

## Analyzing Proportion and Susceptibility Markers of Sarcopenia In Korean Younger Female

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### | Abstract |

**PURPOSE:** This investigation in the study aimed to assess to determine proportion and susceptibility makers of sarcopenia in Korean younger female aged 30 to 39 years.

**METHODS:** To address the complex sampling design of Korea National Health and Nutrition Examination Surveys, appropriate individual weights were incorporated into the analysis. The data employed a stratified, clustered, multistage probability sampling design. A total of 2,098 participants were enrolled and categorized into two groups based on their skeletal muscle mass index scores. One hundred and twenty-four individuals were placed in the sarcopenia group, while 2,024 were allocated to a normal group. The study examined various markers as variables, including age, height, weight, body mass index waist circumference, skeletal muscle mass index, systolic and diastolic blood pressure, fasting glucose, triglyceride, and total cholesterol levels, and smoking and drinking habits.

**RESULTS:** The study found that proportion of sarcopenia in this population was 3.78% (CI: 2.89-4.94) in sarcopenia group and 96.22% (CI: 95.06-97.11) in normal with weighed values. Several susceptibilities including height, weight, BMI, waist circumference, diastolic blood pressure, and total cholesterol levels were risk factor for sarcopenia ( $p < .05$ ), exhibited significant differences between the sarcopenia and normal groups.

**CONCLUSION:** This investigation provides the proportion of sarcopenia and identifies relevant susceptibility markers among community dwelling younger women in Korea.

**Key Words:** Odds ratio, Proportion, Sarcopenia, Susceptibility marker

### I. Introduction

Advancements in applied science and healthcare technology, combined with socioeconomic development, have led to a worldwide increase in the average lifespan. In 2019, approximately more than seven hundreds million people globally were aged 65 years or older, and this number is projected to grow to 1.5 billion by 2050 [1]. Life expectancy has risen in all countries, with a disproportionately larger increase in the elderly population [2]. Consequently,

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healthcare services are facing additional strain due to the growing number of elderly individuals. To cope with the challenges posed by age-related chronic diseases and the increasing burden on healthcare systems. It is essential to gain a deeper understanding of aged related condition.

Sarcopenia is one of most common age-related disease and a condition that develops gradually in aging individuals, characterized by the widespread and progressive loss of muscle mass and function [3]. This age-related decline in muscle health is closely linked to frailty, a state in which elderly individuals become more vulnerable to various stressors that can lead to adverse health outcomes, increased risk of disability, and even mortality [4]. Frailty is essentially a state of heightened susceptibility in the elderly population.

Understanding and addressing both sarcopenia and frailty are crucial in promoting healthy aging and improving the overall well-being of older adults. These conditions can put significant strain on healthcare systems and impact the quality of life of elderly individuals. By developing interventions that target sarcopenia and frailty, we can potentially reduce the burden on healthcare services and enhance the health outcomes and longevity of the aging population.

Several studies have consistently shown that the proportion of sarcopenia is greater in females compared to males. For instance, Dam et al. conducted a screening of 10,063 individuals and reported a prevalence of 11.80% in women and 5.10% in men [5,6]. Similarly, Hunt et al. investigated 1,921 Japanese individuals residing in the community and found a proportion of sarcopenia of 16.56% in females and 10.34% in males [6].

A substantial portion of the older adult population, particularly females in Korea, faces a considerable risk of developing sarcopenia. However, the early detection of sarcopenia in female patients remains a complex task in comparison to the extensive research focused on male sarcopenia patient [7-10]. The rising number of elderly females and the potential adverse consequences associated

with sarcopenia underscore the importance of addressing this issue. Yet, healthcare professionals, including physical therapists and primary care clinicians, encounter challenges in diagnosing sarcopenia due to limited knowledge and access to appropriate diagnostic tools. In primary care settings, where time with each patient is constrained, clinicians must assess the likelihood of sarcopenia before considering referrals for diagnosis and treatment. Moreover, the lack of awareness about sarcopenia as a medical condition among clinicians increases the risk of missed diagnoses [11]. To overcome these challenges effectively, it is crucial to comprehend the key susceptibility markers associated with early detection and prevention [12]. Timely identification of symptomatic individuals can significantly impact early diagnosis and intervention, as delays or missed diagnoses can lead to complications such as compromised functional recovery, diminished quality of life, and inefficient utilization of healthcare resources.

However, it is noteworthy that the majority of sarcopenia research has primarily concentrated on individuals aged 40 years and older [13-21], despite the fact that age-related muscle loss can initiate as early as the 30s [22-30]. Hence, the identification of susceptibility markers for muscle loss at an earlier stage becomes imperative for effective prevention and treatment of this condition. Thus, the aim of present study investigates the susceptibility markers and proportion of sarcopenia in younger women between 30 and 39 years old. The hypothesis posited that specific proportion and susceptibility markers might be exist in this particular age group.

