

Body Mass Index and Its Relationship with the Independence of Elderly Women: A Cross-Sectional Study in Mambal Village

Ida Ayu Diah Jenaki^{1*}, Putu Ayu Sita Saraswati², Luh Putu Ratna Sundari³, Govinda Vittala⁴

¹Undergraduate and Professional Physiotherapy Program, Faculty of Medicine, Udayana University, Denpasar, Bali, Indonesia

^{2,4}Department of Physiotherapy, Faculty of Medicine, Udayana University, Denpasar, Bali, Indonesia

³Department of Physiology, Faculty of Medicine, Udayana University, Denpasar, Bali, Indonesia

*Correspondence author at. Jl. Raya Kampus Unud, Jimbaran, South Kuta, Badung Regency, Bali 80361, Indonesia

E-mail address: dayudiah@gmail.com

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Abstract

Introduction: Body Mass Index (BMI) plays an important role in the physical functioning of older adults. A high BMI may limit mobility, while a low BMI is often linked to malnutrition and muscle weakness. Previous studies have reported inconsistent findings regarding the relationship between BMI and the independence of older individuals in daily activities. This study aims to examine the association between BMI and the level of independence among older adults in Mambal Village.

Methods: This observational analytic study used a cross-sectional design with purposive sampling. Conducted in February 2024, it involved 60 older women in Mambal Village. BMI was measured using height and weight, while independence was assessed using the Barthel Index. Data were analyzed using the chi-square test and Spearman's rho correlation.

Results: The chi-square test showed a significant relationship between BMI and independence level ($p = 0.017$). Spearman's rho test also indicated a significant result ($p = 0.024$) with a correlation coefficient of $r = 0.292$, suggesting a low but positive correlation between BMI and the ability to perform daily activities independently.

Conclusion: There is a significant relationship between BMI and the level of independence among older adults in Mambal Village. A higher BMI within a normal range is positively associated with greater independence. These findings highlight the need to maintain an optimal BMI in older adults. Future research should explore additional influencing factors such as family support, socioeconomic status, education, and comorbidities.

Keywords: body mass index, independence, daily activities, elderly women

Introduction

Elderly individuals (seniors) are defined as those aged over 60 years.¹ At this stage, the aging process occurs, characterized by the accumulation of changes that progressively develop throughout human life.² Alongside this aging process, the physical condition of seniors inevitably declines, resulting in physiological deterioration, including decreased physical capabilities such as muscle weakness, balance impairment, and reduced muscle strength, which can affect their ability to perform daily activities.^{3,4}

The elderly population in Indonesia continues to experience significant growth. According to data from the Central Statistics Agency in 2022, Indonesia entered the aging population structure in 2020, with seniors accounting for more than 10% of the total population.⁵ This condition is accompanied by an increased prevalence of disabilities among older people, particularly in those aged over 65 years. According to the Ministry of Health, in 2016, more than half of seniors in Indonesia experienced mild to severe disabilities affecting their ability to carry out daily activities.¹

The decline in seniors' independence in performing daily activities, which includes self-care tasks such as eating, dressing, and moving about, as well as more complex activities requiring cognitive functions, such as household chores and medication management, increases their dependence on others, thereby diminishing their quality of life and compromising their overall health, including an elevated risk of problems affecting nearly all organ systems.^{6,7}

Nutritional status influences seniors' independence, as reflected through the Body Mass Index (BMI).⁸ A high BMI in seniors can restrict movement, making it challenging to perform daily activities and leading to increased dependence on others.⁸ Not only is a high BMI a concern, but a low BMI also adversely affects seniors, as it is associated with malnutrition and cognitive disorders, which are risk factors for frailty and dementia.⁹

Previous research by Yue-Bin et al. in 2018 on the relationship between BMI and disability in performing daily activities indicated that seniors with a higher BMI are at a lower risk of experiencing disability in daily activities; conversely, those with a lower BMI are at a higher risk.¹⁰ However, this finding contrasts with a study by Yoga Yatindra et al. in 2021, which explained that being overweight or obese leads to movement restrictions, affecting seniors' independence.⁸

Previous studies often included a combined sample of men and women, which may introduce confounding factors, as older women are at a higher risk of being overweight or underweight due to post-menopausal hormonal factors.^{11,12} Additionally, older women are more likely to experience limitations in performing daily activities.¹³ This is due to women generally having lower physical strength compared to men and experiencing a more rapid decline in cognitive function, which can affect their ability to carry out daily activities.¹⁴ Therefore, there is a need for research that specifically addresses the relationship between BMI and independence among older women, as similar studies in Indonesia are still very limited.

