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Associations Between Body Mass Index and Key Health Indicators in Elderly Populations: A Case Study

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ABSTRACT

Objective: This study examined the associations between Body Mass Index (BMI) and key health indicators, including waist circumference, blood pressure, random blood sugar, and uric acid levels, in an elderly community setting.

Methods and Materials: A cross-sectional design was employed, involving 31 participants (mean age: 66.81 ± 2.83 years) selected through purposive sampling.

Findings: Spearman's Rho correlation analysis revealed significant associations between BMI and waist circumference ($r = 0.653$, $p < 0.001$), blood pressure ($r = 0.616$, $p < 0.001$), and uric acid levels ($r = 0.731$, $p < 0.001$). A moderate positive correlation was also observed between BMI and random blood sugar ($r = 0.538$, $p = 0.002$). However, multiple regression analysis demonstrated that BMI significantly predicted waist circumference ($B = 0.400$, $p = 0.006$), blood pressure ($B = 0.274$, $p = 0.008$), and uric acid levels ($B = 0.490$, $p = 0.002$). In contrast, its effect on random blood sugar was not statistically significant ($B = 0.068$, $p = 0.630$).

Conclusion: The findings suggest that BMI is a critical predictor of waist circumference, blood pressure, and uric acid levels, underscoring its importance in managing metabolic and cardiovascular health risks in elderly populations. It is hoped that this study will provide practical implications for mitigating larger health risks by integrating tailored physical activity programs, dietary modifications, and routine health monitoring to address obesity-related complications in older adults.

Keywords: BMI, waist circumference, blood pressure, elderly.

Introduction

Aging is a natural process that affects all individuals, resulting in changes in various bodily systems as we age. In 2015, the World Health Organization (WHO), a United Nations affiliate, updated its classification of age groups across various life stages. According to this classification, individuals aged 60–75 years are categorized as elderly (Akhmet, 2017). Aging brings about changes in multiple aspects, including psychology, cognitive function, physiology, and mental health, in elderly populations (Kwak et al., 2018; Mitina et al., 2020). According to

Leyane, Jere, and Houreld (2022) and Sinclair & Abdelhafiz (2020), aging is linked to chronic inflammation and oxidative stress, both of which increase the risk of diseases that are leading causes of mortality.

Currently, cardiovascular diseases (CVDs) are the leading cause of death worldwide (Di Cesare et al., 2024). Aging, as an irreversible physiological process, results in the gradual deterioration of tissue and cellular functions, thereby increasing vulnerability to age-related diseases, including various heart and cardiovascular conditions, as well as metabolic disorders (Zhang et al., 2023). Moreover, obesity and type 2 diabetes have become significant metabolic conditions that pose global public health challenges as populations age (Cesare et al., 2024). Simply put, older adults are a direct outcome of the aging process, a demographic particularly prone to chronic and degenerative diseases due to biological aging, which has the potential to reduce their overall quality of life and well-being.

While the terms "frailty" and "aging" are often associated with older people, the reality is that the pace of aging and levels of frailty vary significantly among older adults due to differences in genetics, lifestyle, and overall health. This variability creates unique health challenges within this population (Ferrucci & Kuchel, 2021). Meanwhile, efforts to prevent leading causes of death often involve early detection using Body Mass Index (BMI) as a health indicator. BMI is a widely used measure to evaluate an individual's health status based on weight relative to height (Khanna et al., 2022). Although BMI is a convenient and general indicator of potential health risks, it has notable limitations, especially in elderly populations (Wu et al., 2024). A primary limitation is its inability to differentiate between muscle mass and fat mass, a distinction that becomes increasingly important with age, given the heterogeneity of the elderly population. Consequently, relying solely on BMI may overlook critical insights into the health status of older adults. To address these limitations, additional health indicators, such as waist circumference, blood pressure, random blood sugar, and uric acid levels, must be included to provide a more comprehensive understanding of metabolic and cardiovascular risks (World Health Organization, 2011).

Nevertheless, BMI remains a valuable predictor of health. In healthy adult populations, it is well established that an increase in BMI often correlates with an increase in waist circumference, an indicator of abdominal obesity. This increase also heightens the risk of hypertension. Furthermore, high BMI is linked to elevated blood sugar levels, which can progress to type 2 diabetes. Additionally, individuals with a high BMI are at greater risk of developing elevated uric acid levels, which can lead to gout. However, to the best of the author's knowledge, studies examining the combined impact of BMI on multiple health indicators in elderly populations remain limited.

