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Nutritional Status and Functional Independence in Older Adults: A Cross-Sectional Study

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Abstract

Introduction: The rapid growth of the elderly population in Indonesia has created major public health challenges, particularly the decline of functional independence. Nutritional indicators such as body mass index (BMI), calf circumference, and mid-upper arm circumference (MUAC) are known to influence functional capacity. This study aimed to analyze the association between BMI, calf circumference, and MUAC with functional status in older adults attending the Sudiang Public Health Center, Makassar.

Methods: A cross-sectional study was conducted with 108 purposively selected older adults. Nutritional status was assessed using BMI, calf circumference, and MUAC, while functional status was measured with the Lawton Instrumental Activities of Daily Living (IADL) scale. Data analysis employed Somers' D correlation to examine the strength and direction of associations.

Results: BMI was significantly associated with functional status ($p = 0.016$; $D = –0.176$), as were calf circumference ($p = 0.001$; $D = 0.297$) and MUAC ($p = 0.027$; $D = –0.208$). Lower BMI and MUAC were associated with reduced functional independence, whereas larger calf circumference was positively associated with functional capacity.

Conclusion: Nutritional status, as reflected by BMI, calf circumference, and MUAC, shows a significant association with functional independence in older adults. Regular nutritional screening should be integrated into geriatric care to preserve autonomy and quality of life among aging populations.

Keywords

aged, nutritional status, body mass index, calf circumference, mid-upper arm circumference, activities of daily living

Introduction

The global elderly population continues to grow, including in Indonesia. According to the United Nations, the number of individuals aged 65 years and over is projected to rise from 761 million in 2021 to 1.6 billion by 2050.[1] In Indonesia, data from the Central Statistics Agency (Badan Pusat Statistik) indicate that the elderly population exceeded 27 million in 2020 and is expected to reach 40 million by 2025.[2] This demographic shift increases the risk of age-related health problems, particularly functional decline due to physiological changes associated with aging.[3]

One of the primary health issues among older adults is sarcopenia—a loss of muscle mass and strength—which contributes to impaired mobility, reduced balance, and an increased risk of falls and injuries.[4] Changes in body composition, such as increased fat mass and decreased muscle mass, also influence the functional status of older individuals.[5] Functional status refers to an individual's ability to independently perform daily activities, commonly assessed using instruments such as the Lawton Instrumental Activities of Daily Living (IADL) scale.[6]

Several anthropometric indicators are used to evaluate the nutritional and muscular status of older adults, including Body Mass Index (BMI), calf circumference, and mid-upper arm circumference (MUAC). Research has shown that BMI may affect mobility in the elderly, while calf circumference and MUAC are more directly associated with muscle strength and postural balance.[7] For example, a study by Prasetya demonstrated a significant association between BMI and reduced mobility among older adults in nursing homes. Similarly, Utami and Kartika reported that smaller calf circumference is associated with diminished walking ability and balance in older populations.[7]

Although each of these indicators has been widely used individually, studies investigating their simultaneous relationship with functional status in older adults remain limited, particularly in Indonesia. The combined influence of BMI, calf circumference, and MUAC on functional status in the elderly—especially within the Sudiang Health Center area of Makassar City—has yet to be clearly elucidated.[8]

A preliminary assessment conducted on October 27, 2024, at the Sudiang Health Center revealed that most older adults exhibited muscle loss and dependence in daily living activities. Among 10 individuals assessed, 8 had low muscle mass, 5 were categorized as underweight based on MUAC, and 5 were dependent on others for performing daily activities. These findings highlight the need for a comprehensive analysis of the aforementioned indicators.

This study aims to analyze the relationship between Body Mass Index (BMI), calf circumference, and mid-upper arm circumference (MUAC) and the functional status of older adults at the Sudiang Public Health Center in Makassar. The study hypothesizes that both calf circumference and MUAC are significantly associated with functional status, while the association between BMI and functional status is complex and influenced by body composition.

