J Korean Soc Phys Med, 2024; 19(1): 43-51
https://doi.org/10.13066/kspm.2024.19.1.43

Online ISSN: 2287-7215
Print ISSN: 1975-311X

Research Article

Open Access

Sarcopenic Obesity Frequency and Associated Risk Factors in Young Korean Women: A Comprehensive Cross-Sectional Analysis

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Received: January 25 2024 / Revised: January 25 2024 / Accepted: February 1 2024

| Abstract |

PURPOSE: Sarcopenic obesity (SO) is a clinical condition that combines sarcopenia and obesity. This study examined the frequency of SO in young Korean females between 20 and 29 years of age.

METHODS: The study involved 1,000 participants. The height, weight, body mass index (BMI), waist circumference, skeletal muscle mass index, fasting glucose, triglyceride, total cholesterol levels, systolic and diastolic blood pressure, alcohol consumption, and smoking status were the research variables. The skeletal muscle mass index was calculated as appendicular skeletal muscle mass (ASM) divided by the BMI. The ASM was assessed using dual X-ray absorptiometry. Complex sampling analysis and multiple logistic regression were used for analysis.

RESULTS: A .74(.30-1.80) frequency of SO was observed. The statistically significant risk factors in females were height, weight, BMI, waist circumference, skeletal muscle mass index, total cholesterol, systolic blood pressure, and diastolic blood pressure ($p < .05$).

CONCLUSION: Young Korean adults with SO have a .74(.30–1.80) frequency of occurrence that is linked to specific risk factors. Hence, primary care clinicians and health care professionals should consider these factors when patients require a referral for early detection and treatment. Healthcare professionals and clinicians can identify potential SO patients by acknowledging these risk factors.

Key Words: Frequency, Obesity, Risk factors, Sarcopenia, Young females

Ⅰ. Introduction

Sarcopenic obesity (SO) is characterized by the simultaneous occurrence of sarcopenia and obesity [1]. Sarcopenia, arising from age-related decline in muscle mass, is marked by reduced muscle strength, endurance, and overall functional capacity. Obesity is delineated by the excessive accumulation of body fat mass. SO arises when individuals exhibit sarcopenia and obesity concurrently, resulting in a spectrum of detrimental health consequences. These consequences include compromised physical function

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as well as impaired metabolic activity, a decline in the overall quality of life, and an increased susceptibility to mortality [2]. The intricate interplay between reduced muscle mass and excessive adiposity in SO underscores the multifaceted challenges individuals grappling with this condition face. The amalgamation of sarcopenia and obesity has a synergistic effect, amplifying the adverse impact on health.

Consequently, individuals with SO may encounter difficulties performing daily activities owing to weakened musculature and metabolic dysregulation associated with obesity [3]. Furthermore, the presence of SO correlates with an elevated risk of mortality, underscoring the need for targeted interventions addressing both facets of this intricate condition. Recognizing the intricate relationship between sarcopenia and obesity in SO is essential for formulating comprehensive strategies to mitigate the diverse health risks posed by this dual challenge [4].

The elderly demographic in Asia is undergoing rapid expansion, with South Korea standing out for its notably high proportion of older adults. Projections for 2050 indicate a significant increase in South Korea's elderly population, from 15% (as of 2022) to an anticipated 40%, resulting in the number of older individuals surging from five million to nineteen million [5]. This demographic shift raises concerns about potential future health challenges related to aging, including age-related skeletal muscle mass loss and obesity within Korean society. Moreover, South Korea has witnessed a substantial increase in obesity rates from 2009 to 2019 [6]. The growing incidence of obesity among the elderly, alongside the expanding elderly population, emphasizes the increasing importance of a comprehensive approach to longitudinal studies on SO in South Korean society. Therefore, it is crucial to prioritize proactive measures to prevent SO in the specific context of Korean society. The rates of obesity in Korea have consistently increased since 2009, with a notable rise among females [6]. The simultaneous growth of obesity in the elderly population, along with the expanding elderly demographic, highlights the escalating risks associated with SO in Korea. Consequently, it is imperative to prioritize preventive measures addressing SO within Korean society.

The identification of SO remains a critical concern with significant ramifications. Nevertheless, healthcare professionals and primary care practitioners encounter challenges related to the requisite knowledge and diagnostic tools. The time constraints inherent in primary care settings, where clinicians typically allocate less than ten minutes per patient visit, may result in a scenario where the consideration of diagnosing and treating SO only occurs if suspicion arises. This limited awareness among clinicians regarding SO as a distinct condition heightens the likelihood of overlooked diagnoses [7]. Therefore, it is imperative to recognize the crucial role of early detection and prevention, achieved through an understanding of the essential risk factors, to ensure a timely diagnosis of SO. Neglecting to diagnose and intervene promptly in cases of SO can lead to delays in functional recovery, diminished quality of life, and inefficient utilization of government healthcare resources [8].

