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Prevalence and Risk Factors of Self-Reported Sarcopenia and Its Association With Multimorbidity in Community-Dwelling Older Adults: A Cross-Sectional Study

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ABSTRACT

This cross-sectional study aimed to identify the impact of multimorbidity on self-reported sarcopenia and compare the differences in the prevalence and associated factors of sarcopenia in community-dwelling older adults with and without multimorbidity. We enrolled 876 community-dwelling older adults in South Korea. Multimorbidity was defined as the coexistence of two or more chronic diseases, and sarcopenia was evaluated using the Strength, Assistance in walking, Rising from a chair, Climbing stairs, and Falling Questionnaire. Binomial logistic regression analyses were performed. Our study revealed that the prevalence of sarcopenia was significantly higher (43.5%) in older adults with multimorbidity than in those without multimorbidity (20.8%). This finding underscores the significant impact of multimorbidity on sarcopenia. We also found that poor perceived health status was the strongest predictor of sarcopenia in older adults with multimorbidity, while oldest-old age (≥ 85 years) was the strongest predictor of sarcopenia in those without multimorbidity. Large prospective cohort studies using objective sarcopenia screening tools are needed to demonstrate the synergistic effects of multimorbidity and sarcopenia on health outcomes among community-dwelling older adults.

1 | Introduction

Sarcopenia is a condition marked by the gradual loss of muscle mass, strength, and physical activity (Coletta and Phillips 2023). This condition begins to develop in early adulthood, progressively worsening with age, and can result in substantial muscle impairment later in life (Cruz-Jentoft et al. 2019). The global prevalence of sarcopenia among adults aged 60 and above ranges from 10% to 27% (Petermann-Rocha et al. 2022; Therakomen, Petchlorlian, and Lakananurak 2020), with the

rate significantly increasing in individuals over 80 years (Tu et al. 2021). Sarcopenia is associated with severe health challenges in older adult population, including higher risks for disability, poor quality of life, and increased mortality (Zhao et al. 2023). Additionally, sarcopenia can lead to substantial healthcare costs owing to increased hospitalization and long-term care (Petermann-Rocha et al. 2022). Although sarcopenia is often considered a part of the natural aging process, it can also be driven by chronic diseases, making its prevention and management critical.

Abbreviations: CI, Confidence interval; IPAQ-SF, International Physical Activity Questionnaire-Short Form; IRB, Institutional Review Board; KRW, Korean won; MET, Metabolic equivalent of task; OR, Odds ratio; SARC-F, Strength, Assistance with walking, Rising from a chair, Climbing stairs, and Falls; VIF, Variance inflation factor

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Summary

- This study emphasized that older adults with multimorbidity were at approximately two times higher risk of sarcopenia than those without multimorbidity.
- In both older adults with and without multimorbidity, those aged 85 years or older with no job, poor perceived health status, and physical inactivity were at a higher risk of sarcopenia.
- Poor perceived health status was the most potent risk factor for sarcopenia in older adults with multimorbidity, whereas age 85 years or older was the most potent risk factor for sarcopenia in older adults without multimorbidity.

Multimorbidity, defined as the coexistence of multiple chronic diseases, is common in older adults, with over half of individuals aged 60 and above being affected (Veronese et al. 2021). Overall, the prevalence of multimorbidity was 37.2% and increases with age (Chowdhury et al. 2023). Multimorbidity can exacerbate the likelihood of sarcopenia in older adults, as chronic conditions contribute to muscle wasting and physical inactivity (Dodds et al. 2020; Xia et al. 2024). Multimorbidity may lead to the development of sarcopenia through various mechanisms. For instance, chronic diseases often lead to chronic low-grade inflammation, in which elevated cytokines promote muscle breakdown and inhibit regeneration (Antuña et al. 2022). Physical inactivity due to chronic diseases results in muscle disuse and further decline (Hämäläinen et al. 2024). Nutritional deficiencies, common in chronic conditions, also impair muscle protein synthesis and accelerate muscle loss (Bhattacharya et al. 2022). Additionally, polypharmacy, which involves medications such as corticosteroids and statins, can exacerbate muscle weakness, worsening sarcopenia (Prokopidis et al. 2023). However, there remains a lack of in-depth research on the relationship between sarcopenia and multimorbidity in community-dwelling older adults. Understanding these associations is essential for developing targeted interventions to mitigate the impact of sarcopenia in this vulnerable population.

The European Working Group on Sarcopenia in Older People defined sarcopenia as “a syndrome characterized by the progressive and generalized loss of skeletal muscle mass and strength” (Coletta and Phillips 2023). While muscle mass is important for diagnosing sarcopenia, specialized medical tools like dual-energy X-ray absorptiometry are necessary for precise measurement (Zhao et al. 2023). However, self-reported sarcopenia, which is marked by reduced muscle strength and low physical performance, is considered clinically more relevant and sufficient to initiate interventions, regardless of muscle mass (Cruz-Jentoft et al. 2019; Zhao et al. 2023). It can be quickly evaluated by the Strength, Assistance with walking, Rising from a chair, Climbing stairs, and Falls (SARC-F) questionnaire (Cruz-Jentoft et al. 2019; Zhao et al. 2023). Previous studies have described that the SARC-F questionnaire is a validated and valuable tool for identifying patients with low muscle strength in community settings (Kim, Kim, and Won 2018; Malmstrom and Morley 2013). Early screening for sarcopenia

can provide significant information regarding the prevention and delay of sarcopenia, with a gradual loss of both muscle mass and strength among older adults.

