Original Article

HEALTH SCIENCES
MEDICINE

DOI: 10.32322/jhsm.1681741

J Health Sci Med. 2025;8(3):489-497

Are fat free mass, fat mass and meal frequency associated with malnutrition in institutionalized elderly: a cross-sectional study

Merve Özgür, Müjgan Öztürk

Department of Nutrition and Dietetics, Faculty of Health Sciences, Doğu Akdeniz University, Famagusta, Northern Cyprus

Cite this article as: Özgür M, Öztürk M. Are fat free mass, fat mass and meal frequency associated with malnutrition in institutionalized elderly: a cross-sectional study. *J Health Sci Med.* 2025;8(3):489-497.

Received: 22.04.2025 ◆ **Accepted**: 15.05.2025 ◆ **Published**: 30.05.2025

ABSTRACT

Aims: Malnutrition is a major concern that increases morbidity and mortality in older adults living in nursing homes. This study aimed to evaluate the nutritional status, body composition, and dietary intake of older adults in nursing homes while identifying the risk factors contributing to malnutrition.

Methods: This is a descriptive and cross-sectional study conducted with 150 older adults from two nursing homes. Malnutrition was assessed using the full version of mini nutritional assessment (MNA). Data were collected by face to face interview and anthropometric measurements and body composition analysis were performed. Statistical analyses included the Mann-Whitney U test, independent sample T test, Chi-square test, Spearman correlation coefficient and logistic regression.

Results: Among participants 81.80% were male. Mean age was 75.13±7.35 years. The prevalence of malnutrition/malnutrition risk was 14.7%. While energy, macronutrient intake, and nutrient adequacy ratio (NAR) were similar between participants with good nutritional status and malnutrition/malnutrition risk, vitamin E intake was significantly higher in older adults with good nutritional status (p=0.009). A higher number of chronic diseases significantly increased the risk of malnutrition (OR=2.083, p=0.038, OR:2.065, p=0.027). However, consuming more meals per day (OR=0.086 p<0.001, OR:0.130, p=0.001), higher fat mass (OR=0.911, p=0.030) and a greater Fat Free Mass Index (OR 0.697, p=0.009) were found to be protective.

Conclusion: Assessing nutritional status, determining food consumption and identifying the factors contributing to malnutrition are crucial for the early prevention and management of malnutrition in older adults. Longitudinal studies with larger sample sizes are needed to develop effective strategies for improving the nutritional well-being of nursing home residents.

Keywords: Malnutrition, nursing homes, elderly, meal frequency, Fat Free Mass Index, FFMI, fat mass

INTRODUCTION

Aging is defined as accumulation of damage as a result of impaired repair mechanisms, and progressive loss of function which finally results to increase in risk of morbidity and mortality.[1] World's population is aging which is evidenced with people aged over 65 years or over worldwide outnumbered the children under five years old.[2] Moreover projections indicate number of people over 60 years old will become 1.4 billion by 2030 and 2.1 billion by 2050. Aging increases the need for primary health care and long term care and better trained workforce in society.[3]

One of the major problems in elderly is malnutrition, which causes worsening of health and life quality and increasing risk of infection, pressure ulcers and decreasing wound healing.[4,5] Malnutrition is a state of lack of nutritional intake as a result of starvation, disease or ageing which leads to alteration in body composition and body cell mass leading to a decrease in physical and mental function and impaired disease outcome.[6]

Prevalence of malnutrition/malnutrition risk is lower in community dwelling older adults,[7,8] while it increases in long term care facilities or in nursing homes.[5,7-9] There are many reasons contributing to malnutrition in older adults including physiological, socioeconomic and neuropsychological factors which causes inadequate dietary intake leading to undernutrition.[4] Biological changes related to aging such as decreased gastric emptying time, oral changes leading to difficulty in chewing, swallowing and loss of sense of taste and smell may cause decreased energy and nutrient intake.[4,10] In addition to this, chronic diseases increase metabolic demands and impairs nutrient absorption and also cause polypharmacy which can also lead to decrease in food intake.[10,11] To optimize nutritional status and reduce malnutrition/malnutrition risk in nursing homes, optimal dietary intake with adequate energy and protein is needed however data regarding about food and nutrient intake in nursing homes is rare.[9,12] Therefore it is essential to detect early malnutrition risk with systematic

Corresponding Author: Müjgan Öztürk, mujgan.ozturk@emu.edu.tr

tools such as Mini Nutritional Assessment (MNA) and monitor food intake in nursing homes[5]. Futhermore both aging and malnutrition leads to alteration in body composition which results in a significant decrease especially in fat free mass that may cause a decline in functional capacity.[9,13]

The aim of this study was to assess the nutritional status, body composition and energy and nutrient intake of older adults living in nursing homes and find the potential risks associated with malnutrition.

METHODS

Study Design and Participants

This is a descriptive and cross-sectional study which was conducted in 2 nursing homes affiliated with municipalities located in Bursa province of Turkiye, between March-May 2017. Study was designed according to the guidelines in Declaration of Helsinki and approved by the Doğu Akdeniz University Scientific Researches and Publication Ethics Committee (Date: 06.03.2017, Decision No: 2017/39-05). Study was conducted with older adults 60 years and over who do not have any obstacles for anthropometric measurements, who can communicate, and who were willing to give an informed consent. Older adults who were bed ridden (n: 11), had dementia (n: 12) and who had psychiatric problems (n: 2) were excluded from the study. The study was completed with 150 older adults (40 women, 110 men). In 2017, there were only two nursing homes affiliated with municipalities in Bursa province. Both institutions agreed to participate in the research. Therefore, instead of performing a priori sample size calculation, we adopted a total population sampling method by including all eligible and consenting residents from these two nursing homes. The sample size (n: 150) reflects the entire accessible and consenting population within the study setting during the data collection period.