Methods

This study was conducted at the Sudiang Public Health Center, Makassar City, from January 10 to February 10, 2025. It employed a quantitative, descriptive-analytic design with a cross-sectional approach, which was chosen for its ability to describe the relationships between variables at a single point in time, although it is limited in establishing causality.

A non-probability sampling technique—purposive sampling—was used to select participants who met specific criteria aligned with the study objectives. Inclusion criteria comprised older adults aged >60 years, cooperative, and willing to participate. Exclusion criteria included individuals with physical disabilities or permanent impairments, and those undergoing special medical care.

The independent variables were Body Mass Index (BMI), calf circumference, and mid-upper arm circumference (MUAC). The dependent variable was functional status, while potential confounding variables included nutritional intake and other health conditions such as diabetes, hypertension, or arthritis.

The study population consisted of 147 registered elderly individuals actively engaged with the Sudiang Health Center. The sample size was calculated using the Slovin formula, resulting in 108 participants. To minimize measurement bias, all assessors used the same standardized instruments and received prior training. Selection bias was addressed by applying strict inclusion and exclusion criteria. BMI was calculated by dividing body weight (kg) by height (m^2). Weight was measured using the Omron HN-289 digital scale, and height with a microtoise. Calf circumference was measured while the participant was standing relaxed, at the widest part of the calf muscle. MUAC was measured in a seated position, at the midpoint between the acromion and olecranon. Both circumference measures were taken using a non-elastic, flexible measuring tape.

Functional status was assessed using the validated Indonesian version of the Lawton Instrumental Activities of Daily Living (IADL) questionnaire, as validated by Fikriyah et al.[9] The questionnaire was administered through face-to-face interviews by trained enumerators. Three enumerators were involved in data collection, and their training included instrument familiarization, interview techniques, and measurement simulation to ensure data reliability.

Data analysis included univariate and bivariate procedures. Bivariate analysis was conducted using Somers' D correlation, appropriate for examining relationships where the dependent variable is ordinal and independent variables are ordinal or continuous. Assumptions of normality and linearity were not tested, as Somers' D is a non-parametric test. No missing data were encountered; hence, all data were included in the analysis.

Ethical considerations included informed consent, anonymity, confidentiality, and ethical clearance. Written informed consent was obtained after participants received a clear explanation of the study's objectives, procedures, and their rights. This study received ethical approval from the Ethics Committee of the Faculty of Nursing and Public Health, Hasanuddin University (Ref: 2386/UN4.18.3/TP.01.02/2024, issued on December 31, 2024). All collected data were kept confidential and used solely for research purposes.

Results

This study was conducted from January 10 to February 10, 2025, within the Sudiang Public Health Center working area in Makassar City. Of 147 older adults approached, 108 met the inclusion criteria and agreed to participate, while 39 declined due to health issues or refusal. Respondent characteristics are presented in Table 1.

Table 1. General Characteristics of Respondents

Characteristic	Category	Frequency (n)	Percentage (%)
Age	Elderly (60-74 years)	84	77.8
	Old (75-90 years)	24	22.2
Gender	Male	37	34.3
	Female	71	65.7
Occupation	Housewife	47	43.5
	Retired	28	25.9
	Trader	14	13.0
	Others (combined)	19	17.6

Table 1 shows that the majority of participants were aged 60-74 years (77.8%), and most were female (65.7%). The most common occupation was housewife (43.5%). No data were missing; all participants completed the questionnaires. The distribution of participants based on their Body Mass Index (BMI) categories is presented in Table 2, providing an overview of the nutritional status among the elderly population included in this study.