In South Korea, where the population is aging rapidly, sarcopenia has been highlighted as a significant public health issue (Baek et al. 2021). Approximately 84% of the Korean older population has at least one chronic disease, with an average of 1.9 chronic diseases (Baek et al. 2021). Despite this, there is limited knowledge about the prevalence and risk factors of sarcopenia and multimorbidity in Korean community-dwelling older adults (Jung and Baek 2023). Since sarcopenia is a reversible condition, early screening and assessment could help implement timely, customized interventions. Importantly, understanding the relationship between multimorbidity and sarcopenia in community-living older adults is an essential prerequisite for nurses and healthcare providers to develop integrated care strategies to delay or reduce the risk of sarcopenia and its adverse outcomes (Xia et al. 2024).

Several sociodemographic factors, such as age, marital status, and employment, can influence the risk and progression of sarcopenia. Married individuals often exhibit healthier behaviors, such as increased physical activity and better nutrition, owing to spousal support, which can help prevent sarcopenia (Holt-Lunstad et al. 2015). Employment status can be another key factor influencing sarcopenia. This is particularly true in physically active jobs, as activity helps maintain muscle strength, whereas unemployment or retirement may lead to inactivity and muscle loss over time in older adults (Kirwan et al. 2020). Exploring the interplay between demographic characteristics and sarcopenia may help inform more personalized approaches to sarcopenia prevention and management in older adults.

Therefore, the aims of this cross-sectional study were (1) to identify the impact of multimorbidity on self-reported sarcopenia using the SARC-F questionnaire after controlling for confounding factors and (2) to compare differences in the prevalence and risk factors of sarcopenia in community-dwelling older adults with and without multimorbidity.

2 | Methods

2.1 | Study Design

This study employed a descriptive, cross-sectional design.

2.2 | Study Population

Between August and September 2023, we recruited a convenience sample of registered adults aged 65 years or older residing in Goseong-gun, Gyeongsangnam-do, South Korea, for at least a year. Goseong-gun is a rural county with nearly 50 000 inhabitants. Older adults who used public health services at a community health center were considered eligible participants. These older adults were contacted by phone, leaflets, and in person at the center. In the initial stage, 932 older adults were enrolled. Of these, those who resided in nursing homes or social welfare facilities with physical or mental disabilities, cognitive impairment, or difficulty living independently were

excluded ($n=24$). In addition, we excluded individuals who were unable to walk independently ($n=8$) and those with neuromuscular disorders, such as Parkinson's disease ($n=4$). We excluded individuals with neuromuscular disorders to avoid confounding the assessment of sarcopenia with the muscle loss related to these conditions. Of the 896 patients, 20 had missing interim values and were excluded. Finally, 876 older adults were included in the analysis. Using the G*Power version 3.1.9.2 software (Heinrich Heine University, Düsseldorf, Germany) for a post hoc analysis to determine the sample size adequacy and power of the study, the sample size of this study reached a power ($1-\beta$) of 99.9%, with the odds ratio (OR) of 1.51 of logistic regression analysis in this study, and a 2-sided significance level of 0.05.

2.3 | Study Variables

2.3.1 | Sociodemographic and Health-Related Characteristics

Data regarding the participants' sociodemographic characteristics, such as age, gender, education level, working status, household income, marital status, and living arrangements, were obtained. With regard to marital status, customary marriages deemed valid under the marriage laws in Korea are classified as "married" in the context of classification. In our study, "unmarried" refers to persons who are currently not married and includes those who are "single," "widowed," "separated," or "divorced." Health-related characteristics included current smoking status, alcohol consumption, perceived stress, perceived health status, physical activity, sedentary behavior, and type of chronic disease. To assess perceived stress levels, the participants were asked, "What is the average daily level of stress experienced?" The response options were "very frequently," "often," "sometimes," "rare," and "never." For the analysis, we classified "very frequently" and "often" as the "often" group and "rare" and "never" as the "rare" group. Perceived health status was assessed with a single question, "Overall, how would you rate your health status?" The response options provided were "very good," "good," "fair," "poor," and "very poor." For the purpose of analysis, we classified the responses "excellent" and "good" as the "good" group and "very poor" and "poor" as the "poor" group.