Primary outcomes of the study were defined as assessment of nutritional status, assessment of body composition and its relation with nutritional status and finding the association between malnutrition/malnutrition risk and chronic diseases, polypharmacy, eating habits and energy and nutrient intake.

Data Collection

All participants were interviewed face to face via a survey. The survey consists of 4 sections. First section was developed by the authors and aimed to determine the general background, eating habits and health status of the participants. The second section included a 24 hour dietary recall in order to analyze energy and nutrient intake of the older adults. For the assessment of nutritional status MNA full form was used in the third section and 4th section included anthropometric measurements and body composition data which were measured by the researcher dietitian.

General Background, Eating Habits and Health Status

Data relating to socio-demographic and personal features, educational status, duration of stay in a nursing home, number and type of chronic diseases and medications used, meal frequency, appetite, edibility of meals served in nursing homes were collected in this section.

24 Hour Dietary Recall

Food consumption was assessed with a 24-hour dietary recall. Energy and nutrient intake were analyzed with Nutrition Information Systems Package Program (Beslenme Bilgi Sistemleri Paket Programı 7.0 (BEBİS 7.0).[14] Standard recipes of the food served in nursing homes were applied to the program and the energy and nutrient intake of the older adults were calculated. For the assessment of the adequacy of participant's nutritional intake, nutrient adequacy ratio (NAR) was calculated according to the formula below.[15] Turkish Dietary Guidelines 2022 was taken as reference intake of specific nutrients according to age and gender.[16]

$$NAR = \frac{\text{Daily Specific nutrient intake}}{\text{Reference intake of a secific nutrient}}$$

Mini Nutritional Assessment Full Form (MNA-FF)

The MNA FF has been developed and validated as a tool to assess nutritional status in older adults, commonly used in nursing homes, community, hospitals, and home care. According to the full MNA®, a total score greater than 24 indicates satisfactory nutritional status, a score between 17 and 23.5 indicates risk of malnutrition, and a score <17 indicates malnutrition.[17] Although the full MNA® categorizes individuals into three nutritional status groups, the number of older adults identified as malnourished in this study was very small (0.7%). Therefore, those classified as malnourished and those at risk of malnutrition were combined into a single group for analysis, and all statistical evaluations were conducted based on two groups.

Anthropometric Measurements

For assessment of body composition [total body fat (kg), body fat percentage (%), fat free mass (FFM) (kg)], bioelectric impedance analysis (BIA) was used which is a fast, inexpensive, noninvasive, and a portable method.[18] TANITA BC 418, a segmental body composition analyzer (Tokyo, Japan) with single-frequency constant electrical currents of 500 µA at 50 kHz was used for measurements with an empty bladder, fasting for 8 hours, and wearing light clothing without shoes to the nearest 0.1 kg.[19]

A stadiometer was used to measure height standing still, in an upright position and the head in the Frankfurt plane without shoes. A flexible non stretch tape was used to measure middle upper arm, calf circumference (MUAC) to the nearest 0.1 cm. For measurement of MUAC the arm was first bent to 90 degree angle and the midpoint between olecranon and acromion processes was identified and marked. The arm was then allowed to hang straight down and a measuring tape was wrapped around marked midpoint. Calf circumference (CC) was measured by wrapping the tape around the widest part of the calf. Body-mass index (BMI) (kg/m^2) was calculated by dividing body weight (kg) into the square meters of height[20] and Fat Free Mass Index (FFMI) was calculated by dividing FFM into the square meters of height by the researcher.[21]

Statistical Analysis

Collected data was analyzed with Statistical Package for Social Science 24.0 software (SPSS). Arithmetic mean±standard deviation, median and minimum maximum values were

used for presenting quantitative variables. Shapiro Wilk test was used for testing normality. For independent variables with 2 categories, Mann-Whitney U test was used. Fisher's and Pearson's chi-square was used for comparing qualitative variables. Correlation between variables was evaluated with the Spearman's Correlation Coefficient. Logistic regression was used to relate malnutrition/malnutrition risk with age, gender, marital status, meal frequency, number of chronic diseases, polypharmacy, FFMI and fat mass in 2 different models. For defining malnutrition/malnutrition risk cut of point of MNA was used. Since BMI, CC and MUAC are the variables used to calculate MNA score they are not included into the regression models. A p-value of <0.05 was deemed as statistically significant.

RESULTS

The study consisted of 110 (73.3%) male and 40 (26.70%) female total 150 participants who were 60 years and older. According to the MNA, 85.30% of the participants had good nutritional status. While 16.40% of males had malnutrition/malnutrition risk, only 10% of female had malnutrition/malnutrition risk. There was no difference in MNA scores between males and females (p>0.05) (Table 1).

Comparison of general characteristics, health status and eating habits of the participants were shown in Table 2. No difference was found in between the groups according to age, sex, educational status, length of stay in the nursing home, loss of appetite and ability to eat meals served in the nursing

Table 1. Distribution of nutritional status of the older adults according to gender

MNA score		X±SD		Minimum		Maximum		p*
Male (n=110)		24.8±2.70		15.00		29.00		0.139
Female (n=40)		25.32±2.77		17.50		29.00		
		Male (n=110)		Female (n=40)		Total (n=150)		
		n	%	SD	%	n	%	p**
MNA classification	Good nutritional status	92	83.60	36	90.00	128	85.30	0.438
	Malnutrition risk & malnutrition	18	16.40	4	10.00	22	14.70	

p<0.05, *Mann-Whitney U test, **Fisher's Chi-square, MNA: Mini Nutritional assessment, SD: Standard deviation

Table 2. Distribution of socio-demographic characteristics, health status and eating habits of participants according to nutritional status