Given the differing opinions regarding BMI and the level of independence of seniors in performing daily activities, coupled with the lack of research in Indonesia addressing this issue and the inclusion of samples not explicitly focused on older women, the author is interested in investigating the topic of the relationship between BMI and the level of independence of older women in performing daily activities. This study hypothesizes a significant relationship between Body Mass Index (BMI) and the level of autonomy of older women in performing daily activities. This study aims to describe the BMI of older women, assess the level of independence of older women, and investigate the relationship between BMI and the level of autonomy of older women.

Methods

This study employs an observational analytical method with a cross-sectional approach, using Body Mass Index (BMI) as the independent variable and the level of independence in performing daily activities as the dependent variable. The research was conducted in February 2024 by gathering elderly individuals at the community center during integrated health services (posyandu) and through home visits in Mambal Village. Mambal Village was selected due to its accessibility, the absence of similar research in the area, and the full support from the village authorities, who have been very cooperative from the initial survey to the implementation of the study.

The researcher conducted home visits, and the research team, with the assistance of the local head of the village, scheduled after lunchtime to avoid disturbing elderly individuals who may be resting. Participants were screened using predetermined inclusion and exclusion criteria. The sampling technique applied was purposive sampling, yielding a sample size of 44 individuals determined using the formulas from Snedecor and Cochran. The researcher also added 25% to the sample size to anticipate dropouts, resulting in a minimum sample size of 55 individuals.

Bias control was implemented by accounting for factors such as gender, age, and selection through inclusion and exclusion criteria. The inclusion criteria for this study were women aged 60 to 74, as this age group typically exhibits relatively better physical and cognitive abilities than older seniors (75 years and above). Participants needed to be in good health, assessed through vital signs, possess good communication and writing skills, and be willing to participate in the study by signing an informed consent form. Conversely, the exclusion criteria included elderly individuals with a Mini-Mental State Examination (MMSE) score below 24 and those with visual impairments identified through interviews. The dropout criteria encompassed respondents who withdrew from the study and those who did not follow the research procedures properly.

The research procedure commenced by providing information about the study, including its objectives, benefits, methods, and the importance of conducting this research, along with obtaining informed consent as a form of agreement to participate. If elderly individuals exhibited poor comprehension, the research team would first educate their families and the local health services regarding the study's procedures, objectives, and benefits. This was done to ensure that seniors with limited understanding received clear and adequate support before giving written consent.

Next, general anamnesis was conducted, gathering data on name, age, occupation, address, religion, medical history, and medication use, followed by direct interviews using the MMSE form to assess the cognitive level of the samples. BMI was measured by determining height and weight. Height measurement was conducted using the Onemed digital height gauge equipped with wireless sensor technology (HT701) with a division of 0.1 cm/0.1 in, while weight was measured using the Onemed 872H digital scale with an accuracy of 100g/0.2 lb, and the BMI was then calculated. BMI classifications included underweight ($<18.5 \text{ kg/m}^2$), normal weight ($18.6\text{--}22.9 \text{ kg/m}^2$), and overweight ($>23 \text{ kg/m}^2$) based on Asia-Pacific criteria. BMI was selected as the primary indicator because it is relatively easy, simple, and effective for assessing nutritional status and providing an initial overview of health risks related to weight, such as underweight, overweight, or obesity.

Finally, direct interviews were conducted using a validated Barthel Index questionnaire. The validity and reliability testing of the Barthel Index questionnaire in its Indonesian version showed that the Intraclass Correlation Coefficient (ICC) for each item exceeded 0.75, indicating excellent reliability. At the same time, the question regarding controlling bowel movements had an ICC value of 0.645, categorized as good. The Cronbach's alpha reliability test yielded a value of 0.938, indicating that the Barthel Index questionnaire is reliable for measuring independence in performing daily activities. Samples were categorized as independent or dependent, with samples classified as independent if they scored 100 and dependent if they scored below 100.