## II. Methods

### 1. Research Participants

The present study relied on data obtained from the Korea National Health and Nutrition Examination Surveys (KNHNES), which is a survey program established by the

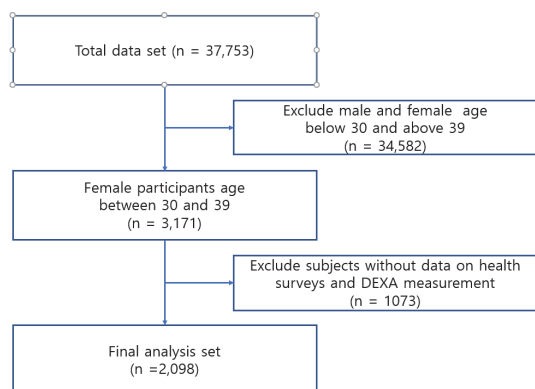


Fig. 1. Flow chart for subject selection.

Centers for Disease Control and Prevention to monitor health-risk behaviors in the population. The survey employed a stratified, clustered, multistage probability sampling design and involved the participation of 37,753 individuals during the period from 2008 to 2011. After excluding 34,582 individuals who fell below 30 or above 39 years of age, the final dataset consisted of 3,171 participants. Among them, 1,073 subjects were further excluded due to the unavailability of data on their health surveys and dual X-ray absorptiometry. Ultimately, the final analysis included 2,098 women aged between 30 and 39 years old. Based on their skeletal muscle mass index score, the participants were divided into two groups, with 74 individuals assigned to the sarcopenia group and 2,024 individuals to the normal group (Fig. 1).

## 2. Research Variables

The research encompassed several variables for the analysis, including age, height, weight, body mass index (BMI), waist circumference (WC), skeletal muscle index (SMI), smoking and drinking habits, fasting glucose levels, triglyceride levels, total cholesterol (TC) levels, systolic blood pressure, and diastolic blood pressure.

To determine the waist circumference, the researchers measured the circumference at the midpoint between the bottom of the ribcage and the top of the iliac crest during

full expiration. For blood tests, participants underwent an eight-hour fast, and systolic and diastolic blood pressures were measured using a mercury sphygmomanometer after a ten-minute rest in a chair. Smoking and drinking statuses were categorized into non-users, ex-users, and current users.

## 3. Criteria for Sarcopenia

The criteria for diagnosing sarcopenia involve the measurement of skeletal muscle mass in the limbs. This condition is identified using the ICD-10-CM code M62.84. To determine the amount of skeletal muscle mass in the limbs [31], the researchers utilized Dual X-ray absorptiometry with QDR4500A equipment from Hologic, Inc. in Bedford, MA.

The assessment of muscle mass was conducted by calculating the ASM (Appendicular Skeletal Muscle Mass) to BMI ratio, commonly referred to as the skeletal muscle mass index (SMI). The SMI value was compared to specific thresholds to diagnose sarcopenia: a SMI value below than .521 for women, in accordance with the criteria established by the Foundation for the National Institutes of Health sarcopenia Project [25]. This rigorous methodology accurately identified sarcopenia among the participants in the study.

## 4. Analysis

Statistical analyses for this study were performed using SPSS version 22.0. To address the complex sampling design of KNHANES, appropriate weights were incorporated into the analysis. The data employed a stratified, clustered, multistage probability sampling design. To compare the variables between participants with sarcopenia and those without, independent t-tests and chi-square analyses were employed. These tests allowed for the assessment of any significant differences in the variables based on sarcopenia. Furthermore, multiple logistic regression analysis with enter method was conducted to determine the odds ratio of sarcopenia. This analysis helps identify the relationship between sarcopenia and the various markers under

investigation. Throughout the study, the statistical significance level was set at  $p = .05$ , ensuring that only results with a probability of less than 5% of occurring by chance were considered significant. This approach helps ensure the robustness and reliability of the findings.

### III. Result

#### 1. Proportion of sarcopenia

In Table 1, the weighted proportion of sarcopenia was

Table 1. Proportion of sarcopenia

	Sarcopenia (n = 74)	Normal (n = 2024)	Total (N = 2098)
Un-weighted (%)	3.53	96.47	100
Weighted (%)	3.78 (2.89-4.94)	96.22 (95.06-97.11)	100

Weighed values present the 95% confidence interval.

reported as 3.78% (with a 95% confidence interval of 2.89-4.94%). This value was calculated using the specific weights to individuals account for the complex sampling design of the study. On the other hand, the unweighted proportion of sarcopenia, which does not consider the sampling design, was found to be 3.53%. These proportion figures provide valuable insights into the occurrence of sarcopenia in the studied population, considering both the weighted and unweighted estimates.

