Determination of Nutritional Status Using Various Screening Tools in Elderly

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ABSTRACT

The present study was carried out to determine the nutritional status of the elderly living in nursing homes through dissimilar nutritional screening tools, to compare the said screening tools, and to check the malnutrition status of the elderly group in question. A total of 88 volunteers (M=60, F=28) with a mean age of 76.91±8.18 years living in a private nursing home were included in the study. Anthropometric measurements, hand grip strength, and serum albumin values were obtained from health record files. Malnutrition status according to different nutritional screening test results were as follows: NSI 1.1% was high-risk, MUST was 3.4% in the medium-risk, MNA 3.4% was in the malnutrition, GNRI 10.2% was determined to have low risk. A low correlation between BMI (p=0.032), mid-upper arm circumference (MUAC) (p=0.003), and calf circumference (p=0.009) was spotted; a very high correlation (p<0.001) between GNRI score and albumin, a lower one between PAL (p=0.004) and waist/hip (p=0.015) were figured out; a low correlation between NSI score and only waist/height (p=0.040) and PAL (p=0.001) was discovered. A negative correlation between NSI score and MNA score (r=-0.419) and a positive correlation between GNRI and MNA scores (r= 0.424) was unveiled. For early diagnosis, malnutrition screening tools should be selected in accordance with the lifestyle of the elderly in a home, nursing home, or hospital and should be followed up by repeating screening tests at regular intervals.

Key Words: *Malnutrition screening tools, Anthropometric measurements, Elderly, Nutritional status*

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INTRODUCTION

The world's rate of population aging is increasing due to the simultaneous decrease in birth rates as well as the increased mortality rates, leading to the phenomenon of demographic burden. The World Health Organization (WHO) declared the issue of aging to be a priority and stated the need for multisectoral action plans in this regard [1]. Approximately one-fifth of the world population is predicted to be over 65 years old by 2030 [2]. Nutrition is an important factor affecting the course of physical and cognitive functions in aging [3]. In addition, a fair number of conditions, such as comorbidities, depression, dementia, disability, drug use, taste disorders, and dysphagia, are all associated with malnutrition [4]. Physiological and psychological responses to food choices and preferences appear to alter during aging. That said, little is yet known about the mechanisms of appetite control changes throughout life [5]. That said, it is clear that malnutrition is a common clinical condition in the elderly. Treatment of the existing diseases will get further complicated if malnutrition is not diagnosed and treated. In addition, malnutrition increases morbidity and mortality as it will cause an increase in patient-related complications. It is also worth noting herein that inadequate food consumption in the elderly living in hospitals or nursing homes, usually due to lack of appetite, has increased malnutrition prevalence [6].

Although the prevalence of malnutrition in the elderly varies depending on the characteristics of the population and the defined criteria, it was mainly determined as 5-10%, 30-60%, and 15-65% in the elderly living at home, nursing homes, and in hospitals respectively [6-9]. In a comprehensive study conducted with nursing home residents aged ≥65 years between 2007 and 2018 participating in a 6-month nutritionDay-project, it was

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unearthed that 10.5% of 11,923 non-malnourished residents developed malnutrition within these 6 months [10]. Diagnosis of malnutrition can be difficult due to some physiological changes that occur in the natural course of the aging process. Therefore, it is important to perform nutritional screening as part of regular checkups [11]. In fact, regular evaluation of nutritional status is of prime importance in the elderly group with a high risk of malnutrition [1]. Attention should be paid to high-risk groups with inadequate nutritional intake, low body mass index (BMI), severe cognitive impairment, immobility, and advanced age [10].

The path to be followed in the detection and treatment of malnutrition in the elderly, therefore, should follow the following route: screening, detection, intervention, monitoring, and evaluation, respectively. Malnutrition screening is a simple, quick, and general procedure to detect the risk of major nutritional problems at an earlier time. Numerous screening tests such as Nutritional Risk Screening-2002 (NRS-2002), Short Nutrition Assessment Questionnaire (SNAQ), Seniors in the Community: Risk Evaluation for Eating and Nutrition (SCREEN II), Malnutrition Universal Screening Tool (MUST), Malnutrition Screening Tool (MST), Subjective Global Assessment (SGA), Mini Nutritional Assessment (MNA), Mini Nutritional Assessment-Short Form (MNA-SF), and Geriatric Nutritional Risk Index (GNRI) have hitherto been developed to evaluate malnutrition and/or risk in the geriatric age group. SGA, NRS-2002, and MNA are frequently used in clinical evaluations of malnutrition in the elderly [12]. Apparently, these malnutrition screening tools were used to create significant differences in the prevalence of malnutrition [13].

