



Research Article

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Sarcopenia and Its Associated Factors among Urban Sedentary Adults in Jakarta: Evidence from a Large Multidistrict Dataset

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Abstract

Background: Sarcopenia is a major public health concern in aging populations, particularly in urban sedentary settings, where physical inactivity and metabolic disorders contribute to muscle decline. **Objective:** To identify factors associated with muscle strength and muscle mass and to develop a simplified scoring system for sarcopenia in urban sedentary pre-elderly and elderly populations. **Methods:** A cross-sectional study was conducted using secondary data from the PRIMBON 2025 database in Jakarta. A total of 425 participants were analyzed. Sarcopenia components were assessed using AWGS criteria. **Results:** Male sex (OR=1.897; $p=0.008$), depression (OR=1.739; $p=0.012$), and type 2 diabetes mellitus (OR=4.923; $p<0.001$) were independently associated with higher odds of low muscle strength, whereas central obesity was independently associated with lower odds of low muscle strength (OR=0.519; $p=0.011$). Older age was strongly associated with low muscle mass (OR=2.850; $p<0.001$), while hypertension, obesity, and central obesity demonstrated inverse associations. ROC analysis showed moderate discrimination for muscle strength (AUC=0.690; 95%CI=0.639–0.741) and excellent discrimination for muscle mass (AUC=0.879; 95%CI=0.845–0.912). **Conclusions:** Sarcopenia in urban sedentary populations is influenced by multifactorial determinants, including demographic, psychological, and metabolic factors. The developed scoring system provides a practical tool for early screening and risk stratification, although further validation is needed.

Keywords: Diabetes mellitus; Muscle strength; Muscle mass; Sarcopenia; Sedentary lifestyle; Urban population.

ساركوبينيا وعواملها المرتبطة بين البالغين من سكان جاكرتا: أدلة من مجموعة بيانات كبيرة متعددة المناطق

الخلاصة

الخلفية: الساركوبينيا تشكل مصدر قلق رئيسي للصحة العامة في الأشخاص المتقدمين في السن، خاصة في المناطق الحضرية الخاملة، حيث تساهم قلة النشاط البدني والاضطرابات الأيضية في تدهور العضلات. **الهدف:** تحديد العوامل المرتبطة بقوة العضلات وكتلة العضلات وتطوير نظام تقييم مبسط للساركوبينيا في السكان الحضريين الخاملين كبار السن. **الطرائق:** أجريت دراسة مقطعية باستخدام بيانات ثانوية من قاعدة بيانات PRIMBON 2025 في جاكرتا. تم تحليل ما مجموعه 425 مشاركاً. تم تقييم مكونات ساركوبينيا باستخدام معايير AWGS. **النتائج:** الجنس الذكري (OR=1.897) كانت السمنة المركزية مرتبطة بشكل مستقل باحتمالية انخفاض قوة العضلات (p=0.012؛ OR=1.739)، والسكري من النوع الثاني (OR=4.923)؛ بشكل مستقل باحتمالية انخفاض قوة العضلات، في حين ارتبطت السمنة المركزية بشكل مستقل باحتمالات أقل لضعف قوة العضلات (OR=0.519؛ p=0.011). ارتبط التقدم في العمر بشكل كبير بانخفاض كتلة العضلات (p<0.001؛ OR=2.850)، بينما أظهرت ارتفاع ضغط الدم، السمنة، والسمنة المركزية ارتباطات عكسية. أظهر تحليل ROC تمييزاً معتدلاً في قوة العضلات (AUC=0.690؛ 95%CI=0.639–0.741) وتمييزاً ممتازاً لكتلة العضلات (AUC=0.879؛ 95%CI=0.845–0.912). **الاستنتاجات:** تتأثر الساركوبينيا في السكان الحضريين الخاملين بالمحددات متعددة العوامل، بما في ذلك العوامل الديموغرافية والنفسية والاستقلابية. يوفر نظام التقييم المطور أداة عملية للفحص المبكر وتصنيف المخاطر، رغم الحاجة إلى مزيد من التحقق.

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INTRODUCTION

Sarcopenia has emerged as a major global public health problem, particularly in aging populations, with prevalence estimates ranging from 10% to 27% worldwide based on large meta-analyses involving over 690,000 individuals [1]. In Indonesia, several studies have reported substantial variation in sarcopenia prevalence, ranging from approximately 9.1% to 59%, depending on the population characteristics, age distribution, and diagnostic

criteria used [2]. The condition begins insidiously as early as the fourth decade of life, with muscle mass declining by approximately 1–2% per year after the age of 50, leading to a substantial cumulative burden in older adults [3]. This progressive decline in muscle strength and mass is strongly associated with adverse outcomes, including falls, fractures, frailty, disability, and increased mortality, making sarcopenia a critical determinant of healthy aging [4]. The burden of sarcopenia is further amplified in urban and sedentary populations, where lifestyle factors such as physical

