The Relationship of Body Mass Index and Physical Activity with Blood Pressure among Older Adults with Hypertension at Ciptomulyo Community Health Center Indonesia

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Abstract. Hypertension is a major health problem in the elderly, influenced by various factors, including Body Mass Index (BMI) and physical activity. Physiological changes that occur with age can increase the risk of hypertension, especially in elderly people with excess weight and low physical activity. This study aims to determine the relationship between BMI and physical activity on blood pressure in elderly people with hypertension at the Ciptomulyo Community Health Center in Malang City. This study used a cross-sectional design on 150 respondents selected by purposive sampling. BMI was measured through weight and height measurements, physical activity was measured using the Physical Activity Scale for Elderly (PASE) questionnaire, and blood pressure was measured using a sphygmomanometer. Data analysis was performed using the Spearman Rank correlation test. The results showed that the majority of hypertensive respondents had a BMI in the mild obesity category and physical activity in the moderate to high category. There was a significant relationship between physical activity and blood pressure (p value = 0.027, r = -0.180), and BMI showed a significant relationship with blood pressure (p value = 0.000, r = 0.300). It was concluded that physical activity and BMI play a significant associated with blood pressure in older adults with hypertension. Therefore, weight control and increased physical activity should be part of nursing interventions to control hypertension in older adults.

Keywords: Blood Pressure, Body Mass Index, Elderly, Hypertension, Physical Activity.

1 Introduction

Hypertension is clinically defined as elevated blood pressure, with a systolic score of ≥140 mmHg and a diastolic score of ≥90 mmHg [1]. This threshold is used because at this level, the risk of cardiovascular complications, namely stroke, heart failure, and

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chronic kidney disease, increases significantly. Hypertension is often known as the silent killer because it often has no symptoms, but it can have serious consequences if not detected and treated properly.

As they age, older adults experience degenerative physiological changes, such as decreased blood vessel elasticity, thickened artery walls due to collagen buildup, and decreased kidney and endocrine function. These conditions lead to increased peripheral resistance and decreased blood vessel elasticity, leading to a gradual increase in blood pressure in older adults. Therefore, older adults are a highly susceptible group to hypertension.

Epidemiological data shows that hypertension is one of the leading causes of death worldwide. According to the World Health Organization (WHO), the global prevalence of hypertension reaches 1.12 billion people, meaning 1 in 3 adults is diagnosed with hypertension. By 2025, the number of hypertension sufferers is expected to increase to 1.5 billion, with deaths reaching 9.4 million. In Indonesia, according to the 2018 Basic Health Research (Riskesdas) data, the prevalence of hypertension among the elderly is 45.6% (55-64 years), 58.9% (65-74 years), and 62.6% (>75 years) [2].

According to the 2018 Basic Health Research (Riskesdas) data, as reported by Astuti et al. (2021), high-risk factors for hypertension include smoking in 29.3% of cases, central obesity in 31%, general obesity in 21.8%, and physical inactivity in 35.5%. Compared to the findings of the 2013 Basic Health Research (Riskesdas), showed an increase of hypertension prevalence among elderly population [3]. Physiological changes that occur in the elderly, such as decreased blood vessel elasticity and changes in kidney function, increase the risk of hypertension. In the elderly, hypertension increases the workload of the heart, resulting in decreased oxygen supply to the tissues due to the reduced ability of the aortic wall to support and stretch the blood vessels.

In the elderly, physical activity tends to decline due to age, limited mobility, and other comorbidities, increasing the risk of hypertension. Research by Ningrum et al. (2023) showed that the majority of elderly people, 68 (70.8%), had a good level of physical activity. Approximately 68% of hypertensive patients exhibited light levels of physical activity [4].

Elderly people who are less physically active tend to tire more easily, which then triggers an increased heart rate. The greater the workload of the heart in pumping blood, the greater the pressure placed on the arteries, which can ultimately lead to increased blood pressure. If not properly managed, this condition can significantly reduce the quality of life in the elderly [5].

Previous studies have examined the relationship between BMI or physical activity and blood pressure separately. For example, research by Iswahyuni (2017) showed a link between physical activity and hypertension [6]. The more physically active a person is, the more normal their blood pressure is, and the less physically active they are, the higher their blood pressure is. Meanwhile, research by Praningsih et al. (2023) found that BMI and systolic ($p=0.170$) and diastolic ($p=0.603$) blood pressure were correlated with p values >0.05, indicating no relationship between BMI and either systolic or diastolic blood pressure [7].

