



Relationship between food insecurity and geriatric syndromes in older adults: A multicenter study in Turkey

Kevser Tari Selcuk^{a,*}, Ramazan Mert Atan^b, Sedat Arslan^a, Nursel Sahin^a

^a Department of Nutrition and Dietetics, Bandirma Onyedi Eylul University, Balikesir 10200, Turkey

^b Department of Nutrition and Dietetics, Institute of Health Sciences, Istanbul Medipol University, Istanbul, Turkey

ARTICLE INFO

Section Editor: Ricki Colman

Keywords:

Food insecurity
Frailty
Sarcopenia
Malnutrition
Older adults

ABSTRACT

Aims: In this study, the aim was to determine the prevalence of geriatric syndromes such as frailty, sarcopenia risk and malnutrition in older adults and to investigate the relationship between food insecurity, and frailty, risk of sarcopenia and malnutrition.

Methods: The study was cross-sectional. It was conducted between February 2022 and June 2022 with 707 older adults. The data were collected through the face-to-face interview method with a questionnaire including the Descriptive Information Form, Household Food Insecurity Access Scale (HFIAS), Frail Scale, Sarcopenia Risk Screening Scale (SARC-F) and Mini Nutritional Assessment-Short Form (MNA-SF). Numbers, percentages, mean, standard deviation, Pearson chi-square test and binary logistic regression analysis were used in data analysis.

Results: In the present sample, 30% of the participants experienced some degree of food insecurity. The prevalence of frailty, sarcopenia risk, and malnutrition in the participants was 15.3%, 19.5%, and 1.3%, respectively. We determined that food insecurity was not associated with pre-frailty/frailty and sarcopenia risk. After adjustment for potential confounders moderate and severe food insecurity was associated with higher odds of malnutrition risk and malnutrition (AOR: 2.06, 95% CI: 1.21–3.51, p:0.007).

Conclusion: While food insecurity is not associated with pre-frailty/frailty and sarcopenia risk, moderate and severe food insecurity is a modifiable risk factor for malnutrition risk and malnutrition. Thus, economic and social policies to eliminate food insecurity should be implemented, and efforts to prevent food insecurity should be planned through inter-sectoral cooperation.

1. Introduction

Geriatric syndromes, which had adverse effects on quality of life, disability and mortality in older adults is accepted as a non-disease clinical condition that manifests itself in many signs and symptoms such as cognitive disorders, sleep disorders, delirium, polypharmacy, urinary incontinence, depression, falls, frailty, sarcopenia, and malnutrition (Cesari et al., 2017; Sanford et al., 2020; Essomba et al., 2020; Bulut et al., 2018). Of these syndromes, frailty is defined as an inadequate response to acute stressors due to decreased organ reserve and functions, while sarcopenia is expressed as decreased muscle function/strength due to loss of lean body mass (Bulut et al., 2018). Frailty, the incidence of which increases with age, is closely associated with sarcopenia, and these two syndromes negatively affect individuals' activities of daily living and quality of life, and increase duration and number of

hospitalizations, morbidity-mortality rate, and fall and fracture risk (Bulut et al., 2017; Dokuzlar et al., 2017). In health institutions, sarcopenia risk can be determined with the Sarcopenia Risk Screening Scale (SARC-F). This questionnaire is based on the individual's perception of his or her limitations in strength, walking ability, experience of getting up from a chair, climbing stairs, and falling. On the other hand, the European Working Group on Sarcopenia in Older People (EWGSOP) considers that the SARC-F is a cheaper, easier and faster method than are methods such as Dual-energy X-ray absorptiometry (DXA), Bioelectrical Impedance Analysis (BIA), and grip strength measurement. The EWGSOP also recommends that the SARC-F should be used for screening the risk of sarcopenia in clinical practices (Cruz-Jentoft et al., 2019). One of the risk factors for frailty and sarcopenia is malnutrition (Cruz-Jentoft et al., 2017), which is closely associated with increased morbidity and mortality rates in people with acute or chronic diseases (Volkert et al.,

* Corresponding author.

E-mail addresses: kselecuk@bandirma.edu.tr (K. Tari Selcuk), ramazan.atan@std.medipol.edu.tr (R.M. Atan), sarslan@bandirma.edu.tr (S. Arslan), nurselsahin@bandirma.edu.tr (N. Sahin).

<https://doi.org/10.1016/j.exger.2022.112054>

Received 10 October 2022; Received in revised form 2 December 2022; Accepted 7 December 2022

Available online 10 December 2022

0531-5565/© 2022 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

2019).

Geriatric syndromes have a heterogeneous etiology and they are affected by clinical, psychological, social and environmental factors (Cesari et al., 2017). Food insecurity, one of these factors, is defined as “individuals' inability to obtain the energy and nutrients they need to sustain their lives and have difficulty in obtaining adequate food in socially acceptable ways” (Thomas et al., 2019). Among the age groups in which the rate of food insecurity is high, older adults take the lead (Zarei et al., 2021), and the prevalence of food insecurity is gradually increasing in them. According to a limited number of studies conducted in Turkey, the prevalence of food insecurity varies between 22 % and 69 % (Simsek et al., 2013; Eştürk, 2015; Büyüksöy Bulucu, 2021).

As is stated in the literature, individuals with food insecurity mostly prefer cheaper foods with high carbohydrate and fat content and low micronutrient content (Naja et al., 2020). In addition, in studies, it is reported that low-protein/high-carbohydrate diets cause obesity and lean body mass loss, which paves the way for sarcopenia and increase frailty (Pérez-Zepeda et al., 2016), and that in individuals with food insecurity, low quality diet-related malnutrition is associated with an increased risk of sarcopenia (Smith et al., 2021). Although in the international literature, there are studies in which food insecurity is indicated as a risk factor for geriatric syndromes such as frailty, sarcopenia, and malnutrition (Pérez-Zepeda et al., 2016; Frith and Loprinzi, 2018; Tucher et al., 2021; Smith et al., 2021), the number of studies conducted on the relationship between food insecurity and geriatric syndromes in Turkey is limited (Simsek et al., 2013).

In the present study, we aimed to determine the prevalence of geriatric syndromes such as frailty, sarcopenia and malnutrition in older adults who presented to primary health care centers and to investigate the relationship between food insecurity and variables such as frailty, risk of sarcopenia and malnutrition. It was hypothesized that older adults with mild, moderate, or severe food insecurity were at a higher risk of frailty, sarcopenia, and malnutrition than were those with food security.

2. Methods

2.1. Study type and sample

This cross-sectional study was conducted in Bandirma, a district of Balıkesir, a province located on the coast of the Marmara Sea in the northwestern part of Turkey. The study was conducted in five Family Health Centers (FHCs) randomly selected from the FHCs located in the eastern, western, central, northern and southern regions of Bandirma district center, representing each region. The minimum sample size to be included in the study was calculated as 652 people in the G*Power 3.1.9.7 program (power: 95 %, $\alpha = 0.05$, $d = 0.02$ effect size) (Faul et al., 2007; Faul et al., 2009). The number of individuals aged 65 and over who presented to the five FHCs between February 2022 and June 2022 was 1431. Of them, those who presented to the FHC due to emergencies ($n = 91$), who did not have the cognitive competence to answer the study questions ($n = 16$), who had hearing impairment and speech impairment preventing them from answering the study questions ($n = 51$), who were cachectic due to diseases such as cancer and chronic kidney disease ($n = 19$), who were not able to meet their nutritional needs orally and/or who had difficulty in chewing and/or swallowing ($n = 1$), and who had a physical health problem that would prevent the measurement of Body Mass Index (BMI) or calf circumference ($n = 4$) were excluded from the study. The data obtained from 707 of the remaining 1249 older adults, who spoke Turkish and volunteered to participate in the study were evaluated.