inactivity, obesity, and metabolic disorders are increasingly prevalent. Globally, approximately 30% of the population is classified as overweight or obese, conditions that interact complexly with muscle loss and may contribute to sarcopenic obesity, with prevalence estimates around 11% in adults aged ≥ 60 years [4,5]. This combined phenotype is associated with a significantly higher risk of cardiometabolic disease and mortality compared to either condition alone. Moreover, evidence suggests that the prevalence of sarcopenic obesity increases with age, reaching up to 51.1% in individuals aged 80–89 years [7]. Although simplified screening tools such as SARC-F, SARC-CalF, and MSRA facilitate the identification of individuals at risk of sarcopenia in clinical and community settings, their diagnostic performance varies across populations and may not fully capture the multidimensional nature of sarcopenia [8,9]. SARC-F relies primarily on self-reported functional limitations and generally has limited sensitivity, while SARC-CalF improves detection by incorporating calf circumference but remains subject to heterogeneous diagnostic performance. Importantly, Indonesian and other Asian studies have reported limited sensitivity and discriminatory performance of these instruments, potentially reflecting differences in anthropometry, body composition, physical activity, and demographic characteristics across populations. These limitations may be particularly relevant in sedentary urban populations, where individuals may remain functionally independent despite reduced muscle strength or mass and therefore be missed by symptom-based screening. Thus, beyond existing screening instruments, there is a need for a population-specific, data-driven scoring system incorporating objective demographic, anthropometric, and muscle-related factors to improve the early identification of sarcopenia in urban Indonesian populations. Therefore, this study aims to identify factors associated with lower muscle strength and muscle mass and to develop a simplified, data-driven scoring system for sarcopenia among sedentary pre-elderly and elderly populations in Jakarta using a large multidistrict dataset.

METHODS

Study design and setting

This study employed a cross-sectional design using secondary data from the PRIMBON (Partnership for Research, Innovation, and Multisectoral Benefit for Outreach and Networking) database developed by Universitas Tarumanagara since June 2024. Data were obtained from the 2025 PRIMBON dataset, which includes community-based health screening data. The study was conducted in four urban regions of Jakarta, including West Jakarta (three locations), North Jakarta (one location), and South Jakarta (one location). The study population consisted of pre-elderly and elderly individuals (aged ≥ 50 years, with elderly defined as ≥ 65 years) [10] residing in urban Jakarta.

Inclusion and exclusion criteria

Inclusion criteria were participants classified as pre-elderly and elderly with complete clinical, anthropometric, and laboratory data. Exclusion criteria included 1) incomplete or missing key variables; 2) participants outside Jakarta regions; 3) conditions affecting handgrip strength measurement (e.g., hand injury, neuromuscular disorders, myasthenia gravis); 4) conditions affecting body composition measurement (e.g., metallic implants, pacemakers); 5) secondary hypertension or conditions affecting blood pressure measurement; 6) hematological disorders such as thalassemia major or sickle cell disease; 7) hereditary lipid disorders including familial hypercholesterolemia, familial combined hyperlipidemia, familial dysbetalipoproteinemia, familial hypertriglyceridemia, and familial chylomicronemia; and 8) type 1 diabetes mellitus. Laboratory parameters included total cholesterol, HDL, LDL, triglycerides, fasting blood glucose, and uric acid.

Sample Size

Seventeen candidate variables were considered for inclusion in the multivariable logistic regression analyses based on their clinical relevance and availability within the dataset. The adequacy of the regression models was assessed using the events-per-variable (EPV) framework, applying the conventional heuristic of approximately 10 outcome events for each candidate variable. Accordingly, with 17 candidate variables, approximately 170 outcome events would be required to achieve an EPV of 10 and support an adequately powered multivariable model.

Outcome measurements

Muscle-related outcomes were defined according to the Asian Working Group for Sarcopenia (AWGS) 2025 consensus criteria. Muscle strength was assessed using handgrip strength measured with a calibrated dynamometer. Age- and sex-specific cut-off values were applied. Low handgrip strength was defined as less than 34 kg for men and less than 20 kg for women aged 50–64 years, and as less than 28 kg for men and less than 18 kg for women aged 65 years and older. Muscle mass was assessed using bioelectrical impedance analysis (BIA), with appendicular skeletal muscle mass adjusted for height squared ($ASM/height^2$) used as the muscle mass index. Low muscle mass was defined as $ASM/height^2 < 7.6 \text{ kg/m}^2$ for men and $< 5.7 \text{ kg/m}^2$ for women aged 50–64 years and $< 7.0 \text{ kg/m}^2$ for men and $< 5.7 \text{ kg/m}^2$ for women aged ≥ 65 years. According to AWGS 2025, sarcopenia was defined by the presence of both low muscle strength and low muscle mass. Physical activity was assessed using the Physical Activity Level (PAL) coefficient, calculated as the ratio of total daily energy expenditure to basal metabolic rate ($PAL = TEE/BMR$). PAL was classified into four categories: very low activity or sedentary (1.20–1.39), light activity (1.40–1.69), moderate activity (1.70–