Preliminary study data from the Ciptomulyo Community Health Center recorded 1,920 elderly people suffering from hypertension between January and August 2025. Data

from the Malang City Health Office shows that the Ciptomulyo Community Health Center is the area with the second highest number of cases of elderly people suffering from hypertension [8].
The ethical clearance was obtained from research ethic committee at Faculty Of Health Sciences, Brawijaya University with approval number 327/UN10.F17.10.4./TU/2025. Each participants were well informed and formally put their consent to participate. This study strictly complied with ethical principles of autonomy, confidentiality, beneficence, nonmaleficence, and justice.
The aim of this study is to determine the relationship between BMI and physical activity and blood pressure in elderly patients with hypertension at the Ciptomulyo Community Health Center.

2 Methods

This research is quantitative, with a correlational analytical research design using a cross-sectional approach.
The population of this study was 240 elderly people with hypertension in Ciptomulyo CHC. Therefore, to determine the sample size from this population, the Slovin technique was used with the following Slovin formula:

$$n = \frac{N}{1 + N(e)^2}$$

n = sample size / number of respondents
N = population size
e = degree of error / error used

Accordingly, the minimum number of samples will be obtained in this study is as follows:

$$n = \frac{240}{1 + 240(0.05)^2}$$
$$n = \frac{240}{1 + 0.6}$$
$$n = \frac{240}{1.6}$$
$$n = 150$$

Using purposive sampling, participants were selected using the following criteria: (1) elderly with hypertension at Ciptomulyo Community Health Center that are able to communicate normally, (2) routinely consuming hypertension controlling drugs, (3) willing to participate, and (4) ability to communicate. Participants were excluded if experiencing severe cognitive impairment, acute illness, or severe physical limitations. This research was conducted from November 3 to December 1, 2025.

2.1 Research Instruments

The Physical Activity Scale for Elderly (PASE) is a questionnaire used to measure physical activity in older adults. This scale includes 10 physical activity items that focus on three activity domains: six leisure-time activities, three household activities, and one work-related item. The PASE instrument used in this study has been translated into Indonesian and tested for validity and reliability by Muna & Hartati (2024). The validity test results showed a t-value of 0.365 (t-count > 0.361), while the alpha reliability value was 0.723.

The PASE evaluates the physical activity of older adults in the past week. Physical activity includes walking outdoors, light, moderate, and vigorous sports and recreation, recorded based on frequency (never, rarely, sometimes, and often) and duration (>1 hour, 1-2 hours, 2-4 hours, and >4 hours). Household activities include yard maintenance, home repairs, outdoor gardening, and caring for others, which are recorded based on a "yes" or "no" response, without specifying frequency or duration.

The PASE score is calculated from activity weight and activity frequency. Responses to the first statement regarding sitting are not scored. The frequency value for paid or voluntary work is the number of hours worked in the past week divided by seven. The activity frequency value is zero if the work is mostly sedentary with minimal arm movement. A higher score indicates a better level of physical activity for the respondent. Physical activity based on the PASE questionnaire is grouped into three categories: 0-40 (low activity), 41-90 (moderate activity), and >90 (vigorous activity).

2.2 Data Collection

From November 3 to December 1, 2025, participants were selected using simple random sampling and then matched to the established inclusion criteria. During elderly care at the community health center, selected participants were contacted to confirm their willingness to participate in the study. Next, they measured their BMI and blood pressure, and completed the PASE questionnaire. During the questionnaire completion, participants were accompanied by an enumerator to assist with any questions they did not understand or needed further explanation regarding items in the PASE questionnaire.

3 Result

3.1 Participants Demographics

The participants demographics of the study, including age and gender, are presented in table 1. These characteristics describe the study sample and provide a foundation for the interpretation of the research findings.

Table 1. Demographic characteristics

Characteristics	Category	(n=308)	%
Age	60-74	120	80
	75-90	30	20
Gender	Female	102	68
	Male	48	32

Table 1 shows that the majority of respondents were 120 (80.0%) between the ages of 60 and 79. The majority were female (102 (68.0%). All elderly people in this study (100%) were taking hypertension medication. This finding indicates that although all elderly people with hypertension were taking their medication regularly, their blood pressure was still not well-controlled. This indicates that the treatment they were taking was not optimal in lowering or stabilizing their blood pressure.

3.2 BMI, Physical Activity Levels, And Blood Pressure Distribution

Participants also demonstrated unique health profile characteristics as illustrated in the table below.