Physical activity was assessed using the Korean version of the International Physical Activity Questionnaire-Short Form (IPAQ-SF) (Oh et al. 2007), which was originally developed by Craig et al. (2003). The IPAQ-SF is widely accepted to have high reliability (ranging from 0.66 to 0.88) (Lee et al. 2011). Participants were asked to provide information about their physical activity during the previous seven days. This included the average duration per day, the number of days per week, and the intensity of physical activity. Physical activity was categorized into active and inactive (low active) based on the metabolic equivalent of task (MET). Sedentary behaviors were measured using a single question in the IPAQ-SF, which examined the number of hours spent sitting during the past week. Based on a previous study (Kim and Lee 2019), sedentary time was divided into two groups: less than 8 h and more than 8 h.

2.3.2 | Multimorbidity

In our study, chronic diseases included hypertension, arthritis or rheumatism, diabetes, cardiovascular diseases (coronary heart disease and heart failure), gastrointestinal disease, cerebrovascular disease, chronic liver disease, chronic lung disease, chronic kidney disease, and cancer. In the current study, we defined multimorbidity as participants having two or more chronic conditions simultaneously, whereas non-multimorbidity was defined as respondents suffering from one or no chronic disease.

2.3.3 | Self-Reported Sarcopenia

The Korean version of the SARC-F questionnaire (Kim, Kim, and Won 2018), developed by Malmstrom and Morley (2013), was used to screen for sarcopenia. The questionnaire comprised five items scored from 0 to 2, with a total possible score ranging from 0 to 10. A score of 4 and more indicates sarcopenia. Cronbach's α in this study was 0.876.

2.4 | Data Analysis

This study employed IBM SPSS version 28.0 (IBM Corp., Armonk, NY, USA). Participants' sociodemographic and health-related characteristics were analyzed using descriptive statistics comprising frequency, percentage, mean, and standard deviation. The chi-squared test was used to compare differences in the presence of sarcopenia according to the participants' general characteristics in the two groups with and without multimorbidity.

Binomial logistic regression analysis was applied to identify the impact of multimorbidity on self-reported sarcopenia in older adults. According to tolerance values (>0.01) and the variance inflation factor (VIF) <10 results, there was no evidence of multicollinearity in the logistic regression model. Model 1 was unadjusted, whereas Model 2 incorporated multimorbidity and adjusted for the variables in Model 1. In addition, binomial logistic regression was conducted to investigate the risk factors for sarcopenia in the groups with and without multimorbidity. Unadjusted and adjusted OR with 95% confidence interval (CI) were estimated using logistic regression. Confounding variables in binomial logistic regression were entered as statistically significant ($p < 0.05$) in univariate analyses (Table 2 and Table S1). All statistical tests were two-tailed, with the significance level set at $p < 0.05$.

2.5 | Ethical Considerations

Institutional Review Board (IRB) approval was obtained from the primary investigator's university institution (IRB No. 1041078-20240615-HR-149). Before study inclusion, the purpose and procedure were explained to the participants. Considering that the participants were older adults, we provided them with sufficient time to make decisions regarding their participation in the study. Additionally, for any parts of the explanation that were unclear, we offered a thorough Q&A opportunity and provided further clarification as needed. Each participant voluntarily signed an informed consent form after understanding their right to confidentiality, withdrawal, and protection of identifying details.

TABLE 1 | General characteristics of the participants ($N=876$).

Characteristics	Categories	<i>n</i> (%) or <i>Mean</i> $\pm$ <i>SD</i>
Sociodemographic characteristics		
Age (year)		77.42 $\pm$ 7.62
	65–74	333 (38.0)
	75–84	373 (42.6)
	≥ 85	170 (19.4)
Gender	Men	326 (37.2)
	Women	550 (62.8)
Education level	Illiterate	220 (25.1)
	Elementary school	318 (36.3)
	Middle school	155 (17.7)
	Above high school	183 (20.9)
Working status	Yes	516 (58.9)
	No	360 (41.1)
Household income (10000 KRW)	< 200	729 (83.2)
	≥ 200	147 (16.8)
Marital status	Unmarried	367 (41.9)
	Married	509 (58.1)
Living arrangements	Alone	325 (37.1)
	Spouse or family	551 (62.9)
Health-related characteristics		
Current smoker	Yes	75 (8.6)
	No	801 (91.4)
Current alcohol consumption	Yes	207 (23.6)
	No	669 (76.4)
Perceived stress	Often	132 (15.1)
	Sometimes	441 (50.3)
	Rare	303 (34.6)
Perceived health status	Poor	406 (46.3)
	Fair	315 (36.0)
	Good	155 (17.7)
Physical activity	Inactive	431 (49.2)
	Active	445 (50.8)
Sedentary behaviors (hours/day)	< 8	719 (82.1)
	≥ 8	157 (17.9)
Chronic diseases ^a	Hypertension	463 (52.9)
	Arthritis or rheumatism	258 (29.5)
	Diabetes mellitus	170 (19.4)

(Continues)

TABLE 1 | (Continued)

Characteristics	Categories	<i>n</i> (%) or <i>Mean</i> ± <i>SD</i>
	Cardiovascular disease	100 (11.5)
	Gastrointestinal disease	71 (8.1)
	Cerebrovascular disease	47 (5.4)
	Chronic liver disease	28 (3.2)
	Chronic lung disease	23 (2.6)
	Chronic kidney disease	17 (1.9)
	Cancer	21 (2.4)
Multimorbidity (≥ 2)	Yes	361 (41.2)
	No	515 (58.8)
Sarcopenia (≥ 4)	Yes	264 (30.1)
	No	612 (69.9)

Abbreviations: KRW, Korean won; SD, standard deviation.