Table 2. Distribution of Body Mass Index (BMI)

BMI Category	Frequency (n)	Percentage (%)
Severely Underweight	7	6.5
Underweight	6	5.6
Normal	52	48.1
Overweight	20	18.5
Obese	23	21.3

Table 2 presents the distribution of BMI among the elderly. Most respondents (48.1%) were classified in the normal category (BMI 18.5-25.0). Table 3 presents the distribution of Body Mass Index (BMI) categorized by gender, age group, and occupation, highlighting patterns in nutritional status across demographic and occupational subgroups within the elderly population.

Table 3. BMI by Gender, Age Group, and Occupation

Characteristics	Severely Underweight n (%)	Underweight n (%)	Normal n (%)	Overweight n (%)	Obese n (%)	Total n (%)
Gender						
Male	1 (0.9)	3 (2.8)	22 (20.4)	6 (5.6)	5 (4.6)	37 (34.3)
Female	6 (5.6)	3 (2.8)	30 (27.8)	14 (13.0)	18 (16.7)	71 (65.7)
Total	7 (6.5)	6 (5.6)	52 (48.1)	20 (18.5)	23 (21.3)	108 (100)
Age Group						
Young-old (60–74)	5 (4.6)	4 (3.7)	41 (38.0)	12 (11.1)	22 (20.4)	84 (77.8)
Old-old (≥75)	2 (1.9)	2 (1.9)	11 (10.2)	8 (7.4)	1 (0.9)	24 (22.2)
Total	7 (6.5)	6 (5.6)	52 (48.1)	20 (18.5)	23 (21.3)	108 (100)
Occupation						
Laborer	1 (0.9)	0 (0.0)	4 (3.7)	1 (0.9)	0 (0.0)	6 (5.6)
Driver	0 (0.0)	0 (0.0)	1 (0.9)	0 (0.0)	0 (0.0)	1 (0.9)
Teacher	0 (0.0)	0 (0.0)	1 (0.9)	1 (0.9)	1 (0.9)	3 (2.8)
Housewife / RT	5 (4.6)	2 (1.9)	22 (20.4)	9 (8.3)	9 (8.3)	47 (43.5)
Head						
	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.9)	1 (0.9)
Trader	1 (0.9)	1 (0.9)	5 (4.6)	2 (1.9)	5 (4.6)	14 (13.0)
Retired	0 (0.0)	1 (0.9)	15 (13.9)	6 (5.6)	6 (5.6)	28 (25.9)
Tailor	0 (0.0)	0 (0.0)	1 (0.9)	0 (0.0)	1 (0.9)	2 (1.9)
Rickshaw Driver	0 (0.0)	1 (0.9)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.9)
Parking Attendant	0 (0.0)	0 (0.0)	1 (0.9)	0 (0.0)	0 (0.0)	1 (0.9)
Entrepreneur	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.9)	1 (0.9)	2 (1.9)
Total	7 (6.5)	6 (5.6)	52 (48.1)	20 (18.5)	23 (21.3)	108 (100)

Table 3 illustrates that normal BMI was most prevalent among female respondents (27.8%) and in the 60–74-year age group (38.0%). Housewives constituted the largest occupational group with normal BMI (20.4%). Table 4 displays the distribution of calf circumference across gender, age groups, and occupational categories, illustrating variations in lower-limb muscle mass that may be associated with functional mobility among older adults.