SO exhibits a higher frequency of occurrence in women than men [9,10]. Newman et al. [9] examined 2,917 adults in the United States. They reported that women had a higher frequency of SO than men, with rates of 11.5% and 14.5%, respectively. Stenholm et al. [10] examined 1,189 individuals in the Netherlands and reported a 5.1% and 5.9% occurrence for men and women, respectively. Consequently, women are more susceptible to experiencing a combination of reduced skeletal muscle mass and increased body fat associated with SO than men. Identifying risk factors and effective management of SO among the female population present challenges, particularly in the dearth of research on females with SO compared to well-established studies on men [4,11,12].

Most SO research has concentrated on individuals aged 30 and above [13-23]. On the other hand, recent findings indicate that the onset of sarcopenia and obesity may initiate as early as the 20s [24-31]. Only two studies on sarcopenia have evaluated individuals in their twenties [30,31], and there is a notable absence of research on SO in those in their 20s. Recognizing the significance of implementing preventative measures against age-related muscle loss earlier, it becomes crucial to identify the risk factors prevalent among young women.

This study examined the frequency of occurrence and identified the risk factors associated with sarcopenic obesity in women aged 20 to 29 residing in the community. This research tested two hypotheses: there would be discernible frequency of SO among young women living in the community, and particular risk factors would be linked to the emergence of SO in this specific age demographic of women.

Ⅱ. Methods

1. Participants

This investigation relied on data from the Korean National Health and Nutrition Examination Surveys conducted by the Korean Center for Disease Control and Prevention. A comprehensive survey of 37,753 individuals was conducted from 2008 to 2011 using a complex sampling method known as stratified, clustered, multistage probability sampling. Of these, 35,355 individuals were excluded from the study because they did not fall within the 20 to 29 age range for women. Consequently, the final sample size for the study comprised 1,945 participants. An additional 709 participants were excluded because they had not undergone a dual-energy X-ray absorptiometry examination or completed the health survey. Another 236 participants were excluded because they had neither pure sarcopenia nor pure obesity. In this ultimate group, a subset of 1000 women aged between 20 and 29 years was selected for analysis. These participants were then categorized into two groups based on their skeletal muscle mass index score, with eight individuals constituting the SO group and the remaining 992 individuals classified as the normal group. The study received ethical approval from the institutional review board of the Center for Disease Control and Prevention, and all participants provided informed written consent to participate in the study.

2. Sarcopenic Obesity Definition

The two facets of SO, encompassing the simultaneous frequency of age-related skeletal muscle mass loss and obesity, are explicated as follows. Sarcopenia, which is age-related skeletal muscle mass loss, was assessed by measuring the appendicular skeletal muscle mass using dual X-ray absorptiometry (DEXA, QDR4500A Hologic, Inc., Bedford, MA, USA). The skeletal muscle mass index (SMI) was derived by dividing the appendicular skeletal muscle mass (ASM) obtained from DEXA by the body mass index (BMI), expressed in kilograms per square meter (kg/m^2) The Foundation for the National Institutes of Health Age-related Loss of Skeletal Muscle Mass Project established the criteria for diagnosing age-related skeletal muscle mass loss. In females, age-related skeletal muscle mass loss is defined as having an SMI below .521. This methodology was applied to diagnose age-related skeletal muscle mass loss within the study cohort [32]. Obesity is characterized by abnormal or excessive body fat accumulation, adversely affecting overall health. Identification is based on a BMI ≥ 25 kg/m2 and central obesity, which is denoted by a waist circumference (WC) exceeding 90 cm among the Asian population [23].

3. Research Variables

The variables examined in this study encompassed age, height (measured in centimeters), weight (measured in kilograms), BMI, WC, SMI, smoking and drinking habits, fasting glucose levels, triglyceride levels, total cholesterol (TC) levels, systolic and diastolic blood pressure (SBP and DBP, respectively). The BMI was calculated using the height and weight data, while the waist circumference was determined by measuring at the midpoint between the bottom of the ribcage and the top of the iliac crest during full expiration. The SMI, a gauge of muscle mass crucial for assessing SO, was calculated. The participants' smoking and drinking status were categorized into three groups: non-users, ex-users, or current users. The fasting glucose level assessed the blood glucose levels after an eight-hour fasting period, serving as a parameter for evaluating glycemic control. Triglycerides represented the blood triglyceride levels, a component of the lipid profile, while the TC evaluated the overall cholesterol levels in the blood, another significant lipid marker. The SBP and DBP were the higher and lower of the two blood pressure readings, respectively, measured using a mercury sphygmomanometer after a ten-minute rest.