After data collection, the gathered data were checked for missing values. If any data were missing, the next step was to determine the mechanism of the missing data, whether Missing Completely at Random (MCAR), Missing at Random (MAR), or Missing Not at Random (MNAR). If the collected data were complete without missing values, the data would proceed to statistical analysis using IBM SPSS version 26.0, including univariate and bivariate analyses. Univariate analysis aimed to identify each variable's characteristics and frequency distribution, such as age, cognitive function, body mass index, and the level of independence in daily activities. In contrast, bivariate analysis was utilized to examine the relationship between independent and dependent variables using the chi-square test. If a significant relationship were found, further testing would be conducted using the Spearman-Rho test to determine the direction and

strength of the correlation between the two variables. Both statistical tests were performed because the BMI data were ordinal, and the level of independence was nominal.

Additionally, neither non-parametric test was selected because the assumption of data normality could not be met. Non-parametric tests, such as chi-square and Spearman Rho tests, do not require normally distributed data, making them more suitable for analyzing data that do not meet normality assumptions. This study did not focus on subgroup analyses; therefore, no further division was based on specific subgroups. The primary focus of this study is to explore the relationship between Body Mass Index (BMI) and the level of independence of older women in performing daily activities. This research has received ethical approval from the Ethics Research Commission of the Faculty of Medicine, Udayana University, with ethical approval number 0191/UN14.2.2.VII.14/LT/2024.

Results

This study obtained subjects comprising older women aged 60 to 74 years from the elderly population residing in Mambal Village. Subject selection was conducted according to research criteria using a purposive sampling technique, resulting in 60 subjects with no missing data. The research flow is illustrated in Figure 1.

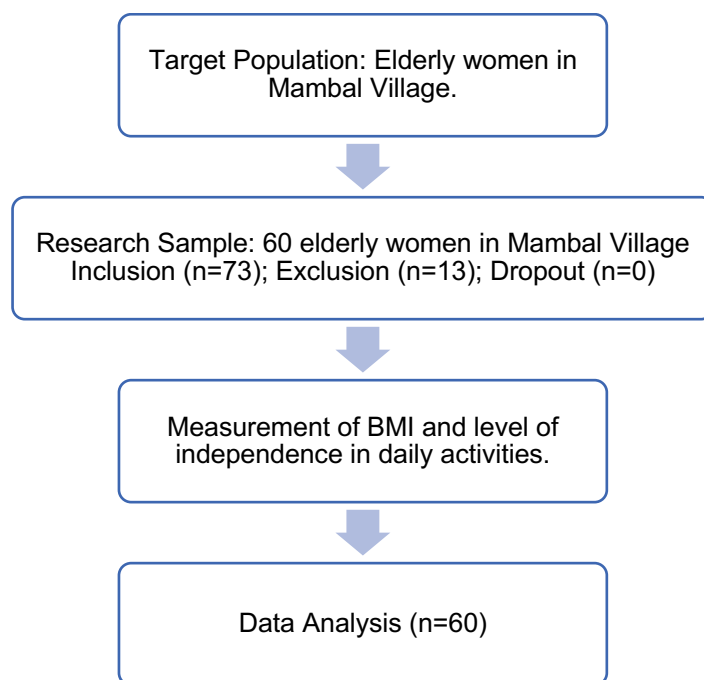


Figure 1. Research Flowchart

From the reachable population in Mambal Village, 73 older women met the inclusion criteria. In contrast, 13 others were excluded from the study due to a Mini-Mental State Examination (MMSE) score below 24, with no other reasons for exclusion. The following tables present the data collected and the results of statistical analyses conducted in this study. Table 1 describes the general characteristics of the study subjects. Table 2 and Table 3 show the frequency distribution of participants based on Body Mass Index (BMI) categories and levels of daily activity, respectively. Table 4 presents the results of the chi-square test examining the relationship between BMI and independence in daily activities, while Table 5 provides the results of the Spearman's rho correlation test to assess the strength and direction of the association.

Table 1. Characteristics of Subjects

Variable	Frequency (n=60)
Age (mean $\pm$ SD)	66.8 $\pm$ 4.21
Cognitive Function (mean $\pm$ SD)	26.52 $\pm$ 1.73

Based on Table 1, the sample is 60 to 74 years old, with a mean age of 66.8 years. The average cognitive function score of the sample is 26.52.

Table 2. Frequency Based on BMI Categories

Variable	Frequency (n=60)	Percentage (%)
BMI (mean $\pm$ SD)	22.84 $\pm$ 4.67	
Low BMI	14	23.3%
Normal BMI	19	31.7%
High BMI	27	45%

Table 2 shows that the research sample includes 14 individuals (23.3%) categorized as having low BMI, 19 individuals (31.7%) with normal BMI, and 27 individuals (45%) with high BMI, with an average BMI of 22.84 and a standard deviation of 4.67. This indicates that the proportion of elderly individuals with high BMI is relatively high compared to those with low and normal BMI.