Key health indicators, such as waist circumference, are vital parameters for assessing visceral fat accumulation (Després et al., 2008), a type of fat stored around internal organs. High levels of visceral fat are strongly associated with an increased risk of metabolic syndrome and cardiovascular diseases. This excess fat can also trigger insulin resistance, thereby increasing the risk of type 2 diabetes and other metabolic disorders (Hardy et al., 2012). Additionally, high blood pressure, or hypertension, is a significant risk factor for cardiovascular disease, the leading cause of death among the elderly. Research by Rismayanthi (2024) indicates that obesity, characterized by an elevated BMI, is often associated with increased blood pressure, further elevating the risk of cardiovascular complications (Rismayanthi, 2024).

In addition to waist circumference and blood pressure, elevated random blood sugar levels are a critical indicator of impaired glucose tolerance (Kesavadev et al., 2021). Left untreated, this condition can progress into diabetes mellitus. Furthermore, uric acid is used as a health indicator in the elderly because of its role as a risk marker for metabolic and cardiovascular diseases, gout, kidney disorders, and its association with systemic inflammation. Therefore, random blood sugar and uric acid levels offer essential insights into metabolic and renal health, respectively.

Measuring these key health indicators is a critical step in supplementing BMI assessments. Early detection of changes in these indicators provides a more comprehensive picture of elderly health, which can ultimately improve quality of life and well-being in this population. This study, conducted among members of the Elderly Association, investigated the combined influence of BMI on multiple health indicators in elderly populations, including waist circumference, blood pressure, random blood sugar, and uric acid levels. The study hypothesizes that increased BMI will correlate positively with waist circumference, blood pressure, and uric acid levels, while its influence on random blood sugar may vary. The findings aim to provide a deeper understanding of the interaction between BMI and other health factors in the elderly, serving as a foundation for developing more effective health interventions and as a basis for further research.

Methods and Materials

Study Design and Participants

This study is a quantitative research using a cross-sectional study design with observational methods. According to Kesmodel (2018), the cross-sectional study design is employed to help researchers determine the prevalence of a disease or phenomenon observed from a research sample at a specific point in time. In this case, the focus of the study aims to observe how key health indicators (independent variables), such as waist circumference, blood pressure, random blood sugar, and uric acid levels, are associated with BMI (dependent variable) and how these key health indicators simultaneously influence BMI in an elderly population. Informed consent was obtained from all participants before data collection, ensuring they understood the study's objectives, procedures, and potential risks and benefits.

This study was conducted in an urban area, specifically within an elderly community known as the Elderly Association, which provides health education programs and opportunities for social participation for its members. Since the elderly population is highly heterogeneous (citation here), the sample for this study was selected using purposive sampling based on the following inclusion criteria: 1) individuals aged 60 years or older, or within the elderly age range defined by WHO; 2) a minimum educational attainment of senior high school or its equivalent; 3) no medical conditions or current medication use that could influence measurement results; 4) willingness and physical and mental ability to participate in health tests; and 5) agreement to share research data by signing the consent form voluntarily without coercion.

Out of a total of 53 elderly individuals (24 men and 29 women) registered in the Elderly Association, 22 participants (9 men and 13 women) were excluded for not meeting the inclusion criteria, with the following details: 2 had mobility limitations and could not participate in health tests, six refused to provide blood samples, one was on medication, 4 had severe medical histories (e.g., stroke, coronary heart disease), 3 were over 80 years old, and six declined to sign the consent form. Consequently, the study population consisted of 31 members of the Elderly Association, aged 60-77 years (15 men and 16 women). The sample size in this study was relatively small due to the availability of participants within a single specific community.