1.99), and vigorous activity (2.00–2.40). Very low activity was characterized by predominantly sedentary behavior with minimal movement, light activity by predominantly sedentary or office-based activities with limited walking or light household activities, moderate activity by active occupations or regular exercise several times per week, and vigorous activity by occupations or activities involving substantial physical exertion. In the present study, the term "sedentary" was operationalized based on the PAL classification and was not inferred solely from the urban setting. Depressive symptoms were assessed using the Depression Anxiety Stress Scales-42 (DASS-42). The instrument comprises 42 items divided into three 14-item subscales assessing depression, anxiety, and stress. Each item is scored on a 4-point scale from 0 to 3, with the depression subscale yielding a total score ranging from 0 to 42. Depression severity was classified as normal (0–9), mild (10–13), moderate (14–20), severe (21–27), and extremely severe (≥ 28). DASS-42 was used as a screening measure of depressive symptoms rather than as a clinical diagnostic instrument; therefore, depression in this study refers to depressive symptoms identified according to the prespecified DASS-42 classification.

Ethical considerations

This study was conducted using secondary data obtained from the PRIMBON database without direct participant involvement. Ethical approval was granted by the Universitas Tarumanagara Human Research Ethics Committee (UTHREC) under reference number 023-UTHREC/UNTAR/IV/2026. All data were anonymized prior to analysis to ensure confidentiality and privacy of participants, and the study was conducted in accordance with the Declaration of Helsinki.

Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics version 27.0 and Microsoft Excel 365. Univariate analysis was used to describe participant characteristics, while bivariate analysis using the chi-square test with Yates correction was performed to assess associations and calculate odds ratios (ORs) with 95% confidence intervals (CIs). Multivariable binary logistic regression was subsequently performed to identify factors independently associated with the respective outcomes. Variables with $p < 0.25$ in the bivariate analysis were considered for inclusion in the multivariable model, and backward stepwise selection was applied to obtain the final model. Regression coefficient (B), adjusted ORs ($\text{Exp}[B]$), 95% CIs, and p -values were reported. Receiver operating characteristic (ROC) curve analysis was performed to evaluate the discriminatory performance of the final models, with the area under the curve (AUC) used to quantify their ability to discriminate between participants with and without the respective outcomes. Based on the final multivariable logistic regression models, a simplified

scoring system was subsequently developed by converting the regression coefficients of independently associated variables into weighted integer scores, with the coefficients scaled relative to the smallest coefficient and rounded to the nearest whole number. The total score was calculated by summing the points assigned to each variable. ROC analysis of the total score was then used to determine the optimal score threshold for identifying participants with the respective outcome, based on the best discriminatory performance. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated at the selected cut-off. The resulting score ranges were used to classify participants according to their estimated likelihood of the respective outcome.

RESULTS

A total of 425 participants were included in this study (the data selection process is presented in Figure 1), with a mean age of 62.61 ± 9.79 years, predominantly pre-elderly (62.1%) and female (66.6%).

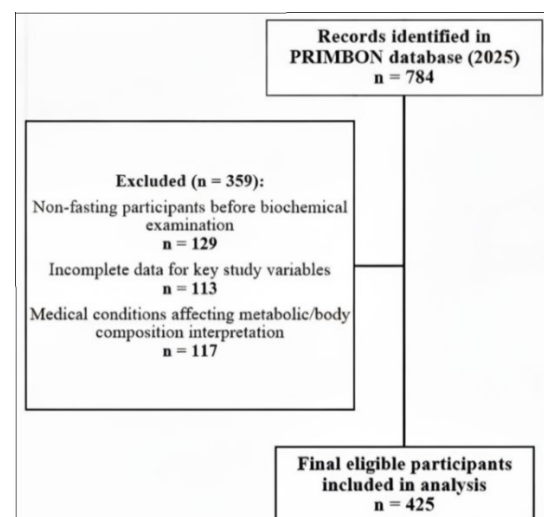


Figure 1: Flow diagram of participant recruitment, exclusion, and final inclusion from the PRIMBON database.

Most participants were unemployed (69.9%) and married (98.6%), with a low mean physical activity level (1.13 ± 0.03), indicating generally sedentary behavior (Table 1).

Table 1: Baseline sociodemographic of the population studied

Parameter	Result
Age (year)	62.61± 9.79
Elderly	161(37.9)
Pre-Elderly	264(62.1)
Gender	
Male	142(33.4)
Female	283(66.6)
Occupation	
Employee	108(25.4)
Self-employed	20(4.7)
Unemployed	297(69.9)
Marital status	
Married	419(98.6)
Unmarried	6(1.4)
Physical activity level	1.13±0.03

Values are presented as frequency, percentage, and mean±SD.