	Good nutritional status		Malnourished/malnutrition risk		Total		p
Gender*	**n**	**%**	**n**	**%**	**n**	**%**	
Male	92	71.90	18	81.80	110	73.30	0.330
Female	36	28.10	4	18.20	40	26.70	
Age (years)§	**X±SD**	**Min-max**	**Median**	**X±SD**	**Min-max**	**Median**	
Mean age§	75.13±7.35	62-102	74.00	72.91±7.75	65-96	71.00	0.109
Age (years)*	**n**	**%**	**n**	**%**	**n**	**%**	
65-75	66	51.60	15	68.20	81	54.00	
76-85	54	42.20	6	27.30	60	40.00	0.351
85+	8	6.30	1	4.50	9	6.00	
Marital status*	**n**	**%**	**n**	**%**	**n**	**%**	
Married	77	60.20	6	27.30	83	55.30	0.004
Single/divorced/widow	51	39.80	16	72.70	67	44.70	
Educational status*	**n**	**%**	**n**	**%**	**n**	**%**	
Illiterate	16	12.50	2	9.10	18	12.00	
Primary/secondary school	70	54.70	15	68.20	85	56.70	0.498
High school/university	42	32.80	5	22.70	47	31.30	
Duration of stay in nursing home*	**n**	**%**	**n**	**%**	**n**	**%**	
<12 months	69	53.90	11	50.00	80	53.40	
1-5 years	34	26.60	4	18.20	38	25.30	0.386
>6 years	25	19.50	7	31.80	32	21.30	
Loss of appetite‡	**n**	**%**	**n**	**%**			
Yes	24	18.80	5	22.7	29	19.30	0.426
No	104	81.30	17	77.3	121	80.70	
Able to eat meals served in nursing home‡	**n**	**%**	**n**	**%**	**n**	**%**	
Yes	105	82.00	17	77.3	122	81.30	0.392
No	23	18.00	5	22.7	28	18.70	
Medication use	**X±SD**	**Min-max**	**Median**	**X±SD**	**Min-max**	**Median**	
Medication use per day§	2.88±1.72	0-8	3.00	4.36±1.94	1-8	4.00	0.002
Chronic diseases	**X±SD**	**Min-max**	**Median**	**X±SD**	**Min-max**	**Median**	
Number of chronic diseases§	3.14±1.82	0-8	3.00	4.54±1.59	2-8	4.00	0.001
Total number of meals consumed§	**X±SD**	**Min-max**	**Median**	**X±SD**	**Min-max**	**Median**	
Meals consumed/day	4.17±0.89	3-6	4.00	2.95±0.78	1-4	3.00	<0.001

‡Fisher's Chi-square, *Pearson's Chi-square, §Mann-Whitney U test, n: Number of participants, X±SD: Mean±standard deviation, Min: Minimum, Max: Maximum

home (p>0.05). On the contrary it was found that the older adults with good nutritional status had fewer chronic diseases, used less medication, consumed more meals per day and had a significantly higher rate of being married when compared to those with malnutrition/malnutrition risk (p<0.05).

Table 3 shows the comparison of anthropometric measurements according to nutritional status and gender. No difference was found between the female participants. However male participants with good nutritional status had significantly higher weight, total body fat (kg), body fat percentage (%), FFM (kg) and FFMI (kg/m^2) than the participants with malnutrition/malnutrition risk (p<0.05).

Comparison of energy and macronutrient intake and NAR according to nutritional status was shown on Table 4. No significant difference was found between the participants with good nutritional status and malnutrition/malnutrition risk except the vitamin E. Nutrient adequacy ratio of vitamin E was significantly higher in participants with good nutritional status (p=0.009).

Table 5 shows the correlation between MNA score and number of chronic diseases, number of medications used, meals consumed and age. A moderate strong negative correlation was found between number of chronic diseases, and number of medications used per day while a moderate strong positive correlation was found between total number of meals consumed per day (p<0.001). According to these results as number of chronic diseases and medication used increases MNA score decreases, on the contrary as meal frequency increases MNA score increases.

Many factors may influence nutritional status. According to the models in Table 6, age, gender, marital status and number of medications used were not associated with nutritional status. Meal frequency, fat mass and FFMI were found to be protective against malnutrition/malnutrition risk while having chronic diseases was found to be a risk factor for malnutrition/malnutrition risk. One unit increase in daily meal count was found 11.62 fold (OR: 0.086) (p<0.001) protective in the first model and 7.69 fold (OR:0.130) (p<0.001) in the second model and one unit increase in FFMI (kg/m^2) (p=0.009) has a 1.43 fold (OR:0.697) (Model 1), one unit increase in fat mass (kg) (p=0.030) has a 1.09 fold (OR=0.911) protective from malnutrition/malnutrition risk (Model 2). On the contrary for each additional chronic disease malnutrition risk increases by 2.083 times (p=0.038) in the first model and 2.065 times (p=0.027) in the second model.

