Original Article

Malnutrition and its risk factors in a home for seniors in Shanghai

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Background and Objectives: Older adults residing in senior homes are at a high risk of malnutrition. In this study, we investigated the nutritional status of these individuals and factors associated with malnutrition in this population. **Methods and Study Design:** This cross-sectional study (September 2020–January 2021) included a total of 583 older adults residing in a senior home in Shanghai (mean age, 85.0±6.6 years). The Mini Nutritional Assessment Short Form (MNA-SF) questionnaire was administered to assess the nutritional status of the participants. Patients with possible sarcopenia were identified according to the guidelines recommended by the Asian Working Group for Sarcopenia in its 2019 consensus (AWGS 2019). Moreover, the factors influencing malnutrition were determined through multivariate analyses. **Results:** The likelihoods of having malnutrition and being at a risk of malnutrition were noted in 10.5% and 37.4% of the participants, respectively. In both male and female participants, handgrip strength (HGS) and calf circumference (CC) increased significantly with increasing scores on the aforementioned questionnaire (p<0.001). Among the participants, 44.6% had ≥3 chronic diseases and 48.2% used multiple medicines. Multivariate analyses revealed that dysphagia (OR, 3.8; 95% CI, 1.7–8.5), possible sarcopenia (OR, 3.6; 95% CI, 2.2–5.6), and dementia (OR, 4.5; 95% CI, 2.8–7.0) were correlated with a relatively high prevalence of malnutrition/malnutrition risk. Exercise (at least thrice a week) reduced malnutrition risk. **Conclusions:** Malnutrition is common among older adults residing in senior homes; therefore, the associated factors must be identified, and appropriate interventions should be administered.

Key Words: nutritional status, chronic disease, senior home, older adult, malnutrition

INTRODUCTION

Adequate nutrition is essential for healthy aging. Malnutrition is associated with numerous adverse outcomes, such as frailty, decreased immunity, and increased chronic disease and mortality risks. The risk of malnutrition increases with increasing age and decreasing functional ability.[1] In older adults, appetite loss in common and can be attributed to underlying acute or chronic medical conditions or adverse effects of medications.[2] Moreover, taste and smell deficits may adversely affect food choice and intake in older adults. During the coronavirus disease 2019 pandemic, malnutrition emerged as a major concern, which can be attributed to individuals' inactivity and difficulty in obtaining fresh food items because of social distancing and lockdown.[3] The Seventh National Census of China revealed that Chinese individuals aged ≥60 years accounted for 18.7% of the total population in 2020; the corresponding value was 23.4% in Shanghai.[4] The trend toward an increasingly older population will inevitably lead to increased incidence rates of not only chronic diseases but also disability and malnutrition due to multitudinous etiologies.

Older adults residing in senior homes constitute a unique population. The nutritional status of these individuals may be affected by various medical conditions, including mobility issues and systemic and chronic health conditions.[5-7] Consequently, the risk of malnutrition in older adults residing in senior homes is higher than that in the general population. Active nutritional surveys help prevent the deterioration of nutritional status and diseases

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in older adults; hence, such surveys are essential for promoting healthy aging and achieving the national goal of "Healthy China 2030."[8] The Seventh National Census of China indicated that the aging population in Shanghai has been gradually increasing in number; accordingly, the number of older adults residing in senior homes has been steadily increasing.[4]

The Mini Nutritional Assessment Short Form (MNA-SF) is a valid nutritional screening tool for detecting malnutrition and malnutrition risk in older adults.[9] To the best of our knowledge, few studies have focused on the status of malnutrition in Chinese older adults residing in senior homes and the factors associated with malnutrition in this population; furthermore, only a few surveys have been conducted using the MNA-SF questionnaire to detect malnutrition and its risk in older adults. Thus, in the present study, we investigated the prevalence of malnutrition in older adults residing in senior homes in Shanghai as well as the factors associated with malnutrition in these individuals.

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METHODS

Participants

This cross-sectional study was conducted between September 2020 and January 2021 and included all residents of a senior home in Changning, Shanghai (Figure 1). The only inclusion criterion was an age of ≥60 years. The study protocol was approved by the Research Ethics Committee of Huadong Hospital affiliated to Fudan University (approval number: 2020K178). All participants provided written informed consent for participation.