#### 2. Susceptibility Markers for Sarcopenia

The statistical analysis revealed that Susceptibility markers including height, weight, BMI, WC, SMI, DBP, and total cholesterol, showed significant differences between two group ( $p < .05$ ). On the other hand, other variables such as SBP, drinking status, smoking status, fasting glucose, and triglyceride levels did not demonstrate significant differences ( $p > .05$ ). These findings are presented in Table 2 and provide significant level, mean,

Table 2. Susceptibility markers related to sarcopenia

	Sarcopenia (N = 74)	Normal (N = 2024)	p
Age (years)	35.405 ± 2.689	34.895 ± 2.781	.121
Height (cm)	151.807 ± 4.99	160.073 ± 5.088	.000
Weight (kg)	59.488 ± 11.706	57.016 ± 9.2	.025
BMI (kg/m <sup>2</sup> )	25.785 ± 4.745	22.239 ± 3.343	.000
WC (cm)	79.547 ± 11.282	74.704 ± 8.863	.000
SMI (g/m <sup>2</sup> )	498.797 ± 19.088	673.382 ± 77.827	.000
SBP (mmHg)	107.851 ± 11.276	105.93 ± 11.43	.155
DBP (mmHg)	73.068 ± 9.053	70.309 ± 8.974	.009
Drinking status (%) (current-/ex-/non-drinker)	75.432 / 21.521 / 3.047	78.309 / 16.229 / 5.463	.360
Smoking status (%) (current-/ex-/non-smoker)	9.068 / 7.278 / 83.654	13.12 / 5.054 / 81.826	.594
FG (mg/dL)	93.366 ± 13.142	90.65 ± 14.596	.122
Triglyceride (mg/dL)	104.155 ± 50.776	90.584 ± 62.726	.072
TC (mg/dL)	189.07 ± 36.312	174.785 ± 30.288	.000

WC, waist circumference; SMI, skeletal muscle mass index SBP, systolic blood pressure; DBP, diastolic blood pressure; FG, fasting glucose; TC, total cholesterol.

Values are expressed as the mean ± standard deviation. The independent *t*-test and chi-square test were performed.

Table 3. Odds ratio for sarcopenia

Variables	Odds ratio (95% CI)	p
Height	.005(.003-.007)	.000
Weight	67.327(20.981-216.046)	.000
BMI	10.693(.070-167.786)	.000
WC	3.716(2.207-6.257)	.000
SMI	.002(.001-.003)	.000
TC	1.108(1.062-1.157)	.000
DBP	10.459(7.723-14.164)	.000

WC, waist circumference; SMI, skeletal muscle mass index; TC, Total cholesterol; DBP, diastolic blood pressure.

Odds ratio values are present as the 95% confidence interval (CI). Multiple logistic regression with enter method in complex sampling performed.

and standard deviation about the markers that have a significant impact on the sarcopenia in the population.

### 3. Multiple Logistic Regression for Odds Ratio

Table 3 lists the odds ratios with their corresponding 95% confidence intervals (CI) are presented for significant predictors of sarcopenia in females, as determined through multiple logistic regression analysis. The following variables were found to be statistically significant ( $p < .05$ ): height .005(.003-.007), weight 67.327(20.981-216.046), BMI 10.693(.070-167.786), WC 3.716(2.207-6.257), SMI .002 (.001-.003), TC 1.108(1.062-1.157), DBP 10.459(7.723-14.164).

## IV. Discussion

The purpose of this study was to examine the proportion and susceptibility markers of sarcopenia in individuals living in the community. Given the increasing aging population in Korea and Asia, the incidence of sarcopenia has been on the rise, particularly among females. However, healthcare professionals, including physical and occupational

therapists, often encounter challenges in diagnosing sarcopenia due to limited knowledge and diagnostic tools, resulting in missed diagnoses and potential complications. To address this issue, the study carefully considered easily accessible and cost-effective variables, such as height, weight, body mass index, waist circumference, skeletal muscle index, blood pressure, blood laboratory test variables, and drinking and smoking status.

The significance of early detection and prevention of sarcopenia cannot be overstated, considering its potential negative consequences. By identifying several susceptibility markers associated with sarcopenia in this population, including circumference measurements, systolic and diastolic blood pressure, fasting glucose, triglyceride, and total cholesterol levels, the study provides valuable insights for healthcare professionals to intervene proactively and implement effective preventive strategies against sarcopenia.

