JTS

The Journal of Transdisciplinary Studies, 8(2): 173-181, 2024
https://doi.org/10.22685/JTS.2024.8.2.173

Prevalence of Sarcopenia and Sarcopenia Obesity using Public Data in Korea: Using National Physical Fitness 100 Measurement Data*

Jun-Young Sung[1], Sun-Yong Kwon[2], Chaewoon Kim[3], Hongsun Song[4], Byung Mun Lee[5], Sunbo Cho[6], Byung Hoon Lee[7], Jiyoun Kim[1,8]

[1]Professor, Department of Exercise Rehabilitation, Gachon University, Korea (sjy7067@gmail.com), First Author
[2]Professor, Department of Physical Education, Seoul National University, Korea (kwonsy@snu.ac.kr)
[3]Professor, Department of Physical Education, Gyeongin National University of Education, Korea (cwkim1@ginue.ac.kr)
[4]Professor, Department of Physical Education, Andong national University, Korea (hssong@anu.ac.kr)
[5]Professor, Department of Computer Engineering, Gachon University, Korea (bmlee@gachon.ac.kr)
[6]Professor, Department of Electronic Engineering, Gachon University, Korea (sbcho@gachon.ac.kr)
[7]Professor, Department of Orthopaedics Surgery, Gil Medical Center, Gachon University College of Medicine, Korea (oselite@gilhospital.com)
[8]Professor, Department of Exercise Rehabilitation, Gachon University, Korea (eve14jiyoun@gachon.ac.kr), Corresponding Author

ARTICLE INFO

Article history:
Received 18 July 2024
Revised 12 August 2024
Accepted 22 August 2024

Keywords:
National physical fitness,
Obesity,
Older adults,
Public data,
Sarcopenia

ABSTRACT

This study aimed to analyze the differences in the prevalence of sarcopenia, sarcopenic obesity, and motor function using multi-year big data to confirm the prevalence of sarcopenia and sarcopenic obesity in Korean society and analyze the differences in motor function in each group. Data measured for 6 years from 2013 to 2018 were used among the 100 data points on national physical strength, and the total number of participants was 154,884 older adults (male, 51,653; female, 103,227). For statistical analysis, differences between groups were evaluated using one-way ANOVA, and Tukey's test was used for postmortem analysis. Hierarchical regression analysis was performed to analyze the relationship between sarcopenic obesity and each variable. The frequency survey by group showed the following results (normal n = 100,880; possible n = 24,830; Sarcopenia = 14,055; SO n = 15,119), and the hierarchical regression analysis results were as follows: (Model 1: R^2, 0.108; p<0.001; Model 2: R^2, 0.193; p<0.001; Model 3: R^2, 0.484; p<0.001). This study analyzed the differences in the prevalence of sarcopenia, sarcopenic obesity, and motor function using big data in Korea and analyzed the relationship between the differences in each stage of sarcopenia and the variables affecting sarcopenia. These studies might play an important role in improving the quality of life of the older adults by preventing sarcopenia and improving the community healthcare system.

* This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2019S1A5A2A03037891).

1. Introduction

The number of older adults (aged ≥65 years) is increasing worldwide. In 2017, older adults accounted for 13% of the world's population, and this number is expected to reach 2.1 billion by 2050 (UN, 2017). Most chronic diseases worsen with aging, which is associated with serious body composition changes, such as increased fat mass and redistribution, and decreased muscle and bone mass (Batsis & Villareal, 2018). In 2016, sarcopenia was classified according to the International Statistical Clinical Amendment Code for Diseases and Related Health Problems (ICD-10-CM code M62) (Anker et al., 2016).

Sarcopenia is closely associated with morbidity, mortality, falls, and physical disability. Sarcopenia can occur simultaneously with obesity and can be exacerbated by increased body fat. Sarcopenic obesity (SO) was recently defined by the European Society for Clinical Nutrition and Metabolism (ESPEN) and European Society for Obesity Research (EASO) (Donini et al., 2022). Previous studies reported that patients with SO have an approximately 60% higher risk of death than those without sarcopenia (Benz et al., 2016).