2.2. Study variables

2.2.1. Dependent and independent variables

Geriatric syndromes such as frailty, sarcopenia risk and malnutrition

were the dependent variables of the study. Household food insecurity was the independent variable of the study.

2.2.2. Covariates

Age, sex, marital status, education level, perceived economic status, presence of social security, perceived health level, presence of a chronic disease, physical activity status, presence of a physical disability, daily water consumption, smoking, alcohol consumption and use of dietary supplements use were covariates.

2.3. Data collection tools

The data were collected with a questionnaire including the Descriptive information form, HFIAS, Frail Scale, SARC-F and MNA-SF.

2.3.1. Descriptive Information Form

The form prepared by the researchers based on the literature includes items questioning the participants' sociodemographic characteristics and health characteristics such as smoking status, alcohol consumption status and physical activity status (at least 150 min a week, brisk walking, low-paced jogging, dancing, moderate exercise etc.) (Simsek et al., 2013; Pérez-Zepeda et al., 2016; Smith et al., 2021; TUBER, 2015).

2.3.2. Household Food Insecurity Access Scale (HFIAS)

The HFIAS developed by Coates et al. (2007) measures the degree of food insecurity in the households over the past four weeks (Coates et al., 2007). The HFIAS which has 1 dimension and 18 questions was adapted to Turkish by Bor (2018). Of the 18 questions, some are occurrence questions and some are frequency-of-occurrence questions. The minimum and maximum possible scores that can be obtained from the scale are 0 and 27 respectively. The increase in the score indicates an increase in the severity of food insecurity experienced by the household (Coates et al., 2007; Bor, 2018). In the present study, food insecurity was categorized as food secure, mildly food insecure, moderate food insecure and severe food insecure according to the cut-off points specified in the study conducted by Coates et al. (2007). However, in the analysis phase, it was categorized as food secure, mildly food insecure, moderate and severe food insecure (Coates et al., 2007).

2.3.3. Frail Scale

The 5-item scale developed by Morley et al. (2012) and adapted into Turkish by Hymabaccus Muradi in 2017 questions fatigue level, resistance, ambulation, weight loss and other existing diseases in an individual. A score of “0” or “1” can be obtained from each item, and the person is evaluated based on the sum of the scores obtained from the overall scale. If the score obtained from the scale is 0 points, the person is considered as non-frail, if it is 1–2 points, the person is considered as pre-frail, and if it is higher than 2, the person is considered as frail (Morley et al., 2012; Hymabaccus Muradi, 2017). In the present study, frailty was evaluated in two categories as non-frail and pre-frailty/frailty.

2.3.4. Sarcopenia Risk Screening Scale (SARC-F)

The SARC-F developed by Malmstrom and Morley (2013) to assess the risk of sarcopenia quickly and easily was adapted into Turkish by Cansin Kış and Karaca (2021). SARC-F is an acronym of five domains included in the questionnaire: 1) Strength, 2) Assistance in walking, 3) Rise from a chair, 4) Climb stairs, and 5) Falls. Responses given to the items are rated on a 3-point Likert type scale ranging from 0 to 2 (0 = I can never do it, 1 = I can do it a little, 2 = I can hardly or cannot do it). The lowest and highest possible scores that can be obtained from the scale are 0 and 10 respectively. A score of ≥ 4 indicates that the person is at risk of sarcopenia (Malmstrom and Morley, 2013; Cansin Kış and Karaca, 2021).

2.3.5. Mini Nutritional Assessment-Short Form (MNA-SF)

The MNA-SF developed by Rubenstein et al. (2001) consists of six questions. It is administered to outpatients, especially older adults, in outpatient settings (Rubenstein et al., 2001). In the MNA-SF, scoring is performed by determining whether the patient has experienced changes in appetite during the last 3 months, whether the patient has lost weight in the last 3 months, whether the patient is mobile, whether the patient has experienced psychological distress or acute illness in the last 3 months, whether the patient has neuropsychological problems, and by calculating the patient's Body Mass Index (BMI). If the older adult's BMI cannot be calculated, his or her calf circumference is measured instead of BMI. While a score ranging between 12 and 14 indicates "normal nutritional status", a score ranging between 8 and 11 indicates "at risk of malnutrition" and a score ranging between 0 and 7 points indicates "malnutrition" (Kaiser et al., 2009). The validity study of MNA-SF in screening older adults for nutritional risk in Turkey was conducted in 2015 (Sarikaya et al., 2015). In the present study, malnutrition was evaluated in two categories: (1) normal nutritional status and (2) malnutrition risk/malnutrition.

2.4. Data collection

The older adults who agreed to participate in the study and who were included in the study according to the inclusion and exclusion criteria were informed about the purpose and scope of the study were asked to sign the informed consent form. Then, they were administered a questionnaire including the Descriptive information form, HFIAS, Frail Scale, SARC-F, and MNA-SF by the researchers through face-to-face interviews. In order to assess malnutrition using the MNA-SF within the scope of the study, the participants' BMI was calculated by measuring their body weight and height in accordance with the instructions stated in the form. If a participant's body weight and height were measured, then his or her calf circumference was measured. In order to calculate the participants' BMI, first their body weight was measured by the researchers who were specialized in the field of nutrition and dietetics, using a portable SECA brand digital scale with 100-g precision. During the weighing, the participants wore light clothes and took off their shoes. Then their height was measured in centimeters (cm) with a portable height-measuring rod with a capacity of 14–200 cm and 1 mm intervals, while the individual was in an upright position as his or her head was level with the Frankfurt plane (an imaginary line in which ear canal and orbital lower border are aligned) (Pekcan, 2012). Finally, BMI was calculated by dividing body weight (in kilograms) by the square of height (in meters). In older adults whose BMI could not be calculated, the calf circumference was measured with a non-flexible measuring tape, with one millimeter precision, while the person was sitting or lying down. The measuring tape was placed around the region of the calf of the left or right leg where the plane perpendicular to the long axis of the calf had the maximum circumference (Rolland et al., 2003).

2.5. Data analysis

The study data were analyzed using the Statistical Package for the Social Sciences (SPSS) 23.0. In the analysis of the data, numbers, percentages, arithmetic mean and standard deviation were used. Pearson chi-square test was used to find out whether there was a difference between the participants' pre-frailty/frailty, sarcopenia risk, and malnutrition risk/malnutrition prevalence in terms of their sociodemographic and health characteristics. Whether household food insecurity was a risk factor in terms of pre-frailty/frailty, sarcopenia risk and malnutrition risk/malnutrition was investigated by binary and multivariate logistic regression analysis (enter method). In all the models created, household food insecurity was the independent variable (Food secure = 0, mildly food secure = 1, moderate/severe food insecurity = 2), frailty (Non-frailty = 0, pre-frailty/Frailty = 1) whereas sarcopenia risk (Normal = 0, sarcopenia risk = 1) and malnutrition (Normal nutritional status = 0,

malnutrition risk/malnutrition = 1) were dependent variables. In addition to the aforementioned dependent and independent variables, age (65–69 = 0, 70–74 = 1, ≥ 75 = 2), sex (Men = 0, Women = 1), marital status (Married = 0, Single = 1), education level (Senior high school and above = 0, Junior high school and below = 1), perceived economic status (Good = 0, Medium = 1, Bad = 2), presence of social security (Yes = 0, no = 1), perceived health level (Good = 0, Medium = 1, Poor = 2), presence of a chronic disease (No = 0, yes = 1), physical activity status (Yes = 0, no = 1), presence of a physical disability (No = 0, Yes = 1), smoking status (Non-smoker = 0, current smoker = 1), alcohol consumption status (No = 0, yes = 1) and dietary supplement use (Yes = 0, no = 1) were included in Model 2, Model 3, and Model 4 as covariates.