Table 2. Health Profile Characteristics

Category	(n=192)	%
BMI category		
Underweight	4	2,7
Normal	26	17,3
Overweight	30	20
Obese 1	74	49,3
Obese 2	16	10,7
Physical ac-tivity level		
Low	8	5,3
Moderate	39	26
High	103	68,7
Blood pres-sure category		
Pre hypertension	13	8,7
Hypertension level 1	102	68
Hypertension level 2	35	23,3

Based on Table 2 above, in the Obesity I category, with 74 respondents (49.3%). Furthermore, the overweight category was in second place with 30 respondents (20.0%), followed by the normal BMI category with 26 respondents (17.3%). Meanwhile, there

were 16 respondents in Obesity II (10.7%), and the underweight category had the smallest proportion, with 4 respondents (2.7%). Overall, these results indicate that the majority of elderly people in the study had nutritional status ranging from overweight to obesity.

The distribution of physical activity, the majority of respondents had a high level of physical activity, namely 103 people (68.7%). Furthermore, 39 respondents (26.0%) had moderate physical activity. Meanwhile, respondents with low physical activity made up the smallest proportion, with 8 people (5.3%). These results indicate that the majority of elderly people in the study continued to engage in high levels of physical activity.

Pertaining to the distribution of blood pressure, the majority of respondents were in the Stage 1 Hypertension category, namely 102 people (68.0%). Furthermore, respondents with Stage 2 Hypertension numbered 35 people (23.3%). Meanwhile, the pre-hypertension category made up the smallest proportion, namely 13 respondents (8.7%). These results indicate that the majority of elderly people in the study had experienced hypertension, especially stage 1.

3.3 The Relationship Between BMI, physical activity, and Blood Pressure in Elderly People with Hypertension

Table 3. Relationship between BMI, Physical Activity, and Blood Pressure in Elderly People with Hypertension

Variables	Correlation coefficient	P value
BMI	0,300	0,001
Blood Pressure		
Physical activity level	-0,180	0,027
Blood Pressure		

Based on the table 3 above, the statistical test results showed a correlation coefficient of 0.300 was obtained, indicating a weak relationship between BMI and blood pressure in the elderly. The relationship between the two variables is unidirectional, meaning that the higher the BMI, the higher the blood pressure in the elderly. The significance value of 0.001 is less than the alpha value of 0.05, indicating a significant relationship between BMI and blood pressure in the elderly.

According to the statistical test results, a correlation coefficient of -0.180 was obtained, indicating a weak relationship between physical activity and blood pressure in the elderly. The relationship between the two variables is not unidirectional, meaning that higher levels of physical activity tend to lower blood pressure in the elderly. The significance value of 0.027 is less than the alpha value of 0.05, indicating a significant relationship between physical activity and blood pressure in the elderly.

4 Discussion

The study results showed that the majority of elderly people with hypertension in the Ciptomulyo Community Health Center area were in the obese Body Mass Index (BMI) category, particularly obesity category I. This finding indicates that excess weight remains a dominant problem in elderly people with hypertension. Epidemiologically, obesity has long been identified as a major risk factor for hypertension because it is associated with increased peripheral vascular resistance and cardiac workload [9].

Obesity may affect blood pressure through several mechanisms, including increased plasma volume, increased cardiac output, and activation of the renin-angiotensin-aldosterone system (RAAS), resulting in higher blood pressure. Susanto (2020) also stated that the greater the body fat mass, the greater the heart's workload in pumping blood throughout the body [10].

This research aligns with Ningrum (2023), who found that seniors still maintain high levels of physical activity from domestic activities, even though they don't exercise regularly. Light physical activity still helps improve blood circulation, but its effect on lowering blood pressure is not as strong as moderate-to-vigorous physical activity [4].

However, there are still elderly people with low physical activity, especially those with physical limitations and comorbidities. Low physical activity in the elderly is often associated with increased sedentary behavior, which contributes to increased blood pressure, decreased insulin sensitivity, and an increased risk of cardiovascular disease. Population-based studies of the elderly54 show that low physical activity is associated with an increased risk of hypertension and its complications [11].

Increased blood pressure in the elderly is influenced by the aging process, which causes arterial stiffness, reduced blood vessel elasticity, decreased baroreceptor function, and increased peripheral vascular resistance. Furthermore, the elderly also experience decreased kidney function, including a decreased glomerular filtration rate (GFR) and impaired kidney ability to regulate fluid and electrolyte balance. This results in sodium and water retention, which can increase blood pressure. This is exacerbated if the elderly consume high-salt foods, such as crackers, salted fish, or processed foods.

The results of the study showed a significant relationship between BMI and blood pressure in elderly people with hypertension in the Ciptomulyo Community Health Center (Puskesmas). The statistical test showed a p-value of <0.05, with a positive correlation coefficient, indicating that the higher the BMI, the higher the blood pressure level in the elderly. This finding suggests that BMI plays an important role in influencing the severity of hypertension in the elderly.