Table 4. Calf Circumference by Gender, Age Group, and Occupation

Characteristics	Low n (%)	Normal n (%)	Total n (%)
Gender			
Male	19 (17.6)	18 (16.7)	37 (34.3)
Female	43 (39.8)	28 (25.9)	71 (65.7)
Total	62 (57.4)	46 (42.6)	108 (100)
Age Group			
Young-old (60–74)	45 (41.7)	39 (36.1)	84 (77.8)
Old-old (≥75)	17 (15.7)	7 (6.5)	24 (22.2)
Total	62 (57.4)	46 (42.6)	108 (100)
Occupation			
Laborer	6 (5.6)	0 (0.0)	6 (5.6)
Driver	1 (0.9)	0 (0.0)	1 (0.9)
Teacher	1 (0.9)	2 (1.9)	3 (2.8)
Housewife	29 (26.9)	18 (16.7)	47 (43.5)
Neighborhood Head	0 (0.0)	1 (0.9)	1 (0.9)
Trader	4 (3.7)	10 (9.3)	14 (13.0)
Tailor	1 (0.9)	1 (0.9)	2 (1.9)
Retired	16 (14.8)	12 (11.1)	28 (25.9)
Rickshaw Driver	0 (0.0)	1 (0.9)	1 (0.9)
Parking Attendant	1 (0.9)	0 (0.0)	1 (0.9)
Entrepreneur	3 (2.8)	0 (0.0)	3 (2.8)
Self-employed	0 (0.0)	1 (0.9)	1 (0.9)
Total	62 (57.4)	46 (42.6)	108 (100)

Table 4 shows that low calf circumference was more common among females (39.8%) and among those aged 60–74 years (41.7%). Housewives were the most dominant group with low calf circumference (26.9%). Table 5 presents the distribution of Mid-Upper Arm Circumference (MUAC) categorized by gender, age group, and occupation, providing insights into upper body nutritional status and its potential implications for functional capacity in older adults.

Table 5. Mid-Upper Arm Circumference (MUAC) by Gender, Age Group, and Occupation

Characteristics	Obese n (%)	Overweight n (%)	Normal n (%)	Low n (%)	Poor n (%)	Total n (%)
Gender						
Male	0 (0.0)	0 (0.0)	7 (6.5)	30 (27.8)	0 (0.0)	37 (34.3)
Female	0 (0.0)	1 (0.9)	38 (35.2)	32 (29.6)	0 (0.0)	71 (65.7)
Total	0 (0.0)	1 (0.9)	45 (41.7)	62 (57.4)	0 (0.0)	108 (100)
Age Group						
Young-old (60–74)	0 (0.0)	1 (0.9)	34 (31.5)	49 (45.4)	0 (0.0)	84 (77.8)
Old-old (≥75)	0 (0.0)	0 (0.0)	11 (10.2)	13 (12.0)	0 (0.0)	24 (22.2)
Total	0 (0.0)	1 (0.9)	45 (41.7)	62 (57.4)	0 (0.0)	108 (100)
Occupation						
Laborer	0 (0.0)	0 (0.0)	0 (0.0)	6 (5.6)	0 (0.0)	6 (5.6)
Driver	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.9)	0 (0.0)	1 (0.9)
Teacher	0 (0.0)	0 (0.0)	2 (1.9)	1 (0.9)	0 (0.0)	3 (2.8)
Housewife	0 (0.0)	1 (0.9)	21 (19.4)	25 (23.1)	0 (0.0)	47 (43.5)
Neighborhood Head	0 (0.0)	0 (0.0)	1 (0.9)	0 (0.0)	0 (0.0)	1 (0.9)
Trader	0 (0.0)	0 (0.0)	7 (6.5)	7 (6.5)	0 (0.0)	14 (13.0)
Tailor	0 (0.0)	0 (0.0)	2 (1.9)	0 (0.0)	0 (0.0)	2 (1.9)
Retired	0 (0.0)	0 (0.0)	11 (10.2)	17 (15.7)	0 (0.0)	28 (25.9)
Rickshaw Driver	0 (0.0)	0 (0.0)	1 (0.9)	0 (0.0)	0 (0.0)	1 (0.9)
Parking Attendant	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.9)	0 (0.0)	1 (0.9)
Entrepreneur	0 (0.0)	1 (0.9)	0 (0.0)	2 (1.9)	0 (0.0)	3 (2.8)
Self-employed	0 (0.0)	0 (0.0)	1 (0.9)	0 (0.0)	0 (0.0)	1 (0.9)
Total	0 (0.0)	1 (0.9)	45 (41.7)	62 (57.4)	0 (0.0)	108 (100)

Table 5 demonstrates that 62 participants (57.4%) had low MUAC, with a near-even gender distribution: 27.8% male and 29.6% female. Most were from the elderly age group (45.4%). Housewives represented the largest group with low MUAC (23.1%). Table 6 illustrates the distribution of functional status based on the Lawton Instrumental Activities of Daily Living (IADL) scale, classified by gender, age group, and occupation. This table highlights the levels of independence among older adults in performing daily activities across various demographic profiles.