2.6. Ethical approval

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Before it was conducted, ethical approval was obtained from the Bandirma Onyedi Eylul University Health Sciences Non-Interventional Research Ethics Committee (decision date and number: January 07, 2022/2021–81).

3. Results

The mean age of the participants was 70.98 ± 5.10 years. Of them, 47.5 % were in the age group of 65–69 years, 54.0 % were women, 72.1 % were married, 63.1 % had primary school or below education, 63.1 % perceived their economic situation as moderate, 11.4 % did not have social security, 45.1 % perceived their health level as moderate, 13.3 % did not have a chronic disease, 58.4 % did moderate physical activity for at least 150 min a week, 77.5 % did not have a physical disability, 60.0 % consumed <8 glasses of water a day, 13.9 % smoked at least one cigarette a day, 7.5 % drank alcohol, 19.7 % had 2 meals a day and 30.4 % took dietary supplements. The most commonly consumed dietary supplements by older adults who stated that they consumed dietary supplements were vitamin B12 (44.2 %), vitamin D (16.3 %), and iron (8.4 %) (Table 1).

The mean score the participants obtained from the HFIAS was 1.26 ± 2.63 (min = 0, max = 21). According to the scores they obtained from the scale, 14.2 % experienced food insecurity moderately, and 0.9 % experienced food insecurity severely. According to the scores they obtained from the Frail Scale, SARC-F and MNA-SF, the prevalence of frailty was 15.3 %, the risk of sarcopenia was 19.5 %, and the prevalence of malnutrition was 1.3 % (Table 2). The prevalence of frailty, sarcopenia risk, and malnutrition according to household food insecurity status is presented in Fig. 1.

In Table 3, the results of the univariate analysis for frailty, sarcopenia risk and malnutrition status were given. Accordingly, the risk of malnutrition and the prevalence of malnutrition were statistically significantly higher in those whose food insecurity was moderate or severe. In the participants who were ≥ 75 years old, were women, were single, had a junior high school education and below, perceived their economic status and health level as bad, had chronic diseases, did not do moderate physical activity for at least 150 min a week, had physical disabilities, were not smokers, did not drink alcohol, the frequency of pre-frailty and frailty was statistically significantly higher. In the participants who were ≥ 75 years old, were women, were single, had a junior high school education level and below, perceived their economic status and health level as bad, did not have social security, had chronic diseases, did not do moderate physical activity for at least 150 min a week, were physically disabled and were non-smokers, the risk of sarcopenia was statistically significantly higher. In the participants who were ≥ 75 years old, who were women, who were single, who had a junior high school education or below, those who perceived their economic status and health level as bad, had chronic diseases, did not do moderate physical activity for at least 150 min a week and were

Table 1
Sociodemographic and health characteristics (n = 707).

Characteristics	Number (n)	percentage (%)
Age (Mean ± SD:70.98 ± 5.10. min:65. max:93 years)		
65–69	336	47.5
70–74	210	29.7
≥75	161	22.8
Sex		
Women	382	54.0
Men	325	46.0
Marital status		
Married	510	72.1
Single/widowed/divorced	197	27.9
Education level		
Primary school and below	446	63.1
Junior high school	85	12.0
Senior high school	106	15.0
University and above	70	9.9
Perceived economic status		
Good	188	26.6
Moderate	446	63.1
Bad	73	10.3
Social security		
Yes	624	88.6
No	80	11.4
Perceived health level		
Good	250	35.4
Moderate	319	45.1
Bad	138	19.5
Chronic disease ^a		
None	94	13.3
Cardiovascular disease	500	70.7
Diabetes	282	39.9
Asthma/COPD	90	12.7
Cancer	26	3.7
Others	29	4.1
Physical activity (at least 150 min per week, moderate)		
Yes	412	58.4
No	294	41.6
Physical disability ^a		
None	547	77.5
Orthopedic	76	10.8
Vision	63	8.9
Hearing	43	6.1
Speaking	1	0.1
The amount of water consumed daily		
<8 glasses	420	60.0
8–10 glasses	191	27.3
>10 glasses	89	12.7
Smoking		
Never	488	69.0
Current	98	13.9
Past	121	17.1
Alcohol consumption		
No	653	92.5
Yes	53	7.5

Table 1 (continued)

Characteristics	Number (n)	percentage (%)
The number of meals per day		
2 main meals	139	19.7
3 main meals	302	42.7
3 main meals and at least 1 snack	266	37.6
Dietary supplement use		
No	492	69.6
Yes	215	30.4
Type of dietary supplement used ^{a,b}		
Vitamin B12	95	44.2
Vitamin D	35	16.3
Iron	18	8.4
Vitamin C	14	6.5
Multivitamin	13	6.0
Omega-3 / Fish oil	7	3.3
B complex vitamins	6	2.8
Zinc	6	2.8
Magnesium	6	2.8
Probiotic, Calcium, Folic acid, Vitamin K, Collagen	10	4.7

COPD: Chronic Obstructive Pulmoner Disease.

^a More than one option was marked.

^b 174 of the older adults stated the type of dietary supplement used.

Table 2

Household food insecurity, frailty, sarcopenia risk, and malnutrition prevalence.

Variables	%(n)	Mean ± SD	Range
Household food insecurity		1.26 ± 2.63	0.00–21.00
Food secure	70.2(495)		
Mildly food insecure	14.8(104)		
Moderate food insecure	14.2(100)		
Severe food insecure	0.9(6)		
Frailty		1.08 ± 1.15	0.00–5.00
Non-frail	42.2(297)		
Pre-frail	42.5(299)		
Frail	15.3(108)		
Sarcopenia risk		1.79 ± 1.98	0.00–10.00
Normal	80.5(567)		
Sarcopenia risk	19.5(137)		
Malnutrition		12.51 ± 1.75	4.00–14.00
Normal nutritional status	74.8(524)		
Malnutrition risk	24.0(168)		
Malnutrition	1.3(9)		

SD: Standart Deviation.

physically disabled, malnutrition risk and the frequency of malnutrition were statistically significantly higher ($p < 0.05$, Table 3).

In Table 4, the relationship between household food insecurity and geriatric syndromes according to binary logistic regression analysis was given. We determined that food insecurity was not associated with pre-frailty/frailty and sarcopenia risk. Moderate and severe food insecurity was associated with higher odds of malnutrition risk and malnutrition (UOR 1.95, 95 % CI:1.24–3.07, $p:0.003$) in the univariate logistic regressions. After adjustment for age and sex, moderate and severe food insecurity was associated with higher odds of malnutrition risk and malnutrition (AOR: 2.02, 95 % CI:1.33–3.36, $p:0.001$). After adjustment for multiple potential confounders including age, sex, marital status, education level, perceived economic status, perceived health level, chronic illness, physical activity, physical disability and dietary supplement use, moderate and severe food insecurity was associated with higher odds of malnutrition risk and malnutrition (AOR: 2.06, 95 % CI:1.21–3.51, $p:0.007$).