General data collection

Relevant data were collected through questionnaire surveys and face-to-face interviews. These data included the participants' demographics, exercise frequency (per week), diet type, nutritional supplement use, nursing care requirement, medical history, and medication use.

Diet was divided into the following two categories: general and nongeneral. Nutritional supplements included protein powders, mineral and vitamin supplements, and oral nutritional supplements.

The care requirement of the participants was assessed by professionals on a semiannual basis in accordance with the DB31/T684-2013 Standard issued by the Shanghai Municipal Bureau of Quality and Technical Supervision (2013).[10] The assessment included the evaluation of various dimensions of self-care ability, cognitive ability, emotion, and vision. On the basis of the assessment results, the nursing care requirements of older adults were classified into four levels. Higher levels indicated the individuals' poorer ability to live independently. Levels 3 and 4 indicated the need for high levels of nursing care.

Medical history included the history of tumors, stroke, dysphagia, Alzheimer's disease, osteoporosis, chronic bronchitis, lumbar disease, Parkinson's disease, fractures, chronic obstructive pulmonary disorder, and renal insufficiency. Taking ≥5 medications per day was regarded as polypharmacy.[11]

Nutritional status

Nutritional status was assessed using the MNA-SF questionnaire.[9] The questionnaire provides information on

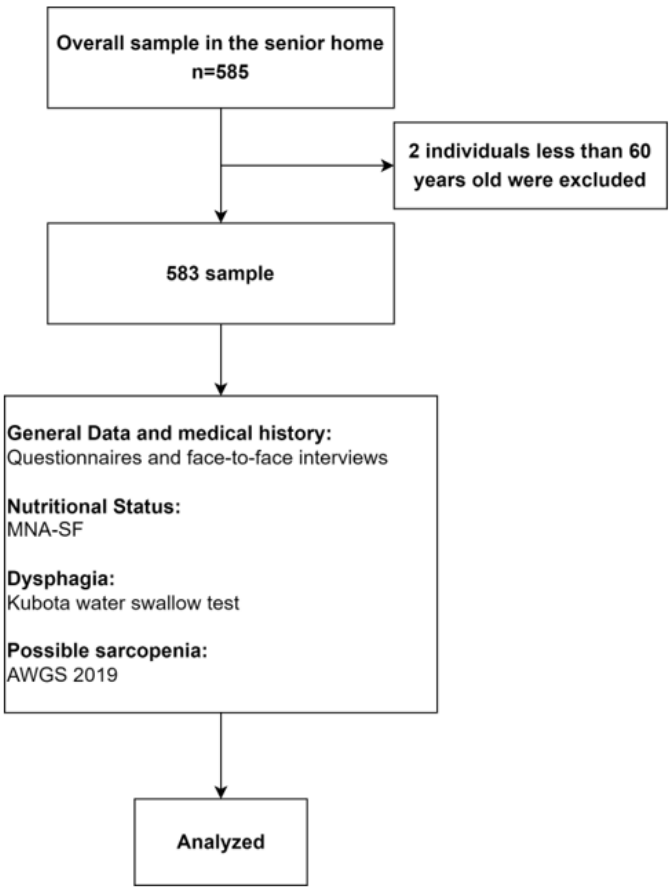

Figure 1. Flowchart for participant inclusion. MNA-SF: Mini Nutritional Assessment-short form; AWGS 2019: Asian Working Group for Sarcopenia 2019 Consensus.

appetite and food intake, weight loss, mobility, psychological stress or acute disease in the past 3 months, mental status, and body mass index (calf circumference [CC] is used if height and weight cannot be measured). The total score is 14; scores of ≥12, 8–11, and <8 indicate normal nutrition, malnutrition risk, and malnutrition, respectively.