Table 1

General characteristics of the research sample

N		Age (year)	Weight (kg)	Height (cm)	BMI (kg/m^2)	Waist circumference (cm)	Blood pressure (mmHg)		Random Blood sugar (mg/dL)	Uric acid (mg/dL)
							Systolic	Diastolic		
Total	31	66.81±2.83	59.63±11.80	156.71 ± 8.22	24.17±3.76	97.71±12.96	145.94±14.77	92.26±12.44	183.35±87.89	6.74±1.82
Female	16	66.06±2.24	55.65±10.10	150.81±3.60	24.38±3.88	99.06±13.22	144.81±10.40	87.69±7.96	164.25±6383	6.35±2.07
Male	15	67.60±3.25	63.88±12.30	163±6.99	23.95±3.76	96.27±12.98	147.13±18.67	97.13±14.63	203.73±106.43	7.38±1.16

Data Measurement

Several measurements were taken to assess health metrics. Body Mass Index (BMI) was calculated using the standard formula: body weight in kilograms divided by the square of height in meters (Nuttall, 2015). Height was measured using a stadiometer, while body weight was measured using a digital scale. The calculated BMI was then classified according to the BMI category criteria for the Indonesian population set by the Kementerian Kesehatan RI (2024) as follows: 1) severely underweight (BMI <17), 2) mildly underweight (BMI 17.0–18.4), 3)

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normal (BMI 18.5–25.0), 4) overweight (BMI 25.1–27.0), and 5) obese (BMI >27.0).

Waist circumference was measured using a measuring tape placed at the midpoint between the lowest rib and the top of the iliac crest, following the World Health Organization (2011). The measured waist circumference was classified according to the WHO cut-off recommendations: 1) Low Risk (men = <94 cm; women = <80 cm), 2) Increased Risk (men = 95–102 cm; women = 80–88 cm), and 3) Substantially Increased Risk (men = >102 cm; women = >88 cm).

Blood pressure was measured using a digital blood pressure monitor, specifically the Omron HEM-7130 model. Blood pressure was classified based on the reference by Skeete et al. (2018): 1) normal (<120/80 mmHg), 2) elevated (120–129/<80 mmHg), 3) high stage 1 (130–139/80–89 mmHg), and 4) high stage 2 (>140/>90 mmHg).

Random blood sugar and uric acid levels were measured using a portable glucometer, specifically the Easytouch GCU 3-in-1 (ISO EN 15197:2013). Both tests were conducted by taking capillary blood samples and using a rapid test tool. Random blood sugar measurements were classified according to the American Diabetes Association (2012) as follows: 1) normal (79–140 mg/dL), 2) prediabetes (140–200 mg/dL), and 3) higher risk of diabetes (>200 mg/dL). Furthermore, uric acid levels were classified as normal within the range of 1.5–6 mg/dL for women or 2.5–7 mg/dL for men (M. Jin et al., 2012).

Data Analysis

The collected data were analyzed using a combination of descriptive statistics, Spearman's rho correlation test, and simple regression analysis. Descriptive statistics provided a general overview of the data.

Spearman's rho correlation test, which measures the strength and direction of the relationship between ordinal variables, was used to assess the correlation between variables. Spearman's Rho correlation was chosen because the data did not meet the assumptions of normality. Therefore, a non-parametric approach was deemed appropriate. The correlation coefficient (rho) was interpreted based on Hinkle (Hinkle, 2003), with values ranging from 0.90 to 1.00 (or -0.90 to -1.00) indicating a very high positive (negative) relationship, 0.70 to 0.90 (or -0.70 to -0.90) indicating a high positive (negative) relationship, 0.50 to 0.70 (or -0.50 to -0.70) indicating a moderate positive (negative) relationship, 0.30 to 0.50 (or -0.30 to -0.50) indicating a low positive (negative) relationship, and 0.00 to 0.30 (or -0.00 to -0.30) indicating a very small or negligible relationship. A correlation was considered significant if the p-value was less than 0.05, indicating that the relationship was not due to chance. Finally, regression analysis was employed to determine the magnitude of the influence of independent variables on the dependent variable.

Findings and Results

This study, conducted with 31 elderly participants from an elderly association, aimed to investigate the relationship between Body Mass Index (BMI) and several health variables, including waist circumference, blood pressure, random blood sugar levels, and uric acid levels. Specifically, the study sought to determine both the presence of a relationship between BMI and these variables and the extent to which BMI influences each of them.