Table 3. Frequency Based on Daily Activity Levels

Variable	Frequency (n=60)	Percentage (%)
Daily Activities (mean $\pm$ SD)	97.58 $\pm$ 3.50	
Independent	38	63.3%
Dependent	22	36.7%

Table 3 indicates that the sample consists of 38 individuals (63.3%) categorized as independent and 22 (36.7%) categorized as dependent, with an average daily activity score of 97.58 and a standard deviation of 3.50. This suggests that more elderly individuals are independent in their daily activities than those who are dependent.

Table 4. Chi-Square Test

Variable	Daily Activities		Chi-Square Value	p-value
	Independent	Dependent		
Low BMI	10 (71.4%)	4 (28.6%)	8.110	0.017
Normal BMI	16 (84.2%)	3 (15.8%)		
High BMI	12 (44.4%)	15 (55.6%)		

Based on Table 4, the proportion of independent older women is highest among those with normal BMI (84.2%). The chi-square analysis revealed a correlation between BMI and daily activities among older women in Mambal Village, Badung, with a p-value of 0.017 ($p < 0.05$), indicating a significant relationship between BMI and the level of independence in daily activities.

Table 5. Spearman Rho Correlation Test

Correlation Variable	Correlation	Significance
BMI	0.292	0.024
Daily Activities		

The chi-square analysis showed a relationship between BMI and daily activities among older women in Mambal Village; however, the direction and strength of this relationship remain unclear, necessitating additional analysis using Spearman's rho. Table 5 indicates that the relationship between BMI and independence in daily activities is significant, with a p-value of 0.024 ($p < 0.05$) and a correlation coefficient (r) of 0.292, which is positive. This means the two variables have a low level of correlation and are directly proportional. A direct relationship suggests that as BMI increases, the level of independence in daily activities may also increase, and vice versa. The low correlation indicates that other factors may also influence the level of autonomy.

Discussion

Characteristics of Research Subjects

The research conducted in Mambal Village yielded results on the Body Mass Index (BMI) of older women, their level of independence, and the relationship between BMI and independence among older women. This was obtained from a sample of 60 subjects aged 60 to 74 years, with an average age of 66.8 years. Based on the BMI measurements of elderly individuals in Mambal Village, 14 subjects (23.3%) had low BMI, 19 subjects (31.7%) had normal BMI, and 27 subjects (45%) had high BMI. This indicates that the older women studied in Mambal Village have excess BMI, aligning with the research by Andriyani et al. in 2022 regarding BMI and WC/HC (waist-to-hip ratio) among older women in South Tangerang, which found that the average BMI of older women was 25.13, categorizing them as having excess BMI.¹⁵ Research conducted by Nuhidayah and Puspitosari in 2023 showed similar results, where 28 out of 43 older women had excess BMI.¹⁶ Generally, elderly individuals experience various physiological changes that can trigger degenerative changes in the sensory organs, such as the eyes, nose, ears, taste nerves on the tongue, and skin. Additionally, older people often experience a decline in cardiovascular and musculoskeletal function. Changes in musculoskeletal function are partly caused by reduced physical activity, which is a contributing factor to excess BMI.¹⁷

Based on the results of the independence measurement in performing daily activities among older women in Mambal Village, 38 older women were categorized as independent (63.3%). In comparison, 22 older women fell into the dependent category (36.7%). This indicates that most older women in Mambal Village are categorized as independent in their daily activities. Research conducted by Wildhan et al. in 2022 showed similar findings, with 53 elderly individuals (66.3%) out of 80 respondents being independent in their daily activities.¹⁸ The results of this study are also consistent with research by Ayuningtyas et al. in 2020, which found that most elderly individuals perform their daily activities independently, while only a small number require assistance in carrying out their daily tasks.¹⁹

Relationship Between Body Mass Index and Level of Independence

Based on the results of the chi-square test (Table 4), a p-value of 0.017 ($p < 0.05$) was found, indicating a connection between BMI and the level of independence among older people. This was followed by a Spearman rho correlation analysis (Table 5), which yielded a p-value of 0.024 and a positive correlation coefficient (r) of 0.292, suggesting a weak relationship between the two variables. In other words, as BMI increases, the level of independence in daily activities among older people also tends to improve, and vice versa. However, other factors may also influence the level of autonomy.