As such, SO is on the rise due to an increase in the older adult population and adoption of Western eating habits; however, The concept of SO has not yet been fully defined not only in Korea but also in the world, studies on sarcopenia and SO have not been actively conducted in Korea. Also, Korea is among the fastest aging countries in the world, and the ratio of sarcopenia to SO is expected to a continuous increase. Therefore, this study aimed to analyze the prevalence of sarcopenia and SO using multi-year big data in Korea, the difference in motor function to confirm the prevalence of sarcopenia and SO in the Korean society, and the difference in motor function between groups.

2. Methods

2.1 Participants

This study was conducted using public data provided by the Korean government. Data measured for 6 years from 2013 to 2018 were used among the data on the National Physical Fitness 100, a physical fitness test conducted by the National Physical Fitness Promotion Agency for individuals. The measurement was conducted by professional personnel at the National Physical Fitness Center in Korea, and the total number of participants were 154,884 older adults aged ≥65 (51,653; female, 103,227).

2.2 Body composition and physical fitness data

Body composition and physical fitness factors were analyzed using data measured using the National Physical Fitness 100. The analyzed data first measured body composition (height, weight, body fat mass, body mass index (BMI), blood pressure, and calf circumference (CC). Based on the data provided, appendicular skeletal muscle (ASM) was calculated using the following formula: skeletal muscle (kg) = 0.244 × body weight + 7.80 × height − 0.098 × age + 6.6 × sex + race − 3.3 (Lee et al., 2016).

The physical strength tests were performed in the following order: main hand grip strength (DHG), sit and reach, eight-way walking, chair seat and stand, timed up-and-go (TUG), and 2-min walking tests.

2.3 Measure physical fitness

2.3.1 Hand grip

To measure the hand grip, we utilized a hand dynamometer. We instructed the participant to exert maximal force on the dynamometer for approximately three seconds, ensuring the arm was positioned at a right angle with the elbow maintained close to the body.

2.3.2 Sit and reach

The procedure describes a test method that measures the distance between a customer or patient sitting and stretches forward to reach their fingertips. The customer or patient places a ruler between their legs, aligns their heels to the tape line, and reaches out their arms and as far as possible. The test is trialled three times, and records the greatest distance. Breathe normally and keep your knees out during the test.

2.3.3 8 way walking

To carry out the “eight-shaped walk” following the Sidha guidelines, establish a path that is 6 to 8 feet wide and 12 to 16 feet long, oriented from north (“N”) to south (“S”). Begin your walk in a clockwise direction starting from the south, and continue the “eight-shaped walk” for 10 to 15 minutes continuously.

2.3.4 Chair sit and stand

The 30 Second Sit to Stand Test, also referred to as the 30 Second Chair Stand Test (30CST), was originally created to assess leg strength and endurance in older adults. It is included in the Fullerton Functional Fitness Test Battery. This test was designed to address the limitations of the five or ten repetition sit to stand tests for older adults. While there is some interest in using it as a physical performance measure for younger adults and athletes, additional research may be required.

2.3.5 Timed up-and-go (TUG)

The TUG was used to measure mobility and balance. The participant began seated in a chair, stood up, walked a distance of 3 meters, turned around, walked back to the chair, and sat down. The time taken to complete the task was recorded, with shorter times indicating better functional mobility.

2.4 Diagnostic criteria for sarcopenia

Using the Asian sarcopenia diagnostic criteria, muscle loss was classified as normal, possible sarcopenia, and sarcopenia (Chen et al., 2020) and SO was based on the SO algorithm (Fonfría et al., 2023) developed in 2023. Based on the Asian criteria, the diagnosis of sarcopenia is mainly made in accordance with the guidelines set out by the Asian Working Group for Sarcopenia (AWGS The diagnostic criteria for sarcopenia used in this study are as follows.