Failure to identify the effectiveness of malnutrition screening procedures, despite the increase in the prevalence of malnutrition and its negative effects on health, inescapably causes delays both in diagnosis and treatment [14]. This study intends to determine the nutritional status of the elderly by using anthropometric measurements, hand grip strength, and different screening tools (MNA, MUST, NSI, and GNRI) and to evaluate the compatibility of these data with each other.

MATERIALS AND METHODS

This research was designed as a cross-sectional, descriptive, and quantitative study. Data were collected from a nursing home in Ankara, the capital of Turkey, after obtaining the necessary permissions. The inclusion criteria were being over 65 years old, living in a nursing home for at least 6 months, and having serum albumin levels checked within the last three weeks of the relevant period. The exclusion criteria were determined as having a disease-causing cognitive impairment such as Alzheimer's or dementia, having a severe hearing problem, and being bedridden. The study was carried out voluntarily, and a total of 88 individuals who agreed to participate, met the inclusion criteria, and signed the informed consent form were included in the research.

A face-to-face investigation technique for the questionnaire, a patient file review, and anthropometric measurements were utilized to collect the data. The questionnaire included questions about the participating individuals' demographic information and general health status. The albumin values of the participants were obtained by examining the tests performed in the last three weeks of the said period from the health records. MNA, MUST, NSI and GNRI screening tests were applied to all the participants, and hand grip strength measurements and anthropometric measurements were also included.

Ethical considerations

The ethical approval was obtained from the related University Ethics Committee with the decision numbered 60 and dated 12/24/2021. The study was planned and completed in compliance with the Declaration of Helsinki.

Determination of nutritional status

Malnutrition screening tools, which are MNA, MUST, NSI, and GNRI, used in the recent study are suitable and validated to be resorted to for a study with Turkish older adults. All four screening tools were applied by a trained dietitian, as described in the references [15-18].

Mini nutritional assessment (MNA)

The Mini Nutritional Assessment is a single, rapid assessment of the nutritional status of elderly patients in outpatient clinics, hospitals, and nursing homes. After calculating the total score, the subjects were classified into three categories: (I) <17 as those with protein-calorie malnutrition, (II) 17–23.5 as those carrying the risk of malnutrition, and (III) ≥ 24 as those with the adequate nutritional status [19].

Malnutrition universal screening tool (MUST)

The malnutrition Universal Screening Tool is a simple and quick method for a comprehensive nutritional assessment. Patients were classified as having normal nutrition with scores 0-1 and at risk of malnutrition with scores ≥ 2 [20].

The nutrition screening initiative (NSI)

The Nutrition Screening Initiative form was developed by the American Academy of Family Medicine, the American Diet Academy, and the National Aging Council to assess the nutritional status and risk factors for the elderly [21]. A total score between 0-2 points reflects a low risk for nutritional evaluation, which necessitates reevaluation after 6 months; 3-5 points reflect a moderate risk, which calls for reevaluation after 3 months; ≥6 points reflect high risk.

Geriatric nutritional risk index (GNRI)

The Geriatric Nutrition Risk Index was defined by Boulline *et al*. for use in the elderly living at home or in a nursing home [22]. The albumin value used in the calculation was taken from the results of the analysis made within the last 3 months of the health records of the elderly. For GNRI, the patients who scored <82 were classified as severe risk, 82 to <92 were classified as those carrying moderate risk, the ones scoring 92-98 were classified as possessing a mild risk, and those scoring >98 were classified as having no malnutrition risk.