Table 6. Functional Status (Lawton IADL) by Gender, Age Group, and Occupation

Characteristics	Independent n (%)	Requires Assistance n (%)	Dependent n (%)	Total n (%)
Gender				
Male	17 (15.7)	20 (18.5)	0 (0.0)	37 (34.3)
Female	35 (32.4)	36 (33.3)	0 (0.0)	71 (65.7)
Total	52 (48.1)	56 (51.9)	0 (0.0)	108 (100)
Age Group				
Young-old (60–74)	49 (45.4)	35 (32.4)	0 (0.0)	84 (77.8)
Old-old (≥75)	3 (2.8)	21 (19.4)	0 (0.0)	24 (22.2)
Total	52 (48.1)	56 (51.9)	0 (0.0)	108 (100)
Occupation				
Laborer	4 (3.7)	2 (1.9)	0 (0.0)	6 (5.6)
Driver	0 (0.0)	1 (0.9)	0 (0.0)	1 (0.9)
Teacher	3 (2.8)	0 (0.0)	0 (0.0)	3 (2.8)
Housewife	22 (20.4)	25 (23.1)	0 (0.0)	47 (43.5)
Neighborhood Head	1 (0.9)	0 (0.0)	0 (0.0)	1 (0.9)
Trader	8 (7.4)	6 (5.6)	0 (0.0)	14 (13.0)
Tailor	1 (0.9)	1 (0.9)	0 (0.0)	2 (1.9)
Retired	10 (9.3)	18 (16.7)	0 (0.0)	28 (25.9)
Rickshaw Driver	0 (0.0)	1 (0.9)	0 (0.0)	1 (0.9)
Parking Attendant	0 (0.0)	1 (0.9)	0 (0.0)	1 (0.9)
Entrepreneur	2 (1.9)	1 (0.9)	0 (0.0)	3 (2.8)
Self-employed	1 (0.9)	0 (0.0)	0 (0.0)	1 (0.9)
Total	52 (48.1)	56 (51.9)	0 (0.0)	108 (100)

Table 6 indicates that a majority of older adults needed assistance with daily activities. Females were more likely to require help (33.3%). The elderly group (60–74 years) had the highest proportion of independent individuals (45.4%). Table 7 presents the results of the Somers' D correlation analysis between Body Mass Index (BMI) and functional status among older adults. This analysis aims to determine the strength and direction of the association between nutritional status and the ability to perform instrumental daily activities.

Table 7. Somers' D Correlation Between BMI and Functional Status

Variable	n	p-value	r
BMI	108	0.016	-0.176

Table 7 reveals a significant negative correlation between BMI and functional status ($p = 0.016$, $r = -0.176$), indicating that higher BMI may be associated with decreased functional independence. Table 8 displays the results of the Somers' D correlation analysis examining the association between calf circumference and functional status. This analysis explores whether lower limb muscle mass, as estimated by calf circumference, is significantly related to older adults' ability to perform instrumental activities of daily living.

Table 8. Somers' D Correlation Between Calf Circumference and Functional Status

Variable	n	p-value	r
Calf Circumference	108	0.001	0.297

Table 8 shows a significant positive correlation (p = 0.001, r = 0.297), suggesting that greater calf circumference is associated with better functional status. Table 9 presents the results of the Somers' D correlation analysis between mid-upper arm circumference (MUAC) and functional status. This table evaluates whether upper body nutritional status, as estimated by MUAC, is significantly associated with functional independence in older adults.