The results presented in Table 2 show the frequency distribution of BMI categories (slim, normal, and overweight) by waist circumference, categorized by gender. The table reveals a clear trend: participants with a normal BMI tend to have a normal waist circumference, regardless of gender. Among the 17 participants with a normal BMI, 13 (76%) had a normal waist circumference, indicating a strong alignment between normal BMI and healthy central fat distribution. On the other hand, the group categorized as overweight shows a concerning pattern. Of the 12 participants classified as overweight, 8 (67%) exhibited an abnormal waist circumference, particularly among women (7 out of 10 participants). This underscores the potential gender differences in fat distribution, as women appear more likely to develop central obesity with increasing BMI. These findings suggest that as BMI increases, so does the risk of abnormal waist circumference, which is a key indicator of central obesity. Given the established links between central obesity and metabolic disorders, this trend highlights the importance of managing BMI to prevent risks associated with abnormal fat distribution in elderly populations.

Table 2

Results of the Frequency Distribution of BMI and Waist Circumference

Gender			BMI			Total
			Slim	Normal	Overweight	
Male	Waist Circumference	Normal	1	7	0	8
		Not Normal	1	1	5	7
	Total		2	8	5	15
Female	Waist Circumference	Normal		6	0	6
		Not Normal		3	7	10
	Total			9	7	16
Total	Waist Circumference	Normal	1	13	0	14
		Not Normal	1	4	12	17
	Total		2	17	12	31

According to Table 3, the data reinforce the connection between higher BMI and elevated blood pressure severity, particularly among those with an overweight BMI who are more likely to experience advanced stages of hypertension. Managing BMI effectively could serve as a critical component in reducing the progression of hypertension and lowering cardiovascular risks, especially in elderly populations where these conditions are prevalent.

The data highlights a noteworthy pattern: participants with an overweight BMI are predominantly represented in the High Stage 2 blood pressure category (11 out of 12 participants, 92%). This observation suggests that as BMI increases, the likelihood of developing more severe hypertension becomes more pronounced. Among those with a normal BMI, blood pressure levels are distributed across categories, with a substantial proportion falling into High Stage 1 (8 participants, 47%) and High Stage 2 (7 participants, 41%). In contrast, individuals classified as slim primarily exhibited Elevated blood pressure (2 out of 2 participants, 100%), hinting at the potential role of other factors, such as genetics or lifestyle habits, in influencing blood pressure within this group.

Table 3

Results of the Frequency Distribution of BMI and Blood Pressure

		BMI			Total
		Slim	Normal	Overweight	
Blood Pressure	Elevated	2	2	0	4
	High Stage 1	0	8	1	9
	High Stage 2	0	7	11	18
Total		2	17	12	31

The frequency distribution in Table 4 provides insight into the relationship between BMI and random blood sugar levels. Most respondents with a normal BMI also exhibited normal random blood sugar levels, with 14 out of 17 individuals (82%) in this category having blood sugar within the normal range. In contrast, those classified as overweight showed a different trend, with the majority (10 out of 12 individuals, 83%) having abnormal random blood sugar levels. This suggests a possible connection between higher BMI and impaired blood sugar regulation.

Interestingly, participants with a slim BMI displayed an equal distribution between normal and abnormal random blood sugar levels, indicating that factors other than BMI may influence blood sugar levels in this group. These findings suggest that as BMI increases, there may be an elevated risk of abnormal blood sugar levels, potentially driven by mechanisms such as insulin resistance and metabolic dysregulation, which are often associated with higher BMI categories.

Table 4

Results of the Frequency Distribution of BMI and Random Blood Sugar

		BMI			Total
		Slim	Normal	Overweight	
Random Blood Sugar	Normal	1	14	2	17
	Not Normal	1	3	10	14
Total		2	17	12	31

The frequency distribution in Table 5 provides a clear picture of the association between BMI and uric acid levels across gender categories. Among participants with a normal BMI, the majority (12 out of 17 individuals, 71%) had normal uric acid levels, regardless of gender. This aligns with the expectation that individuals with a normal BMI are less likely to exhibit metabolic disturbances.

However, among participants classified as overweight, a different trend emerges. The majority of this group (10 out of 12 individuals, 83%), particularly women, had abnormal uric acid levels, suggesting a heightened vulnerability to hyperuricemia as BMI increases. Notably, all respondents with a slim BMI had normal uric acid levels, further supporting the idea that lower BMI is associated with reduced risk of metabolic complications.