Sarcopenia has consistently been associated with certain susceptibility markers, specifically waist circumference. Various studies have consistently reported that women with larger waist circumferences are at a higher risk of developing sarcopenia [32-34]. For instance, a population-based cohort study conducted in the US National Health and Nutrition Survey revealed that adults with sarcopenia exhibited a larger waist circumference [33]. Similarly, a cohort study conducted among individuals with sarcopenia in Brazil also observed a larger waist circumference compared to the normal population [34]. Additionally, a study carried out in Japan among community-dwelling individuals suggested that those with sarcopenia tended to have larger waist circumferences than non-sarcopenic individuals [32]. The underlying theoretical rationale behind the association between larger waist circumference and sarcopenia lies in the interdependence of enhanced fat mass and reduced muscle mass [35]. Sarcopenic individuals often face issues with muscle power and function due to muscle loss, leading to reduced physical activity levels, such as difficulties in sitting-to-stand and

walking long distances indoors and outdoors [36]. Consequently, this reduced physical activity is strongly linked to decreased total daily energy expenditure and increased fat stores, particularly in the visceral and abdominal areas, resulting in an enlargement of the waist volume [36]. As a result, the relationship between decreased muscle mass and increased fat mass in sarcopenia is bidirectional and mutually reinforcing [37].

Total cholesterol levels were identified as a susceptibility marker for sarcopenia in women. This finding is consistent with earlier studies on sarcopenia [32,38]. For instance, Du et al. [38] reported that the female sarcopenic group had higher total cholesterol levels compared to their in the normal group. Similarly, Sanada and colleagues evaluated 1488 Japanese individuals and found that total cholesterol levels were significantly higher in those with sarcopenia compared to the normal group [32]. The potential underlying mechanism for the elevated levels total cholesterol may be associated with insulin resistance [39] and an increased volume of inflammatory cytokines [40]. These factors can lead to disturbances in lipid metabolism, contributing to total cholesterol levels in individuals with sarcopenia.

The study findings highlight that diastolic blood pressure (DBP) serve as additional susceptibility markers for women with sarcopenia, and these results align with earlier studies conducted on sarcopenia group [41-44]. For example, Atkins et al. [42] conducted a British cohort study with 4,252 participants and observed that the sarcopenia group exhibited significantly higher DBP levels compared to the normal group. Yin et al. [44] conducted a study on 14,926 Chinese individuals and found that females with sarcopenia had significantly elevated DBP compared to normal adults. The potential mechanisms underlying the elevated DBP in women with sarcopenia involve metabolic alterations and muscle mass loss due to skeletal muscle decline. This can lead to reduced energy expenditure and physical activity, insulin resistance, and arterial stiffness in adults

[45-47]. Additionally, the accumulation of visceral fat mass may trigger an inflammatory response, leading to thickening of blood vessel walls, constriction of vascular passages, and obstruction of blood flow [48]. In summary, elevated DBP are significant susceptibility markers for women with sarcopenia. The association between sarcopenia and higher blood pressure levels can be attributed to factors such as metabolic changes, muscle mass loss, insulin resistance, and the impact of visceral fat accumulation on vascular.

This study's key strength lies in its examination of female-specific susceptibility markers in a representative population of individuals in their 30s, a critical age when the decline in skeletal muscle mass typically begins. Unlike many studies that combine both sexes into a single group, this research focused solely on women, providing valuable gender-specific insights into the factors influencing sarcopenia [33,14,49].

However, it is crucial to acknowledge a limitation that should be considered in future research. The cross-sectional design utilized in this study, despite having a large sample size of participants representative of the entire population through statistical weighting, may have limitations in establishing causal relationships for the identified susceptibility markers. Cross-sectional studies only capture data at a specific point in time, making it difficult to infer causality between variables. To enhance the robustness of the findings, future studies should consider employing longitudinal or randomized case-control study designs, enabling a more comprehensive understanding of the temporal relationships and causative factors contributing to sarcopenia among the female population. In addition, Discrepancies in group sizes between sarcopenia and normal groups might cause substantial limitations to statistical analysis, potentially compromising the credibility research outcomes. Finally, the study omitted the consideration of sarcopenic obesity, a condition where individuals experience both diminished muscle mass and

heightened body fat. To better understand the outcomes, it becomes imperative to contemplate the presence of sarcopenic obesity, as it might cause better understanding in increased weight increase and expansion of waist circumference.

## V. Conclusion

This research investigation shedding light on the susceptible markers and proportion of sarcopenia among Korean females in their thirties. The study reveals that the estimated proportion of sarcopenia within this demographic is approximately 3.78%, with a confidence interval ranging from 2.89% - 4.94%. The research identifies several susceptibility markers associated with sarcopenia, such as height, weight, BMI, waist circumference, diastolic blood pressure, and total cholesterol levels. By recognizing the proportion and susceptibility markers of sarcopenia, healthcare professionals can effectively identify and detect potential sarcopenia patients in the future. Nonetheless, further research is warranted to gain a comprehensive understanding of the relationship between these predictors and sarcopenia.

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