(1) possible sarcopenia: For grip strength (male, < 28.0 kg; female, < 18 kg) or chair seat and stand > 12 seconds (low strength)
(2) sarcopenia: ASM (male, < 7.0 kg/m^2; female, < 5.7 kg/m^2) + grip (male, < 28.0 kg; female, < 18 kg) or chair seat and stand >12 seconds (Low muscle mass and muscle strength or decreased physical function)
(3) sarcopenia obesity: BMI (> 24.9 kg/m^2) + grip strength (male, < 28.0 kg; female, < 18 kg) + fat mass (male, < 27.0%; female, < 38%) (Low muscle mass and muscle strength or decreased physical function + obesity)

2.5 Statistical analysis

All statistical analyses were performed using SPSS version 26.0 (SPSS Corp., Armonk, NY, USA). Differences between groups were evaluated using one-way analysis of variance (ANOVA). Hierarchical regression analysis was performed to analyze the relationship between SO and each variable, and a model was constructed with sarcopenia as the dependent variable and each variable as the independent variable. The results were classified using the model by checking the F and R^2 values. All results are expressed as the mean±standard deviation, and statistical significance was set at $p< 0.05$.

3. Results

As a result of the frequency survey of the sarcopenia group, approximately 65% of the participants did not have sarcopenia, 16% had possible sarcopenia, 9.1% had sarcopenia, and 9.8% had SO. The frequency survey results for the sarcopenia group were as follows: normal (n = 100,880), possible Sarcopenia (n = 24,830), sarcopenia (n = 14,055); SO (n = 15,119).

Table 1 shows the individual characteristics. As a result of one-way ANOVA of individual characteristics for each muscle loss group, statistically significant differences occurred for each muscle loss group in all variables. The analysis showed that weight, BMI, and ASM had the highest results in the following order: SO, normal, possible sarcopenia, and sarcopenia (Table 1).

Table 1. The One-way ANOVA results of basic characteristic affecting sarcopenia

Variable	Normal (n, 100,880)	Possible (n, 24,830)	Sarcopenia (n, 14,055)	SO (n, 15,119)	F	*p*
Age (years)	71.26±4.73	73.47±5.43	77.08±5.84	74.86±5.63	7271.714	**<0.001*****
Height (cm)	158.00±8.00	157.38±7.65	149.29±5.89	153.17±7.91	6305.887	**<0.001*****
Weight (kg)	61.77±9.01	58.89±6.17	48.09±4.73	65.14±7.83	13496.027	**<0.001*****
BMI (kg/m^2)	24.71±3.90	23.80±2.25	21.60±2.06	27.72±2.21	13485.823	**<0.001*****
ASM	7.19±1.43	7.20±1.16	5.11±0.54	7.54±1.37	10946.884	**<0.001*****

Values are means±SD****p*<.001 by sarcopenia groups; Normal, possible, possible sarcopenia; SO, sarcopenia obesity; BMI, body mass index; ASM, appendicular skeletal muscle

Table 2 shows the fitness factors of the participants. As a result of one-way ANOVA of fitness factors for each muscle loss group, statistically significant differences occurred for each muscle loss group in all variables. The results of the analysis confirmed that the SO group showed lower results for sit and reach, chair sit and stand exercises than the sarcopenia group in terms of weight, BMI, and ASM (Table 2).

Table 2. The One-way ANOVA results of fitness factors affecting sarcopenia

Variable	Normal (n, 100,880)	Possible (n, 24,830)	Sarcopenia (n, 14,055)	SO (n, 15,119)	F	*p*
Hand grip (kg)	26.36±6.76	18.80±5.43	14.13±3.30	16.89±5.21	28340.741	**<0.001*****
Sit and reach (reps)	11.41±9.38	7.08±10.16	9.99±8.20	6.97±9.55	2043.803	**<0.001*****
8 way walking (sec)	25.15±6.61	28.26±8.97	31.58±10.73	31.38±10.49	5106.292	**<0.001*****
Chair sit and stand (cm)	20.07±6.13	17.31±5.96	15.73±5.96	15.35±5.65	4823.661	**<0.001*****
Timed up and go (sec)	6.28±1.91	7.09±2.52	8.04±3.58	8.01±3.29	4287.243	**<0.001*****

Values are means±SD****p*<.001 by sarcopenia groups; Normal, possible, possible sarcopenia; SO, sarcopenia obesity

Table 3 shows the classification of the sarcopenia groups and the hierarchical regression analysis results for each variable. In the analysis of Model 1 (basic characteristics), statistically significant results were found for age (B = 0.059; t = 130.953; p<0.001) and sex (B = -0.237; t = -46.258; p<0.001).