4. Discussion

In the present study aimed at determining the prevalence of frailty,

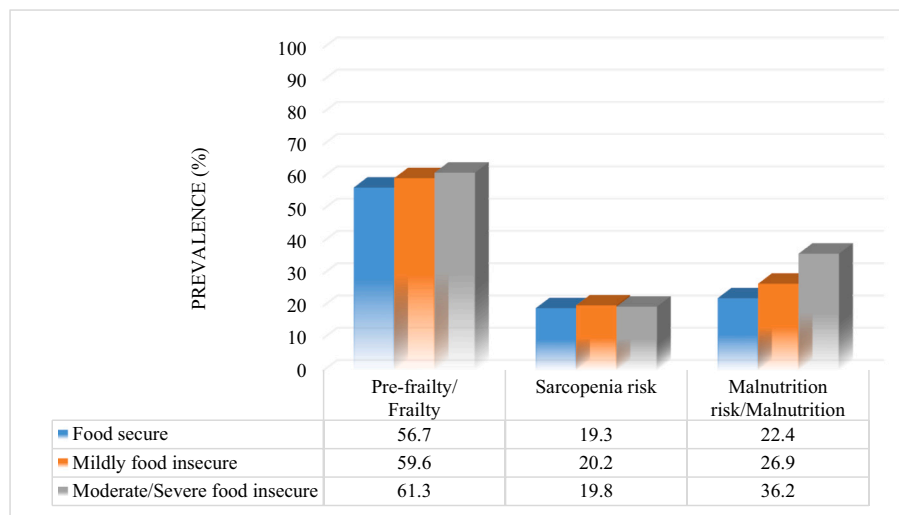


Fig. 1. Prevalence of pre-frailty/frailty, risk of sarcopenia, and malnutrition risk/malnutrition according to household food insecurity.

sarcopenia and malnutrition among older adults who presented to primary health care centers, and investigating the relationship between food insecurity and these geriatric syndromes, it was determined that geriatric syndromes were common among older adults, and that the prevalence of frailty was approximately 15 %. In studies conducted at the community level and in health institutions in countries such as China, Mexico, Australia, and Malaysia, the prevalence of frailty in older adults has been reported to vary between 4 % and 59 % (Woo et al., 2015; Díaz de León González et al., 2016; Liu et al., 2020; Rohrmann, 2020; Thompson et al., 2020; Thiam et al., 2021). In studies conducted in Turkey, the prevalence of frailty in older adults varied between 10 % and 36 % (Akin et al., 2015; Akin et al., 2019; Aşik et al., 2022).

One of the main physiological components of frailty is sarcopenia. Hormonal changes occurring due to aging and increase in inflammatory cytokines lead to a decrease in muscle strength, muscle mass and physical function and thus cause sarcopenia (Lu et al., 2021). It is hypothesized that the causal mechanisms underlying sarcopenia also contribute to frailty. Therefore, the physical phenotype of frailty tends to overlap with sarcopenia significantly (Bahat et al., 2021). It is estimated that there will be an increase in the prevalence of sarcopenia ranging approximately from 64 % to 72 % by 2045 in Europe, and that one-quarter to half of individuals aged 65 and over will be affected by sarcopenia (Ethgen et al., 2017). Our review of the literature demonstrated that the prevalence of sarcopenia in older adults varied between 6 % and 69.5 % (Tang et al., 2018; Ishida et al., 2020; Papadopoulou et al., 2020; Lu et al., 2021; Perna et al., 2022). In studies conducted in Turkey, the prevalence of sarcopenia ranges between 13 % and 49 % (Bahat Öztürk et al., 2021; Ozer et al., 2021; Sacar et al., 2021). Factors such as sex, socioeconomic status, age, ethnic differences, and chronic diseases affect the prevalence of frailty and sarcopenia (Rohrmann, 2020; Sacar et al., 2021). The majority of the participants in the present study were female older people with chronic diseases, moderate-bad economic status and low education level. The differences between the findings of the studies conducted in Turkey and those of the studies conducted in other countries may be due to the differences between the participants' sociodemographic characteristics or the differences between the measurement tools used to assess frailty and sarcopenia.

Malnutrition, which plays a key role in the pathogenesis of frailty and sarcopenia, is a modifiable risk factor for both (Cruz-Jentoft et al., 2017; Sieber, 2019). Malnutrition in older adults is generally associated with decreased energy intake and adequate protein intake, which is the building block of muscle metabolism, due to aging anorexia (Sieber, 2019). Aging anorexia is the result of both physiological changes such as altered sense of taste and smell, slower gastric emptying and disruption

of hormonal responses, and physical and mental disorders, chewing/swallowing problems. Due to aging anorexia, insufficient energy and protein intake causes loss of lean body mass by disrupting the balance between muscle protein synthesis and muscle breakdown. In addition, the presence of more than one disease and polypharmacy can significantly impair food consumption and lead to malnutrition in older adults (Cruz-Jentoft et al., 2017). Malnutrition is observed not only in individuals with low BMI but also in those with obesity or sarcopenic obesity (Sieber, 2019). Malnutrition risk /malnutrition increases with age and becomes more severe in advanced age people, which predisposes malnourished older individuals to the risk of developing geriatric syndromes (Norman et al., 2021). In the present study, in the participants, the risk of malnutrition and malnutrition was approximately 24 % and 1 % respectively. These findings are compatible with the literature (Serrano-Urrea and Garcia-Meseguer, 2013; Simsek et al., 2013; Crichton et al., 2019). On the other hand, the low prevalence of malnutrition detected in the present study may be due to the fact that the study was conducted in an urban area, the majority of the participants had social security and benefited from health services free of charge, and that in Turkey, older people in need of medical care could access free home care services provided by the Ministry of Health. It is reported that the prevalence of malnutrition is higher in individuals living in urban areas than in individuals living in rural areas, and malnutrition is effectively treated in older people who receive home care services provided by a multidisciplinary team (Crichton et al., 2019).

Geriatric syndromes have a heterogeneous etiology and they are affected by clinical, psychological, social and environmental factors (Cesari et al., 2017), one of which is food insecurity (Pérez-Zepeda et al., 2016; Smith et al., 2021; Pereira et al., 2022). Due to the significant increase in the older population, in the public health system, food insecurity should be investigated more (Zarei et al., 2021). In addition, food insecurity, which is also evaluated within the scope of the Sustainable Development Goals, is especially widespread among older people, who are homebound, socially isolated, live alone or in rural areas, and have more than one comorbidity (Tucher et al., 2021). Nearly 14 % of households in the USA, 13 % of Australian seniors, 13 % of Canadian households, and 23 % of Portuguese seniors are reported to experience food insecurity and adverse health outcomes caused by food insecurity (Tarasuk et al., 2013; Russell et al., 2014; World Population Ageing, 2015; Fernandes et al., 2018). In studies conducted in Turkey, the prevalence of food insecurity in households varies between 22 % and 69 % (Simsek et al., 2013; Eştürk, 2015; Büyüksöy Bulucu, 2021). According to the Turkey Nutrition and Health Survey (TNHS), approximately 23 % of individuals could not consume healthy and nutritious

Table 3
Univariate analysis for pre-frailty/frailty, sarcopenia risk, and malnutrition risk/malnutrition prevalence.^a