Pearson chi-square analysis with Yates correction (Table 2) demonstrated that male sex (OR= 1.846;

95% CI= 1.188–2.869; $p= 0.008$), depression (OR= 1.531; 95% CI= 1.026–2.286; $p= 0.047$), and type 2 diabetes mellitus (OR= 3.688; 95% CI= 1.875–7.254; $p < 0.001$) were significantly associated with higher odds of low muscle strength, whereas obesity (OR=

0.607; 95% CI= 0.402–0.915; $p= 0.022$) and central obesity (OR= 0.573; 95% CI= 0.356–0.922; $p= 0.028$) were associated with lower odds of low muscle strength; age, high LDL, and underweight showed borderline associations.

Table 2: Association between clinical and metabolic factors and low muscle strength (functional status)

Parameter		Low Function	Normal Function	Odds Ratio (95% CI)			p -value
				OR	Lower	Upper	
Ages Classification	Elderly	113(70.2)	48(29.8)	1.53	1.007	2.325	0.058
	Pre-elderly	160(60.6)	104(39.4)				
Gender	Male	104(73.2)	38(26.8)	1.846	1.188	2.869	0.008
	Female	169(59.7)	114(40.3)				
Depression Disorder	Present	142(69.3)	63(30.7)	1.531	1.026	2.286	0.047
	Absent	131(59.5)	89(40.5)				
Anxiety Disorder	Present	166(66.1)	85(33.9)	1.223	0.818	1.828	0.38
	Absent	107(61.5)	67(38.5)				
Stress Disorder	Present	130(67.4)	63(32.6)	1.284	0.86	1.917	0.261
	Absent	143(61.6)	89(38.4)				
Hypertension	Yes	109(59.9)	73(40.1)	0.719	0.482	1.073	0.13
	No	164(76.5)	79(32.5)				
Anemia	Yes	159(63.6)	91(36.3)	0.935	0.624	1.4	0.823
	No	114(65.1)	61(34.9)				
High Cholesterol	Yes	152(61.5)	95(38.5)	0.754	0.502	1.131	0.206
	No	121(68)	57(32)				
Low HDL	Yes	112(62.5)	67(62.5)	0.883	0.591	1.318	0.611
	No	161(65.4)	85(34.6)				
High LDL	Yes	201(61.7)	125(38.3)	0.603	0.367	0.99	0.058
	No	72(72.7)	27(27.3)				
High Triglyceride	Yes	141(65.9)	73(27.3)	1.156	0.777	1.719	0.539
	No	132(62.6)	79(37.4)				
Diabetes Mellitus	Type 2 DM	61(84.7)	11(15.3)	3.688	1.875	7.254	<0.001
	No	212(60.1)	141(39.9)				
Hyperuricemia	Yes	25(55.8)	19(44.2)	0.675	0.357	1.277	0.295
	No	249(65.2)	133(34.8)				
Kidney Function	Decrease	27(62.8)	16(37.2)	0.933	0.486	1.792	0.968
	No	246(64.4)	136(25.6)				
Underweight	Absent	18(85.7)	3(14.3)	3.506	1.106	12.101	0.061
	Present	255(63.1)	149(36.9)				
Obesity	Absent	147(59.5)	100(40.5)	0.607	0.402	0.915	0.022
	Present	126(70.8)	52(29.2)				
Central Obesity	Absent	191(61)	122(39)	0.573	0.356	0.922	0.028
	Present	82(73.2)	30(26.8)				

In the multivariable logistic regression model (Table 3), male sex (OR= 1.897; 95% CI= 1.184–3.041; $p= 0.008$), depression (OR= 1.739; 95% CI= 1.131–2.673; $p= 0.012$), and type 2 diabetes mellitus (OR= 4.923; 95% CI= 2.426–9.990; $p < 0.001$) remained independently associated with higher odds of low

muscle strength, whereas central obesity (OR= 0.519; 95% CI= 0.313–0.862; $p= 0.011$) remained independently associated with lower odds; age and hypertension showed borderline associations (Table 3).

Table 3: Multivariable logistic regression analysis of factors associated with low muscle strength (final model, step 5)

Parameter		B±SE	Wald	p -value	Exp(B)	95% CI for EXP(B)	
						Lower	Upper
Step 5 ^a	Age Cat (1)	0.426±0.225	3.599	0.058	1.531	0.986	2.377
	Sex (1)	0.641±0.241	7.082	0.008	1.897	1.184	3.041
	Depression (1)	0.553±0.219	6.364	0.012	1.739	1.131	2.673
	Hypertension (1)	-0.407±0.219	3.465	0.063	0.665	0.433	1.022
	Diabetes (1)	1.594±0.361	19.484	0.000	4.923	2.426	9.990
	Central obesity (1)	-0.656±0.259	6.424	0.011	0.519	0.313	0.862
	Constant	0.424±0.288	2.162	0.141	1.528		

Chi-square analysis with Yates correction (Table 4) showed that elderly status was strongly associated with higher odds of low muscle mass (OR= 2.64; 95% CI= 1.754–3.974; $p < 0.001$), whereas hypertension (OR = 0.57; 95% CI= 0.387–0.841; $p= 0.006$), low HDL (OR= 0.497; 95% CI= 0.336–0.735; $p < 0.001$),

obesity (OR = 0.39; 95% CI= 0.022–0.068; $p < 0.001$), and central obesity (OR= 0.114; 95% CI = 0.064–0.202; $p < 0.001$) were associated with lower odds of low muscle mass; triglycerides showed a borderline association ($p= 0.088$), while other variables were not significantly associated.