Model 2 (Model 1 + body position) analysis revealed statistically significant results in age (B, 0.024 t, 24.549; p<0.001), sex (B, 1.771 t, 33.461; p<0.001), height (B, -0.035; t, -15.088; p<0.001), weight (B, 0.013; t, 4.466; p<0.001), BMI (B, 0.056; t, 6.172; p<0.001), body fat mass (B, 0.037; t, 76.430; p<0.001), ASM (B, -0.485; t, -23.770; p<0.001).

Model 3 (Model 2 + fitness factors) analysis revealed statistically significant results in age (B , -0.021 t, -26.387; p<0.001), sex (B, 3.189 t, 73.914; p<0.001), height (B, -0.022; t, -12.020; p<0.001), weight (B, 0.042; t, 18.448; p<0.001), BMI (B, 0.109; t, 15.002; p<0.001), body fat mass (B, 0.013; t, 31.968; p<0.001), ASM (B, -0.770; t, -46.901; p<0.001), grip strength (B, -0.111; t, -273.131; p<0.001), sit and reach (B, -0.002; t, -8.420; p<0.001), 8-way walking (B, 0.002; t, 7.825; p<0.001), timed up and go (B, 0.009; t, 9.313; p<0.001), and chair sit and stand

(*B*, 0.001; *t*, 2.888; *p*<0.001). The Durbin-Watson value of the model was 0.702 (Table 3).

Table 3. Results of hierarchial regression analysis of sarcopenia diagnostic factors

	independent variable	Model 1				Model 2				Model 3			
		B	*β*	*t*	*p*	*B*	*β*	*t*	*p*	*B*	*β*	*t*	*p*
A	(Constant)	-3.547		-108.637	**<0.001*****	3.872		10.971	**<0.001*****	6.854		24.22	**<0.001*****
	Age	0.059	0.317	130.953	**<0.001*****	0.024	0.130	24.549	**<0.001*****	-0.021	-0.114	-26.387	**<0.001*****
	Sex	-0.237	-0.112	-46.258	**<0.001*****	1.771	0.837	33.461	**<0.001*****	3.189	1.507	73.914	**<0.001*****
	Area	0.001	0.004	1.734	0.083	0.001	0.006	2.494	0.013	0.000	-0.002	-0.951	0.342
	Hight					-0.035	-0.290	-15.088	**<0.001*****	-0.022	-0.185	-12.020	**<0.001*****
	Weight					0.013	0.117	4.466	**<0.001*****	0.042	0.388	18.448	**<0.001*****
	BMI					0.056	0.169	6.172	**<0.001*****	0.109	0.330	15.002	**<0.001*****
	Body fat					0.037	0.292	76.430	**<0.001*****	0.013	0.100	31.968	**<0.001*****
	ASM					-0.485	-0.712	-23.770	**<0.001*****	-0.770	-1.132	-46.901	**<0.001*****
	Grip strength									-0.111	-0.855	-273.131	**<0.001*****
	Sit and reach									-0.002	-0.019	-8.420	**<0.001*****
	8 way walking									0.002	0.020	7.825	**<0.001*****
	Chair sit and stand									0.000	0.002	0.837	0.402
	Time up and go									0.009	0.022	9.313	**<0.001*****
	F (p)	*6203.469 (**<0.001*****)*				*4590.956 (**<0.001*****)*				*11066.918 (**<0.001*****)*			
	R^2	*0.108*				*0.193*				*0.484*			
	$_{adj}R^2$	*0.108*				*0.193*				*0.484*			

Significant difference, **p*< .05, ***p*< .01, ****p*< .001; tested by Hierarchial regression analysis; A(dependent variable); Sarcopenia; Model 1, basic characteristics; Model 2, Model 1 + body composition; Model 3, Model 2 + fitness factors; BMI, body mass index; ASM, Appendicular skeletal muscle

4. Discussion

This study aimed to analyze the prevalence of sarcopenia and SO using multi-year big data in Korea and the difference in motor function and the difference in motor function between the groups.