Sarcopenia screening

The concept of possible sarcopenia in Asian populations was introduced by the Asian Working Group for Sarcopenia in its 2019 consensus (AWGS 2019). This serves as a basis for the practical and feasible diagnosis of sarcopenia.[12] Decreased muscle strength is a key symptom of sarcopenia; it is central to sarcopenia diagnosis and helps predict adverse outcomes.[13] Using the AWGS 2019 data, individuals with possible sarcopenia were identified as follows: screening in addition to CC measurements and the simple five-item questionnaire (SARC-F) or SARC-F combined with CC (SARC-CalF) questionnaire during the case finding stage, followed by the assessment of handgrip strength (HGS) in the screen-positive population to identify patients with possible sarcopenia.

The circumference of the widest area of the calf was measured using a nonelastic tape with the participants in the sitting position and their knee flexed at 90°. The SARC-F questionnaire is used for the rapid screening of sarcopenia. The scores on this questionnaire range from 0 to 10; scores of ≥4 indicate an abnormal status.[14] SARC-F involves the following five items: lifting and carrying a 10-lb weight, walking across a room, getting up from a bed or chair, climbing 10 stair steps, and the number of falls in the previous year. The SARC-CalF questionnaire incorporates CC into the SARC-F questionnaire; the scores on SARC-Ca1F range from 0 to 20; scores of ≥11 indicate an abnormal status.[15]

HGS was measured using a digital hand dynamometer (CAMRY EH101, Guangdong, China).[16] The participants were in the standing position with their arms drooping naturally and elbows extended, and they were instructed to use their dominant hand to squeeze the handle of the dynamometer using their maximum strength. The test was performed at least twice, and the higher of the two readings was used in analysis. If the participants could not stand independently, they could sit during the test.

As per the recommendations of the AWGS 2019 consensus, sarcopenia is indicated by a CC of <34 cm for men, CC of <33 cm for women, SARC-F score of ≥4, or SARC-CalF score of ≥11.[12] Low muscle strength is indicated by an HGS of <28 kg for men and <18 kg for women.[12]

Statistical analysis

Statistical analyses were performed using SPSS Statistics (version 26.0; IBM Corporation, Armonk, NY, USA). Data are presented in terms of mean ± standard deviation or number and percentage values. Continuous variables were analyzed using Student's t or Mann–Whitney U tests, whereas categorical variables were analyzed using Pearson's chi-square or Fisher's exact tests. The correlations between variables were analyzed using Spearman's correlation coefficients. A two-tailed p value of <0.05 indicated statistical significance. The factors associated with malnutrition were assessed using the OR for binary logistic regression and 95% CI. Variables with a p value of <0.1 in univariate analysis (Pearson's chi-square test) were included in a binary logistic regression model (forward layer recurrent). The *Hosmer–Lemeshow* (H–L) test was used to evaluate the goodness of fit of the binary logistic regression model.

RESULTS

Nutritional status and chronic diseases

This study included a total of 583 older adults (mean age, 85.96±6.58 years); among them, 204 (35.0%) were men (mean age, 85.25±7.81 years) and 333 (65.0%) were women (mean age, 86.35±5.79 years). The mean MNA-SF scores of all participants was 11.1±2.4 (Table 1). The difference between the two sexes in terms of the prevalence of malnutrition was nonsignificant (p>0.05). On the basis of the participants' scores on the MNA-SF questionnaire, 61 residents (10.5%) were regarded as malnourished individuals, 218 (37.4%) were identified to be at a risk of malnutrition, and 304 (52.1%) were regarded as well-nourished individuals (Figure 2).

Among the diseases surveyed, the top five chronic diseases with the highest prevalence were hypertension (69.6%), possible sarcopenia (65.9%), stroke (46.5%), coronary heart disease (40.3%), and dementia (31.6%). Of the participants, 90.7% had ≥2 chronic diseases, 44.6% had ≥3 chronic diseases, and 48.2% used multiple medicines. Significant differences were noted between the sexes in terms of the prevalence of osteoporosis and coronary heart disease (p<0.05).

Risk factors for malnutrition

Table 2 summarizes the results of the univariate analysis. Significant differences were observed between participants with malnutrition or those at malnutrition risk and participants with normal nutritional status in terms of nursing care requirement, exercise frequency, diet type, protein powder use, mineral and vitamin supplement use, comorbidities (n ≥3), and polypharmacy (p<0.05). The prevalence of dysphagia, stroke, dementia, fracture history, and possible sarcopenia was higher in participants with malnutrition and those at malnutrition risk than in participants with normal nutritional status (p<0.05).