Table 5

Results of the Frequency Distribution of BMI and Uric Acid

Gender			BMI			Total
			Slim	Normal	Overweight	
Male	Uric Acid	Normal	2	5	0	7
		Not Normal	0	3	5	8
	Total		2	8	5	15
Female	Uric Acid	Normal		7	0	7
		Not Normal		2	7	9
	Total			9	7	16
Total	Uric Acid	Normal	2	12	0	14
		Not Normal	0	5	12	17
	Total		2	17	12	31

To further strengthen the findings of the frequency distribution analysis of BMI against waist circumference, blood pressure, random blood sugar, and uric acid levels, the results of the correlation analysis are presented in Table 6.

Table 6

Correlation analysis results

Variables	N	rho value (ρ)	p-value	Meanings
Waist circumference	31	.653	< 0.001	Moderate positive relationship
Blood pressure	31	.618	< 0.001	Moderate positive relationship
Random blood sugar	31	.538	0.002	Moderate positive relationship
Uric acid	31	.731	< 0.001	High positive relationship

From the results presented in Table 6, it can be concluded that BMI is significantly associated with waist circumference ($\rho = 0.653$, $p < 0.001$), blood pressure ($\rho = 0.618$, $p < 0.001$), and uric acid levels ($\rho = 0.731$, $p < 0.001$), as all these p-values are below the standard significance threshold of $p < 0.05$. BMI also shows a significant association with random blood sugar ($\rho = 0.538$, $p = 0.002$), meeting the same threshold.

Following the correlation analysis, a multiple regression analysis was conducted to assess the simultaneous influence of BMI on waist circumference, blood pressure, random blood sugar, and uric acid levels.

This analysis aimed to determine which variables are most influenced by BMI and to provide insight into the practical implications of these associations.

Table 7

Results of multiple regression analysis

Variable	Regression Coefficient (B)	Std. Error	Nilai t	p-value
Waist circumference	.400	.310	-.321	.006
Blood pressure	.274	.134	2.989	.008
Random blood sugar	.068	.096	2.864	.630
Uric acid	.490	.139	.487	.002
R-square	.745			
Adjusted R-square	.706			

The multiple regression analysis results, as presented in Table 7, indicate that BMI has a significant influence on waist circumference (B = 0.400, p = 0.006), blood pressure (B = 0.274, p = 0.008), and uric acid levels (B = 0.490, p = 0.002). For example, the regression coefficient for waist circumference suggests that for every one-unit increase in BMI, there is an approximate 0.4-unit increase in waist circumference. Similarly, a one-unit increase in BMI corresponds to a 0.27-unit increase in blood pressure and a 0.49-unit increase in uric acid levels. These findings highlight the critical role of BMI in influencing these health variables and underscore its potential impact on metabolic and cardiovascular risks in elderly populations. In contrast, the coefficient for random blood sugar (B = 0.068, p = 0.630) was not statistically significant, indicating that factors beyond BMI, such as insulin resistance and dietary patterns, which will be further discussed in the discussion section.

The regression model demonstrates a strong explanatory power, with an R-square value of 0.745, indicating that 74.5% of the variability in BMI can be explained by the included predictors: waist circumference, blood pressure, random blood sugar, and uric acid levels. The adjusted R-squared value of 0.706 confirms that the model retains its robustness after adjusting for the number of predictors, explaining 70.6% of the variance. These values indicate that the model is well-suited to the data and accurately captures the primary factors influencing BMI within this population.

Discussion and Conclusion

This study identified significant associations between BMI and key health indicators: waist circumference, blood pressure, random blood sugar, and uric acid levels. BMI demonstrated a moderate positive association with waist circumference (r = 0.653, p < 0.001), blood pressure (r = 0.616, p < 0.001), and random blood sugar (r = 0.538, p = 0.002), and a strong positive association with uric acid levels (r = 0.731, p < 0.001). These findings indicate that BMI is a strong predictor of uric acid levels, while its associations with other variables are moderately optimistic. Multiple regression analysis revealed that waist circumference (b = 0.400, p = 0.006), blood pressure (B = 0.274, p = 0.008), and uric acid levels (B = 0.490, p = 0.002) significantly contributed to the dependent variable (BMI), with uric acid emerging as the strongest predictor. In contrast, random blood sugar (B = 0.068, p = 0.630) did not significantly contribute to the model. This suggests that, while an association exists, other factors not examined in this study, such as dietary patterns, physical activity, and genetic predisposition, may play a more significant role in regulating blood sugar levels among elderly individuals (Genova et al., 2018).