Previous studies have reported that a study of elderly women over 65 years of age in community healthcare settings has a high prevalence of sarcopenia of 22.1% and 29% in elderly women over 79 years of age, with a range of 11-50% in older adults over 80 years of age (Cruz-Jentoft et al., 2014). In a study of females >65 years of age in Korea, the prevalence of sarcopenia was 22.1% (Kwon et al., 2016). In this study, it was confirmed that the average age group of the participants was in their 70s in all groups, with about 17% of participants with sarcopenia and SO, and 33% with possible sarcopenia, similar to previous studies, but slightly higher prevalence. Korea has the fastest increasing older adult population among OECD countries and a country with an increasing risk of sarcopenia. In this study, the ratios of possible sarcopenia (n = 24,830), sarcopenia (n = 14,055), and OS (n = 15,119) are shown, representing approximately 30% of all participants.

In addition, looking at the results of the fitness factor analysis of the sarcopenia group, the physical strength level was significantly weakened from the possible sarcopenia to the non-sarcopenia group. In contrast, in the case of the SO group, the fitness factors showed better results than possible sarcopenia and sarcopenia; however, the results confirmed that the physical factors of the SO group were also significantly reduced.

According to Chen et al. (2020), in the relationship between sarcopenia and BMI, obesity considerably affects the relationship between BMI and sarcopenia, which reduces the accuracy of predicting sarcopenia in individuals (Scott et al., 2014). As such, patients with obesity have difficulty in diagnosing sarcopenia; therefore, a classification of SO has been created using a novel concept.

Decisively, hierarchical regression analysis confirmed that sarcopenia and SO were related to several lifestyle variables. These factors were closely related to sex and age and were consistent with the results reported in previous studies (Marzetti et al., 2017). This was attributed to age-related differences due to aging. Next, the body composition part of Model 2 was greatly influenced by weight, BMI, body fat, and ASM, and it was proven that these factors act as the main variables of sarcopenia and OS. Finally, looking at the results of the fitness factor analysis of Model 3, a significant window between the variables was confirmed for all measurement factors except for chair seat and stand. These results demonstrate the importance of fitness factors in sarcopenia and SO.

This study analyzed the differences in the prevalence of sarcopenia, SO, and motor function using big data from multiple years in Korea and analyzed the association of differences in each stage of sarcopenia and variables affecting sarcopenia. However, there is a limitation in that the analysis was conducted using existing measured public data and that it was measured at a young facility. Therefore, a follow-up study should be conducted to accurately determine the prevalence of sarcopenia in Korea by measuring and comparing the prevalence of sarcopenia in the older adults in the community, based on the results of this study.

5. Conclusion

This study identified the prevalence of sarcopenia in terms of physical activity using public data, which can be used to establish basic data on the prevalence of sarcopenia and SO in the Korean society and can be used to improve the quality of life by preventing sarcopenia and predicting related chronic diseases. However, it is necessary to confirm similar results in various populations through follow-up studies and clarify the correlation between sarcopenia, obesity, and eating habits in Korea. These studies are expected to play an important role in improving the quality of life of the older adults by contributing to the prevention of sarcopenia and improvement of the community health care system.

Conflicts Interest

No author has any other conflict of interest to declare.

References

Anker, S. D., Morley, J. E., & von Haehling, S. (2016). Welcome to the ICD-10 code for sarcopenia. *Journal of Cachexia, Sarcopenia and Muscle, 7* (5), 512-514.

Batsis, J. A., & Villareal, D. T. (2018). Sarcopenic obesity in older adults: aetiology, epidemiology and treatment strategies. *Nature Reviews, Endocrinology, 14* (9), 513-537.