^aMultiple responses.

After obtaining written informed consent from the participants, the research data were collected by the researcher, who was assisted by two trained research assistants.

3 | Results

3.1 | General Characteristics of the Participants

Among the 876 participants, the prevalence of self-reported sarcopenia was 30.1%, and multimorbidity was observed in 41.2%. As presented in Table 1, the mean age of the participants was 77.42 years, and 62.8% of them were women. Regarding education level, 25.1% were illiterate, and 36.3% completed elementary school. For employment and income status, 58.9% were working, and 83.2% had a household income of less than 2000000 Korean won (KRW). Regarding marital status, 58.1% were married, and 62.9% lived with their spouse or family.

Pertaining to health-related characteristics, 8.6% were current smokers and 23.6% reported current alcohol consumption. About 50.3% of participants reported feeling stressed sometimes, and 46.3% reported poor perceived health. Nearly 50.8% of participants reported being physically active, and 82.1% had less than 8 h of sedentary behavior. The prevalence of chronic diseases was in the following order: hypertension (52.9%), arthritis or rheumatism (29.5%), and diabetes mellitus (19.4%).

3.2 | Differences in Sarcopenia Prevalence by participants' Characteristics in Community-Dwelling Older Adults With and Without Multimorbidity

As shown in Table 2, the prevalence of self-reported sarcopenia was 43.5% in those with multimorbidity and 20.8% in those without multimorbidity.

In both groups with and without multimorbidity, a greater proportion of participants with sarcopenia were older, female, illiterate,

unemployed, and living alone than those without sarcopenia. In addition, those with sarcopenia reported current alcohol consumption, poor perceived health status, physical inactivity, and sitting for more than 8 h, than those without sarcopenia in both groups with and without multimorbidity. Regarding household income, there was a significant difference in the presence of sarcopenia only among participants without multimorbidity compared to participants without multimorbidity.

Regarding current smoking status and perceived health status, there were no significant differences in the prevalence of sarcopenia between the groups with and without multimorbidity. The proportion of low-household-income participants with sarcopenia was higher in the multimorbidity group.

3.3 | The Influence of Multimorbidity on Sarcopenia Using Binomial Logistic Regression

To determine the influence of multimorbidity on sarcopenia, we first entered the general characteristics that were significantly associated with sarcopenia ($p < 0.05$) into Model 1 (Table 3). Multimorbidity was added to Model 2. Finally, multimorbidity remained a statistically significant factor of sarcopenia with an adjusted OR of 1.51 (95% CI, 1.02–2.24; $p = 0.040$) after adjusting for confounding factors. In addition, older (75–84 years) and oldest (85 years or older) age groups, working status, marital status, perceived health status, and physical activity were found to be associated with sarcopenia. The explanatory power was 50.8% in Model 2 (Nagelkerke $R^2 = 0.508$).

3.4 | Predictors of Sarcopenia in Older Adults With and Without Multimorbidity

We performed subgroup analyses using binomial logistic regression to identify the predictors of sarcopenia among older adults with (Table 4) and without multimorbidity (Table 5).

TABLE 2 | Differences in the prevalence of sarcopenia by general characteristics in the participants with and without multimorbidity (*N* = 876).

