

# Converging Pathways: Exploring the Interplay of Malnutrition, Sarcopenia, and Frailty in Nursing Home Residents: A Cross-sectional Study

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ABSTRACT

**Background:** Within the context of nursing home care, malnutrition, sarcopenia, and frailty stand as notable conditions, each exerting distinct yet interconnected impacts on residents' well-being. The objective of this cross-sectional study is to elucidate the intricate interplay among malnutrition, sarcopenia, and frailty among nursing home residents. **Methodology:** It is a community-based, cross-sectional, descriptive study among nursing home residents of Vatsalyadham Vrudhsharam, which is an institution for aged old-age people in Jamnagar from April 2023 to July 2023. The estimated minimum sample size was 345. A self-structured questionnaire was used to collect the data containing sociodemographic characteristics, anthropometric assessment, and bio-impedance indices. The handgrip was measured by a hand dynamometer. Assessment of the risk of malnutrition was performed using the Mini Nutritional Assessment-Short Form questionnaire and was confirmed by the Global Leadership Initiative for Malnutrition (GLIM) criteria. Sarcopenia was assessed by a bio-impedance analyzer using the Asian Working Group of Sarcopenia 2019. Frailty was assessed using the fatigue, resistance, ambulation, illness, and loss (FRAIL) screener. Descriptive statistics were used for the representation of percentages and frequencies. Both Chi-square and logistic regression analyses were used for the association.  $P < 0.05$  was considered statistically significant, respectively. **Results:** About 345 participants were included, and mean age of the participants was  $85 \pm 5.6$  years, about 159 (49%) participants belonged to the age group of more than 80 years, 220 (63.7%) were males, then malnutrition was diagnosed by GLIM criteria, about 154 (44.6%) were found to have malnutrition. Sarcopenia was found in 184 (53%) participants. The FRAIL screening was used to identify frailty, according to that prefrail was around 170 (49%) and frail was about 122 (35%), respectively. Age, gender, and history of falls were associated with frailty and sarcopenia ( $P < 0.001$ ). Only, age and gender were associated with malnutrition but not a history of falls. **Conclusion:** The findings of this study suggest that frailty, sarcopenia, and malnutrition are prevalent among nursing home residents. Health-care providers should identify and manage these conditions in older adults to improve their quality of life.

**KEYWORDS:** Frailty, history of falls, malnutrition, nursing home residents, sarcopenia

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## INTRODUCTION

Malnutrition, sarcopenia, and frailty are three common conditions that affect nursing home residents. Malnutrition is a condition that occurs when

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the body does not receive enough nutrients, leading to weight loss, muscle wasting, and weakness.<sup>[1]</sup> Sarcopenia is the loss of muscle mass and strength that occurs with aging, which can lead to decreased mobility and an increased risk of falls.<sup>[2]</sup> Frailty is a condition characterized by weakness, fatigue, and decreased physical function, which can lead to an increased risk of disability and mortality.<sup>[3]</sup>

While these conditions are often studied separately, evidence suggests that they may be interrelated. For example, malnutrition can lead to sarcopenia and frailty, while sarcopenia and frailty can contribute to malnutrition.<sup>[4]</sup> Understanding the interplay between these conditions is important for improving the quality of care for nursing home residents.

Frailty is estimated to affect 15% of individuals over the age of 65% and 25% of persons over the age of 85 years.<sup>[5]</sup> Sarcopenia was revealed to be a significant predictor of all-cause death among older New Hampshire residents in a review and meta-analysis.<sup>[6]</sup>

The prevalence of malnutrition and the risk of malnutrition among NH inhabitants is determined by a variety of factors, including the methods and evaluation criteria utilized. The Global Leadership Initiative for Malnutrition (GLIM) recently proposed a two-step strategy that begins with screening for malnutrition and then progresses to diagnosis and grading the degree of malnutrition.<sup>[7]</sup>