Benz, E., Pinel, A., Guillet, C., Capel, F., Pereira, B., De Antonio, M., Pouget, M., Cruz-Jentoft, A. J., Eglseer, D., Topinkova, E., Barazzoni, R., Rivadeneira, F., Ikram, M. A., Steur, M., Voortman, T., Schoufour, J. D., Weijs, P. J. M., & Boirie, Y. (2024). Sarcopenia and sarcopenic obesity and mortality among older people. *JAMA Network Open, 7* (3), e243604.

Chen, C. Y., Tseng, W. C., Yang, Y. H., Chen, C. L., Lin, L. L., Chen, F. P., & Wong, A. M. K. (2020). Calf Circumference as an optimal choice of four screening tools for sarcopenia among ethnic chinese older adults in assisted living. *Clinical Interventions in Aging, 15*, 2415-2422.

Chen, L. K., Woo, J., Assantachai, P., Auyeung, T. W., Chou, M. Y., Iijima, K., Jang, H. C., Kang, L., Kim, M., Kim, S., Kojima, T., Kuzuya, M., Lee, J. S. W., Lee, S. Y., Lee, W. J., Lee, Y., Liang, C. K., Lim, J. Y., Lim, W. S., Peng, L. N., & Arai, H. (2020). Asian working group for warcopenia: 2019 consensus update on sarcopenia diagnosis and treatment. *Journal of the American Medical Directors Association, 21* (3), 300-307.e2.

Cruz-Jentoft, A. J., Landi, F., Schneider, S. M., Zúñiga, C., Arai, H., Boirie, Y., Chen, L. K., Fielding, R. A., Martin, F. C., Michel, J. P., Sieber, C., Stout, J. R., Studenski, S. A., Vellas, B., Woo, J., Zamboni, M., & Cederholm, T. (2014). Prevalence of and interventions for sarcopenia in ageing adults: a systematic review. report of the international sarcopenia initiative (EWGSOP and IWGS). *Age and Ageing, 43* (6), 748-759.

Donini, L. M., Busetto, L., Bischoff, S. C., Cederholm, T., Ballesteros-Pomar, M. D., Batsis, J. A., Bauer, J. M., Boirie, Y., Cruz-Jentoft, A. J., Dicker, D., Frara, S., Frühbeck, G., Genton, L., Gepner, Y., Giustina, A., Gonzalez, M. C., Han, H. S., Heymsfield, S. B., Higashiguchi, T., Laviano, A., & Barazzoni, R. (2022). Definition and diagnostic criteria for sarcopenic obesity: ESPEN and EASO consensus statement. *Obesity Facts, 15* (3), 321-335.

Fonfría-Vivas, R., Pérez-Ros, P., Barrachina-Igual, J., Pablos-Monzó, A., & Martínez-Arnau, F. M. (2023). Assessing quality of life with SarQol is useful in screening for sarcopenia and sarcopenic obesity in older women. *Aging Clinical and Experimental Research, 35* (10), 2069-2079.

Kwon, H. J., Ha, Y. C., & Park, H. M. (2016). Prevalence of sarcopenia in the korean woman based on the korean national health and nutritional examination surveys. *Journal of Bone Metabolism, 23* (1), 23-26.

Lee, R. C., Wang, Z., Heo, M., Ross, R., Janssen, I., & Heymsfield, S. B. (2000). Total-body skeletal muscle mass: development and cross-validation of anthropometric prediction models. *The American Journal of Clinical Nutrition, 72* (3), 796-803.

Marzetti, E., Calvani, R., Tosato, M., Cesari, M., Di Bari, M., Cherubini, A., Collamati, A., D'Angelo, E., Pahor, M., Bernabei, R., & Landi, F. (2017). Sarcopenia: an overview. *Aging Clinical and Experimental Research, 29* (1), 11-17.

Scott, D., Sanders, K. M., Aitken, D., Hayes, A., Ebeling, P. R., & Jones, G. (2014). Sarcopenic obesity and dynapenic obesity: 5-year associations with falls risk in middle-aged and older adults. *Obesity (Silver Spring, Md.), 22* (6), 1568-1574.

United Nations. Department of international economic. (2017). *World Population Ageing*, 2016. UN.