Characteristic	Pre-frailty/ Frailty %(n)	p-value	Sarcopenia risk %(n)	p-value	Malnutrition risk/ Malnutrition %(n)	p-value
Household food insecurity						
Food secure	56.7(279)	0.631	19.3(95)	0.976	22.4(110)	0.012
Mildly food insecure	59.6(62)		20.2(21)		26.9(28)	
Moderate/Severe food insecure	61.3(65)		19.8(21)		36.2(38)	
Age (years)						
65–69	49.4(166)	<0.001	14.0(47)	<0.001	22.2(74)	0.127
70–74	62.9(132)		21.0(44)		26.0(54)	
≥75	69.0(109)		28.9(46)		30.6(49)	
Sex						
Women	68.4(260)	<0.001	26.6(101)	<0.001	30.1(114)	0.001
Men	45.4(127)		11.1(369)		19.6(63)	
Marital status						
Married	54.0(275)	0.001	16.1(82)	<0.001	19.7(100)	<0.001
Single/widowed/divorced	67.7(132)		28.2(55)		39.7(77)	
Education level						
Junior high school and below	62.6(331)	<0.001	21.6(114)	0.013	28.3(149)	0.001
Senior high school and above	43.4(76)		13.1(23)		16.0(28)	
Perceived economic status						
Good	46.8(87)	0.001	11.8(22)	0.001	20.7(39)	0.038
Moderate	60.7(270)		20.7(92)		25.4(112)	
Bad	68.5(50)		31.5(23)		36.1(26)	
Social security						
Yes	56.7(352)	0.065	18.5(115)	0.048	24.3(150)	0.067
No	67.5(54)		27.8(22)		33.8(27)	
Perceived health status						
Good	44.0(109)	<0.001	8.1(20)	<0.001	18.5(46)	<0.001
Moderate	58.5(186)		19.1(61)		24.1(76)	
Bad	81.2(112)		40.9(56)		39.9(55)	
Chronic disease						
No	39.8(379)	<0.001	7.4(7)	0.002	15.2(14)	0.017
Yes	60.6(370)		21.3(130)		26.8(163)	
Physical activity						
Yes	46.2(189)	<0.001	9.5(39)	<0.001	21.2(86)	0.003
No	73.8(217)		33.4(98)		31.0(91)	
Physical disability						
No	53.7(292)	<0.001	16.1(88)	<0.001	22.0(119)	<0.001
Yes	71.7(114)		30.4(48)		35.8(57)	
The amount of water consumed daily						
<8 glasses	59.1(247)	0.732	21.9(92)	0.173	25.7(107)	0.547
8–10 glasses	56.8(108)		15.9(30)		22.1(42)	
>10 glasses	55.1(49)		16.9(15)		27.3(24)	
Smoking						
Non-smoker	59.7(362)	0.010	20.8(126)	0.026	25.8(156)	0.379
Current smoker	45.9(45)		11.2(11)		21.6(21)	
Alcohol consumption						
No	58.9(383)	0.028	20.3(132)	0.055	25.6(166)	0.307
Yes	43.4(23)		9.4(5)		19.2(10)	
The number of meals per day						
2 main meals	63.8(88)	0.247	24.6(34)	0.218	24.3(33)	0.336
3 main meals	55.3(167)		17.7(53)		23.0(69)	
3 main meals and at least 1 snack	57.6(152)		18.8(50)		28.3(75)	
Dietary supplement use						
Yes	62.8(135)	0.076	19.5(42)	0.974	28.0(60)	0.260
No	55.6(272)		19.4(95)		24.0(117)	

^a Pearson Chi Square test.

food and the types of food they consumed decreased in the last year, and of them, 13 % had to skip meals and 17 % consumed less food than they needed (TNHS, 2019). According to the Food and Agricultural Organization (FAO), food insecurity results from inability to access food, inadequate purchasing power, inadequate food in the household, or the unequal distribution of food among individuals (FAO, 2015). In addition, FAO reports that food insecurity will further increase due to increased unemployment and decreased food availability after the COVID-19 pandemic started (Gkiouras et al., 2020). In Turkey, food insecurity is thought to result from increasing food demand, consumer awareness, drought, fluctuations in agricultural production and increases in food prices (Eştürk, 2015). In the present study, the prevalence of food insecurity in the participants was approximately 30 %,

which is higher than are the results in the literature. This result is probably due to the fact that older adults' pensions are low in Turkey, which limited their accessibility to food due to rising food prices, and that social support plans due to the reduced household income as a result of the COVID-19 pandemic were interrupted.

In the present study, no relationship was determined between food insecurity, and frailty and sarcopenia. In a limited number of studies in the literature conducted with older adults, it has been reported that food insecurity is associated with increased frailty and sarcopenia (Jackson et al., 2019; Batsis et al., 2020; Smith et al., 2021; Muhammad et al., 2022). Frailty and sarcopenia are geriatric syndromes that are closely related with each other, and food status plays an important role in the emergence of both. Poor diet quality, decreased nutritional diversity,

Table 4
Relationship between household food insecurity and pre-frailty/frailty, sarcopenia risk, and malnutrition risk/malnutrition.

Variables	Model 1 (Crude model)		Model 2 (Adjusted model)		Model 3 (Adjusted model)		Model 4 (Adjusted model)	
	UOR(%95CI)	p-value	AOR(%95CI)	p-value	AOR(%95CI)	p-value	AOR(%95CI)	p-value
Pre-frailty/Frailty								
Food secure	1.00	Ref.	1.00	Ref.	1.00	Ref.	1.00	Ref.
Mildly food insecure	1.12(0.73–1.73)	0.586	1.11(0.70–1.73)	0.662	0.93(0.58–1.50)	0.792	0.96(0.59–1.58)	0.899
Moderate/Severe food insecure	1.21(0.78–1.86)	0.384	1.38(0.88–2.17)	0.160	1.09(0.67–1.78)	0.722	1.25(0.745–2.11)	0.393
Sarcopenia risk								
Food secure	1.00	Ref.	1.00	Ref.	1.00	Ref.	1.00	Ref.
Mildly food insecure	1.05(0.62–1.79)	0.836	1.04(0.60–1.80)	0.881	0.79(0.44–1.41)	0.437	0.85(0.46–1.57)	0.623
Moderate/Severe food insecure	1.03(0.60–1.75)	0.906	1.18(0.68–2.05)	0.547	0.74(0.39–1.39)	0.360	0.72(0.36–1.43)	0.361
Malnutrition risk/Malnutrition								
Food secure	1.00	Ref.	1.00	Ref.	1.00	Ref.	1.00	Ref.
Mildly food insecure	1.27(0.78–2.06)	0.327	1.26(0.77–2.06)	0.347	1.04(0.62–1.74)	0.866	1.02(0.60–1.72)	0.932
Moderate/Severe food insecure	1.95(1.24–3.07)	0.003	2.12(1.33–3.36)	0.001	1.84(1.10–3.07)	0.020	2.06(1.21–3.51)	0.007

UOR: Unadjusted Odds Ratio, AOR: Adjusted Odds Ratio, CI: Confidence Interval. Pre-frailty/Frailty: Model 2. Adjusted for age, sex, marital status, education level, perceived economic status, Model 4. Adjusted for age, sex, marital status, education level, perceived economic status, perceived health status, chronic disease, physical activity, physical disability, smoking, alcohol consumption, dietary supplement use. Sarcopenia risk: Model 2. Adjusted for age, sex, Model 3. Adjusted for age, sex, marital status, education level, perceived economic status, Model 4. Adjusted for age, sex, marital status, education level, perceived economic status, social security, perceived health level, presence of a chronic illness, physical activity, presence of a physical disability, smoking status, dietary supplement use. Malnutrition risk/Malnutrition: Model 2. Adjusted for age, sex, Model 3. Adjusted for age, sex, marital status, education level, perceived economic status, Model 4. Adjusted for age, sex, marital status, education level, perceived economic status, perceived health level, presence of a chronic illness, physical activity, presence of a physical disability, dietary supplement use.

and especially inadequate intake of antioxidant micronutrients in older adults with food insecurity may increase the risk of frailty and sarcopenia (Cruz-Jentoft et al., 2017; Kim et al., 2021; Smith et al., 2021). On the other hand, malnutrition is involved in the pathogenesis of both sarcopenia and frailty. The common features of frailty and sarcopenia such as low lean body mass and decreased physical function are often the result of malnutrition (Roberts et al., 2021). Therefore, in most of older people, frailty and sarcopenia develop after malnutrition. In the present study, no significant relationship was determined between food insecurity, and frailty and sarcopenia, due to the low rate of the participants with malnutrition (1.3 %). However, failure to take necessary medical care in older adults at risk of malnutrition included in this study may lead to the development of fragility and sarcopenia in addition to malnutrition in the future. In such a situation, nutritional insecurity is likely to be associated with frailty and sarcopenia.