Sarcopenia, or loss of muscular strength and mass, is a natural part of aging that is increased by inactivity and illness. Sarcopenia impairs the capacity to do activities of daily living, such as walking, toileting, eating, and socializing, and so increases reliance.<sup>[8]</sup> The recent Asian Working Group of Sarcopenia (AWGS) criteria focuses on low muscle strength as the key characteristic of probable sarcopenia and uses the detection of low muscle quantity and quality to confirm the sarcopenia diagnosis.<sup>[9]</sup>

The purpose of this present study is to explore the interplay of malnutrition, sarcopenia, and frailty in nursing home residents. Determining the prevalence of these conditions and their relationship to one another helps to identify potential interventions that can improve the health and well-being of nursing home residents.

## METHODOLOGY

It is a community-based cross-sectional descriptive study among Nursing Home Residents of Vatsalyadham Vrudhsharam, which is an institution for aged old-age people in Jamnagar from April 2023 to July 2023. The sample size was calculated by taking the prevalence of

frailty as 34%<sup>[2]</sup> and 5% absolute error, the estimated sample size was 345. Participants were included by simple random technique. Inclusion criteria for participation were age  $\geq 70$  years and the ability to rise from a seated position. Exclusion criteria were body mass index (BMI)  $>30$  kg/m<sup>2</sup>, use of protein-rich oral nutritional supplements, severe dysphagia, tube feeding, bedridden, severe kidney disease, terminal stage of life, and inability to give informed consent. After assessing the eligibility criteria, about 345 participants were included in the study. Written informed consent was taken from the participants before enrolling them in the study. The study was approved by the Institutional Ethical Committee of the host institute (REF No: 89/02/2023).

## Study procedure

Malnutrition was measured in a two-step method, beginning with screening, as recommended by the GLIM collaboration. The Mini Nutritional Assessment-Short Form (MNA-SF) was used for screening (0–14; 12–14 = normal nutritional status; 8–11 = at risk of malnutrition; and 0–7 = malnourished). Malnutrition was diagnosed using the GLIM format, which needs at least one phenotypic criterion, such as weight loss, underweight, or poor muscle mass, linked with at least one etiologic criterion, such as reduced food intake or severe illness load. Malnutrition severity is classified as Stage 1 (moderate) or Stage 2 (severe) based on the degree of phenotypic criterion deviation. A BMI of 22 kg/m<sup>2</sup> showed underweight, whereas a BMI of 20 kg/m<sup>2</sup> indicated severe malnutrition.<sup>[8]</sup>

Bioelectrical impedance analysis (omron-karada scan 720T) was performed to estimate body composition including skeletal muscle%. Sarcopenia was assessed by the AWGS. AWGS 2019 retains the previous definition of sarcopenia but revises the diagnostic algorithm, protocols, and some criteria: low muscle strength is defined as handgrip strength  $<28$  kg for men and  $<18$  kg for women; criteria for low physical performance are 6-m walk  $<1.0$  m/s, Short Physical Performance Battery score  $\leq 9$ , or 5-time chair stand test  $\geq 12$  s. AWGS 2019 retains the original cutoffs for height-adjusted muscle mass: dual-energy X-ray absorptiometry,  $<7.0$  kg/m<sup>2</sup> in men and  $<5.4$  kg/m<sup>2</sup> in women; and bioimpedance,  $<7.0$  kg/m<sup>2</sup> in men and  $<5.7$  kg/m<sup>2</sup> in women.<sup>[9]</sup>

The fatigue, resistance, ambulation, illness, and loss (FRAIL) questionnaire (0–5p; 0 = robust; 1–2 = prefrail and 3–5 = frail) was used to screen for frailty.<sup>[10]</sup>

## Statistical analyses

Data are presented using the descriptive statistics, i.e., mean and standard deviation for continuous variables.

The SPSS version 26 (IBM's headquarters Armonk, New York, United States). was used for the statistical calculations. The logistic regression was used to the association between sociodemographic characteristics with the presence of frailty, sarcopenia, and malnutrition.  $P < 0.05$  was considered statistically significant.