DISCUSSION

Malnutrition is a growing problem in older adults, especially for those over 65 years of age which leads to muscle weakness, decreased functionality, increased risk of infection and mortality. Therefore, early diagnosis of malnutrition is very important to prevent malnutrition or slow the progression of its consequences.[22] This study was conducted in order to assess malnutrition prevalence in nursing homes, to determine the body composition of older adults and find the factors contributing to malnutrition. Based on full MNA 14.70% of the older adults found to have malnutrition risk/malnutrition (Table 1) which was lower when compared to other studies. Various studies showed different malnutrition/

Table 3. Comparison of anthropometric measurements of participants according to gender and nutritional status

	MNA										
Anthropometric easurements	**Good nutritional status**					**Malnutrition risk & malnutrition**					
Male (SD=110)	**n**	**X±SD**	**Median**	**Min**	**Max**	**n**	**X±SD**	**Median**	**Min**	**Max**	**p***
Height (cm)	92	164.32±9.00	165.00	140.00	183.00	18	166.11±6.29	166.50	155.00	180.00	0.588
Weight (kg)	92	76.11±13.74	75.50	50.00	108.90	18	64.46±13.23	59.40	49.30	94.20	0.002
BMI (kg/m^2)	92	28.34±5.19	27.05	19.10	41.10	18	23.38±4.82	22.40	16.70	34.60	<0.001
MUAC (cm)	92	27.51±3.12	28.00	20.00	34.00	18	24.58±2.93	25.00	20.00	31.00	0.001
Calf circumference (cm)	92	32.03±2.19	32.00	27.00	38.00	18	28.33±2.32	28.00	26.00	36.00	<0.001
Total body fat (kg)	92	21.15±8.49	20.00	8.90	50.60	18	15.02±7.80	12.50	4.90	31.30	0.005
Body fat percentage (%)	92	26.74±7.28	26.10	12.70	49.90	18	21.07±7.37	20.65	9.70	38.20	0.005
Fat free mass (kg)	92	54.74±8.49	54.50	28.40	77.8v	18	50.48±6.46	50.90	41.60	65.80	0.027
Fat Free Mass Index (kg/m^2)	92	20.27±2.77	19.90	10.50	28.50	18	18.28±2.06	17.70	15.00	24.10	0.001
Female (SD=40)	**n**	**X±SD**	**Median**	**Min**	**Max**	**n**	**X±SD**	**Median**	**Min**	**Max**	**p***
Height (cm)	36	149.99±9.15	148.50	132.00	176.00	4	156.25±7.89	156.50	147.00	165.00	0.175
Weight (kg)	36	71.50±17.59	67.90	47.80	141.00	4	68.57±13.36	73.00	49.20	79.10	0.892
BMI (kg/m^2)	36	31.43±5.37	31.05	23.30	42.30	4	28.62±7.92	29.90	18.10	36.60	0.513
MUAC (cm)	36	27.61±3.58	27.00	20.00	36.00	4	25.25±3.77	25.00	21.00	30.00	0.239
Calf circumference (cm)	36	30.92±1.81	31.00	27.00	34.00	4	27.75±1.26	29.00	27.00	30.00	0.022
Total body fat (kg)	36	26.35±9.65	24.90	11.10	45.90	4	23.47±10.72	25.60	9.40	33.20	0.718
Body fat percentage (%)	36	37.50±8.54	39.30	16.50	50.70	4	32.82±10.56	35.10	19.10	42.00	0.344
Fat free mass (kg)	36	42.29±7.46	41.90	24.60	63.30	4	49.32±13.35	45.40	37.80	68.60	0.176
Fat Free Mass Index (kg/m^2)	36	18.87±3.10	19.20	9.30	24.30	4	20.28±5.33	20.20	13.80	26.80	0.528

*Mann-Whitney U test, X±SD: Mean±standard deviation, Min: Minimum, Max: Maximum, MNA: Mini nutritional assessment, BMI: Body-mass index, MUAC: Middle upper arm, calf circumference

Table 4. Comparison of the daily energy and macronutrient intake (a) and NAR (b) of elderly individuals according to nutritional status									
	Good nutritional status (n=128)				Malnutrition risk & malnutrition (n=22)				
Energy and macronutrients (a)	**X±SD**	**Median**	**Min**	**Max**	**X±SD**	**Median**	**Min**	**Max**	**p***
Energy (kcal)†	1860.27±358.33	1841.91	937.00	2688.91	1734.83±485.30	1715.58	701.89	2484.74	0.154
Protein (gr)§	80.83±20.65	77.73	39.37	155.19	75.77±23.77	74.02	26.82	121.37	0.543
Protein (%)§	17.78±3.12	17.00	12.00	30.00	17.95±4.71	18.00	12.00	37.00	0.991
Carbohydrate (gr)†	155.86±41.03	155.84	58.01	248.72	138.82±51.83	141.04	48.03	228.97	0.086
Carbohydrate (%)§	33.50±6.39	33.00	18.00	60.00	31.59±6.36	32.00	22.00	42.00	0.274
Fat (gr)†	100.75±23.37	100.77	27.07	161.05	96.72±30.19	103.58	32.31	151.85	0.476
Fat (%)§	48.72±7.22	49.00	23.00	69.00	50.41±8.83	51.00	22.00	61.00	0.201
NAR of nutrients (b)	**X±SD**	**Median**	**Min**	**Max**	**X±SD**	**Median**	**Min**	**Max**	**p***
Protein (gr)§	1.07±0.31	1.04	0.44	1.87	1.15±0.44	1.09	0.47	1.95	0.570
Carbohydrate (gr)§	1.19±0.31	1.19	0.45	1.91	1.06±0.39	1.08	0.37	1.76	0.154
Fiber (gr)§	0.86±0.30	0.84	0.22	2.66	0.87±0.28	0.97	0.24	1.38	0.293
Vitamin A (mcg)§	1.78±0.94	1.56	0.30	5.63	1.61±0.80	1.36	0.40	3.72	0.235
Vitamin E (mg)§	1.22±0.40	1.19	0.15	2.44	0.94±0.46	1.05	0.19	1.91	0.009
Vitamin K (mcg)§	3.34±1.52	2.99	0.27	8.21	2.78±1.39	2.66	0.54	6.09	0.141
Vitamin B12 (µg)§	1.41±0.59	1.25	0.50	3.13	1.33±0.63	1.19	0.23	2.68	0.690
Vitamin B1 (mg)§	0.64±0.16	0.65	0.28	1.41	0.62±0.15	0.62	0.19	0.90	1.000
Vitamin B2 (mg)§	1.17±0.27	1.17	0.55	1.76	1.09±0.28	1.13	0.32	1.39	0.410
Vitamin B6 (mg)§	0.76±0.18	0.77	0.38	1.21	0.68±0.24	0.69	0.18	1.15	0.151
Folate (µg)§§	0.96±0.27	0.95	0.44	2.64	0.90±0.22	0.90	0.35	1.33	0.547
Calcium (mg)§	0.95±0.23	0.97	0.30	1.44	0.93±0.28	0.99	0.28	1.38	0.784
Potassium (mg)§	0.47±0.12	0.46	0.19	0.98	0.46±0.13	0.52	0.16	0.63	0.728
Magnesium (mg)§	0.73±0.18	0.72	0.32	1.27	0.72±0.19	0.72	0.25	0.99	0.892
Phosphorus (mg)§	2.12±0.42	2.09	1.15	3.18	2.06±0.51	2.13	0.71	2.67	0.842
Iron (mg)§	1.05±0.27	1.05	0.42	2.07	0.97±0.28	1.01	0.20	1.37	0.459