Table 9. Somers' D Correlation Between MUAC and Functional Status

Variable	n	p-value	r
MUAC	108	0.027	-0.208

Table 9 demonstrates a statistically significant negative correlation (p = 0.027, r = -0.208) between MUAC and functional status, implying that higher MUAC is weakly associated with lower functional independence.

Discussion

The results of this study indicated a significant association between Body Mass Index (BMI) and the functional status of older adults at Puskesmas Sudiang, with a p-value of 0.016 and a negative correlation (r = -0.176). Older adults with high BMI, particularly those classified as overweight or obese, tend to experience functional limitations due to increased joint load and a higher risk of chronic diseases such as diabetes and hypertension.[9] Conversely, older adults with low BMI are more susceptible to muscle mass loss (sarcopenia), which negatively impacts physical strength and increases dependence in daily activities.[7] While BMI is commonly used as an indicator of nutritional status, these findings suggest that BMI alone is insufficient to comprehensively assess functional status, as it does not differentiate between fat and muscle mass.[4]

Calf circumference was found to be a stronger predictor of functional status in older adults, showing a significant relationship (p = 0.001, r = 0.297). A majority of participants (57.4%) had low calf circumference, indicating a high prevalence of sarcopenia and limited mobility.[10] Older adults with larger calf circumference tend to have greater muscle strength, which contributes to balance and reduces the risk of falls.[11] Physiologically, the calf muscles are essential in maintaining posture and enabling standing and walking, making a reduced calf circumference a marker of compromised stability and mobility. Female participants showed a higher prevalence of low calf circumference compared to males, likely due to postmenopausal hormonal changes that accelerate muscle degradation.[12] Furthermore, participants aged ≥75 years were more prone to reductions in muscle mass, contributing to decreased mobility and a heightened risk of injury.[4]

The findings also revealed a significant association between Mid-Upper Arm Circumference (MUAC) and functional status (p = 0.027, r = -0.208). Interestingly, a higher MUAC did not always correlate with better functional status. This may be explained by the phenomenon of sarcopenic obesity, in which older adults have excess fat accumulation but still suffer from muscle mass loss, leading to reduced mobility.[9] Female participants tended to have greater MUAC values than males, but their body composition often contained more fat than active muscle tissue.[13] Thus, a higher MUAC does not necessarily equate to better physical strength or functional capacity, as excess fat provides no benefit to functional performance.[4]

In terms of age, participants aged ≥75 years were more likely to experience reductions in both calf circumference and MUAC, leading to decreased functional status. Progressive muscle mass loss with age reduces balance, grip strength, and physical endurance in performing daily tasks.[5] Ponti et al. demonstrated that muscle loss accelerates after age 70, placing this group at higher risk of mobility limitations and functional dependence.[14]

In addition to age and sex, occupational history was also associated with functional status. Older adults who previously engaged in physically demanding jobs, such as manual labor or informal work, tended to have lower BMI and calf circumference than retirees or housewives.[15] This may be related to strenuous work patterns accompanied by inadequate nutritional intake to maintain muscle mass.[3] In contrast, those who were not employed but consumed high-calorie diets were more prone to overweight and obesity, which can exacerbate functional decline due to reduced physical activity post-retirement.[4] In practice, calf circumference measurement can serve as a simple screening tool in primary care settings to detect early risk of functional impairment in older adults.

Overall, this study demonstrates significant associations between BMI, calf circumference, and MUAC with the functional status of older adults, albeit with varying correlation strengths. Calf circumference exhibited the strongest association, emphasizing the role of muscle mass in maintaining mobility and independence.[11] BMI and MUAC displayed more complex relationships, where overweight, low muscle mass, and sarcopenic obesity negatively affected functional status.[16] Therefore, health interventions for older adults should not focus solely on weight management but also aim to improve muscle mass and promote physical activity to support balance and independence in daily living.[12] Nutritional interventions such as protein supplementation are also recommended to preserve muscle mass in the elderly. However, due to the cross-sectional nature of this study, the observed relationships are associative and do not establish causality.