**RESULTS**

Table 1 shows that the mean age of the participants was  $85 \pm 5.6$  years, about 159 (46%) participants belonged to the age group of more than 80 years, 220 (63.7%) were males, and nearly half 183 (53%) participants had a history of fall in the past. The most commonly associated comorbidity was hypertension (64%).

Table 2 shows the mean BMI of the participants was  $24.3 \pm 4.9$  kg/m<sup>2</sup>, all participants were initially assessed

for malnutrition using MNA-SF, and then malnutrition was diagnosed by GLIM criteria. According to that about 70 (20%) came under severe malnutrition and 84 (24.3%) were having moderate malnutrition.

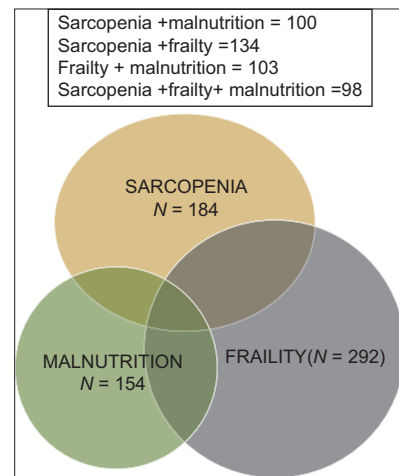
Sarcopenia was assessed using AWGS, according to that about 220 (63.7%) patients were having probable sarcopenia, and 184 (53%) were having confirmed sarcopenia. The FRAIL screening was used to identify frailty, according to that prefrail was around 170 (49%) and Frail was about 122 (35%), respectively, [Figure 1].

Table 3 shows that males have four times more odds of getting frailty than females, age group of more than

**Table 1: Sociodemographic characteristics of the participants (n=345)**

Variables	Category	Frequency, n (%)
Age	70–80	186 (54)
	>80	159 (46)
Gender	Male	220 (64)
	Female	125 (36)
History of fall	Yes	183 (53)
	No	162 (47)
Comorbidities	Diabetes	186 (54)
	Hypertension	223 (65)
	Both	101 (29)
	History of CAD	72 (21)

CAD: Coronary artery disease



**Figure 1: Prevalence and overlap of malnutrition, sarcopenia, and frailty in the participants**

**Table 2: Comparison of nutritional status, sarcopenia, and frailty by gender in participants**

Variables	All (n=345), n (%)	Male (n=220), n (%)	Female (n=125), n (%)
Mean BMI	24.3±4.9	25.8±4.4	23.4±4.2
MNA-SF (0–14p)			
Median (IQR)	10 (8–13)	11 (10–13)	12 (11–13)
Normal (12–14p)	185 (54)	114 (52)	71 (57)
At risk (8–11)	102 (30)	55 (25)	47 (38)
Malnourished (0–7p)	58 (16)	51 (23)	7 (5)
Malnutrition according to GLIM			
Not malnourished	191 (55)	120 (55)	71 (57)
Moderate malnutrition	84 (24)	54 (24.5)	30 (24)
Severe malnutrition	70 (20)	46 (21)	24 (19)
Sarcopenia according to AWGS			
Not sarcopenic	161 (47)	121 (55)	40 (32)
Confirmed sarcopenia	184 (53)	99 (45)	85 (68)
FRAIL (0–5p)			
Median (IQR)	1 (0–3)	1 (0–3)	0 (0–2)
Robust (0p)	53 (15)	32 (15)	21 (17)
Prefrailty (1–2p)	170 (49)	124 (56)	46 (37)
Frail (3–5)	122 (36)	64 (29)	58 (46)

BMI: Body mass index, MNA-SF: Mini nutritional assessment-short form, IQR: Interquartile range, GLIM: Global leadership initiative for malnutrition, AWGS: Asian Working Group of Sarcopenia, FRAIL: Fatigue, resistance, ambulation, illness, and loss

80 years have five times more odds of getting frailty than 70–80 years, and history of fall participants were four times more odds of having frailty than those without the history of falls.