§Mann-Whitney U test, †Independent sample T test, X±SD: Mean±standard deviation, Min: Minimum, Max: Maximum, NAR: Nutrient adequacy ratio

Table 5. Correlation of age, number of medications used, number of chronic diseases and meal frequency with MNA score		
Variable		**MNA score**
Age	r	-0.097
	p	0.239
Number of medications used daily	r	-0.453
	p	<0.001
Number of chronic diseases	r	-0.372
	p	<0.001
Total number of meals consumed daily	r	0.493
	p	<0.001

r: Spearman correlation coefficient, MNA: Mini nutritional assessment

malnutrition risk prevalence altering between 16-63%.[5,7-9] The low prevalence can be explained with the selection criteria of this study which excluded the patients who were bed ridden, had dementia and psychiatric problems and moreover the variation between all these studies might be related with different screening methods used for detecting malnutrition. Even though malnutrition is an important problem in nursing homes or residential care centers still there is no universal malnutrition screening method.[22]

When anthropometric measurements and body composition data were analyzed, it was found that male participants who were malnourished/at risk of malnutrition had significantly lower weight (kg), BMI (kg/m^2), MUAC (cm), CC (cm), total body fat (kg), body fat percentage (%), FFM (kg) and FFMI (kg) than the ones who had good nutritional status ($p<0.05$). For the female participants the only significant difference was with CC. Calf circumference of participants who were malnourished/at risk of malnutrition was lower ($p=0.022$). A study conducted with 154 community dwelling older adults which analyzed BMI, MUAC, CC, FMI, FFM and FFMI reported no significant difference between the well-nourished participants and participants at risk of malnutrition about BMI, MUAC, CC, FMI and FFMI. The only difference found between the groups was FFM.[11] On the contrary, a study which was conducted with 100 instiutionalized older women found that the ones who were malnourished had significantly lower weight, BMI, body fat (%), MUAC and CC than the ones who were well nourished.[23] Another study which was conducted with 296 geriatric obese outpatients, it was found that patients who were undernourished had significantly lower MUAC, CC, skeletal muscle mass, FFM, however no difference was found about BMI.[24] Most of the screening methods assessing malnutrition use anthropometric measurements as a

Table 6. Association of malnutrition/malnutrition risk with respect to age, gender, meal frequency, number of chronic diseases, daily medication used and FFMI

		Model 1		
Malnutrition/malnutrition risk*	**B**	**SE**	**p**	**OR (95% CI)**
Constant	10.007	5.165	0.053	22181.152
Age (years)	-0.008	0.058	0.895	0.992 (0.887-1.111)
Gender (Ref: female)	-0.590	0.884	0.505	0.554 (0.098-3.135)
Marital status (Ref: married)	0.691	0.732	0.346	1.995 (0.475-8.380)
Total number of meals consumed daily	-2.448	0.656	<0.001	0.086 (0.024-0.312)
Number of chronic diseases	0.734	0.354	0.038	2.083 (1.041-4.168)
Number of medications used daily	0.252	0.324	0.437	1.286 (0.682-2.426)
FFMI (kg/m^2)	-0.362	0.139	0.009	0.697 (0.530-0.915)
Nagelkerke R^2		58.8%		
		Model 2		
Malnutrition/malnutrition risk*	**B**	**SE**	**p**	**OR (95% CI)**
Constant	3.124	4.439	0.482	22.735
Age (years)	-0.003	0.055	0.963	0.997 (0.896-1.110)
Gender (Ref: female)	0.045	0.868	0.959	1.046 (0191-5.731)
Marital status (Ref: married)	0.686	0.731	0.348	1.985 (0.474-8.319)
Total number of meals consumed daily	-2.038	0.609	0.001	0.130 (0.040-0.430)
Number of chronic diseases	0.725	0.328	0.027	2.065 (1.086-3.926)
Number of medications used daily	0.237	0.296	0.424	1.267 (0.709-2.264)
Fat mass (kg)	-0.094	0.043	0.030	0.911 (0.837-0.991)
Nagelkerke R^2		56.7%		