Anthropometric measurements

The researchers performed anthropometric measurements following the techniques found in the literature. The body-weight was measured using the BC-532 TANITA. Height, waist circumference (WC), hip circumference (HC), mid-upper arm circumference (MUAC), calf circumference (CC), ulna length, and arm span measurements in the elderly were carried out by the researchers with a non-stretchable measuring tape [23]. Body Mass Index (BMI) was calculated with the formula of body weight (kg)/height (m^2). As is well known, with aging, muscle mass decreases, and the visceral adipose tissue in the trunk and abdomen increases. This is also related to losing subcutaneous lean tissue in the arms and legs. This situation reduces the validity of BMI in the evaluation of nutritional status. A modified BMI below 23 kg/m^2 is accepted as an indicator of malnutrition [24]. Classification of BMI was considered in the following way: <23.0 kg/m^2 as underweight; 24.0-26.9 kg/m^2 as normal; >27 kg/m^2 as overweight [25]. Hand grip strength was measured with a hand dynamometer. The participant sat on a chair upright and was requested to squeeze the dynamometer three times with each (right and left) of the hands. The mean value of three measurements was reported accordingly [26].

Physical activity level (PAL)

The sleep duration of the participants, the activities they did at night (e.g., visiting the toilet, changing clothes, praying, and the like.), and the activities they did in their private areas (rooms) were questioned, the physical activities in the common areas were observed and recorded as 15 minute-periods, the 24-hour physical activity levels were determined, and the PAL value was calculated [27].

Statistical analysis

Quantitative data are expressed as percentage, mean, and standard deviation. For two-group comparisons, the t-test was referred to for the normally distributed data in independent groups, the Mann Whitney-U test was made use of for the data that was not normally distributed, ANOVA was used for the normally distributed data in comparisons of more than two groups, and Kruskal Wallis test was preferred for data without distribution. The Spearman Correlation Coefficient was employed in cases of two continuous variables. SPSS 21 (SPSS Inc., Chicago, Ill, USA) program was run in the analysis of the data; p <0.05 was taken as the level of significance. A linear regression model was deployed to estimate the dependent variable of the MNA score and to analyze the influencing factors. First off, the independent variables were analyzed using univariate regression. Then, the model was created using the enter method in multiple regression analysis.

RESULTS AND DISCUSSION

A total of 88 individuals, 60 male (68.8%) and 28 (31.8%) female, were included in the study. The length of stay in the nursing home was 47.13±59.61 months. The mean age of women (81.18±6.99 years) is higher than men (74.92±7.97 years) (p=0.01). Most of the elderly (n=79, 89.8%) have been diagnosed at least with one chronic disease, 33.0% have chewing and swallowing problems, and 4.0% have appetite problems. It was understood by the participants that systolic and diastolic blood pressure did not differ according to the gender. Whilst the number of snacks was higher in women (p=0.014), the number of main meals did not differ according to gender (p>0.05) **(Table 1)**.

Table 1. Nutritional habits, demographics, and other characteristics of the participants

Variables	Male X̄±SD	Female X̄±SD	Total X̄±SD	P value
Age (years)	74.92±7.97	81.18±6.99	76.91±8.18	0.001*
Length of stay in a nursing home (months)	36.59±45.15	69.71±78.88	47.13±59.61	0.046*
Number of main meals	2.92±0.28	2.96±0.19	2.93±0.254	0.415
Number of snacks	0.78±0.56	1.14±0.76	0.90±0.64	0.014*
Water intake (mL/day)	1132.50±554.32	942.86±518.672	1072.16±547.51	0.131
Systolic blood pressure (mmHg)	127.66±10.30	127.32±11.59	127.55±10.67	0.893
Diastolic blood pressure (mmHg)	81.17±9.09	81.07±13.49	81.14±10.65	0.967