The findings of this study are supported by previous research. Susanto et al. (2024) found that an increase in BMI has a protective effect on daily activities, with a sample of 167 respondents in Lamongan Regency yielding a correlation coefficient of 0.167 and $p < 0.05$.²⁰ Similar results were obtained by Samuel et al. (2021), where a higher BMI was associated with better ability to perform daily activities, achieving a correlation coefficient of 0.64 with a p-value

of < 0.05 , indicating a very high level of significance.²¹ Furthermore, Borda et al. (2021) stated that a BMI categorized as underweight negatively affects the level of independence in daily activities among older people, with a p-value of 0.049 from their study.⁹

Many factors influence BMI in older people. Elderly individuals with low BMI are associated with gender, where men are less likely to experience underweight compared to women. Elderly individuals living in urban areas, those married, and those with good sleep quality are also less likely to be malnourished.²² Nutritional intake, such as insufficient polyunsaturated n-6 fats, also contributes to underweight.²³ Economic status and education level also affect individuals who are malnourished, as they influence knowledge and behavior regarding health and nutrition fulfillment.²⁴

Conversely, elderly individuals with high BMI are associated with gender, as older women are more likely to experience obesity. This aligns with the findings of this study, where older women in Mambal Village tend to have high BMI. Elderly individuals with higher economic status, non-smokers, and non-drinkers also tend to have higher BMI.²² A sedentary lifestyle or lack of physical activity, as well as a genetic predisposition to higher BMI, are also risk factors for elderly individuals having high BMI.²⁵

In this study, it was found that elderly individuals with high BMI have better levels of independence. This can be explained by the association between low BMI in older adults and the incidence of malnutrition and cognitive impairment, which are risk factors for frailty and dementia. Frailty is associated with the occurrence of sarcopenia, a condition characterized by loss of muscle mass.²⁶ Decreased muscle mass leads to characteristics such as weakened grip strength and slower walking speed, resulting in lower physical activity levels.²⁷ Malnutrition also affects cognitive function, which is crucial in daily activities. Older women with low BMI have a higher risk of experiencing cognitive impairment, mainly due to decreased estrogen levels post-menopause. Estrogen has a protective role in brain areas related to cognitive function, such as the cerebral cortex and hippocampus. Nutritional deficiencies can also accelerate neurodegeneration; for example, low levels of vitamin B increase homocysteine, contributing to neuronal damage.^{28,29}

On the other hand, a high BMI in elderly individuals indicates better muscle mass, as BMI and muscle mass represent body composition. This means that elderly individuals with higher BMI have a lower chance of experiencing sarcopenia, suggesting a negative relationship between BMI and muscle mass concerning sarcopenia in older people.³⁰ Based on this, low BMI in older people is associated with a higher likelihood of dependence in performing daily activities, which aligns with the findings of this study, where elderly individuals with low BMI had lower daily activity scores. Those with low levels of independence are likely to become dependent on their families, affecting their quality of life. This dependence arises from several factors, including decreased mobility, cognitive function, and health status.¹⁸ Although high BMI correlates positively with increased independence, it is essential to note that high BMI also increases the risk of stroke.³¹ High BMI contributes to the development of atherosclerosis, increased blood pressure, and damage to endothelial function, all of which are involved in the occurrence of stroke, particularly ischemic stroke.³² Furthermore, high BMI can increase the risk of diseases such as hypertension, diabetes, and heart disease, all of which are classified as chronic conditions.³³

Based on the assessment of the independence of elderly individuals in performing daily activities, those with dependence predominantly struggle to control urination and require assistance when ascending or descending stairs. The impairment of urination control in older women can occur due to several age-related factors, such as decreased cognitive function, weakened pelvic floor muscles, and increased intra-abdominal pressure.³⁴ Meanwhile, the limitations experienced by elderly individuals when climbing or descending stairs are also related to aging, mainly due to decreased musculoskeletal function. Elderly individuals experience muscle mass, bone density, and joint function reductions.³⁵ Several factors, including hormonal changes, decreased physical activity, and inadequate nutrition, cause muscle mass decline. The decrease in bone density occurs due to hormonal changes, especially in older women who have undergone menopause, which can lead to osteoporosis. Joint function decline results from cartilage degradation, ligament and tendon flexibility changes, and synovial fluid alterations related to joint function.^{35,36}

Although the results of this study indicate a weak correlation, this finding is still significant as it demonstrates a trend that even a slight increase in BMI can positively impact the independence of elderly individuals. This weak relationship may also reflect the complexity of other factors influencing elderly autonomy, suggesting that BMI is not the sole determinant but remains a significant factor in the overall context.