In several studies it is stated that individuals with food insecurity prefer foods rich in carbohydrate and fat content, cheaper, consume less food than they should and have an impaired diet such as skipping meals, and that most of these individuals' dietary quality is low (Naja et al., 2020; Leung and Wolfson, 2021), which makes especially older adults prone to malnutrition, hypertension, diabetes and other health problems (Christian et al., 2020; Zarei et al., 2021). In their study conducted with 121 older people who presented to a primary health care center, Gkiouras et al. (2020) determined that the risk of malnutrition was an important predictor of food insecurity. In another study conducted in the older population, moderate and severe food insecurity was associated with an increased risk of malnutrition (Grammatikopoulou et al., 2019). In a study conducted with older people living in a region where the socioeconomic level was low in Turkey, it was reported that food insecurity increased the risk of malnutrition and malnutrition 2.5 times (Simsek et al., 2013). In the present study, we determined that moderate and severe food insecurity was a risk factor for malnutrition risk and malnutrition. Food insecurity is directly related to insufficient energy and macro-micronutrient intake (Zarei et al., 2021). Considering that this is the case, the finding obtained in this study can be said to be an expected result. On the other hand, there is a mutual relationship between food insecurity and malnutrition. Food insecurity leads to worse health outcomes and malnutrition, which triggers food insecurity, and causes a complex cycle to continue (Ganhão-Arranhado et al., 2018).

4.1. Strengths and limitations of the study

The strengths of the present study are that it is one of the first studies carried out on this issue in Turkey, that three different geriatric syndromes were evaluated together, that it was conducted in five primary health care centers located in different parts of a district with a relatively large group, and that its data were collected by the researchers who were specialized in the field of nutrition and dietetics. On the other hand, the study has some limitations. Among the limitations of the study are that it was a cross-sectional type study, that sequence was not observed in a causal relationship, that there was a selection bias because the study was conducted with individuals presenting to FHCs, that no physical fitness tests were performed to diagnose sarcopenia, and that sarcopenia was measured by a self-reported questionnaire (SARC-F) by the participants, which could misrepresent the data.

5. Conclusion

In the present study, we determined that approximately one third of the participants experienced food insecurity, and that while food insecurity was not associated with pre-frailty/frailty and sarcopenia risk, moderate and severe food insecurity was a risk factor for malnutrition and a risk of malnutrition. Follow-ups of older adults recommended to be performed twice a year in primary health care centers in Turkey should to be performed regularly, and geriatric syndromes and nutritional status should be comprehensively screened and evaluated during these follow-ups. In addition, food insecurity should be added to the follow-up guidelines used in the follow-ups of older people in primary health care centers, and it should be ensured that food insecurity should be questioned in the follow-ups. Economic policies that will increase the incomes of older adults and prevent price increases regarding the elimination of food insecurity, which is determined to be a risk factor for malnutrition in older people should be put into practice. Nutritional aid practices such as meals given to older adults at home who have insufficient purchasing power and have difficulty in accessing food should be performed. In addition, community health practices that will increase their consumer awareness and social policies aimed at preventing food insecurity should be planned through inter-sectoral cooperation. We also recommend that population-based studies in which geriatric

syndromes are evaluated objectively to assess the relationship between food insecurity and geriatric syndromes should be conducted.

Financial support

The authors declare that they did not receive any financial support from any funding agency in the public, commercial, or not-for-profit sectors.

CRediT authorship contribution statement

Keyser Tari Selcuk: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Supervision, Visualization, Writing – review & editing, Project administration. **Ramazan Mert Atan:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Writing – original draft. **Sedat Arslan:** Conceptualization, Data curation, Investigation, Methodology, Supervision, Writing – review & editing. **Nursel Sahin:** Conceptualization, Data curation, Investigation, Methodology, Visualization, Writing – review & editing.

Declaration of competing interest

The authors declare that there are no conflicts of interest.

Data availability

The data that has been used is confidential.