Education level n (%)	<Highschool	29(48.3)	19(67.9)	48 (54.5)	0.232
	Highschool	19 (31.7)	4(14.3)	23 (26.1)	
	University	12 (20.0)	5(17.9)	17 (19.3)	
Chronic Diseases n (%)	Yes	54(90.0)	25(89.3)	79 (89.8)	0.919
	No	6(10.0)	3(10.7)	9(10.2)	
Appetite n (%)	Poor	45(75.0)	12(42.9)	4(4.5)	0.001*
	Mid	14(23.3)	13(46.4)	27(30.7)	
	Good	1(1.7)	3(10.7)	57(64.8)	
Chewing and Swallowing Problems n (%)	Yes	17(28.3)	12(42.9)	29(32.9)	0.181
	No	43(71. 7)	16(57.2)	59(67.0)	
Tooth loss n (%)	Yes	20(33.3)	9(32.2)	6(6.8)	0.415
	No	10(16.7)	0(0.0)	29(32.9)	
	Complete denture	30(50.0)	19 (67.86)	49(55.68)	
BMI classification N (%)	<23.0	12(20.0)	4(14.3)	16 (18.2)	0.355
	23.0-26.9	30(50.0)	13(46.4)	43(48.9)	
	>27.0	18(30.0)	11(39.3)	29(32.9)	

Abbreviations: SD, standard deviation; BMI, body mass index. Descriptive statistics are expressed as frequency(percentage) or mean (standard deviation).
* $p < 0.05$ obtained from t-test, Mann–Whitney U, and chi-square test.

While the waist, hip, mid-upper arm, and calf circumferences and the BMI of the participants did not differ according to gender, a statistically significant difference was found between other anthropometric and hand grip strength measurement values. Significantly higher MNA, GNRI, and NSI scores were found in males (p=0.044; p=0.014; p=0.044, respectively) **(Table 2)**.

Table 2. The anthropometric measurements of the participants and the results of different screening tools

Variables	Male (n=60)		Female (n=28)		p value
	X̄ ± SD	(Min-Max)	X̄ ± SD	(Min-Max)	
Body weight (kg)	76.09±16.03	51.0-123.0	65.98±12.22	47.0-85.3	0.013**
Height (cm)	164.41±6.89	149.5-177.0	149.69±5.56	139.0-162.8	<0.001**
BMI (kg/m^2)	28.09±5.36	19.9-44.0	29.49±5.41	20.4-42.4	0.202
Waist circumference (cm)	98.99±12.38	78.0-136.0	94.18±9.75	76.0-112.0	0.150
Hip circumference (cm)	101.80±8.47	88.0-133.0	100.38±10.54	86.6-121.0	0.404
Waist to hip ratio	0.97±0.73	0.8-1.2	0.90±0.59	0.8-1.1	<0.001**
Waist to height ratio	0.59±0.79	0.4-0.8	0.63±0.67	0.5-0.7	0.042*
Mid-upper arm (cm)	29.30±3.84	21.0-40.0	28.66±3.44	23.0-35.0	0.455
Calf circumference (cm)	35.13±3.69	27.5-43.5	34.55±3.92	29.0-41.5	0.503
Ulna length (cm)	36.74±1.92	32.0-42.0	34.38±1.92	30.0-38.0	<0.001**
Knee height (cm)	51.14±1.98	42.00-57.00	47.23±2.19	46.00-50.30	<0.001**
Arm span (cm)	85.84±4.49	77.0-96.5	79.16±3.40	71.0-86.0	<0.001**
Right hand grip strength (kg)	27.243±8.38	6.5-48.0	14.92±5.19	6.3-24.0	<0.001**
Left hand grip strength (kg)	25.991±8.208	11.7-49.6	15.924±10.78	7.2-27.1	<0.001**
MNA Score	25.05±3.24	15-29	24.23±2.41	17.5-28.5	0.044*
GNRI Score	102.20±3.55	92.44-114.70	100.47±3.12	93.80-107.30	0.014*
NSI Score	1.3±1.38	0-7	1±1.44	0-5	0.034*

Abbreviations: SD, standard deviation; BMI, body mass index; MNA, Mini Nutritional Assessment; GNRI, Geriatric Nutritional Risk Index; NSI, Nutritional Risk Screening.Descriptive statistics are expressed as minimum, maximum, and mean (standard deviation). * $p < 0.05$, **$p<0.001$ obtained from t-test and Mann–Whitney U.