The correlations of nutrition status with HGS and CC were analyzed using Spearman's correlation coefficients (Figure 3). Significant positive correlations were noted between HGS and MNA-SF scores in both men (Rs=0.54; p<0.001) and women (Rs=0.45; p<0.001). Similarly, significant positive correlations were observed between CC and MNA-SF scores in both men (Rs=0.56; p<0.001) and women (Rs=0.47; p<0.001). Both HGS and CC increased significantly with increasing MNA-SF scores in both men and women (p<0.001).

Independent factors influencing malnutrition risk

Variables with a p value of <0.10 in the univariate analysis and age were included in the multivariate analysis model. The p value (0.582) for the multivariate analysis model was obtained using the H–L test. Table 3 presents the correlation between the prevalence of malnutrition or

Table 1. Nutritional status and chronic diseases in participants

Characteristic	Overall (n=583)	Men (n=204)	Women (n=379)	*p*
MNA-SF, (mean±sd)	11.1±2.4	11.0±2.4	11.1±2.4	0.563
Malnutrition, n (%)	61 (10.5)	21 (10.3)	40 (10.6)	0.405
At risk of malnutrition, n (%)	218 (37.4)	84 (41.2)	134 (35.4)	
Normal nutritional status, n (%)	304 (52.1)	99 (48.5)	205 (54.1)	
Number of comorbidities, n (%)				0.163
<3	323 (55.4)	12 (59.3)	202 (53.3%)	
≥3	260 (44.6)	83 (40.7)	177 (46.7%)	
Polypharmacy, n (%)	281 (48.2)	103 (50.5)	178 (47.0)	0.417
Hypertension, n (%)	406 (69.6)	140 (68.6)	266 (70.2)	0.697
"Possible sarcopenia", n (%)	384 (65.9)	134 (65.7)	250 (66.0)	0.946
Stroke, n (%)	271 (46.5)	106 (52.0)	165 (43.5)	0.520
Coronary disease, n (%)	235 (40.3)	71 (34.8)	164 (43.3)	0.047
Dementia, n (%)	184 (31.6)	54 (26.5)	130 (34.3)	0.520
Osteoporosis, n (%)	141 (24.2)	29 (14.2)	112 (29.6)	<0.001
Diabetes, n (%)	131 (22.5)	45 (22.1)	86 (22.7)	0.861
Dysphagia, n (%)	72 (12.3)	22 (10.8)	50 (13.2)	0.399
Hyperlipidemia, n (%)	71 (12.2)	23 (11.3)	48 (12.7)	0.642
Chronic bronchitis, n (%)	65 (11.1)	22 (10.8)	43 (11.3)	0.837
Lumbar disease, n (%)	57 (9.8)	15 (7.4)	42 (11.1)	0.148
History of tumors, n (%)	35 (6.0)	15 (7.4)	20 (5.3)	0.314
Renal insufficiency, n (%)	32 (5.5)	14 (6.9)	18 (4.7)	0.285
COPD, n (%)	21 (3.6)	9 (4.4)	12 (3.2)	0.441
Parkinson's syndrome, n (%)	20 (3.4)	10 (4.9)	10 (2.6)	0.152

MNA-SF: Mini Nutritional Assessment-short form; COPD: chronic obstructive pulmonary disorder.