References

- Akin, S., Mazıcıoğlu, M.M., Mucuk, S., Gocer, S., Deniz Şafak, E., Arguvanlı, S., Ozturk, A., 2015. The prevalence of frailty and related factors in community-dwelling Turkish elderly according to modified Fried frailty index and FRAIL scales. *Aging Clin. Exp. Res.* 27 (5), 703–709.
- Akin, S., Ozer, F., Erturk, G., Gocer, S., Mazıcıoğlu, M., Safak, E., Mucuk, S., 2019. Which frailty scale predicts 4-year mortality in community-dwelling Turkish elderly better: the FRAIL scale or the Fried frailty index? *Erciyes Med. J.* 41 (1).
- Aşık, Z., Kılınç, Ş., Kurşun, Ö., Özen, M., 2022. Validation of the Clinical Frailty Scale version 2.0 in Turkish older patients. *Geriatrics & Gerontology International*. 22 (9), 730–735.
- Bahat Öztürk, G., Kiliç, C., Bozkurt, M.E., Karan, M.A., 2021. Prevalence and associates of fear of falling among community-dwelling older adults. *J. Nutr. Health Aging* 25 (4), 433–439.
- Bahat, G., Ozkok, S., Kilic, C., Karan, M.A., 2021. SARC-F questionnaire detects frailty in older adults. *J. Nutr. Health Aging* 25 (4), 448–453.
- Batsis, J., Petersen, C., Gooding, T., 2020. Association of food insecurity and sarcopenia: the national health and nutrition examination surveys. *Innov. Aging* 4 (Suppl. 1), 773.
- Bor, H., 2018. Investigation of the relationship between obesity and food insecurity among university students [dissertation]. Ankara (Turkey): Hacettepe University.
- Bulut, E.A., Soysal, P., Aydin, A.E., Dokuzlar, O., Kocyyigit, S.E., Isik, A.T., 2017. Vitamin B12 deficiency might be related to sarcopenia in older adults. *Exp. Gerontol.* 95, 136–140.
- Bulut, E.A., Soysal, P., Isik, A.T., 2018. Frequency and coincidence of geriatric syndromes according to age groups: single-center experience in Turkey between 2013 and 2017. *Clin. Interv. Aging* 13, 1899.
- Büyüksöy Bulucu, G.D., 2021. The determination of the prevalence of household food insecurity in a region of Central Anatolia. *Health and Society* 31 (1), 159–166.
- Cansın Kış, H., Karaca, K.E., 2021. The adaptation and validity of SARC-F Scale in individuals over the age of 65. *The Online Journal of Science and Technology* 11 (2), 71–81.
- Cesari, M., Marzetti, E., Canevelli, M., Guaraldi, G., 2017. Geriatric syndromes: how to treat. *Virulence* 8 (5), 577–585.
- Christian, V.J., Miller, K.R., Martindale, R.G., 2020. Food insecurity, malnutrition, and the microbiome. *Curr. Nutr. Rep.* 9 (4), 356–360.
- Coates, J., Swindale, A., Bilinsky, P., 2007. Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide: Version 3.
- Crichton, M., Craven, D., Mackay, H., Marx, W., Marshall, S., de van der Schueren, M., 2019. A systematic review, meta-analysis and meta-regression of the prevalence of protein-energy malnutrition: associations with geographical region and sex. *Age and ageing* 48 (1), 38–48.
- Cruz-Jentoft, A.J., Kiesswetter, E., Drey, M., Sieber, C.C., 2017. Nutrition, frailty, and sarcopenia. *Aging Clin. Exp. Res.* 29 (1), 43–48.
- Cruz-Jentoft, A.J., Bahat, G., Bauer, J., Boirie, Y., Bruyère, O., Cederholm, T., Extended Group for EWGSOP2, 2019. Sarcopenia: revised European consensus on definition and diagnosis. *Age Ageing* 48 (1), 16–31. <https://doi.org/10.1093/ageing/afy169>.
- Dokuzlar, O., Soysal, P., Isik, A.T., 2017. Association between serum vitamin B12 level and frailty in older adults. *Northern Clinics of Istanbul* 4 (1), 22.
- Essomba, M.J.N., Atsa, D., Noah, D.Z., Zingui-Ottou, M., Paula, G., Nkeck, J.R., Ashuntantang, G., 2020. Geriatric syndromes in an urban elderly population in Cameroon: a focus on disability, sarcopenia and cognitive impairment. *Pan Afr. Med. J.* 37.
- Eştürk, Ö., 2015. Farklı Gıda Güvencesi Düzeylerinde hanelerin Tüketim Alışkanlıkları: Adana İli Örneği. *Ardahan University Journal of the Faculty of Economics and Administrative Sciences.* 1 (2), 249–264.
- Ethgen, O., Beaudart, C., Buckinx, F., Bruyère, O., Reginster, J.Y., 2017. The future prevalence of sarcopenia in Europe: a claim for public health action. *Calcif. Tissue Int.* 100 (3), 229–234.
- Faul, F., Erdfelder, E., Lang, A.G., Buchner, A., 2007. G* power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav. Res. Methods* 39 (2), 175–191.
- Faul, F., Erdfelder, E., Buchner, A., Lang, A.G., 2009. Statistical power analyses using G* power 3.1: tests for correlation and regression analyses. *Behav. Res. Methods* 41 (4), 1149–1160.
- Fernandes, S.G., Rodrigues, A.M., Nunes, C., Santos, O., Gregório, M.J., De Sousa, R.D., Canhão, H., 2018. Food insecurity in older adults: results from the epidemiology of chronic diseases cohort study 3. *Front. Med.* 5, 203.
- Food and Agriculture Organization of the United Nations (FAO), 2015. The State of Food Insecurity in the World. www.fao.org/publications. (Accessed 7 October 2022).
- Frith, E., Loprinzi, P.D., 2018. Food insecurity and cognitive function in older adults: brief report. *Clin. Nutr.* 37 (5), 1765–1768.
- Ganhão-Arranhado, S., Paúl, C., Ramalho, R., Pereira, P., 2018. Food insecurity, weight and nutritional status among older adults attending senior centres in Lisbon. *Arch. Gerontol. Geriatr.* 78, 81–88.
- Gkiouras, K., Cheristanidis, S., Papailia, T.D., Grammatikopoulou, M.G., Karamitsios, N., Goulis, D.G., Papamitsou, T., 2020. Malnutrition and food insecurity might pose a double burden for older adults. *Nutrients* 12 (8), 2407.
- Grammatikopoulou, M.G., Gkiouras, K., Theodoridis, X., Tsimiri, M., Markaki, A.G., Chourdakis, M., Goulis, D.G., 2019. Food insecurity increases the risk of malnutrition among community-dwelling older adults. *Maturitas* 119, 8–13.
- Hymabaccus Muradi, B.A.B., 2017. Validation of FRAIL Scale in Turkish older adults [dissertation]. Ankara (Turkey): Hacettepe University..
- Ishida, Y., Maeda, K., Nonogaki, T., Shimizu, A., Yamanaka, Y., Matsuyama, R., Mori, N., 2020. SARC-F as a screening tool for sarcopenia and possible sarcopenia proposed by AWGS 2019 in hospitalized older adults. *J. Nutr. Health Aging* 24 (10), 1053–1060.
- Jackson, J.A., Branscum, A., Tang, A., Smit, E., 2019. Food insecurity and physical functioning limitations among older US adults. *Prev. Med. Rep.* 14, 100829.
- Kaiser, M.J., Bauer, J.M., Ramsch, C., Uter, W., Guigoz, Y., Cederholm, T., Sieber, C.C., 2009. Validation of the Mini Nutritional Assessment Short-Form (MNA®-SF): a practical tool for identification of nutritional status. *JNHA-The Journal of Nutrition, Health and Aging* 13 (9), 782–788.
- Kim, Y.M., Yang, N., Kim, K., 2021. Effects of perceived food store environment on malnutrition and frailty among the food-insecure elderly in a Metropolitan City. *Nutrients* 13 (7), 2392.
- de León, Díaz, González, E., Gutiérrez Hermosillo, H., Martínez Beltran, J.A., Chavez, J. H.M., Palacios Corona, R., Salinas Garza, D.P., Rodriguez Quintanilla, K.A., 2016. Validation of the FRAIL scale in Mexican elderly: results from the Mexican health and aging study. *Aging Clin. Exp. Res.* 28 (5), 901–908.
- Leung, C.W., Wolfson, J.A., 2021. Food insecurity among older adults: 10-year National Trends and associations with diet quality. *J. Am. Geriatr. Soc.* 69 (4), 964–971.
- Liu, F., Heng, Y., Li, Q., He, Q., 2020. Frailty. *J. Biosci. Med.* 8 (10), 148.
- Lu, J.L., Ding, L.Y., Xu, Q., Zhu, S.Q., Xu, X.Y., Hua, H.X., Xu, H., 2021. Screening accuracy of SARC-F for sarcopenia in older adults: a diagnostic meta-analysis. *J. Nutr. Health Aging* 25 (2), 172–182.
- Malmstrom, T.K., Morley, J.E., 2013. SARC-F: a simple questionnaire to rapidly diagnose sarcopenia. *J. Am. Med. Dir. Assoc.* 14 (8), 531–532.
- Morley, J.E., Malmstrom, T.K., Miller, D.K., 2012. A simple frailty questionnaire (FRAIL) predicts outcomes in middle aged african americans. *J. Nutr. Health Aging* 16 (7), 601–608.
- Muhammad, T., Saravanakumar, P., Sharma, A., Srivastava, S., Irshad, C.V., 2022. Association of food insecurity with physical frailty among older adults: study based on LASI, 2017–18. *Arch. Gerontol. Geriatr.* 104762.
- Naja, F., Itani, L., Kharroubi, S., El Harake, M.D., Hwalla, N., Jomaa, L., 2020. Food insecurity is associated with lower adherence to the Mediterranean dietary pattern among Lebanese adolescents: a cross-sectional national study. *Eur. J. Nutr.* 59 (7), 3281–3292.
- Norman, K., Haß, U., Pirlich, M., 2021. Malnutrition in older adults—recent advances and remaining challenges. *Nutrients* 13 (8), 2764.
- Ozer, F.F., Akin, S., Tasci, İ., Tasar, P.T., Savas, S., Cincin, A.T., Saka, B., 2021. Risk of sarcopenia in hospitalized patients and related clinical factors: a multicenter study from Turkey. *Eur. Geriatr. Med.* 12 (4), 863–870.
- Papadopoulou, S.K., Tsintavis, P., Potsaki, G., Papandreou, D., 2020. Differences in the prevalence of sarcopenia in community-dwelling, nursing home and hospitalized individuals. A systematic review and meta-analysis. *J. Nutr. Health Aging* 24 (1), 83–90.
- Pekcan, G., 2012. Beslenme Durumunun Saptanması, in: Baysal A. (Eds.), *Diyet El Kitabı*, Ankara, Hatipoğlu Publishing.
- Pereira, M.H., Pereira, M.L., Campos, G.C., Molina, M.C., 2022. Food insecurity and nutritional status among older adults: a systematic review. *Nutr. Rev.* 80 (4), 631–644.
- Pérez-Zepeda, M.U., Castrejón-Pérez, R.C., Wynne-Bannister, E., García-Peña, C., 2016. Frailty and food insecurity in older adults. *Public Health Nutr.* 19 (15), 2844–2849.