The regression model also demonstrated an R^2 value of 0.745, indicating that these predictors explained 74.5% of the variability in BMI. However, the cross-sectional design of this study limits its ability to infer causal associations. In this regard, previous studies have consistently shown that BMI is strongly associated with metabolic disorders (Koziarska-Rościszewska et al., 2021; Xue et al., 2024) and an increased risk of cardiovascular disease (Khan et al., 2018; Yamamoto et al., 2024) in elderly populations. Therefore, the association between BMI and all key health indicators may stem from mechanisms arising from the interplay between metabolic and cardiovascular factors influenced by BMI.

Obesity in adults is primarily caused by an imbalance between energy intake and expenditure, leading to fat accumulation, particularly in the visceral region. Visceral fat is metabolically active, releasing pro-inflammatory adipokines such as TNF-α and IL-6, which promote chronic low-grade inflammation (Jin et al., 2023). This contributes to insulin resistance, dyslipidemia, and hypertension, collectively increasing the risk of cardiovascular diseases, including atherosclerosis, coronary artery disease, and stroke. Excess free fatty acids (FFAs) from adipose tissue further exacerbate dyslipidemia, characterized by elevated triglycerides and LDL cholesterol, and reduced HDL cholesterol (Bays et al., 2024).

Regardless of the mechanisms underlying how BMI influences metabolic and cardiovascular disorders, several previous studies support the findings of this research. A survey by Whelton (2018) identified a link between BMI and blood pressure, finding that individuals with higher BMIs tend to have higher blood pressure (Whelton et al., 2018). Zeng et al. (2021) and Gupta et al. (2024) found that increasing BMI is significantly associated with greater waist circumference, a key indicator of metabolic syndrome risk (Gupta et al., 2024; Zeng et al., 2021). The associations with waist circumference and blood pressure highlight BMI's potential contribution to the development of hypertension and central obesity.

As previously explained, excess adiposity, particularly in the visceral region, contributes to increased sympathetic nervous system activity and activation of the renin-angiotensin-aldosterone system, mechanisms that elevate blood pressure (Shariq & McKenzie, 2020). Central obesity, characterized by increased waist circumference, further exacerbates these risks and serves as a key component of metabolic syndrome, a cluster of conditions that significantly increase the risk of cardiovascular diseases and diabetes. A study by Choi found a strong correlation between higher BMI and elevated uric acid levels, considerably increasing the risk of gout (Roddy & Choi, 2014). The strong positive relationship between BMI and uric acid levels highlights the crucial role of obesity management in preventing hyperuricemia, a recognized risk factor for gout and chronic kidney disease.

These findings underscore the importance of managing BMI in older adults to mitigate the risks of metabolic and cardiovascular diseases. Effective BMI management not only reduces these risks but also enhances physical function (Anton et al., 2011), improves quality of life (Gill et al., 2015; Messier et al., 2013), and alleviates the healthcare burden associated with obesity-related chronic conditions (Reinbacher et al., 2023). Public health strategies that integrate regular physical activity, dietary modifications, and health education for older adults and their caregivers can amplify these benefits. These strategies also promote adherence to lifestyle changes and consistent health monitoring, thereby comprehensively addressing the interconnected risks of an elevated BMI.

Healthcare providers can incorporate BMI monitoring and waist circumference measurements into routine check-ups at community clinics or home health visits. Training programs for caregivers on using simple tools, such as measuring tapes for waist circumference or portable devices for uric acid monitoring, can further enhance the accessibility of these interventions. Waist circumference, as a cost-effective and accessible marker of central obesity, helps identify individuals at risk of metabolic syndrome and cardiovascular complications (Ross et al., 2020). Similarly, regular screening of uric acid levels helps detect hyperuricemia early, potentially preventing gout and renal complications (Tseng et al., 2019). Together, these measures provide a comprehensive and multidimensional approach to enhancing health outcomes in aging populations. In addition to monitoring, physical activity tailored to individual abilities plays a critical role in maintaining a healthy BMI and managing associated health risks (McPhee et al., 2016). Research has shown that physical activity can help control weight (Sui et al., 2017), lower blood pressure (Kazeminia et al., 2020), and boost metabolism, contributing to the management of uric acid and blood sugar levels. Engaging in low-impact activities, such as walking, yoga, or resistance training, provides a safe and effective way for older adults to maintain their overall health and well-being.