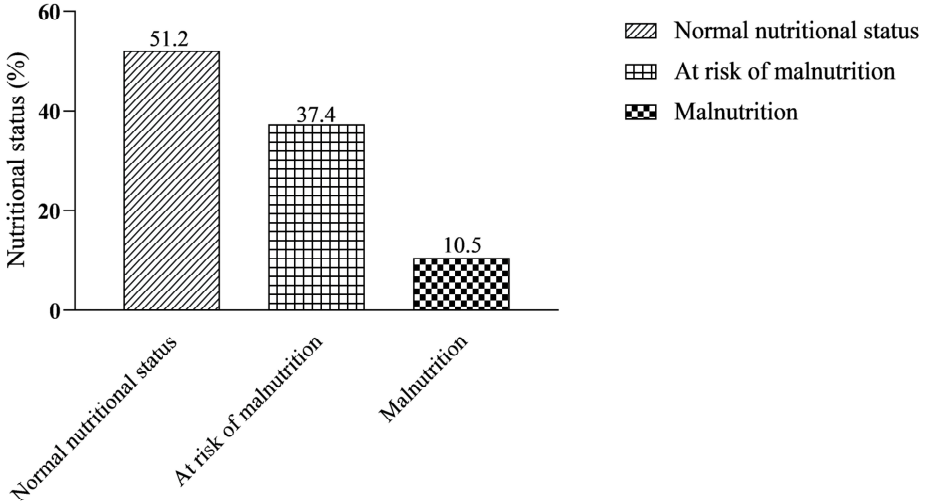

Figure 2. Nutritional status of the participants (determined using the Mini Nutritional Assessment-short form questionnaire).

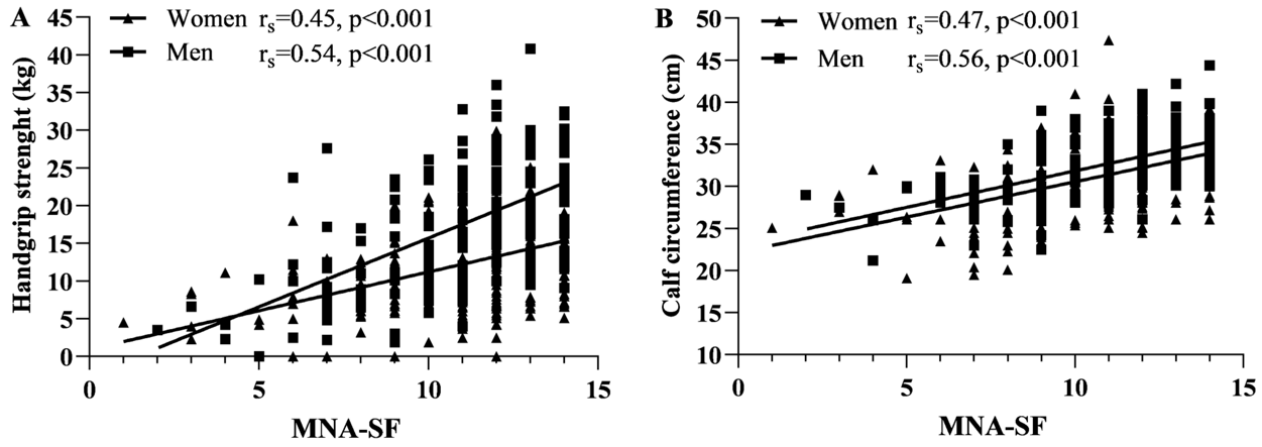

Figure 3. Correlations of nutrition status with handgrip strength and calf circumference.