*Malnutrition/malnutrition risk is defined according to the MNA score, MNA: Mini nutritional assessment, FFMI: Fat Free Mass Index, SE: Standard error, OR: Odds ratio, CI: Confidence interval, B: Beta coefficient

determinant of malnutrition, moreover low muscle mass has also recently been used as a part of malnutrition definition[25] so it is expected to see lower anthropometric measurements in malnourished patients. In this current study it was found similar results with other studies about anthropometric measurements in males, the reason that there was no difference in anthropometric measurements of females is thought to be related with lower number of females in whole sample and low malnutrition/malnutrition risk percentage which caused an imbalance between the groups. When further analyses were done about body composition parameters, it was found that each unit increase in fat mass (kg) (OR: 0.911) and FFMI (kg/m^2) (OR: 0.697) were protective against malnutrition/malnutrition risk ($p<0.05$). Parallel to this study, a study done in China with 386 older adults in nursing homes also found that body fat mass, muscle strength and Skeletal Muscle Index are valid predictors for assessing nutritional risk.[26] A prospective cohort study done with 378 older hospital patients also found that high risk of malnutrition was significantly associated with low muscle mass.[27] Another longitudinal study conducted in Mexico with 241 older adults found that excess fat mass was protective against risk of malnutrition.[28]

Although one of the main determinants of nutritional assessment is the assessment of food intake which was strengthened by the Global Leadership Initiative on Malnutrition (GLIM) consensus,[13] there are few studies analyzing energy and nutrient intake in nursing home residents according to their nutritional status.[9,29] In this study a single 24-hour food recall was used to assess dietary intake. Analysis of the data showed that, energy and macronutrient intakes were similar between the groups ($p>0.05$). Nutrient adequacy ratio of nutrients were also evaluated according to the Turkish Dietary Guidelines, which also showed that there were no difference between the groups except for vitamin E. Older adults with good nutritional status had a significantly higher adequate intake of vitamin E than those with malnutrition/malnutrition risk ($p=0.009$). Although no difference was found between the groups it was seen that both of the groups had inadequate intakes of fiber, vitamin B1, vitamin B6, folate, calcium, potassium and magnesium (**Table 4**) which shows that even though nutritional status was assessed as well nourished, micronutrient intake may be inadequate. A study conducted in Belgium with 74 nursing home residents, which assessed nutritional intake by weighed food records over a 5-day period found that older adults with good nutritional status consumed significantly more energy but similar carbohydrate (g), protein (g) and fat (g) than malnourished ones.[29] Another study done with both institutionalized and community-dwelling elderly, that assessed nutritional status with 2 non-consecutive 24 hour recalls, 8-15 days apart, it was found that inadequate nutrient intake was generally higher for those at risk of malnutrition or malnourished (except for carbohydrates and protein) than for those who were well nourished.[9] Another study done in Portugal with 563 nursing home residents and 837 community dwelling older adults,

assessed dietary intake with 24 hour dietary recalls that repeated every 8-15 day apart across a whole year. Among both in nursing home residents and community dwellers energy intake was inversely associated with malnutrition risk. For macronutrients among nursing home residents, they found higher intake of carbohydrate, fat, monounsaturated fat, polyunsaturated fat and fiber, was protective against being at risk of malnutrition or malnourished. However, when macronutrient intake was adjusted according to the total energy intake the significance for macronutrients were lost. Regarding micronutrients vitamin C, sodium, potassium and magnesium are found associated with malnutrition risk. However, when model was adjusted according to energy intake significance was lost again. In community dwellers similar to nursing home residents, protein, total fat, monounsaturated fat, sodium, potassium and magnesium were inversely associated with malnutrition risk, but after adjusted to energy intake only sodium, and magnesium intake remain significantly associated.[30] When all these studies were examined, it was seen that studies evaluating energy and nutrient intakes have variations in their assessment methods, which may be the reason for the different outcomes.

Various demographic factors and factors related with health status may affect nutritional status such as age, education, marital status, chronic diseases and polypharmacy.[10,11] In this current study, it was found that older adults with good nutritional status had higher rates of being married, had significantly fewer chronic diseases and used fewer medications/day than those with malnutrition/malnutrition risk ($p<0.05$). On the other hand age, gender, educational status and duration of stay in nursing home did not differ between the groups ($p>0.05$) (Table 1). Moreover as the number of medications and chronic diseases increases MNA score decreases, on the contrary when the number of meals consumed increases MNA score increases ($p<0.05$) (Table 5). When further analysis was done for the significant variables, with multiple logistic regression analysis, number of chronic diseases were found to be significantly associated with malnutrition/malnutrition risk ($p<0.05$) while number of medications used and marital status were not ($p<0.05$). An additional chronic disease significantly increases malnutrition/malnutrition risk (OR: 2.083 model 1, OR: 2.065 model 2) ($p<0.05$). Different form our study, a study conducted with 28,004 elderly in India found that aging, being male, being widowed/divorced/separated and having fewer years of education were associated with being underweight in rural areas of India.[31] A study conducted with community dwelling elderly in Turkiye also found that increase in chronic diseases increases the risk of malnutrition, while gender and educational status did not pose a risk. However different from our study, they also found that aging and not being married were also significant risk factors.[32] Bayrak et al conducted a study with 238 community dwelling elderly also found no difference between the groups according to gender, educational status and marital status, however also no relationship with number of medications per day and number of chronic diseases were shown.[33] Another study done in Turkiye with 356 geriatric outpatients who admitted to a hospital. It was found that as number of chronic diseases and number of medications increases MNA score decreases.[34]

Several factors related with eating may affect nutritional status in elderly such as decreased appetite, long overnight fast and eating fewer number of meals.[35,36] In this current study it was found that older adults with good nutritional status eat more meals than those with malnutrition/malnutrition risk and when logistic regression analysis was done it was seen that each one unit increase in number of meals is protective (OR: 0.086 model 1, OR: 0.130 model 2) against malnutrition/malnutrition risk ($p<0.05$). Parallel to our findings, a cross-sectional study conducted 1771 older hospital patient also found that eating fewer than four meals per day increases malnutrition risk 1.878, and malnutrition 3.099 times.[35] Different from our study Bayrak et al.[33] conducted a study with 238 community dwelling elderly and found no difference about meal frequency between the older adults with good nutritional status and malnutrition/malnutrition risk. Another study done in Ethiopia with 594 community dwelling older adults reported that, eating less than 3 meals per day significantly increases undernutrition (OR: 2.01) ($p<0.05$).[37] Moreover, a study with 115 older adults in Turkiye, also found that those eating 1-2 meals/per day had significantly lower MNA scores than those eating 3-4 and 4-6 meals.[38] Evaluating the meal concept from different perspectives is very important since it is complex[36] and in order to make further assumptions longitudinal studies, with more precise definitions related to meals or eating occasions are needed.