Table 4: Association between clinical and metabolic factors and low muscle mass (sarcopenia)

Parameter		Low Muscle Mass	Normal Muscle Mass	Odds Ratio (95% CI)			p -value
				OR	Lower	Upper	
Ages classification	Elderly	108(67.1)	53(32.9)	2.64	1.754	3.974	<0.001
	Pre-elderly	115(43.6)	149(56.4)				
Gender	Male	83(58.5)	59(41.5)	1.437	0.956	2.159	0.100
	Female	140(49.5)	143(50.5)				
Depression	Present	112(54.6)	93(45.4)	1.183	0.808	1.732	0.444
	Absent	111(50.5)	109(49.5)				
Anxiety	Present	137(54.6)	114(45.4)	1.23	0.835	1.811	0.343
	Absent	86(49.4)	88(50.6)				
Stress	Present	102(52.8)	91(72.2)	1.028	0.701	1.507	0.964

	Absent	121(52.2)	111(47.8)				
Hypertension	Yes	81(44.5)	101(55.5)				
	No	142(58.4)	101(41.6)	0.57	0.387	0.841	0.006
Anemia	Yes	134(53.6)	116(46.4)				
	No	89(50.9)	86(49.1)	1.116	0.758	1.643	0.647
High cholesterol	Yes	125(60.6)	122(49.4)				
	No	98(55.1)	80(44.9)	0.836	0.568	1.231	0.419
Low HDL	Yes	76(42.5)	103(57.5)				
	No	147(59.8)	99(40.2)	0.497	0.336	0.735	<0.001
High LDL	Yes	167(51.2)	159(48.8)				
	No	56(56.6)	43(43.4)	0.806	0.513	1.268	0.414
High triglyceride	Yes	103(48.1)	111(51.9)				
	No	120(56.9)	91(43.1)	0.704	0.48	1.031	0.088
Diabetes Mellitus	Yes	37(51.4)	35(48.6)				
	No	186(52.7)	167(47.3)	0.949	0.572	1.576	0.942
Hyperuricemia	Yes	19(44.2)	24(55.8)				
	No	204(53.4)	178(46.6)	0.691	0.366	1.303	0.324
Kidney function	Decreased	22(51.2)	21(48.8)				
	No	201(52.6)	181(47.4)	0.943	0.502	1.773	0.984
Underweight	Absent	21(100)	-	NA	NA	NA	<0.001
	Present	202(50)	202(50)				
Obesity	Absent	63(25.5)	184(74.5)				
	Present	160(89.9)	18(10.1)	0.39	0.022	0.068	<0.001
Central obesity	Absent	127(40.6)	186(59.4)				
	Present	96(85.7)	16(14.3)	0.114	0.064	0.202	<0.001

In the multivariable logistic regression model (Table 5), elderly status remained independently associated with higher odds of low muscle mass (OR= 2.850; 95% CI= 1.658–4.900; $p < 0.001$), whereas hypertension (OR= 0.525; 95% CI= 0.309–0.892; $p = 0.017$), obesity (OR= 0.056; 95% CI = 0.030–0.105;

$p < 0.001$), and central obesity (OR= 0.338; 95% CI= 0.156–0.731; $p = 0.006$) were independently associated with lower odds of low muscle mass; triglycerides showed a borderline association, while other variables were not significantly associated after adjustment.

Table 5: Multivariable logistic regression analysis of factors associated with low muscle mass (sarcopenia) (Final Model)

Category	B±SE	Wald	p-value	Exp(B)	95% CI for EXP(B)	
					Lower	Upper
Age Cat (1)	1.047±0.276	14.348	<0.0001	2.850	1.658	4.900
Sex (1)	0.517±0.290	3.182	0.074	1.677	0.950	2.958
Hypertension (1)	-0.645±0.271	5.665	0.017	0.525	0.309	0.892
Triglycerides Cat	-0.485±0.277	3.070	0.080	0.616	0.358	1.059
Underweight (1)	18.571±8292.427	0.000	0.998	1.1x10 ⁸	0.000	
Obesity (1)	-2.882±0.319	81.584	0.000	0.056	0.030	0.105
Central obesity (1)	-1.084±0.393	7.596	0.006	0.338	0.156	0.731
Constant	3.203±0.634	25.569	0.000	24.616		

^aVariable(s) entered on step 1: Age Cat, Sex, Hypertension, LDL_Cat, Triglycerides_Cat, Underweight, Obesity, Central Obesity.

Receiver operating characteristic (ROC) analysis demonstrated moderate discriminatory ability for the model of low muscle strength (AUC = 0.690; 95% CI = 0.639–0.741; $p < 0.001$) (Table 3 and Figure 2).