Study limitations include an imbalance between male and female respondents, which may influence the findings. Self-reporting bias may also be present, particularly among participants with mild cognitive impairments or memory loss. The assessment of muscle and fat mass relied on BMI, calf circumference, and MUAC, which may not precisely reflect active muscle mass relevant to functional status.

Physiotherapists play a crucial role in preventive and rehabilitative interventions for older adults at risk of functional decline. It is recommended to implement light-to-moderate resistance training programs (e.g., leg extensions, chair squats, and light weight lifting) to improve muscle mass and strength in both upper and lower limbs. Functional

exercises such as sit-to-stand, stair climbing, and balance training using a chair or wall for support are also strongly advised to maintain independence in daily activities. A systematic review by Liu et al. showed that regular resistance training for 8–12 weeks significantly improves muscle strength and balance in older adults. These exercises should be tailored to the physical condition of each participant. Although this study provides valuable insights into the functional status of older adults at Puskesmas Sudiang, the generalizability of the findings may be limited to populations with similar characteristics, and further research is needed to assess the relevance of these findings in other regions or contexts.

Conclusion

This study demonstrates that the nutritional status of older adults—as measured by Body Mass Index (BMI), calf circumference, and mid-upper arm circumference (MUAC)—is associated with functional status among the elderly population at the Sudiang Public Health Center in Makassar. Although the majority of older adults had a normal BMI (52.8%), nearly half (47.2%) exhibited abnormal BMI values, which may place them at risk for reduced physical function. A low BMI may indicate sarcopenia and increased susceptibility to injury due to muscle weakness, whereas a high BMI may impair mobility as a result of excess fat accumulation and related metabolic disorders.

Calf circumference showed a significant positive correlation with functional status ($p = 0.001$; $r = 0.297$), indicating the role of lower limb muscle mass in supporting balance and independence in older adults. Conversely, both MUAC and BMI demonstrated negative correlations with functional status, suggesting that an increase in body size without corresponding gains in muscle mass may negatively affect physical performance.

Based on these findings, healthcare professionals are advised to regularly monitor BMI, calf circumference, and MUAC as part of routine nutritional and functional screening for the elderly. Interventions should focus on promoting and maintaining muscle mass through resistance training and adequate protein intake. Family members are also encouraged to actively support older adults in adopting a healthy diet and engaging in regular physical activity. Additionally, healthcare providers should integrate routine functional assessments into geriatric care programs, particularly in physiotherapy practice aimed at strengthening muscles and preventing fall-related injuries.

It is important to note that BMI, calf circumference, and MUAC have limitations in differentiating between muscle and fat mass. Therefore, the use of more accurate body composition assessment tools—such as bioelectrical impedance analysis (BIA) or dual-energy X-ray absorptiometry (DEXA)—is recommended. Future studies should also consider additional variables, including psychological status, social support, and levels of daily physical activity, as well as assess the effectiveness of intervention programs in improving muscle mass and functional outcomes among older adults.

Author Contribution

Shaskirana Humairah: Conceptualization, methodology, data collection, data analysis, and manuscript drafting.
Andi Rahmaniar Suciani Pujiningrum: Supervision, validation, critical revision of the manuscript, and final approval for submission.
Both authors have read and approved the final version of the manuscript.

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Conflict of Interest Statement

The authors declare that there are no conflicts of interest related to this study.

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Ethics Statement

This study received ethical approval from the Ethics Committee of the Faculty of Nursing and Public Health, Hasanuddin University (Ref: 2386/UN4.18.3/TP.01.02/2024, issued on December 31, 2024). All participants provided informed consent prior to enrollment. The confidentiality of all data was strictly maintained, and the information collected was used solely for research purposes.