The World Health Organization (WHO) (2010) recommends 150–300 minutes of moderate-intensity aerobic physical activity per week for adults, including older adults, to maintain cardiovascular health and reduce the risk of chronic diseases (Bull et al., 2020; World Health Organization, 2011). If the activity intensity increases to high intensity, the recommended time can be reduced to 75–150 minutes per week. Additionally, the American College of Sports Medicine (ACSM) advises muscle-strengthening activities at least twice a week with moderate intensity (Liguori & Medicine, 2020). Given that older adults are more prone to sarcopenia, cardiovascular diseases, and metabolic disorders, combining aerobic and muscle-strengthening exercises is essential for maintaining muscle health, bone strength, preventing metabolic syndrome, and supporting cardiovascular function. Community-based exercise programs tailored for older adults, such as group yoga sessions or walking clubs, can encourage participation and foster social engagement (Fien et al., 2022). Providing low-cost access to local gyms or virtual exercise sessions can make these recommendations more feasible and accessible.

To maximize the effectiveness of these interventions, providing education and support to older adults and their caregivers is crucial. As explained by Langhammer, Bergland, and Rydwik (2018), promoting exercise among the older population is a significant public health and clinical issue. Meanwhile, a key issue is how to encourage older individuals with comorbidities to participate in physical activity. Therefore, increasing awareness of the importance of physical activity and routine health assessments can enhance adherence to healthy lifestyle changes (Chafjiri et al., 2018; Uemura et al., 2021). Specific interventions should focus on lifestyle modifications tailored to the dietary habits of older adults, including promoting a balanced diet rich in fruits, vegetables, and proteins while reducing sodium and refined sugar intake (Juraschek et al., 2021; Putra et al., 2021; Robinson, 2018). These approaches not only improve metabolic and cardiovascular health but also address the broader challenges of managing obesity in aging populations.

While this study was conducted rigorously and provides valuable findings, several limitations must be acknowledged to contextualize its claims. First, the cross-sectional design restricts the ability to infer causal associations, allowing only the demonstration of associations between variables. While associations between BMI and health indicators were observed, it remains unclear whether changes in BMI directly influence these indicators or whether other unmeasured factors, such as diet, physical activity, or a history of chronic disease, play a role. Second, the relatively small and purposively selected sample, drawn from specific elderly groups, may not be representative of the broader population, which limits the generalizability of the findings and introduces potential selection bias. This lack of representativeness, combined with reduced statistical power, constrains the applicability of these results to a wider population.

This study emphasizes the significance of comprehensive health interventions for older adults, particularly those focusing on weight management, and their impact on health outcomes. It also encourages regular health screenings for all key health indicators, including waist circumference, blood pressure, random blood sugar, and uric acid levels. While the findings contribute significantly to understanding the role of BMI in older adult health, they also reveal a lack of a significant association between BMI and random blood sugar levels. To address these gaps, future longitudinal studies should explore the causal associations between BMI and key health indicators over time. Additionally, research involving larger and more diverse samples would enhance the generalizability of findings across different elderly populations. Further investigation into independent factors affecting random blood sugar levels—such as dietary habits, physical activity, and insulin sensitivity—could provide deeper insights into the metabolic health challenges faced by aging individuals.

In conclusion, this study highlights the significant associations between BMI and key health indicators, including waist circumference, blood pressure, and uric acid levels, with uric acid emerging as the strongest predictor. While the findings emphasize the critical role of BMI management in mitigating metabolic and cardiovascular risks in older adults, the lack of a significant association between BMI and random blood sugar suggests that additional factors, not examined in this study, may also be influencing the results. Practical interventions, such as regular monitoring of BMI and related indicators, tailored physical activity, and dietary adjustments, offer a multidimensional approach to addressing obesity-related complications. However, the limitations of the cross-sectional design and sample representation underscore the need for longitudinal research to explore these relationships further and improve the generalizability of the findings. Future studies should also investigate other determinants of random blood sugar levels to enhance the understanding of metabolic health in aging populations.

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Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Declaration of Helsinki, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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Authors' Contributions

All authors equally contributed to this study.

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