Limitations

One of the limitations of this study was the self-reported dietary assessment which may have resulted in under or over reporting of the energy and nutrients consumed by the patients due to various reasons such as social norms and personal beliefs. Moreover a single 24 hour dietary recall may not reflect day to day variability in the diet. Weighed food records for more than one day may provide more accurate results. Another limitation of this study is, nursing homes were not randomly selected since this study was only possible in cooperating institutions. Therefore, these institutions may not be represent all nursing homes.

CONCLUSION

As a conclusion, in district of Bursa, among the nursing home residents malnutrition/malnutrition risk was determined as 14.70%. According to our findings increase in number of chronic diseases, increased risk of malnutrition while increase in fat mass, FFMI and number of meals eaten per day were found to be protective. Understanding these factors when caring for the elderly can help healthcare professionals for prevention of malnutrition. Longitudinal studies with larger sample sizes are needed to support these results and to assess energy and nutrient intake.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Doğu Akdeniz University Scientific Researches and Publication Ethics Committee (Date: 06.03.2017, Decision No: 2017/39-05).

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Keshavarz M, Xie K, Bano D, Ehninger D. Aging-what it is and how to measure it. *Mech Ageing Dev.* 2023;213:111837. doi:10.1016/j.mad.2023.111837
2. World Health Organization (WHO). Aging. Accessed April 18, 2025. https://www.who.int/health-topics/ageing#tab=tab_1
3. United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects: Highlights (ST/ESA/SER.A/423); 2019. Accessed April 18, 2025 https://population.un.org/wpp/assets/Files/WPP2019_Highlights.pdf
4. Katsas K, Mamalaki E, Kontogianni MD, et al. Malnutrition in older adults: correlations with social, diet-related, and neuropsychological factors. *Nutrition.* 2020;71:110640. doi:10.1016/j.nut.2019.110640
5. Castaldo A, Zanetti ES, Nobili A, et al. Food intake and prevalence of malnutrition in nursing homes. A multicenter observational study. *JGG.* 2022;70:223-236.
6. Cederholm T, Bosaeus I, Barazzoni R, et al. Diagnostic criteria for malnutrition-an ESPEN consensus statement. *Clin Nutr.* 2015;34(3):335-340. doi:10.1016/j.clnu.2015.03.001
7. Kiesswetter E, Colombo MG, Meisinger C, et al. Malnutrition and related risk factors in older adults from different health-care settings: an enable study. *Public Health Nutr.* 2020;23(3):446-456. doi:10.1017/S1368980019002271
8. Vandewoude MFJ, van Wijngaarden JP, De Maesschalck L, Luiking YC, Van Gossum A. The prevalence and health burden of malnutrition in Belgian older people in the community or residing in nursing homes: results of the nutri-action II study. *Aging Clin Exp Res.* 2019;31(2):295-298. doi:10.1007/s40520-018-0979-9
9. Madeira T, Peixoto-Plácido C, Sousa-Santos N, et al. Malnutrition among older adults living in Portuguese nursing homes: the PEN-3S study. *Public Health Nutr.* 2019;22(3):486-497. doi:10.1017/S1368980018002318
10. Tomasiewicz A, Polański J, Tański W. Advancing the understanding of malnutrition in the elderly population: current insights and future directions. *Nutrients.* 2024;16(15):2502. doi:10.3390/nu16152502
11. Kujawowicz K, Mirończuk-Chodakowska I, Cyuńczyk M, Witkowska AM. Identifying malnutrition risk in the elderly: a single- and multi-parameter approach. *Nutrients.* 2024;16(15):2537. doi:10.3390/nu16152537
12. Borkent J, Manders M, Nijhof A, et al. Too low protein and energy intake in nursing home residents. *Nutrition.* 2023;110:112005. doi:10.1016/j.nut.2023.112005
13. Cederholm T, Jensen GL, Correia MITD, et al. GLIM criteria for the diagnosis of malnutrition-a consensus report from the global clinical nutrition community. *Clin Nutr.* 2019;38(1):1-9. doi:10.1016/j.clnu.2018.08.002
14. Erhardt J. Beslenme Bilgi Sistemi (BeBiS) [Nutrition Information System] 7.1 Full Version. Stuttgart: Üniversite Hohenheim'de geliştirildi. 2010.
15. Chun H, Ha JH, Im H, Jung CY, Doo M. Assessment of nutrient adequacy in undergraduate students during the undertaking shipboard internship: using 12-day dietary recall through smartphone photography. *BMC Public Health.* 2023;23(1):2365. doi:10.1186/s12889-023-17102-8
16. Türkiye Beslenme Rehberi TÜBER 2022, T.C. Sağlık Bakanlığı Yayın No: 1031, Ankara 2022.
17. Guigoz Y, Vellas B. Nutritional assessment in older adults: MNA® 25 years of a screening tool and a reference standard for care and research; what next? *J Nutr Health Aging.* 2021;25(4):528-583. doi:10.1007/s12603-021-1601-y