Table 2. Characteristics of the participants

Characteristic	Normal nutritional (n=304)	Malnutrition / malnutrition risk (n=279)	*p*
Age (year) (mean±sd)	85.7±6.3	86.2±6.8	0.332
Age (year) [n (%)]			0.369
60 ~ <80	41 (13.5)	45 (16.1)	
≥80	263 (86.5)	234 (83.9)	
Gender [n (%)]			0.200
Men	99 (32.6)	105 (37.6)	
Women	205 (67.4)	174 (62.4)	
High level of nursing care [n (%)]	233 (76.6)	260 (93.2)	<0.001
Exercise frequency (number of times per week; n (%))			
<3	65 (21.4)	182 (65.2)	<0.001
≥3	239 (78.6)	97 (34.8)	
General dietary [n (%)]	64 (21.1)	118 (42.3)	<0.001
Protein powder [n (%)]	22 (7.2)	40 (14.3)	0.005
Minerals and vitamin supplements [n (%)]	52 (17.1)	28 (10.0)	0.013
ONS, n (%)	35 (11.5)	32 (11.5)	0.987
Polypharmacy [n (%)]	130 (42.8)	151 (54.1)	0.006
Dysphagia [n (%)]	9 (3.0)	63 (22.6)	<0.001
History of tumors [n (%)]	19 (6.3)	16 (5.7)	0.794
Stroke [n (%)]	126 (41.4)	145 (52.0)	0.011
Dementia, n(%)	40 (13.2)	144 (51.6)	<0.001
Osteoporosis [n (%)]	64 (21.1)	77 (27.6)	0.065
Hyperlipidemia [n (%)]	41 (13.5)	30 (10.8)	0.313
Chronic bronchitis, n(%)	30 (9.9)	35 (12.5)	0.305
Lumbar disease, n (%)	27 (8.9)	30 (10.8)	0.447
Parkinson's syndrome, n (%)	9 (3.0)	11 (3.9)	0.515
History of fractures [n (%)]	7 (2.3)	31 (11.1)	<0.001
COPD, n (%)	7 (2.3)	14 (5.0)	0.079
Renal insufficiency, n (%)	14 (4.6)	18 (6.5)	0.328
Number of comorbidities ≥3, n (%)	80 (26.3)	180 (64.5)	<0.001
Hypertension, n (%)	222 (73.0)	184 (65.9)	0.063
Coronary disease, n (%)	115 (37.8)	120 (43.0)	0.203
Diabetes, n (%)	66 (21.7)	65 (23.3)	0.647
"Possible sarcopenia", n (%)	145 (47.7)	239 (85.7)	<0.001

ONS: oral nutritional supplement; COPD: chronic obstructive pulmonary disorder.

Table 3. Results of multivariate logistic regression[†]

Variables	OR (95% CI)	*p*
Dysphagia		
No	1	
Yes	3.8 (1.7-8.5)	0.001
Exercise frequency (number of times per week)		
<3	1	
≥3	0.3 (0.2-0.5)	<0.001
Possible sarcopenia		
No	1	
Yes	3.6 (2.2-5.6)	<0.001
Dementia		
No	1	
Yes	4.5 (2.8-7.0)	<0.001

[†]Adjusted for age, nursing care level, exercise frequency, diet categories (general and nongeneral), polypharmacy, dysphagia, stroke, dementia, osteoporosis, history of fractures, chronic obstructive pulmonary disorder, comorbidities and possible sarcopenia.

malnutrition risk and dysphagia (OR=3.8; 95% CI=1.7–8.5). Possible sarcopenia exacerbated malnutrition. The likelihood of having malnutrition or being malnutrition risk (OR=3.6; 95% CI=2.2–5.6) was higher in participants with possible sarcopenia than in non-sarcopenia. Furthermore, dementia was identified to be a risk factor for having malnutrition or being at malnutrition risk (OR=4.5; 95% CI=2.8–7.0). Participants who exercised at least thrice a week exhibited a lower likelihood of having malnutrition or being at malnutrition risk (OR=0.3; 95% CI=0.2–0.5) than did those who exercised <3 times a week.

DISCUSSION

The residents of senior homes are older and have poor health. Malnutrition is a major concern for these older adults. However, the symptoms of malnutrition in these individuals are often overshadowed by aging-related health problems. Thus, relevant diagnosis and treatment are only possible when their nutritional status and disease

deteriorate. Active nutritional surveys and interventions may help prevent and treat malnutrition and improve the health of older adults. MNA-SF scores reflect the nutritional status of individuals; the MNA-SF scores of Chinese older adults are positively correlated with their health-related quality of life.[17] In the present study, 10.5% of the participants had malnutrition and 37.4% of the participants were at a risk of malnutrition. Our findings are consistent with those reported by a cross-sectional study conducted in Shanghai, in which the MNA-SF tool was used to survey a total of 600 older adults (aged ≥65 years) residing in long term care institutions; the findings of the earlier study revealed that 43.7% of the participants were at a risk of malnutrition and 10.7% of the participants had malnutrition.[18] In the present study, 90.7% and 44.6% of the participants had ≥2 and ≥3 chronic diseases, respectively. These findings corroborate those of a cross-sectional study conducted in Nanjing, in which 90.3% of a total of 918 participants (mean age, 86.2 years) had ≥2 chronic diseases.[19]