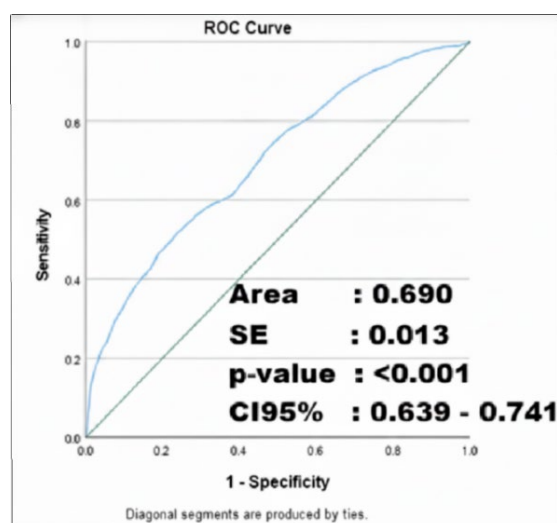


Figure 2: ROC Curve of the Predictive Model for Low Muscle Strength in Urban Sedentary Pre-Elderly and Elderly Populations.

The model for low muscle mass demonstrated excellent discriminatory ability (AUC= 0.879; 95% CI= 0.845–0.912; $p < 0.001$) (Table 5 and Figure 3).

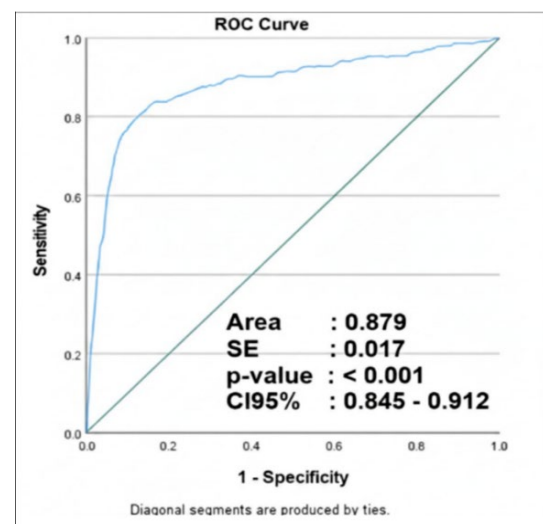


Figure 3: ROC Curve of the Predictive Model for Low Muscle Mass (Sarcopenia) in Urban Sedentary Pre-Elderly and Elderly Populations.

The Hosmer–Lemeshow goodness-of-fit test for the low muscle mass model showed no significant difference between observed and expected probabilities ($\chi^2 = 10.967$, $df = 8$, $p = 0.204$), indicating no evidence of poor model fit, with reasonable agreement between observed and expected probabilities across the risk groups (Figure 4).

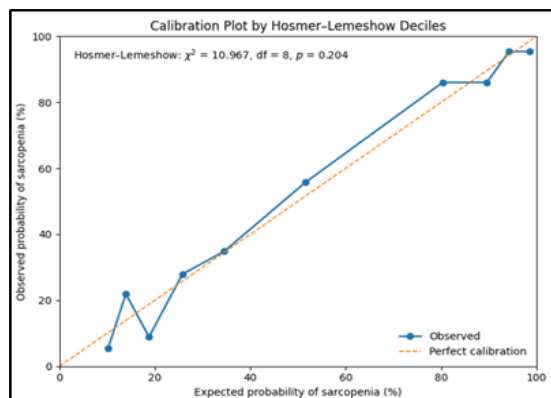


Figure 4: Calibration plot by Hosmer-Lemeshow.

Based on these multivariable findings, a simplified scoring system was developed (Table 6), integrating variables independently associated with low muscle strength, including sex, depression, diabetes, and central obesity, and variables associated with low muscle mass, including age, hypertension, obesity, and central obesity. The scoring system demonstrated a graded increase in estimated probability across score levels, supporting its potential utility as a practical tool for early screening and risk stratification in urban, sedentary pre-elderly and elderly populations.

Table 6: Simplified prognostic scoring system for predicting muscle strength and muscle morphology (sarcopenia) in urban sedentary populations

No.	Question	Yes	No
<i>Muscle strength and functional dimension</i>			
	Are you male?	1	0
	Do you have depression?	1	0
	Do you have diabetes?	2	0
	Do you have central obesity?	0	1
<i>Muscle morphology and structure dimension (sarcopenia)</i>			
	Are you aged 65 years or older?	1	0
	Do you have elevated blood pressure?	0	1
	Do you have obesity?	0	1
	Do you have central obesity?	0	3
Prognosis (Functional Dimension)		Prognosis (Structural Dimension)	
Score	Prognosis (%)	Score	Prognosis (%)
5	99.33	1	98.
4	98.2	0	50
3	95.26	-1	26.89
2	88.08	-2	11.92
1	73.11	-3	4.74
0	50.00	-4	1.8
-1	26.89	-5	0.67