Characteristics	Categories	Multimorbidity, yes (<i>n</i> = 361)			Multimorbidity, no (<i>n</i> = 515)		
		Sarcopenia (<i>n</i> = 157)	Non-sarcopenia (<i>n</i> = 204)	χ^2 (<i>p</i> -value)	Sarcopenia (<i>n</i> = 107)	Non-sarcopenia (<i>n</i> = 408)	χ^2 (<i>p</i> -value)
Age (year)	65–74	18 (11.5)	79 (38.7)	66.35	16 (15.0)	220 (53.9)	108.93
	75–84	68 (43.3)	103 (50.5)	(<0.001)*	43 (40.2)	159 (39.0)	(<0.001)*
	≥ 85	71 (45.2)	22 (10.8)		48 (44.8)	29 (7.1)	
Gender	Men	30 (19.1)	83 (40.7)	19.21	20 (18.7)	193 (47.3)	28.61
	Women	127 (80.9)	121 (59.3)	(<0.001)*	87 (81.3)	215 (52.7)	(<0.001)*
Education level	Illiterate	81 (51.6)	39 (19.1)	48.29	48 (44.9)	52 (12.7)	77.44
	Elementary school	53 (33.8)	86 (42.1)	(<0.001)*	44 (41.1)	135 (33.1)	(<0.001)*
	Middle school	12 (7.6)	35 (17.2)		10 (9.3)	98 (24.0)	
	Above high school	11 (7.0)	44 (21.6)		5 (4.7)	123 (30.2)	
Working status	Yes	51 (32.5)	133 (65.2)	37.99	39 (36.4)	293 (71.8)	46.28
	No	106 (67.5)	71 (34.8)	(<0.001)*	68 (63.6)	115 (28.2)	(<0.001)*
Household income	<200	142 (90.4)	173 (84.8)	2.54	96 (89.7)	318 (77.9)	7.46
(10000 KRW)	≥200	15 (9.6)	31 (15.2)	(0.111)	11 (10.3)	90 (22.1)	(0.006)*
Marital status	Unmarried	98 (62.4)	73 (35.8)	25.25	76 (71.0)	120 (29.4)	62.28
	Married	59 (37.6)	131 (64.2)	(<0.001)*	31 (29.0)	288 (70.6)	(>0.001)*
Living arrangements	Alone	88 (56.1)	73 (35.8)	14.75	54 (50.5)	110 (27.0)	21.58
	Spouse or family	69 (43.9)	131 (64.2)	(<0.001)*	53 (49.5)	298 (73.0)	(<0.001)*
Current smoker	Yes	9 (5.7)	19 (9.3)	1.59	7 (6.5)	40 (9.8)	1.09
	No	148 (94.3)	185 (90.7)	(0.207)	100 (93.5)	368 (90.2)	(0.297)
Current alcohol consumption	Yes	14 (8.9)	46 (22.5)	11.90	19 (17.8)	128 (31.4)	7.71
	No	143 (91.1)	158 (77.5)	(<0.001)*	88 (82.2)	280 (68.6)	(0.006)*
Perceived stress	Often	36 (22.9)	33 (16.2)	2.67	17 (15.9)	46 (11.3)	1.82

(Continues)

TABLE 2 | (Continued)

Characteristics	Categories	Multimorbidity, yes (n = 361)				Multimorbidity, no (n = 515)			
		Sarcopenia (n = 157)		Non-sarcopenia (n = 204)		Sarcopenia (n = 107)		Non-sarcopenia (n = 408)	
		n (%)	n (%)	n (%)	χ^2 (p-value)	n (%)	n (%)	χ^2 (p-value)	
Perceived health status	Sometimes	77 (49.0)	111 (54.4)		(0.264)	52 (48.6)	201 (49.3)		(0.402)
	Rare	44 (28.0)	60 (29.4)			38 (35.5)	161 (39.5)		
	Good	2 (1.3)	23 (11.3)		65.20	8 (7.5)	122 (29.9)		74.14
Physical activity	Fair	19 (12.1)	88 (43.1)		(<0.001)*	25 (23.4)	183 (44.9)		(>0.001)*
	Poor	136 (86.6)	93 (45.6)			74 (69.1)	103 (25.2)		
	Inactive	114 (72.6)	98 (48.0)		22.10	75 (70.1)	144 (35.3)		42.00
Sedentary behaviors (hours/day)	Active	43 (27.4)	106 (52.0)		(<0.001)*	32 (29.9)	264 (64.7)		(>0.001)*
	≥ 8	112 (71.3)	172 (84.3)		8.90	83 (77.6)	352 (86.3)		4.90
	< 8	45 (28.7)	32 (15.7)		(0.003)*	24 (22.4)	56 (13.7)		(0.027)*

Abbreviations: KRW, Korean won.
**p* > 0.05.

TABLE 3 | The influence of multimorbidity on sarcopenia using binomial logistic regression ($N=876$).

Predictors		Model 1		Model 2	
		Unadjusted OR (95% CI)	<i>p</i> -value	Adjusted OR (95% CI)	<i>p</i> -value
Age (ref. 65–74)	75–84	2.11 (1.27–3.49)	0.004*	2.01 (1.21–3.35)	0.007*
	≥ 85	7.24 (3.85–13.61)	<0.001*	6.93 (3.67–13.08)	<0.001*
Gender (ref. Men)	Women	1.68 (1.02–2.77)	0.042*	1.66 (1.00–2.74)	0.050
Education level (ref. Above high school)	Illiterate	1.80 (0.84–3.87)	0.130	1.80 (0.84–3.87)	0.133
	Elementary school	1.50 (0.76–2.97)	0.243	1.51 (0.76–2.99)	0.239
	Middle school	1.22 (0.55–2.66)	0.627	1.23 (0.56–2.71)	0.607
Working status (ref. Yes)	No	2.08 (1.39–3.11)	<0.001*	2.06 (1.37–3.09)	<0.001*
Household income (ref. ≥ 2000000 KRW)	< 2000000 KRW	1.37 (0.71–2.64)	0.356	1.39 (0.71–2.71)	0.333
Marital status (ref. Married)	Unmarried	2.43 (1.22–4.84)	0.012*	2.65 (1.32–5.35)	0.006*
Living arrangements (ref. Spouse or family)	Alone	0.63 (0.32–1.24)	0.181	0.57 (0.29–1.15)	0.116
Current alcohol consumption (ref. Yes)	No	0.89 (0.51–1.53)	0.662	0.86 (0.50–1.49)	0.588
Perceived stress (ref. Rare)	Sometimes	1.19 (0.76–1.85)	0.443	1.17 (0.75–1.82)	0.498
	Often	1.69 (0.93–3.07)	0.087	1.64 (0.90–3.00)	0.105
Perceived health status (ref. Good)	Fair	1.88 (0.84–4.22)	0.123	1.73 (0.77–3.87)	0.186
	Poor	8.59 (4.00–18.44)	<0.001*	7.39 (3.41–16.01)	<0.001*
Physical activity (ref. Active)	Inactive	1.92 (1.28–2.87)	0.002*	1.89 (1.26–2.83)	0.002*
Sedentary behaviors (ref. < 8)	≥ 8	1.11 (0.67–1.83)	0.695	1.08 (0.65–1.79)	0.761
Multimorbidity (ref. No)	Yes			1.51 (1.02–2.24)	0.040*