Table 4 shows males with the age group of more than 80 years have six times more odds of getting sarcopenia and patients with a history of falls have three times more odds of getting sarcopenia than participants without a history of falls.

Table 5 shows females have two times more odds of getting malnutrition than males. Older participants (>80 years) have four times more odds of getting malnutrition than participants <80 years which is statistically significant, respectively.

## DISCUSSION

Based on the present study, it is clear that malnutrition, sarcopenia, and frailty are interrelated conditions that are prevalent among nursing home residents.

The prevalence of malnutrition in the present study was 44.6%, which can be higher when compared with the previous studies malnutrition in the nursing home:<sup>[11]</sup> this study found that approximately 20% of nursing home residents had some form of malnutrition. Depression, cognitive impairment, functional impairment, and swallowing difficulty were consistently associated with malnutrition. Mortality was the major consequence of malnutrition among nursing home residents.

The prevalence of sarcopenia in the present study was 53%, which can also be higher when compared with the previous study. The prevalence and risk factors of sarcopenia among nursing home older residents:<sup>[12]</sup> This study found that sarcopenia is highly prevalent among nursing home residents (33%) and it is more represented among male residents. Sarcopenia was associated with functional and clinical status, and mortality was higher among nursing home residents with sarcopenia.

The current study exhibits a significantly higher prevalence of frailty, standing at 85%, in contrast to the previous study titled "Prevalence of Frailty in Nursing Homes: A Systematic Review and Meta-Analysis."<sup>[13]</sup> This study found that the mean prevalence of frailty among nursing home patients ranged widely from 19.0% to 75.6%. Mortality was higher among nursing home residents with frailty.

Identifying and Managing Malnutrition, Frailty and Sarcopenia in the Community: A Narrative Review:<sup>[14]</sup> This study found that although malnutrition, frailty, and sarcopenia are distinct from each other, there is overlap

**Table 3: Association of sociodemographic characteristics with frailty in the study participants**

Variables	Presence of frailty		OR (CI)
	Yes (n=292), n (%)	No (n=53), n (%)	
Age			
70–80 (186)	142 (76)	44 (34)	5.1 (2.4–10.9)**
>80 (159)	150 (94)	9 (6)	
Gender			
Male (220)	201 (91)	19 (9)	3.9 (2.1–7.3)**
Female (125)	91 (73)	34 (27)	
History of fall			
Yes (183)	170 (93)	13 (7)	4.2 (2.1–8.3)**
No (162)	122 (75)	40 (25)	

*P*<0.05 significant, \*\**P*<0.001-highly significant. OR: Odds ratio, CI: Confidence interval

**Table 4: Association of sociodemographic characteristics with sarcopenia in the study participants**

Variables	Presence of sarcopenia		OR (CI)
	Yes (n=184), n (%)	No (n=161), n (%)	
Age			
70–80 (186)	63 (34)	123 (66)	6.2 (3.8–9.9)**
>80 (159)	121 (42)	38 (58)	
Gender			
Male (220)	151 (69)	69 (31)	6.1 (3.7–9.8)**
Female (125)	33 (26)	92 (74)	
History of fall			
Yes (183)	122 (67)	61 (33)	3.2 (2.0–5.0)**
No (162)	62 (38)	100 (62)	

*P*<0.05 - significant, \*\**P*<0.001 - highly significant. OR: Odds ratio, CI: Confidence interval

**Table 5: Association of sociodemographic characteristics with malnutrition in the study participants**

Variables	Presence of malnutrition		OR (CI)
	Yes (n=154), n (%)	No (n=191), n (%)	
Age			
70–80 (186)	56 (30)	130 (70)	3.7 (2.3–5.8)**
>80 (159)	98 (62)	61 (38)	
Gender			
Female (125)	70 (56)	55 (44)	2.06 (1.3–3.2)**
Male (220)	84 (38)	136 (62)	
History of fall			
Yes (183)	82 (45)	99 (55)	1.2 (0–1.97)
No (162)	72 (44)	92 (56)	

*P*<0.05 - significant, \*\**P*<0.001 - highly significant, OR: Odds ratio, CI: Confidence interval

and synergy between the conditions. Malnutrition plays a key role in the pathogenesis of both frailty and sarcopenia and vice versa. Malnutrition, frailty, and sarcopenia have serious consequences at an individual and societal level, including increased risk

of functional decline, infections, falls, pressure injuries, hospitalization, institutionalization, and mortality.