DISCUSSION

Despite the growing availability of various diagnostic and screening approaches for sarcopenia, including functional assessments, imaging-based measurements, and questionnaire-based tools, their implementation in real-world clinical and community settings remains limited [11]. Several tools such as SARC-F, SARC-CalF, and MSRA have been developed to facilitate early detection; however, these methods demonstrate variable diagnostic performance, with SARC-F showing relatively low sensitivity (27–77%), specificity ranging from 63 to 91%, and AUC values of approximately 0.67 to 0.75, while SARC-CalF improves sensitivity to 57.4–65.5% with overall diagnostic accuracy reaching

75.7–79.2% [8,12]. In addition, inconsistencies among different diagnostic criteria, such as AWGS, EWGSOP, and SDOC, further contribute to heterogeneity in sarcopenia identification and limit their practical applicability [13,14]. These limitations highlight a persistent gap between methodological advances and clinical implementation, reinforcing the need for simpler, integrated models that can be readily applied in routine practice, particularly in urban sedentary populations [11,15]. An interesting finding in this study was that several metabolic characteristics, particularly hypertension, obesity (BMI), and central obesity, were inversely associated with sarcopenia-related muscle outcomes. In the multivariable model, hypertension was inversely associated with low muscle mass ($B = -0.645$; $p = 0.017$), while obesity ($B = -2.882$; $p < 0.001$) and central obesity ($B = -1.084$; $p = 0.006$) were also associated with lower odds of low muscle mass. These findings differ from substantial evidence reporting positive associations between metabolic syndrome [16,17], hypertension [18–20], and sarcopenia. The observed inverse associations between hypertension, obesity, central obesity, and sarcopenia-related outcomes should be interpreted cautiously and should not be considered evidence of a protective or causal effect. While metabolic syndrome has generally been associated with chronic inflammation and adverse muscle outcomes, the relationship between adiposity, blood pressure, and muscle health is complex and may vary according to population characteristics, body composition, age, and diagnostic criteria [13,23]. Higher adiposity may be associated with greater absolute muscle mass or mechanical loading, which could partly contribute to the observed inverse association when muscle mass is assessed using BIA. Similarly, blood pressure characteristics may reflect multiple physiological and vascular factors rather than a single pathological pathway. Previous studies have demonstrated heterogeneous and sometimes contradictory associations: meta-analyses have reported a positive association between hypertension and sarcopenia ($OR = 1.29$; 95% $CI = 1.00–1.67$), with stronger associations in Asian populations ($OR = 1.50$; 95% $CI = 1.35–1.67$) [18], while other analyses have reported increased odds of sarcopenia among individuals with sarcopenic obesity ($OR = 1.49$; 95% $CI = 1.37–1.62$) [24,20]. Conversely, blood pressure variability rather than absolute blood pressure levels has also been associated with sarcopenia ($\beta = 0.20$; $p = 0.024$), suggesting that vascular regulation may be relevant to muscle health [25], while a J-curve relationship has been observed between blood pressure and frailty, with lower blood pressure associated with greater frailty ($OR = 0.872–0.892$ per increment; $p < 0.05$) [26]. These heterogeneous findings indicate that the observed associations between metabolic characteristics and muscle-related outcomes may be context-dependent. In this study, type 2 diabetes mellitus showed a strong independent association with low muscle strength ($B = 1.594$; $p < 0.001$), consistent with the established association between impaired glucose metabolism and sarcopenia-related outcomes [27]. Previous evidence

has consistently demonstrated that individuals with type 2 diabetes have higher odds of sarcopenia (OR= 1.518; 95% CI= 1.110–2.076; $p= 0.009$), while poor glycemic control has also been associated with a greater likelihood of muscle loss (OR= 1.79; 95% CI= 1.17–2.75) [28,29]. Moreover, poor glycemic control and glucose variability have been associated with reduced muscle mass and strength, as reflected by the negative correlation between HbA1c and muscle mass ($r= -0.327$; $p= 0.039$). The relationship between diabetes and muscle health may be bidirectional, as alterations in skeletal muscle mass and function may also be associated with impaired glucose metabolism through changes in muscle-mediated glucose uptake [27,30]. However, the cross-sectional design of the present study does not allow the temporal direction or causality of these associations to be established. Older age remained strongly associated with sarcopenia in this study ($B= 1.047$; $p < 0.001$), consistent with extensive evidence showing progressive reductions in muscle mass and function with advancing age in geriatric populations. In contrast, malnutrition showed a strong but unstable association, reflected by an extremely large coefficient ($B= 18.571$) that could not be reliably estimated in the model. This finding may reflect sparse data or separation within the regression model and should therefore be interpreted cautiously. Previous studies consistently demonstrate that low BMI is strongly associated with sarcopenia and adverse geriatric outcomes, with cut-off values around <19 – 22 kg/m² associated with functional decline, cognitive impairment, and reduced rehabilitation outcomes [31,32]. Large population studies further confirm that underweight is associated with higher odds of sarcopenia (OR= 2.25; 95% CI= 1.17–4.33; $p= 0.015$), while up to 75% of underweight elderly individuals may have sarcopenia. [33,34] In geriatric populations, adequate nutritional status and BMI are closely associated with muscle mass and functional status, whereas malnutrition and underweight frequently coexist with sarcopenia and poorer functional outcomes [35–38]. In this study, male sex and depression were significantly associated with low muscle strength. Previous studies have reported an association between male sex and sarcopenia, potentially reflecting differences in age-related hormonal changes, body composition, and muscle physiology [39], with epidemiological data reporting higher odds of sarcopenia in men (OR up to 2.26 or higher depending on severity) [40]. Depression has also been consistently associated with sarcopenia, with meta-analyses reporting higher odds of sarcopenia among individuals with depression (OR= 1.57; 95% CI= 1.32–1.86), including evidence of associations in both directions [41,42]. Several mechanisms may plausibly contribute to these associations, including reduced physical activity, inadequate nutritional intake, inflammatory processes, and behavioral changes [43–47]. On the other hand, depressive symptoms may also be linked to decreased muscle strength and physical function due to restrictions in activity and autonomy. Nevertheless, these potential pathways remain hypotheses in the context of the present cross-sectional analysis and