A negative correlation was located between NSI and GNRI, which was not statistically significant in terms of the score (p=0.248 r=-0.124). A negative correlation between the MNA and NSI scores (p<0.001, r=-0.419) and a positive relationship between the GNRI and MNA scores (p<0.00.1 r=0.424) was determined. A statistically significant positive correlation between right-hand grip strength and GNRI score (p=0.04 r=0.223), MNA score (p=0.003 r= 0.317), and negative correlation with NSI score (p=0.004 r=-0.310) were determined. A statistically significant positive correlation between left-hand grip strength and GNRI score (p=0.76 r=0.193), MNA score (p=0.005 r= 0.302), and negative correlation with NSI score (p=0.020 r=-0.252) were identified. Whereas there existed a moderately significant relationship between MNA score and albumin, PAL (p<0.001), a lower statistically significant relationship was observed between BMI (p=0.032), MUAC (p=0.003), and calf circumference (p=0.009). There recognized a very high significant correlation between GNRI score and albumin (p<0.001) and a low statistically significant correlation was worked out between GNRI and PAL (p=0.004), waist-hip ratio (p=0.015). A low level of statistically significant correlation was deduced between NSI score and waist height (p=0.040) and PAL (p=0.001) **(Table 3)**.

Table 3. Correlation between MNA, GNRI and NSI scores and parameters

Variables	MNA Score (n=88)		GNRI Score (n=86)		NSI Score (n=88)	
	rs[a]	p	rs[a]	p	rs[a]	p
Age (years)	-0.127	0.237	-0.137	0.209	0.091	0.402
PAL	0.443	<0.001**	0.306	0.004*	-0.352	0.001**
Albumin (g/L)	0.471	<0.001**	0.933	<0.001**	-0.150	0.164
BMI (kg/m^2)	0.228	0.032*	0.010	0.925	0.103	0.341
Waist to hip ratio	0.127	0.238	0.262	0.015*	0.168	0.118
Waist to height ratio	0.136	0.205	-0.083	0.450	0.219	0.040
Mid-upper arm (cm)	0.313	0.003*	0.156	0.151	0.013	0.908
Calf circumference (cm)	0.279	0.009*	0.081	0.457	-0.013	0.903
Systolic blood pressure (mmHg)	0.045	0.681	-0.061	0.582	-0.019	0.865
Diastolic blood pressure (mmHg)	0.009	0.932	-0.192	0.081	0.089	0.415

Abbreviations: PAL, Physical Activity Level; BMI, body mass index. * p < 0.05, **p<0.001 obtained from Spearman Correlation

The participants were analyzed and classified according to the scores out of MUST, NSI, MNA, and GNRI tools **(Table 4)**. The majority of the participants had no nutritional problems and were with low-to-no malnutrition risk. While NSI results differed according to gender (p=0.020), no difference between genders was perceived in other screening tools implemented **(Table 4)**.

Table 4. Distribution of participants according to screening tools

Screening Tools	Score	Male (n=60)		Female (n=20)		Total (n=88)		χ²/ p value
		n	%	n	%	n	%	
MUST								
Normal	0	57	95.0	28	100	85	96.6	1.449 0.484
Low risk	1	1	1.7	-	-	1	1.1	
High risk	2	2	3.3	-	-	2	2.3	
NSI								
Low risk	0-2	48	80.0	15	53.6	63	71.6	7.855 0.020*
Moderate risk	3-5	11	18.3	13	46.4	24	27.3	
High risk	≥6	1	1.7	-	-	1	1.1	
MNA								
Normal	>23.5	47	78.3	18	64.3	65	73.9	4.958 0.084
Risk of malnutrition	17-23.5	10	16.7	10	35.7	20	22.7	
Malnutrition	<17	3	5.0	-	-	3	3.4	
GNRI								
Severe	<82	-	-	-	-	-	-	

Moderate	≥82-92	-	-	-	-	-	-	0.457
Mild	≥92-98	5	8.3	4	14.3	9	10.2	0.306
No malnutrition	≥98	55	91.7	24	85.7	79	89.8	

Abbreviations: MUST, Malnutrition Screening Test; NSI, Nutritional Risk Screening; MNA, Mini Nutritional Assessment; GNRI, Geriatric Nutritional Risk Index. χ^2: The chi-square test of independence. Descriptive statistics are expressed as frequency (percentage). * p < 0.05 obtained from Fisher–Freeman–Halton test.