Note: Model 1. Nagelkerke R^2 was 0.504 and Hosmer–Lemeshow χ^2 was 6.70 ($p=0.537$); Model 2. Nagelkerke R^2 was 0.508 and Hosmer–Lemeshow χ^2 was 8.33 ($p=0.402$).

Abbreviations: CI, confidence interval; KRW, Korean won; OR, odds ratio; ref., reference.

* $p < 0.05$.

In the group with multimorbidity (Table 4), poor perceived health status was the strongest significant predictor of sarcopenia (adjusted OR, 8.67; 95% CI, 1.83–41.15; $p=0.007$). This was followed by being aged over 85 years (adjusted OR, 4.84; 95% CI, 1.97–11.88; $p < 0.001$), unemployment (adjusted OR, 2.16; 95% CI, 1.24–3.78; $p=0.007$), and physical inactivity (adjusted OR, 1.84; 95% CI, 1.05–3.23; $p=0.033$). However, the oldest-old age of 85 group was the strongest predictor of sarcopenia (adjusted OR, 8.81; 95% CI, 3.61–21.50; $p < 0.001$) in the group without multimorbidity (Table 5). This was followed by poor perceived health status (adjusted OR, 8.04; 95% CI, 3.21–20.10; $p < 0.001$), being unmarried (adjusted OR, 3.78; 95% CI, 1.53–9.36; $p=0.004$), aged 75–84 years (adjusted OR, 2.29; 95% CI, 1.12–4.68; $p=0.023$), physical inactivity (adjusted OR, 2.21; 95% CI, 1.23–3.97; $p=0.008$), and being unemployed (adjusted OR, 1.87; 95% CI, 1.02–3.43; $p=0.045$).

4 | Discussion

Our study demonstrated that 41.2% of older adults in the community had multimorbidity, while 30.1% experienced sarcopenia.

Our finding was consistent with a prior study, which reported the multimorbidity prevalence ranging from 40% to 60% among older adults (Veronese et al. 2021). It was also in line with a study in Singapore that reported a sarcopenia prevalence of 32.2% in community-dwelling older adults aged 60 and above (Pang et al. 2021). More importantly, 43.5% of older adults with multimorbidity had sarcopenia compared to 20.8% of those without multimorbidity in our study, indicating a significantly higher sarcopenia prevalence in older adults with multimorbidity. These findings highlight the substantial burden of multimorbidity and sarcopenia in the aging population, and it is crucial to develop integrated care approaches that simultaneously address these conditions.

Our main findings showed that multimorbidity significantly increased the risk of sarcopenia, even after controlling for other factors using binomial logistic regression model. This result mirrors findings from an extensive data analytics study from the UK Biobank involving 499 046 participants, which found that the risk of sarcopenia was strongly associated with multimorbidity, with individuals with multimorbidity having nearly twice the odds of

TABLE 4 | Binomial logistic regression model of sarcopenia in older adults with multimorbidity ($N=361$).