Adequate nutritional intake is necessary to ensure a good nutritional status. Dysphagia impairs individuals' ability to eat and drink, thus reducing the dietary intake of energy, water, and other nutrients, ultimately causing malnutrition (if corrective measures are not adopted).[20] In the present study, dysphagia increased the likelihood of having malnutrition or being at a risk of malnutrition by 3.8 times (OR=1.8; 95% CI=1.7–8.5). In a cross-sectional study conducted in Finland, the MNA questionnaire was used to survey a total of 2,114 nursing home residents (mean age, 82 years); dysphagia was identified to be an independent risk factor for malnutrition (OR=3.0; 95% CI=2.1–4.4). This finding is consistent with that of our study.[21] Cognitive changes affect the nutritional status of individuals. According to the European Society for Clinical Nutrition and Metabolism, the nutritional status and weight of patients with dementia decline with disease progression; this decline may be associated with various factors, such as appetite loss; olfactory and taste dysfunction; inflammatory response; depression; medications' adverse effects; and reduced ability to remember to eat, recognize food, and eat independently. In the present study, patients with dementia (OR=4.5; 95% CI=2.8–7.0) exhibited a higher likelihood of having malnutrition or being at a risk of malnutrition than did those without dementia. A meta-analysis that included six longitudinal studies to explore the factors associated with malnutrition in older adults identified dementia to be a risk factor for malnutrition (OR=2.1; p<0.001).[22] The effects of dementia on the likelihood of having malnutrition or being at risk of malnutrition were stronger in our study than in the aforementioned study; this difference was probably because the two studies differed in terms of design and participants.

Physical activity is essential for improved energy metabolism, appetite, bowel movement, and nutritional status. In the present study, participants who exercised at least thrice a week exhibited a lower likelihood of having malnutrition or being at a risk of malnutrition (OR=0.3; 95% CI=0.2–0.5) than did those who exercised <3 times a week. The positive effects of increased physical activity on the nutritional status of older adults was also demonstrated in a randomized controlled trial, in which a total of 55 older adults (mean age, 82 years) were divided into two groups (SGB group, 6 weeks of group exercise + 6 weeks of home exercise, and LGB group, 12 weeks of group exercise); the findings revealed that exercise helped improved the participants' MNA scores (baseline vs post-test: SGB group: 22.1±2.6 vs. 25±3.6, p<0.001; LGB group: 21.1±3.7 vs 23.9±2.5, p<0.01).[23] In the present study, possible sarcopenia was found to increase the risk of malnutrition (OR=3.6; 95% CI=2.2–5.6). Skeletal muscles are crucial for physical movement, posture, and breathing. A less common but pivotal role of these muscles involves the metabolism of energy, glucose, and protein.[24] Low amounts of skeletal muscle mass is a major factor assessed using the MNA-SF questionnaire and the Global Leadership Initiative on Malnutrition framework to diagnose malnutrition.[9,25] Therefore, sarcopenia is a key risk factor for the loss of skeletal muscles, which leads to malnutrition. We noted significantly positive correlations of HGS and CC with MNA-SF scores in both men and women (p<0.001). The evaluation of HGS and CC, which are the potential indicators of the nutritional status of older adults, is rapid and convenient.[26,27]

The strengths of our study are as follows. We included all residents (aged ≥60 years) of a senior home in Shanghai; thus, the findings appear to reflect real situations. Furthermore, several factors associated with malnutrition were identified in this study; these findings may serve as a reference for future studies aimed at the prevention and treatment of malnutrition in older adults residing in nursing homes.

The present study has some limitations, such as the cross-sectional design and small sample size; thus, future prospective studies and clinical trials with larger sample sizes are warranted to investigate the causes of malnutrition in older adults.

In conclusion, we noted a high prevalence of malnutrition in older adults residing in a senior home in Shanghai. Several factors were found to be independently associated with malnutrition, such as dysphagia, possible sarcopenia, and dementia. Furthermore, exercise (at least thrice a week) was noted to be negatively associated with malnutrition. Systematic screening and personalized interventions should be developed to prevent and treat malnutrition in this population.

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AUTHOR DISCLOSURES

The authors declare no personal or financial conflicts of interest.

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