring muscle strength with hand dynamometer and making a more comprehensive assessment using some biochemical parameters such as

albumin, C-reactive protein and interleukins may be useful in establishing relationships with frailty in the elderly. Secondli, the present study did not consider drugs and nutritional support received by the elderly, so further studies can examine the effects on health-related quality of their life. Finally, determining the physical activity level via physical activity records and appropriate techniques may be useful in evaluating its effects on health-related quality of life in the elderly.

Conclusion

Increased age is associated with increased risk of malnutrition, and males have a lower risk of malnutrition than females. As diet quality increases, the quality of physical life increases. And as the quality of physical and mental life increases, the risk of malnutrition decreases. In addition, decreased waist/height ratio and increased lean tissue mass are associated with increased physical quality of life. Planning further cross-sectional, longitudinal and interventional studies with larger sample sizes to evaluate other factors that affect the relationship between malnutrition, diet quality and health-related quality of life in the elderly, is important in terms of developing preventive public health policies.

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