The effect of parameters on the NSI and GNRI groups of each estimate is given in **Table 5**. An increase in the NSI score by 1 point will increase the probability of being in the "risk group of malnutrition" according to the "no malnutrition" category by 1,732 times and the probability of being grouped under the "malnutrition" category according to the "no malnutrition" category by 2.751 times. Increasing the GNRI score by 1 point will decrease the probability of being in the "risk group of malnutrition" by 0.794 times according to the "no malnutrition" category and will decline 0.969 times the probability of being grouped under the "malnutrition" category according to the "no malnutrition" category.

Table 5. Model parameter estimators

MNA classification		B	p value	Odds ratio	Odds ratio 95% confidence intervals	
					Lower limit	Upper limit
17-23.5 risk of malnutrition	Constant	-2.077	<0.001			
	NSI Score	0.549	0.006	1.732	1.175	2.552
<17 protein-calorie malnutrition	Constant	-5.309	<0.001			
	NSI Score	1.012	0.007	2.751	1.321	5.728
17-23.5 risk of malnutrition	Constant	22.070	0.013			
	GNRI	-0.230	0.009	0.794	0.668	0.945
<17 protein-calorie malnutrition	Constant	0.121	0.995			
	GNRI	-0.031	0.863	0.969	0.680	1.382

Abbreviations: NSI, Nutritional Risk Screening; MNA, Mini Nutritional Assessment; GNRI, Geriatric Nutritional Risk Index.CI, confidence interval; OR, odds ratio, Overall significance of model *p< 0.05, **p< 0.001

When the predictive variables are considered individually in univariate linear regression analysis, it is clear that a 1-point boost in the GNRI score corresponds to a 0.33 increase in the MNA score, a 1-point increase in the NSI score leads to a 1.163-decrease in the MNA score, 1-point increase in the right-hand grip strength score results in a 0.080 increase in the MNA score, a 1-point increase in left-hand grip strength score results in a 0.067 increase in the MNA score.

The coefficient of determination (R^2) of the model was found to be 0.631 **(Table 6)**.

Table 6. Univariate Linear and Multiple Linear Regression between GNRI, NSI scores, hand grip strength, gender, age

Variables	Univariate linear regression				Multiple linear regression			
	p value	B	Odds ratio 95% confidence intervals		p value	B	Odds ratio 95% confidence intervals	
			Lower limit	Upper limit			Lower limit	Lower limit
GNRI score	<0.001	0.330	0.159	0.500	0.020	0.204	0.033	0.374
NSI score	<0.001	-1.163	-1.542	-0.785	<0.001**	-0.799	-1.190	-0.407
HGS left	0.025	0.067	0.009	0.125	0.495	0.029	-0.055	0.113
HGS right	0.011	0.080	0.019	0.141	0.488	0.035	-0.066	0.136
Gender	0.237	-0.818	-2.184	0.548	0.330	0.719	-0.743	2.181
Age	0.870	0.007	-0.072	0.085	0.299	0.039	-0.035	0.112
Constant					0.892	-1.287	-20.035	17.462

Abbreviations: CI, confidence interval; OR, odds ratio, NSI, Nutritional Risk Screening; GNRI, Geriatric Nutritional Risk Index; HGS; hand grip strength. ** Overall significance of model p < 0.001

Plentiful factors such as sarcopenia, cachexia, decreased sensory function, and changes in the gastrointestinal tract with age may all lead to a decrease in energy intake, elevating the risk of malnutrition [11]. For this reason, the elderly are amongst the vulnerable groups in terms of developing the risk of nutritional deficiency. A line of literature points to the malnutrition risk of over 60% for the elderly living in institutions such as nursing homes or hospitals [7, 9].

In this study, 96.6% of the participants, according to the MUST, 71.6% according to the NSI, 73.9% according to the MNA, and 100.0% according to the GNRI, had no nutritional problems and with low-to-no malnutrition risk. There is strong evidence that the WHO BMI classification cut-offs are not appropriate for the BMI assessments of older populations. Along with these, evidence-based practice guidelines to assist clinicians in the BMI classification for the elderly are not yet available. A meta-analysis found a U-shaped relationship between the BMI and all-cause mortality after making the necessary adjustments in relation to smoking statuses, premature deaths, pre-existing diseases, and geographic locations, calculating the lowest risk of death being between BMI=24–31 kg/m^2 [28].