- Perna, S., Gasparri, C., Ferraris, C., Barrile, G.C., Cavioni, A., Mansueto, F., Rondanelli, M., 2022. Validation of the Italian version of the SARC-F questionnaire to assess sarcopenia in older adults. *Nutrients* 14 (12), 2533.
- Roberts, S., Collins, P., Rattray, M., 2021. Identifying and managing malnutrition, frailty and sarcopenia in the community: a narrative review. *Nutrients* 13 (7), 2316.
- Rohrmann, S., 2020. Epidemiology of frailty in older people. In: *Frailty and cardiovascular diseases*, pp. 21–27.
- Rolland, Y., Lauwers-Cances, V., Cournot, M., Nourhashemi, F., Reynish, W., Rivière, D., Grandjean, H., 2003. Sarcopenia, calf circumference, and physical function of elderly women: a cross-sectional study. *J. Am. Geriatr. Soc.* 51 (8), 1120–1124.
- Rubenstein, L.Z., Harker, J.O., Salvà, A., Guigoz, Y., Vellas, B., 2001. Screening for undernutrition in geriatric practice: developing the short-form mini-nutritional assessment (MNA-SF). *J. Gerontol. Ser. A Biol. Med. Sci.* 56 (6), M366–M372.
- Russell, J., Flood, V., Yeatman, H., Mitchell, P., 2014. Prevalence and risk factors of food insecurity among a cohort of older australians. *J. Nutr. Health Aging* 18 (1), 3–8.
- Sacar, D.E., Kilic, C., Karan, M.A., Bahat, G., 2021. Ability of SARC-F to find probable sarcopenia cases in older adults. *J. Nutr. Health Aging* 25 (6), 757–761.
- Sanford, A.M., Morley, J.E., Berg-Weger, M., Lundy, J., Little, M.O., Leonard, K., Malmstrom, T.K., 2020. High prevalence of geriatric syndromes in older adults. *PLoS One* 15 (6), e0233857.
- Sarikaya, D., Halil, M., Kuyumcu, M.E., Kilic, M.K., Yesil, Y., Kara, O., Ariogul, S., 2015. Mini nutritional assessment test long and short form are valid screening tools in Turkish older adults. *Archives of Gerontology and Geriatrics* 61 (1), 56–60.
- Serrano-Urrea, R., Garcia-Meseguer, M.J., 2013. Malnutrition in an elderly population without cognitive impairment living in nursing homes in Spain: study of prevalence using the mini nutritional assessment test. *Gerontology* 59 (6), 490–498.
- Sieber, C.C., 2019. Malnutrition and sarcopenia. *Aging Clin. Exp. Res.* 31 (6), 793–798.
- Simsek, H., Meseri, R., Sahin, S., Ucku, R., 2013. Prevalence of food insecurity and malnutrition, factors related to malnutrition in older adults: a community-based, cross-sectional study from Turkey. *Eur. Geriatr. Med.* 4 (4), 226–230.
- Smith, L., Jacob, L., Barnett, Y., Butler, L.T., Shin, J.I., López-Sánchez, G.F., Koyanagi, A., 2021. Association between food insecurity and sarcopenia among adults aged ≥ 65 years in low-and middle-income countries. *Nutrients* 13 (6), 1879.
- Tang, T., Wu, L., Yang, L., Jiang, J., Hao, Q., Dong, B., Yang, M., 2018. A sarcopenia screening test predicts mortality in hospitalized older adults. *Sci. Rep.* 8 (1), 1–9.
- Tarasuk, V., Mitchell, A., McLaren, L., McIntyre, L., 2013. Chronic physical and mental health conditions among adults may increase vulnerability to household food insecurity. *J. Nutr.* 143 (11), 1785–1793.
- Thiam, C.N., Ooi, C.Y., Seah, Y.K., Chuan, D.R., Looi, I., Ch'ng, A.S.H., 2021. Assessing frailty in the general medical clinic of a tertiary hospital in northern Malaysia: the FRAIL Scale or the Clinical Frailty Scale. *Current Gerontology and Geriatrics Research* 2021.
- Thomas, M., Miller, D.P., Morrissey, T.W., 2019. Food insecurity and child health. *Pediatrics* 144 (4).
- Thompson, M.Q., Theou, O., Tucker, G.R., Adams, R.J., Visvanathan, R., 2020. FRAIL scale: predictive validity and diagnostic test accuracy. *Australas. J. Ageing* 39 (4), e529–e536.
- Tucher, E.L., Keeney, T., Cohen, A.J., Thomas, K.S., 2021. Conceptualizing food insecurity among older adults: development of a summary indicator in the National Health and aging trends study. *J. Gerontol. B Psychol. Sci. Soc. Sci.* 76 (10), 2063–2072.
- Turkey's Nutrition Guide (TUBER). (2015). [Internet]. [accessed 2022 Sep 16]. Available from: <https://hsgm.saglik.gov.tr/depo/birimler/saglikli-beslenme-hareketli-hayat-db/Yayinlar/rehberler/2015-beslenme-rehberi.pdf>.
- Turkey Nutrition and Health Survey (TNHS), 2019. Accessed. In: *Turkey Nutrition Guide (TUBER (2015))*, p. 59. https://hsgm.saglik.gov.tr/depo/birimler/saglikli-beslenme-hareketli-hayat-db/Yayinlar/kitaplar/TBSA_RAPOR_KITAP_20.08.pdf.
- Volkert, D., Beck, A.M., Cederholm, T., Cereda, E., Cruz-Jentoft, A., Goisser, S., Wirth, R., 2019. Management of malnutrition in older patients—current approaches, evidence and open questions. *J. Clin. Med.* 8 (7), 974.
- Woo, J., Yu, R., Wong, M., Yeung, F., Wong, M., Lum, C., 2015. Frailty screening in the community using the FRAIL scale. *J. Am. Med. Dir. Assoc.* 16 (5), 412–419.
- World Population Ageing, 2015. United Nations: 2015. United Nations, Department of Economic and Social Affairs, Population Division. Department of Economic and Social Affairs, Population Division.
- Zarei, M., Qorbani, M., Djalalinia, S., Sulaiman, N., Subashini, T., Appanah, G., Naderali, E.K., 2021. Food insecurity and dietary intake among elderly population: a systematic review. *Int. J. Prev. Med.* 12 (1).