should not be interpreted as established causal mechanisms. The scoring system created in this study could be useful in primary care and community settings for early screening and risk stratification of sarcopenia, especially among sedentary pre-elderly and elderly people living in cities. By integrating readily obtainable variables, including sex, depressive symptoms, type 2 diabetes mellitus, central obesity, age, hypertension, and obesity, the scoring system may help clinicians identify individuals with a higher likelihood of low muscle strength or low muscle mass who may otherwise be overlooked by conventional symptom-based screening tools. Individuals with higher scores could be prioritized for further assessment of handgrip strength and muscle mass according to the AWGS 2025 criteria, while those identified at lower likelihood could undergo routine monitoring and preventive counseling. The use of routinely available clinical characteristics may facilitate targeted allocation of diagnostic resources and support earlier nutritional, physical activity, metabolic, and functional assessment in settings where comprehensive muscle evaluation is not routinely available. Importantly, the scoring system is intended as a screening and risk-stratification tool rather than a substitute for formal sarcopenia assessment according to AWGS 2025.

Strength and Limitations

This study has several strengths, including the use of a relatively large urban dataset, comprehensive evaluation of both functional (muscle strength) and structural (muscle mass) components of sarcopenia based on AWGS 2025 criteria, and the application of multivariable logistic regression and ROC analysis to develop a practical scoring system using clinically relevant and readily obtainable variables. These characteristics may support the potential applicability of the proposed scoring system in community and primary care settings, particularly among urban sedentary populations. However, several limitations should be acknowledged. First, the cross-sectional design precludes determination of temporal or causal relationships between the identified factors and sarcopenia-related outcomes. Second, the use of secondary data limits investigators' control over the completeness, consistency, and original measurement of variables, including the availability of detailed dietary and inflammatory data. Third, the dataset was derived from an urban population in Jakarta, which may limit generalizability to rural populations, other regions of Indonesia, or populations with different demographic and lifestyle characteristics. Fourth, the proposed scoring system was developed and evaluated within the same dataset and has not undergone internal or external validation; therefore, the reported discriminatory performance should be considered preliminary, and further validation and calibration are required before clinical implementation. Fifth, muscle mass was assessed using BIA rather than DXA or other reference imaging methods, and BIA-derived estimates may be affected by hydration status, body composition, and device-specific equations. Sixth, the

predominance of female participants may limit the generalizability of the findings to populations with different sex distributions. Seventh, detailed dietary intake data were not available, limiting assessment of nutritional factors that may be associated with muscle health. Finally, although exclusion criteria were prespecified, none of the participants met the specified exclusion criteria during data collection; therefore, selection bias from their actual application was unlikely in this dataset, although the predefined criteria may still limit applicability to populations with excluded clinical conditions.

Conclusion

Both functional and structural components of sarcopenia were associated with a combination of demographic, clinical, and metabolic factors in urban sedentary pre-elderly and elderly populations. Male sex, depression, and type 2 diabetes mellitus were independently associated with low muscle strength, while older age was strongly associated with low muscle mass. Interestingly, hypertension, obesity, and central obesity showed inverse associations with sarcopenia-related muscle outcomes, suggesting a complex and context-dependent relationship between metabolic characteristics and muscle health. This study developed a simplified scoring system based on readily obtainable clinical variables, which may be useful for early screening and identification of individuals with a higher likelihood of sarcopenia in urban sedentary populations. Given the substantial burden of sarcopenia, early detection and appropriate intervention remain important; however, the proposed scoring system requires further validation in independent and more diverse populations before it can be considered for routine clinical application. Further longitudinal studies are also needed to establish temporal relationships and confirm the observed associations.

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Conflict of interests

The authors declared no conflict of interest.

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Data sharing statement

The data that supports the findings of this study are available from the corresponding author upon a reasonable request.

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