In practice, it is recommended that BMI classification cut-offs be evaluated as <23 kg/m^2 low weight, 24-29.9 kg/m^2 healthy weight, and >30 kg/m^2 overweight for people aged 65 and over [25]. The BMI value is also used in MNA, and similarly, the highest score is given above ≥23kg/m^2 in the evaluation [29].

The MUST accept a BMI> 20 kg/m^2 as normal. In this study, it was discerned that 18.19% of the participants had a BMI below 23 kg/m^{2,} and only 48.8% had a healthy body weight. In the International Dietetic and Nutrition Terminology guideline, it is recommended that individuals over the age of 65 with a BMI<23 kg/m^2 should be considered underweight and should undergo a nutritional evaluation [30]. A BMI below 22 kg/m² is considered an indicator of malnutrition in the elderly. It is also stated that a BMI of up to 27 kg/m² is considered normal in the elderly [31]. On the other hand, the NSI (28.4%), the MNA (26.1%), the MUST (3.4%), and the GNRI (0%) tools gave the highest rate of malnutrition and moderate to high risk of malnutrition, respectively in the nutritional status screening tests used.

The prevalence of obesity, which constitutes an eminent risk factor for many non-communicable diseases regardless of age, is increasing in the elderly as well as in all age groups. It is seen that abdominal obesity peaks, especially when it comes to the age of 60-70. Body weight loss in the elderly is a controversial issue, and it is important to know whether the body weight loss is voluntary or involuntary. While involuntary body weight loss suggests chronic diseases, voluntary body weight loss may provide clinical benefits despite slight decreases in skeletal muscle mass and bone mineral density [32]. The obesity paradox refers to the positive relationship between first-degree obesity and survival in certain diseases. This is still controversial, though, as data supporting the obesity paradox are solely from clinical observations [33]. In a study, being overweight was associated with a reduced risk of cognitive impairment, while abdominal obesity was ascribed to an increased risk of cognitive impairment independent of sociodemographic, lifestyle, and health-related comorbid factors [34].

In the screening tools used, the lower limits of the BMI were ascertained, and the upper limits were not defined. In this study, 29.0% of all the participants had a BMI over 30 kg/m^2. The mean waist circumference is 94.18±9.75 cm in women and 98.99±12.38 cm in men, and these values are risky for men and bear a high risk for women as regards abdominal obesity. Sarcopenic obesity (SO), which is closely related to the changes in body composition due to age, points out an obesity disease that is common in the elderly, in which skeletal muscle mass, strength, and/or function is low, seriously affecting the quality of life, resulting in falls and fractures. However, the pathogenesis of SO has not been fully elucidated to date, and hence, the diagnostic criteria are not uniform. Therefore, the data on its prevalence and the potential consequences are still inconsistent. SO should be considered when evaluating elderly individuals concerning obesity [35]. To do so, it will both be meaningful and purposeful to evaluate muscle mass, muscle strength, and muscle function. Malnutrition in old age affects muscle function in the early period and causes dysfunction in daily activities [36]. Thereupon, in the evaluation of nutritional status, it is recommended to use hand grip strength, which provides data on physiological changes, alongside other nutritional status screening tools [37]. In this study, measurements were completed using a hand dynamometer, and increases in both right and left-hand grip strength values resulted in increases in the MNA score. Crichton *et al*. [38]. Shared that the prevalence of malnutrition is higher in women who are over the age of 80, in patients with one or more comorbidities, and in rural areas. In this study, the rate of intermediate-risk malnutrition was measured to be higher in women according to the NSI results (p=0.020), while no difference was found in other screening tools according to gender. Furthermore, since physical activity, BMI, calf circumference in the MNA, and albumin in the GNRI were among the investigated parameters, it is not surprising to find statistically significant relationships between these data.