References

1. Ida Bagus W, Mayastuti M, Kristyono J. Trends, problems, and policies of the elderly population in East Java Indonesia. Technium Social Sciences Journal. 2022 Nov 9;37:448–60.
2. Roziq M, Warsida RY, Raharja H, Maryani M. Empowering Indonesia's ageing workforce: a strategic roadmap for sustainable economic growth. Jurnal Ketenagakerjaan. 2024 Dec 31;19(3):295–314.

3. Ramadhanti SA, Renovaldi D. Analisis hubungan komposisi tubuh dan indeks massa tubuh terhadap status fungsional pada lansia. Muhammadiyah J Geriatr. 2024 Apr 23;4(2):189.
4. Wang PC, Yeh WC, Tsai YW, Chen JY. Calf circumference has a positive correlation with physical performance among community-dwelling middle-aged, older women. Front Public Health. 2022 Dec 9;10:1081497.
5. Kemala Sari N, Stepvia S, Ilyas MF. The association between anthropometric measurements and body composition with hand grip strength among the elderly population in Indonesia. J Clin Med. 2024 Aug 10;13(16):4697.
6. Koyfman I, Finnell D. A call for interfacing measures of instrumental activities of daily living across the transition of care. Home Healthc Now. 2019 Jan;37(1):44–9.
7. Triguna IPB, Kuswardhani RT, Purnami NKR. Correlation between body mass index and frailty in elderly men at Pemecutan Village, West Denpasar District, Bali. J Penyakit Dalam Udayana. 2021 Jun 30;5(1):9–13.
8. Madyaningrum E, Bintoro BS, Chuang YC, Chuang KY, Chi WC. Biometric indicators can be early signs of declines in activities of daily living functioning among the Indonesian elderly. Disabil Health J. 2021 Apr;14(2):101009.
9. Şavkin R, Bayrak G, Büker N. The effects of the body mass index on the physical function and the quality of life in the elderly. Balt J Health Phys Act. 2020 Dec 31;Supplement 1(1):55–62.
10. Champaiboon J, Petchlorlian A, Manasvanich B, Ubonsutvanich N, Jitpugdee W, Kittiskulnam P, et al. Calf circumference as a screening tool for low skeletal muscle mass: cut-off values in independent Thai older adults. BMC Geriatr. 2023 Dec 8;23(1):826.
11. Luo S, Chen X, Hou L, Yue J, Liu X, Xia X, et al. The accuracy of body mass index and calf circumference values when assessing sarcopenia in a multi-ethnic cohort of middle-aged and older adults: West China health and aging trend study results. Heliyon. 2023 Apr;9(4):e15027.
12. Amorim DNP, Nascimento DC, Stone W, Alves VP, Coelho Vilaça e Silva KH. Body composition and functional performance of older adults. Osteoporos Sarcopenia. 2022 Jun;8(2):86–91.
13. Aguilar-Fernández E, Fernández-Rojas X. The use of the arm circumference as a measure to detect underweight in individuals aged 60 years or older living in Costa Rica. Uniciencia. 2023 Sep 1;37(1):1–12.
14. Ponti F, Santoro A, Mercatelli D, Gasperini C, Conte M, Martucci M, et al. Aging and imaging assessment of body composition: from fat to facts. Front Endocrinol (Lausanne). 2020 Jan 14;10:861.
15. Tsai HJ, Chang FK. Associations between body mass index, mid-arm circumference, calf circumference, and functional ability over time in an elderly Taiwanese population. PLoS One. 2017 Apr 11;12(4):e0175062.
16. Collins L, Beaumont L, Cranston A, Savoie S, Nayiager T, Barr R. Anthropometry in long-term survivors of acute lymphoblastic leukemia in childhood and adolescence. J Adolesc Young Adult Oncol. 2017 Jun;6(2):294–8.