4. Data Analysis

The statistical representation of the study data involved using the mean and standard deviation as indicators of measurement characteristics. Employing complex sampling analysis, the statistical approach considers nationwide representation by incorporating individual weights from the Korean National Health and Nutrition Examination Survey. The analysis was conducted using the SPSS 22.0 window version, developed by IBM Corporation based in Armonk, NY, USA.

The study data adhered to a meticulously designed stratified, clustered, multistage probability sampling framework. The key elements influencing SO were examined using independent t-tests and chi-square analyses. Multiple logistic regression analysis was used to ascertain the odds ratio of SO. The significance level for statistical analysis was established at $\alpha = .05$.

Ⅲ. Results

1. Frequency of Occurrence

After adjusting for the weighted values, the frequency of occurrence in SO was calculated to be .74%, with a 95% confidence interval ranging from .30% to 1.80%. In contrast, without considering the weights, the prevailing rate of SO was .80%, and the prevailing rate of normal muscle mass was 99.20% (Table 1).

2. Risk Factors of SO

Table 2 lists the statistical significance ($p < .05$) observed in the clinical risk factors, such as height, weight, BMI, WC, SMI, TC, and SBP, which exhibited statistical significance ($p < .05$). The DBP, fasting glucose, triglyceride, drinking status, and smoking status did not yield statistically significant results, indicating no significant impact based on the observed p-values ($p > .05$).

3. Odds Ratios for Risk Factors

Table 3 lists the odds ratios for risk factors. The height, weight, BMI, waist circumference, skeletal muscle index, TC, SBP, and DBP exhibited significant associations between the two groups, with p-values < .01. The corresponding values were as follows: Height .000(.000−.000), Weight 3.178(2.212−3.798), BMI 1.983(1.197−3.285), WC 1.629(1.301−2.039), SMI .000(.000−.000), TC 1.185(1.139−1.231), SBP 1.524(1.385−1.678) and DBP 1.285(1.132−1.459).

Table 1. Frequency of occurrence of SO

	Sarcopenic obesity (n = 8)	Normal (n = 992)	Total (N = 1000)
Un-weighted (%)	.80	99.20	100
Weighted (%)	.74 (.30-1.80)	99.26 (98.20-99.70)	100

The weighted values present the 95% confidence interval.

Table 2. Risk factors

	Sarcopenic obesity (n = 8)	Normal (n = 992)	p
Age (years)	23.66 ± 3.38	24.73 ± 2.80	.356
Height (cm)	155.64 ± 5.66	161.41 ± 5.41	.009**
Weight (kg)	74.81 ± 17.37	52.65 ± 6.15	.000**
BMI (kg/m^2)	30.65 ± 5.28	20.19 ± 2.01	.000**
WC (cm)	91.73 ± 14.74	68.17 ± 5.47	.000**
SMI (g/m^2)	494.78 ± 12.87	703.44 ± 82.59	.000**
FG (mg/dL)	87.23 ± 3.89	86.34 ± 9.05	.832
Triglyceride (mg/dL)	94.26 ± 35.88	73.35 ± 44.13	.292
TC (mg/dL)	194.20 ± 48.40	165.51 ± 25.88	.014*
SBP (mmHg)	121.33 ± 11.05	102.71 ± 8.89	.000**
DBP (mmHg)	78.50 ± 9.26	68.16 ± 7.97	.002**
Drinking status (%) (current-/ex-/non-users	68.66 / 31.33 / 0	83.96 / 11.19 / 4.84	.356
Smoking status (%) (current-/ex-/non-users)	41.97 / 16.91 / 41.11	15.77 / 5.48 / 78.74	.120

BMI, body mass index; WC, waist circumference; SMI, skeletal muscle mass index; FG, fasting glucose; TC, total cholesterol; SBP, systolic blood pressure; DBP, diastolic blood pressure.
*p < .05, **p < .01

Table 3. Multiple logistic regression for odds ratios of SO

Variables	Odd ratios (95% of CI)	p
Height	.000(.000-.000)	.000**
Weight	3.178(2.212-3.798)	.000**
BMI	1.983(1.197-3.285)	.000**
WC	1.629(1.301-2.039)	.000**
SMI	.000(.000-.000)	.000**
TC	1.185(1.139-1.231)	.000**
SBP	1.524(1.385-1.678)	.000**
DBP	1.285(1.132-1.459)	.000**

0BMI, body mass index; WC, waist circumference; SMI, skeletal muscle mass index; TC, total cholesterol; SBP, systolic blood pressure.
**p < .01

Ⅳ. Discussion

This study examined the frequency of SO and its associated risk factors among females aged 20–29 years residing in a community. Healthcare professionals, including physical therapists, occupational therapists, and primary care clinicians, often face challenges in diagnosing SO accurately because of the limited knowledge and access to diagnostic tools. This dearth of resources may result in overlooked diagnoses and potential complications associated with SO. This study addressed this issue by examining a spectrum of variables, encompassing height, weight, body mass index, WC, SMI, smoking and alcohol status, fasting glucose levels, triglyceride levels, TC levels, SBP, and DBP. These variables were explicitly chosen for their practicality and ease of accessibility, rendering them valuable tools for identifying potential cases of SO. The risk factors in the study included cholesterol levels, SBP, and DBP.