Based on the cross-tabulation results, respondents with a BMI category of obesity, specifically obesity I and obesity II, were more likely to be in the stage 1 and stage 2 hypertension categories compared to respondents with a normal or overweight BMI. This pattern illustrates that an increase in BMI is associated with an increase in blood pressure levels.

This finding strengthens the results of the statistical test and demonstrates that the relationship between BMI and blood pressure is not only visible numerically, but also in a categorical distribution.

These results support the theory and research by Praningsih et al,(2023), which states that high BMI can increase blood pressure through increased peripheral resistance and vasoconstrictor hormone secretion. These findings confirm that weight control in the elderly is crucial in managing hypertension [7].

Obesity increases the activity of the sympathetic nervous system and the renin-angiotensin-aldosterone system (RAAS), which contribute to vasoconstriction and sodium retention, leading to increased blood pressure [9]. Furthermore, obesity is often accompanied by metabolic abnormalities such as dyslipidemia, which accelerates atherosclerotic plaque formation, and endothelial dysfunction, which increases vascular resistance [12]. At the same time, the insulin resistance that accompanies obesity also promotes increased sympathetic activity and sodium retention by the kidneys, thereby affecting blood pressure [13]. Furthermore, visceral adipose tissue secretes pro-inflammatory cytokines such as TNF-α and IL-6, which cause chronic inflammation, contributing to endothelial dysfunction and increased blood pressure [14]. These mechanisms explain why obesity is an important risk factor in the development of hypertension.

The results of the study showed a significant relationship between physical activity and blood pressure in elderly people with hypertension in the Ciptomulyo Community Health Center area. The statistical test results showed a p-value <0.05 with a negative correlation, indicating that the higher the level of physical activity in elderly people, the lower their blood pressure levels tend to be. This finding suggests that physical activity is an important factor in controlling blood pressure in elderly people with hypertension.

Physical activity plays a crucial role in lowering blood pressure through several physiological mechanisms. Regular physical activity increases the production of nitric oxide (NO), which acts as a vasodilator. Increased NO causes blood vessels to dilate, reducing peripheral resistance and improving blood flow. This mechanism is supported by research by Green et al. (2017), which explains that physical exercise increases NO bioavailability and improves endothelial function in people with hypertension [15]. Furthermore, physical activity also reduces sympathetic nervous system activity and improves the body's autonomic balance, thereby reducing the release of catecholamines such as norepinephrine.

Reduced catecholamines will minimize vasoconstriction and help stabilize blood pressure. This finding aligns with research by Cornelissen et al. (2013), which found that aerobic exercise significantly reduces sympathetic tone and contributes to a decrease in both systolic and diastolic blood pressure [16]. Physical activity also affects the renin–angiotensin–aldosterone system (RAAS), where exercise can reduce levels of angiotensin II, a potent vasoconstrictor. This reduction in RAAS activity supports vasodilation, thereby lowering blood pressure. This mechanism is supported by a study by Desta et al. (2024), which found that regular physical activity reduces RAAS components in individuals with hypertension [17]. Furthermore, physical activity increases insulin sensitivity and reduces inflammation, both of which contribute to improved vascular function.

Research by Rosyida et al. (2022) shows that regular physical exercise can increase insulin sensitivity and improve blood vessel elasticity, making blood pressure easier to control [18]. These findings align with the results of this study, which found that most

older adults had high levels of physical activity. However, respondents' blood pressure remained uncontrolled. This phenomenon is consistent with research by Benetos et al. (2019), which reported that in older adults, adequate physical activity is not necessarily sufficient to lower blood pressure because age, decreased blood vessel elasticity, a long-term history of hypertension, and comorbidities also influence blood pressure control [19].

5 Conclusion

Based on the results of research on the relationship between BMI and physical activity and blood pressure in elderly people with hypertension in the Ciptomulyo Community Health Center area, it can be concluded that The Body Mass Index (BMI) of elderly people with hypertension shows that most are in the obesity category I. This condition indicates a tendency toward overweight in the elderly, which can increase the risk of hypertension complications. The physical activity profile shows that most elderly people have high levels of physical activity. This indicates that elderly people in the study area are still active in household activities, social activities, and religious activities, which contribute to their high physical activity scores. Blood pressure data show that the majority of elderly people have stage 1 hypertension. This indicates that their blood pressure is not fully controlled. There is a siginificant association between BMI and blood pressure in elderly people. The higher the BMI, the higher the blood pressure (p-value 0.000). There is a siginificant association between physical activity and blood pressure in the elderly. The higher the physical activity level, the lower the blood pressure (p-value 0.027). Thus, BMI and physical activity have been shown to be associated with blood pressure in the elderly, and both can be important factors in hypertension control efforts.

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