18. Kyle UG, Bosaeus I, De Lorenzo AD, et al. Bioelectrical impedance analysis-part I: review of principles and methods. *Clin Nutr.* 2004;23(5):1226-1243. doi:10.1016/j.clnu.2004.06.004
19. Völgyi E, Tylavsky FA, Lyytikäinen A, Suominen H, Alén M, Cheng S. Assessing body composition with DXA and bioimpedance: effects of obesity, physical activity, and age. *Obesity (Silver Spring).* 2008;16(3):700-705. doi:10.1038/oby.2007.94
20. Eaton-Evans J. Nutritional assessment/Anthropometry. In: Benjamin Caballero, edt. Encyclopedia of Human Nutrition.2nd ed. London: Elsevier Academic Press; 2005. 311–8.
21. Sedlmeier AM, Baumeister SE, Weber A, et al. Relation of body fat mass and fat-free mass to total mortality: results from 7 prospective cohort studies. *Am J Clin Nutr.* 2021;113(3):639-646. doi:10.1093/ajcn/nqaa339
22. Mathewson SL, Azevedo PS, Gordon AL, Phillips BE, Greig CA. Overcoming protein-energy malnutrition in older adults in the residential care setting: a narrative review of causes and interventions. *Ageing Res Rev.* 2021;70:101401. doi:10.1016/j.arr.2021.101401
23. Moses JS, John S, Monica SJ, Priyadarshini S. Determinants of malnutrition among elderly women living in institutional care. *J Midlife Health.* 2023;14(2):139-145. doi:10.4103/jmh.jmh_26_23
24. Bozkurt ME, Erdogan T, Catikkas NM, et al. Undernutrition in obese older adults by fat percentage. *Aging Clin Exp Res.* 2024;36(1):3. doi:10.1007/s40520-023-02650-1
25. Cruz-Jentoft AJ, Bahat G, Bauer J, et al. Sarcopenia: revised European consensus on definition and diagnosis. *Age Ageing.* 2019;48(1):16-31. doi:10.1093/ageing/afy169
26. Hua N, Zhang Y, Tan X, et al. Nutritional status and sarcopenia in nursing home residents: a cross-sectional study. *Int J Environ Res Public Health.* 2022;19(24):17013. doi:10.3390/ijerph192417013
27. Pierik VD, Meskers CGM, Van Ancum JM, et al. High risk of malnutrition is associated with low muscle mass in older hospitalized patients-a prospective cohort study. *BMC Geriatr.* 2017;17(1):118. doi:10.1186/s12877-017-0505-5
28. López-Teros MT, Vidaña-Espinoza HJ, Esparza-Romero J, Rosas-Carrasco O, Luna-López A, Alemán-Mateo H. Incidence of the risk of malnutrition and excess fat mass, and gait speed as independent associated factors in community-dwelling older adults. *Nutrients.* 2023;15(20):4419. doi:10.3390/nu15204419
29. Buckinx F, Allepaerts S, Paquot N, et al. Energy and nutrient content of food served and consumed by nursing home residents. *J Nutr Health Aging.* 2017;21(6):727-732. doi:10.1007/s12603-016-0782-2
30. Madeira T, Severo M, Correia D, Lopes C, Gorjão Clara J. Nutritional intake and malnutrition in institutionalised and non-institutionalised older adults. *Br J Nutr.* 2022;128(5):921-931. doi:10.1017/S0007114521003925
31. Kandapan B, Pradhan I, Pradhan J. Food insecurity and malnutrition among Indian older adults: findings from longitudinal ageing study in India, 2017-18. *J Popul Ageing.* 2023;16:639-659. doi:10.1007/s12062-022-09378-2
32. Şimşek H, Meseri Dalak R, Şahin S, Uçku R. Prevalence of food insecurity and malnutrition, factors related to malnutrition in the elderly: a community-based, cross-sectional study from Turkiye. *Eur Geriatr Med.* 2013;4(4):226-230. doi:10.1016/j.eurger.2013.06.001
33. Bayrak F, Ersoy S, Pala E. Ümraniye Durmuş Tanış Aile Sağlığı Merkezi'ne başvuran 65 yaş üzeri hastalarda malnütrisyon sıklığı ve ilişkili durumlar. *Abant Med J.* 2021;10(1):93-103. doi:10.47493/abantmedj.2021.38
34. Çiğiloğlu A, Efendioğlu EM, Öztürk ZA. Ayaktan başvuran geriatrik hastalarda beslenme durumu ile ilişkili faktörler. *Namik Kemal Med J.* 2022;10(3):276-282. doi:10.4274/nkmj.galenos.2022.24085

35. Söderström L, Thors Adolfsson E, Rosenblad A, Frid H, Saletti A, Bergkvist L. Mealtime habits and meal provision are associated with malnutrition among elderly patients admitted to hospital. *Clin Nutr.* 2018;37(5):1783-1785. doi:10.1016/j.clnu.2018.05.030
36. Odencrants S, Blomberg K, Wallin AM. The meal is an activity involving at least two people-experiences of meals by older persons in need of elderly care. *Nurs Open.* 2019;7(1):265-273. doi:10.1002/nop2.387
37. Tadesse AD, Anto TG, Birhanu MY, Agedew E, Yimer B, Abejie AN. Prevalence of undernutrition and its associated factors among older adults using mini nutritional assessment tool in Womberma district, West Gojjam Zone, Amhara Region, North West Ethiopia, 2020. *PLoS One.* 2023;18(2):e0274557. doi:10.1371/journal.pone.0274557
38. Çetinkaya O, Ovayolu Ö. Huzurevinde yaşayan yaşlılarda sarkopeni riski ve malnütrisyon ile etkileyen faktörlerin belirlenmesi. *Value Health Sci.* 2025;15(1):110-118. doi:10.33631/sabd.1465755