Several other factors can influence the independence of older people, including family support, economic status, education level, and comorbidities. Family support plays a crucial role in helping elderly individuals complete daily activities. This support includes providing information about healthy lifestyles and nutrition and instrumental assistance, such as managing daily needs and providing meals.³⁷ Socioeconomic status affects daily activities, with individuals in higher economic brackets having more resources to maintain health. In comparison, those in lower economic brackets tend to experience declines in functionality in daily activities.³⁸ Individuals with higher education levels are more likely to have better access to healthcare resources, less physically demanding jobs, and recreational opportunities that support daily independence and health as they age.³⁹ Meanwhile, elderly individuals with chronic illnesses tend to have physical limitations, reduced endurance, and mobility difficulties, necessitating family assistance in daily activities.⁴⁰

Considering evidence from previous research and the findings of this study, elderly individuals should strive to maintain their BMI within a normal range. While this study found that having a higher BMI can improve daily activity scores, it is essential to note that excessive BMI, classified as obesity, also negatively impacts health. It is recommended that the BMI of the elderly remain within the normal range of 18.5 – 22.9 kg/m², as those with a BMI below or above this range are at higher risk of functional capacity decline, gait and balance issues, fall risk, decreased muscle strength, and malnutrition.⁴¹ Therefore, it is vital for elderly individuals to maintain a normal BMI to enhance their independence and quality of life.

This study has several limitations that need to be considered, including sampling techniques, the research population, low correlation strength, BMI measurements, and respondent bias. The study utilized purposive sampling, which carries a risk of affecting the generalizability of the results since the sample was determined based on specific criteria. As a result, the findings may not fully reflect the conditions of a broader population. The research population in this study consisted solely of elderly individuals from Mambal Village, making the findings less representative of a wider demographic.

Regarding correlation strength, the statistical analysis revealed a low correlation between BMI and independence levels ($r=0.292$), indicating that the relationship between these variables may be influenced by other factors not analyzed in this study, such as family support, economic status, education level, and comorbidities. In terms of BMI measurement, while BMI serves as an indicator of body composition, it has limitations because it cannot distinguish between muscle mass and body fat. Therefore, using BMI as the sole indicator may not accurately represent overall body condition. Respondent bias is another limitation, as the measurement of independence (daily activities) was based on subjective reports from respondents. This can lead to overestimation or underestimation of their abilities to perform daily activities. Such bias may affect the accuracy of the data related to independence levels.

Based on the results of this study, BMI plays an essential role in supporting the independence of elderly individuals in performing daily activities. Therefore, healthcare professionals, such as doctors, physiotherapists, and nutritionists, should pay closer attention to managing the BMI of elderly patients during routine examinations. Professionals must encourage elderly individuals to maintain their BMI within a normal range through healthy eating and appropriate physical activity programs tailored to their physical conditions. Intervention programs that combine proper dietary practices with increased physical activity can help elderly individuals maintain their independence in daily activities. Additionally, family support is vital in ensuring that elderly individuals lead a healthy lifestyle and meet their daily needs.

Conclusion

There is a relationship between body mass index (BMI) and the level of independence in performing daily activities among older women in Mambal Village, with a low and positive correlation. Although this relationship is weak, an increase in BMI may contribute to enhanced independence in elderly individuals. Healthcare professionals should focus on nutrition and physical activity interventions to ensure that the BMI of elderly individuals remains within the normal range, supporting their independence in daily activities. Future research is recommended to consider other factors, such as family support, economic status, education level, and comorbidities.

Author Contribution

Ida Ayu Diah Jenaki: Conceptualization, methodology, data collection, data analysis, and manuscript drafting.

Putu Ayu Sita Saraswati: Supervision, guidance on research design, and critical review of the manuscript.

Luh Putu Ratna Sundari: Supervision, validation, and manuscript editing.

Govinda Vittala: Supervision, methodological consultation, and final manuscript review.

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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 was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Research Ethics Committee of the Faculty of Medicine, Universitas Udayana (Approval No. 0191/UN14.2.2.VII.14/LT/2024). All participants provided informed consent prior to data collection.

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