Predictors		Non-sarcopenia (reference) vs. Sarcopenia			
		Unadjusted OR (95% CI)	<i>p</i> -value	Adjusted OR (95% CI)	<i>p</i> -value
Age (ref. 65–74)	75–84	2.90 (1.60–5.26)	<0.001*	1.57 (0.77–3.21)	0.219
	≥85	14.16 (7.03–28.54)	<0.001*	4.84 (1.97–11.88)	<0.001*
Gender (ref. Men)	Women	2.90 (1.79–4.72)	<0.001*	1.68 (0.85–3.34)	0.137
Education level (ref. Above high school)	Illiterate	8.31 (3.87–17.82)	<0.001*	1.36 (0.47–3.95)	0.568
	Elementary school	2.47 (1.17–5.19)	0.017*	0.99 (0.40–2.48)	0.983
	Middle school	1.37 (0.54–3.48)	0.506	1.04 (0.34–3.13)	0.951
Working status (ref. Yes)	No	3.89 (2.51–6.05)	<0.001*	2.16 (1.24–3.78)	0.007*
Marital status (ref. Married)	Unmarried	2.98 (1.94–4.59)	<0.001*	1.10 (0.36–3.35)	0.864
Living arrangements (ref. Spouse or family)	Alone	2.29 (1.50–3.50)	<0.001*	1.21 (0.41–3.52)	0.731
Current alcohol consumption (ref. Yes)	No	2.97 (1.57–5.64)	<0.001*	1.34 (0.60–3.03)	0.477
Perceived health status (ref. Good)	Fair	2.48 (0.54–11.44)	0.243	1.64 (0.32–8.32)	0.549
	Poor	16.82 (3.87–73.05)	<0.001*	8.67 (1.83–21.15)	0.007*
Physical activity (ref. Active)	Inactive	2.87 (1.84–4.48)	<0.001*	1.84 (1.05–3.23)	0.033*
Sedentary behaviors (ref. <8)	≥8	2.16 (1.29–3.60)	0.003*	1.13 (0.57–2.22)	0.727

Abbreviations: CI, confidence interval; OR, odds ratio; ref., reference.

* $p < 0.05$.

sarcopenia (Dodds et al. 2020). Multimorbidity frequently results in mobility limitations owing to the diverse symptoms of the disease and accelerates muscle atrophy and functional decline, leading to sarcopenia (Marzetti et al. 2017). Moreover, multimorbidity can impair appetite, digestion, and nutrient absorption, leading to malnutrition, whereas adequate protein and energy intake is essential for preserving muscle mass and delaying the exacerbation of sarcopenia (Biolo, Cederholm, and Muscaritoli 2014). Therefore, implementing comprehensive and personalized care plans that consider the individual aspects of older adults' health is needed. In addition, establishing multidisciplinary care that includes clinical healthcare providers, nutritionists, physiotherapists, community health nurses, and social workers can ensure a holistic approach to managing multimorbidity and sarcopenia among community-dwelling older adults (Beard et al. 2016).

In the current study, we identified the factors associated with sarcopenia according to the presence of multimorbidity. Poor perceived health status emerged as a significant predictor of sarcopenia in all participants, particularly in those with multimorbidity, aligning with previous findings (Bae and Kim 2017). This likely reflects underlying health issues that contribute to muscle weakness and decline (Caramenti and Castiglioni 2022). Addressing perceived health issues through comprehensive assessments is essential for planning sarcopenia interventions.

Age was another key factor, with the oldest age group being the strongest predictor of sarcopenia in the non-multimorbidity

group. This aligns with well-documented evidence that aging itself is a primary risk factor for sarcopenia (Tan You Mei et al. 2024), driven by hormonal changes, neuromuscular decline, and chronic inflammation ("inflammaging") (Antuña et al. 2022). Targeted interventions are necessary to mitigate the effects of aging on sarcopenia.

Unemployment and physical inactivity were also significant predictors of sarcopenia in both groups. Over 40% of participants were unemployed, highlighting the importance of occupational engagement in maintaining muscle mass and strength, as retirement or unemployment can lead to decreased physical activity (Kirwan et al. 2020). Although we could not explore job details, future research should examine the role of work in sarcopenia prevention. Physical inactivity, affecting approximately half of the participants, underscores the need to promote regular physical activity (Marzetti et al. 2017), as recommended by international guidelines (American College of Sports Medicine (ACSM) 2021; World Health Organization (WHO) 2020). Tailored exercise programs should be prioritized for inactive older adults.

Lastly, marital status was a significant predictor of sarcopenia only in the non-multimorbidity group, suggesting that spousal support may mitigate the sarcopenia risk in healthier individuals. In contrast, multiple chronic conditions may overshadow this effect (Holt-Lunstad et al. 2015). Given that over 40% of participants were unmarried, enhancing social support for

TABLE 5 | Binomial logistic regression model of sarcopenia in older adults without multimorbidity (*N* = 515).