The heightened TC levels have emerged as significant components in women affected by obesity, specifically SO, a trend substantiated by multiple studies [33-35]. In a cross-sectional study conducted in China [35], female participants diagnosed with SO showed higher TC levels than those in the normal group. Lu et al. [33] also reported elevated cholesterol levels in the SO group compared to the normal group. Perna et al. [34] examined Italian subjects and found significantly higher TC levels in the blood of individuals with SO than in the healthy group.

The reasons for the increased TC values involve a multifaceted interplay of physiological factors. A central cause of this phenomenon is insulin resistance [36], a condition where cells exhibit ineffective responses to insulin, disrupting the delicate balance of glucose metabolism. This disturbance triggers a cascade of metabolic changes, notably the overproduction of cholesterol in the liver, culminating in an elevation of total cholesterol levels in the bloodstream. Inflammation is another influencing factor characterized by elevated levels of inflammatory cytokines [37]. These signaling molecules are integral to the immune response and initiate a chain reaction influencing the lipid metabolism. Inflammation facilitates the release of cholesterol from the cell membrane into the bloodstream, contributing significantly to the observed elevation. Moreover, the inflammatory milieu can alter the composition and function of lipoproteins and affect the total and LDL cholesterol levels [38] This intricate interplay underscores the multifactorial nature of lipid metabolism dysregulation, such as elevated total cholesterol in individuals affected by SO.

Another risk factor is hypertension, which manifests as various phenomena, as reported elsewhere [33,39]. A Northwest Chinese cohort study [39] reported an elevation in SBP among females grappling with SO, surpassing the normal level of 130.58 mmHg in the general female population. The DBP levels exhibited an upward trajectory, underscoring the relevance of hypertension in the context of SO. Lu et al. [33] reported a similar outcome, where a cohort of 600 community-dwelling Taiwanese adults showed higher SBP and DBP in the SO cohort than in healthy individuals. The elevated levels can be attributed to multifaceted underlying factors. The intricate interplay between muscle loss and metabolic alterations, leading to decreased energy expenditure and physical activity, is a crucial contributor. This cascade effect contributes to the onset of insulin resistance and increases arterial stiffness [40-42]. Another key factor is the accrual of visceral fat, triggering an inflammatory response. This inflammation instigates a thickening of blood vessel walls, impeding blood flow and constricting vascular passages [43]. The combination of reduced muscle mass and adipose tissue accumulation in the visceral region is a fundamental determinant of hypertension in females with SO.

This investigation offers crucial insights into the frequency of occurrence and specific risk factors associated with SO within a community-dwelling cohort of young females in Korea. The use of representative data sourced from the Korean population and the gold standard Dual-Energy X-ray Absorptiometry (DEXA) technique for accurate SO diagnosis enhances the credibility of the study findings.

Nevertheless, this study had some limitations. The cross-sectional approach in this study, while instrumental in capturing a snapshot of the population, introduces constraints in establishing causal relationships. Therefore, a longitudinal methodology involving recurrent measurements of the same individuals at various intervals will be needed to reinforce these findings. This approach can potentially unravel nuanced insights into the intricate dynamics of SO progression. Moreover, the sample size of the subject group with SO was relatively modest. Enhancing the robustness and credibility of these findings would benefit from expanding the participant pool within the SO subgroup. Hence, future research endeavors should include a larger cohort of participants in the SO category.

Ⅴ. Conclusion

This research delves into the frequency and risk factors associated with sarcopenic obesity among young women in Korean communities. Among the female participants, this study revealed a .74(.30–1.80) frequency of SO. The significant clinical risk factors identified for SO in females were shorter height, increased weight, elevated BMI, increased waist circumference, reduced SMI, elevated TC, and increased SBP and DBP.

Nevertheless, a longitudinal study will be needed using repeated measurements on the same individuals at various time points. This methodological approach would contribute significantly to validating the outcomes, enhancing the credibility of the study, and providing more substantial evidence for comprehensive insights into the dynamics of sarcopenic obesity among young women.

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