Prevalence and Associated Factors of Sarcopenia in Nursing Home Residents: A Systematic Review and Meta-analysis:<sup>[15]</sup> This study found that sarcopenia is highly prevalent in older nursing home residents, and malnutrition may be an associated factor of sarcopenia.

The findings of the study suggest that males have four times higher odds of getting frailty than females, and the age group of more than 80 years has five times higher odds of getting frailty than the age group of 70–80 years. In addition, participants with a history of falls have four times higher odds of having frailty than those without a history of falls. Moreover, males with the age group of more than 80 years have six times higher odds of getting sarcopenia, and patients with a history of falls have three times higher odds of getting sarcopenia than participants without a history of falls. Furthermore, females have two times higher odds of getting malnutrition than males.

Several studies have investigated the association between gender and frailty. A cross-sectional population-based study found that frailty prevalence is higher in females, while mortality is higher in males.<sup>[16]</sup> Another study found that frailty increases steadily with age, and the prevalence of frailty is higher in studies that include older participants.<sup>[17]</sup> Moreover, a study found that a history of falls is linked to frailty in elderly hospitalized patients.<sup>[18]</sup>

Regarding the association between gender and malnutrition, a systematic review and meta-analysis found that boys are more likely to be undernourished than girls.<sup>[19]</sup> However, a study on Indian tribes found that the prevalence rate of moderate undernutrition is higher among females than males.<sup>[20]</sup>

Several studies have investigated the association between sarcopenia and falls. A systematic review and meta-analysis found that sarcopenic individuals have a higher risk of falls than nonsarcopenic individuals.<sup>[21]</sup> Another study found that sarcopenia is a significant predictor of future falls in community-dwelling older populations.<sup>[22]</sup> Moreover, a study found that frailty is a strong predictor of recurrent falls in a US population-representative sample.<sup>[23]</sup>

Based on the findings of the study, it can be concluded that males have higher odds of getting frailty and sarcopenia, while females have higher odds of getting malnutrition. In addition, the age group of more than 80 years has higher odds of getting frailty and sarcopenia than the age group of 70–80 years. Moreover,

participants with a history of falls have higher odds of having frailty and sarcopenia than those without a history of falls. These findings are consistent with previous research that suggests that gender, age, and history of falls are associated with frailty and sarcopenia. It is important for health-care providers to identify and manage these conditions in older adults to reduce the risk of adverse outcomes.

However, this study has some limitations. The study was cross-sectional, which means that causality cannot be established. In addition, the study was conducted on nursing home residents, which limits the generalizability of the findings to other populations. Furthermore, the study did not investigate the potential interactions between frailty, sarcopenia, and malnutrition.

To address these limitations, future research should use longitudinal designs to establish causality and investigate the potential interactions between frailty, sarcopenia, and malnutrition. In addition, future research should investigate these conditions in other populations, such as community-dwelling older adults. Finally, future research should investigate the effectiveness of interventions to prevent and manage frailty, sarcopenia, and malnutrition in older adults.

## CONCLUSION

The findings of this study suggest that frailty, sarcopenia, and malnutrition are prevalent among nursing home residents, and they are interrelated conditions that have serious consequences at an individual and societal level. Health-care providers should identify and manage these conditions in older adults to improve their quality of life and reduce the risk of adverse outcomes. Future research should address the limitations of this study and investigate the potential interactions between these conditions.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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