		Non-sarcopenia (reference) vs. Sarcopenia			
Predictors		Unadjusted OR (95% CI)	<i>p</i> -value	Adjusted OR (95% CI)	<i>p</i> -value
Age (ref. 65–74)	75–84	3.72 (2.02–6.84)	<0.001*	2.29 (1.12–4.68)	0.023*
	≥85	22.76 (11.47–45.18)	<0.001*	8.81 (3.61–21.50)	<0.001*
Gender (ref. Men)	Women	3.91 (2.31–6.59)	<0.001*	1.82 (0.82–4.02)	0.141
Education level (ref. Above high school)	Illiterate	22.71 (8.55–60.29)	<0.001*	2.80 (0.86–9.16)	0.088
	Elementary school	8.02 (3.08–20.87)	<0.001*	2.60 (0.87–7.71)	0.086
	Middle school	2.51 (0.83–7.59)	0.103	1.65 (0.49–5.53)	0.419
Working status (ref. Yes)	No	4.44 (2.84–6.96)	<0.001*	1.87 (1.02–3.43)	0.045*
Household income (ref. ≥2 000 000 KRW)	<2 000 000 KRW	2.47 (1.27–4.81)	0.008*	1.40 (0.51–3.82)	0.511
Marital status (ref. Married)	Unmarried	5.88 (3.68–9.40)	<0.001*	3.78 (1.53–9.36)	0.004*
Living arrangements (ref. Spouse or family)	Alone	2.76 (1.78–4.28)	<0.001*	0.45 (0.19–1.07)	0.070
Current alcohol consumption (ref. Yes)	No	2.12 (1.24–3.63)	0.006*	0.50 (0.23–1.10)	0.083
Perceived health status (ref. Good)	Fair	2.08 (0.91–4.77)	0.082	2.12 (0.82–5.51)	0.124
	Poor	10.96 (5.05–23.79)	<0.001*	8.04 (3.21–20.10)	<0.001*
Physical activity (ref. Active)	Inactive	4.30 (2.71–6.81)	<0.001*	2.21 (1.23–3.97)	0.008*
Sedentary behaviors (ref. <8)	≥8	2.16 (1.29–3.60)	0.003*	1.03 (0.48–2.21)	0.935

Abbreviations: CI, confidence interval; KRW, Korean won; OR, odds ratio; ref., reference.

**p* < 0.05.

unmarried older adults, perhaps through community programs, should be considered.

5 | Limitations

This study has several limitations. First, the cross-sectional design limited the establishment of causality between the observed relationships; therefore, future research should employ longitudinal designs. Second, the study sample was drawn from a specific geographical region in South Korea, limiting the generalizability of the results to populations with different socio-demographic and health characteristics, including potential rural–urban or international differences. Third, multimorbidity was defined as two or more chronic conditions in this study; however, we were unable to measure the severity of the diseases or clarify the combinations of different diseases, which may limit the understanding of specific disease interactions. Moreover, the scope of chronic diseases was limited to those reported by the participants, which may restrict the generalizability of the findings to other chronic conditions. This may underestimate the musculoskeletal disorders of the participants or the association of cachexia with sarcopenia in patients with cancer. Fourth, reliance on self-reported data for variables such as perceived health status and physical activity may introduce recall bias and

subjectivity, especially given the older age of the participants. This may have influenced the findings, particularly in terms of the accuracy and completeness of participants' responses. Fifth, our study focused on patients with self-reported sarcopenia and did not use objective measures of muscle mass, or nutritional factors such as diet and serum albumin level. Incorporating such objective tools in future research could yield different prevalence rates and provide a more comprehensive understanding of sarcopenia. Lastly, the regression analysis did not fully control for certain critical confounders, such as diet or genetic predispositions, which can also impact sarcopenia and multimorbidity. Failing to control for these factors may weaken the conclusion about the relationship between multimorbidity and sarcopenia.

6 | Conclusion

This study demonstrated a significant prevalence of sarcopenia among community-dwelling older adults, particularly those with multimorbidity. These findings emphasize the need for comprehensive and tailored interventions to mitigate the risk of sarcopenia in older adults in relation to multimorbidity. Healthcare providers should strive to improve the overall well-being of older adults by early screening for sarcopenia and developing integrated care to prevent and effectively manage sarcopenia. Such

interventions should include a combination of personalized exercise programs, nutritional strategies, and pharmacological treatments, where appropriate. They should adopt an integrated approach that involves regular monitoring of the progression of sarcopenia and related multimorbidity. Furthermore, collaboration between healthcare professionals managing chronic conditions and sarcopenia and community health workers should be considered a critical strategy for promoting better health and well-being of older adults in the community. Extensive cohort studies are necessary to reveal the combined impact of multimorbidity and sarcopenia in community-living older people.

7 | Relevance For Clinical Practice

This study suggests several important clinical implications. Early screening for sarcopenia should be prioritized in older adults, particularly those with multimorbidity, poor perceived health status, and physical inactivity. Healthcare providers should implement comprehensive management plans for chronic diseases and sarcopenia. These may include exercise training programs, nutritional support, and strategies to increase physical activity using community resources (Centers for Disease Control and Prevention (CDC) 2024; Tuso 2015). Additionally, social support networks, such as community engagement and support peer groups, could be beneficial, particularly for unmarried and retired older adults (Zanjari et al. 2022), given that marital and occupational status were significantly associated with sarcopenia.

Author Contributions

Youn-Jung Son: conceptualization, methodology, writing – original draft, writing – review and editing, supervision, formal analysis. **Yun Mi Lee:** conceptualization, methodology, data curation, supervision, funding acquisition. **Da-Young Kim:** formal analysis, visualization. **Eun-Jung Kim:** formal analysis, visualization. **Jeong-Ah Ahn:** supervision, visualization, writing – original draft, writing – review and editing, validation.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available due to privacy or ethical restrictions.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.