By using screening and evaluation methods, it is possible to diagnose individuals who are at risk for malnutrition or who have malnutrition. Although attention has been drawn to the prevention of malnutrition in nursing homes in recent

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years, the prevalence remains relatively stable [14, 39]. It has been suggested that the reason for this endeavor that is not yet at the desired level is that the risk of malnutrition cannot be determined well enough, and the awareness of the individual interventions that health professionals can make to reduce this rate so far has been insufficient [39]. Screening tools, without doubt, assist in identifying the risk factors, planning treatment in the early period, and solving problems related to nutritional deficiencies [40]. A study comparing screening tools showed that the NRS-2002 had the highest validity, the MUST had the highest specificity in predicting the risk of malnutrition in elderly outpatients and recommended that the NSI be validated with larger samples [41]. Another study reported that the GNRI reflects mortality risk better than the MNA and that the GNRI should be preferred in newly institutionalized elderly [42]. The NSI is a short and easily scored test that does not include anthropometric measurements and can facilitate the identification of the elderly at risk. However, since the main purpose of the NSI is to raise awareness of any malnutrition risk, it is relatively non-specific and may overstate the number of individuals at risk [43]. In this study, the risk of moderate malnutrition was assessed at a higher rate with the NSI than with the other screening tests. Although the NSI has specific advantages, some of the questions it contains cannot be applied to nursing home life. Owing to this, its use can be restricted to raising awareness in nursing homes [44]. There are a bunch of nutritional status screening tools developed for the elderly, and their uses are supported by the evidence of validity [45]. In a study examining the compatibility of the MNA, the MUST, the NSI, the SNAQRC, the SNAQ65+, and the MEONF-II screening tools in pairs, it was announced that the results of all the screening tests were compatible with each other [46]. In the evaluation of the MNA and NSI tests used in this study, the risk of malnutrition increases as the total score increases, and the risk of malnutrition reduces as the total score in GNRI Escalates. It was conceived that the MNA scores had a negative relationship with the NSI and a positive relationship with the GNRI ($p<0.001$). There was no statistically significant relationship between the NSI and the GNRI scores ($p=0.248$). When the effect of the MNA classification on the NSI and the GNRI scores was examined, it was witnessed that an increase in the NSI score raised the probability of carrying the "risk of malnutrition" or being grouped under the "malnutrition" category while an increase in the GNRI score decreased the probability of being in these categories. Albumin levels can be affected by the nutritional status as well as non-nutritional factors [47]. With that being said, it is recommended to consider that low albumin levels pose an independent risk factor for geriatric malnutrition [48]. The use of the GNRI, which requires albumin measurement, may not be very practical in nursing homes. Since the individuals whose albumin values were checked within the last three weeks of the relevant time period were included in this study, the number of samples was limited. The Mini Nutritional Assessment (MNA) tool is recommended as the most effective tool for the determination and assessment of malnutrition risk in the elderly [49] and is considered the gold standard [50]. Further to that, the MNA is the most validated and reliable screening tool that includes both screening and detection tools [42, 44]. As it includes anthropometric measurements and other important variables, it should be considered a more reliable and valid method than the others available.

CONCLUSION

As a result of our study, it is difficult to decide which screening tool to use in nursing homes and which of these methods will be considered superior to the other. The variety of tools and methods used to determine malnutrition could be the reason for the existing wide range of malnutrition prevalence. The elderly who are at risk for malnutrition should be screened for appropriate screening tests. In the elderly population living in nursing homes, regular screening and correct interpretation of factors will be crucial for their health. The risk of malnutrition, as well as malnutrition itself, increases the risk of mortality. Therefore, anthropometric measurements with appropriate screening tests should be administered at regular intervals for the elderly, and a treatment plan should be applied with early diagnosis. Apart from the malnutrition screening tools, the evaluation of food service, which is one of the key factors influencing the nutritional status in nursing homes, will help provide a broader perspective in the planning of future intervention studies.

Limitations

The limitation of this study is that the study was conducted in Ankara, the capital city of Türkiye, making the results difficult to generalize for a wider context. Moreover, the number of participants was limited because only those whose albumin values were checked in the last three weeks were included in this study. In order to generalize the results of the study, there is a need for more comprehensive studies involving elderly people of different age and education groups who live in a nursing home or home alone or with their families.

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