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Original Research Article

INTRODUCTION

Hypertension continues to be a significant global health challenge and a primary factor in cardiovascular disease, the leading cause of death worldwide. Current estimates indicate that cardiovascular conditions are responsible for more than 17 million deaths each year, with

Body Mass Index and Hypertension Among Adults
 at Bhayangkara H. S. Samsoeri Mertojoso Hospital,
 Surabaya

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Abstract

Background: Hypertension is a major public health concern and an important contributor to cardiovascular morbidity and mortality. Increasing evidence indicates that excess body weight is associated with elevated blood pressure through metabolic and hemodynamic mechanisms, particularly in populations undergoing rapid lifestyle and nutritional transitions. However, evidence regarding the association between body mass index (BMI) and hypertension among younger and working-age adults in Indonesian hospital settings remains limited. **Objective:** This study aimed to investigate the association between BMI and hypertension among individuals aged 15–64 years attending the cardiology outpatient clinic at Bhayangkara H. S. Samsoeri Mertojoso Hospital, Surabaya, Indonesia. **Methods:** Sixty participants were incorporated in a cross-sectional investigation utilizing retrospective medical record data. The BMI was determined and categorized following WHO Asia-Pacific guidelines, whereas hypertension was defined based on JNC 8 criteria. **Result:** The Chi-square test indicated a significant correlation between BMI and hypertension status ($p = 0.025$). Individuals categorized as overweight or obese exhibited a significantly elevated incidence of hypertension, with 65% of those in the overweight group identified as hypertensive. **Conclusion:** BMI was significantly associated with hypertension among patients aged 15–64 years attending the cardiology outpatient clinic. These findings support the use of BMI assessment as a simple screening measure to identify individuals who may require further blood pressure monitoring and early lifestyle intervention. This study was limited by its cross-sectional retrospective design, relatively small sample size, and single-center setting, which restrict causal inference and generalizability.

Keywords: Body mass index, Hypertension, Productive age

approximately 9.4 million directly linked to elevated blood pressure. The global prevalence of hypertension has shown a striking increase, affecting an estimated 1.28 billion individuals by 2021, nearly fifty percent of them are oblivious to their illness (Mills et al., 2020; Pickersgill et al., 2022). More recent WHO estimates indicate that the number of adults with hypertension increased to approximately 1.4 billion in 2024, further emphasizing the continuing global burden of this condition.

Indonesia faces a similarly substantial burden of hypertension. National and regional health data indicate that elevated blood pressure is common among Indonesian adults, including those of working and productive age. The burden is particularly relevant in urban populations, where sedentary lifestyles, dietary changes, and increasing rates of overweight and obesity may contribute to cardiometabolic risk (Arifin et al., 2022; Dinkes Jatim, 2022; Kurnianto et al., 2020). This issue is important because hypertension occurring during the productive years may have long-term consequences for cardiovascular health while simultaneously affecting individual productivity and increasing healthcare demands.

Among modifiable risk factors for hypertension, Body Mass Index (BMI) is a widely used and practical surrogate marker of nutritional status and body fat accumulation (Yusni et al., 2024). Previous studies have consistently reported an association between higher BMI and elevated blood pressure. Several biological mechanisms may contribute to this relationship, including insulin resistance, endothelial dysfunction, altered renal sodium handling, and increased sympathetic nervous system activity (Gupta et al., 2025; Harrison et al., 2021). The World Health Organization (WHO) indicates that BMI values of 25 kg/m² or more denote overweight or obesity, significantly elevating the risk of non-communicable diseases such as hypertension, stroke, and type 2 diabetes (Weir & Jan, 2023). Consequently, identifying the relationship between BMI and hypertension may provide a practical basis for early risk identification and lifestyle-oriented prevention.

Although previous research has investigated the correlation between BMI and blood pressure, the majority have concentrated on elderly populations or broad adult cohorts, with limited emphasis on individuals within the productive age group (Anwar et al., 2024; Foti et al., 2022; Huang et al., 2023; Zhang et al., 2021). The productive age group, defined by WHO as individuals aged 15 to 64 years, represents a demographically and economically critical segment. Maintaining the health of the working-age population is essential for sustaining workforce productivity, as non-communicable diseases can contribute to absenteeism and productivity loss among urban workers in Indonesia (Rosmiati et al., 2025). Furthermore, evidence from Indonesia remains limited regarding whether BMI is associated with hypertension among patients of productive age receiving care in hospital-based cardiology services. This gap is clinically relevant because the identification of modifiable anthropometric factors in younger and working-age adults may provide an opportunity for earlier intervention before the development of more advanced cardiovascular complications.

The novelty of the present study lies in examining the association between BMI and hypertension specifically among individuals aged 15–64 years attending a cardiology outpatient clinic in an Indonesian hospital setting. By focusing on this productive-age population and using routinely available clinical data, this study provides context-specific evidence on whether BMI is associated with hypertension in patients receiving cardiovascular care in Surabaya. Such evidence may complement findings from population-based studies and help inform practical approaches to early identification of individuals who may benefit from blood pressure monitoring and weight-management interventions. To overcome this gap, this study examines the relationship between BMI and hypertension among individuals in the productive age group attending the cardiology outpatient clinic at Bhayangkara H. S. Samsoeri Mertojoso Hospital, Surabaya. By elucidating risk patterns within this demographic, the findings aim to inform targeted public health interventions focused on weight management and early detection, thereby contributing to the prevention of hypertension and its long-term cardiovascular consequences.

MATERIALS AND METHODS

Study Design and Setting

This study utilized an observational analytic methodology with a cross-sectional approach to evaluate the relationship between BMI and hypertension in persons of productive age. Data were gathered at the Cardiology Outpatient Clinic of Bhayangkara H. S. Samsoeri Mertojoso Hospital in Surabaya, Indonesia, from November 2024 to February 2025. Data were retrospectively obtained from patients' electronic medical records (EMRs).

Study Population and Sampling

The target population comprised individuals aged 15 to 64 years who attended the cardiology outpatient clinic during the study period. Inclusion criteria were: (1) patients within the specified age range, and (2) availability of complete medical records containing data on blood pressure, height, and weight. Exclusion criteria included: (1) individuals who were pregnant or currently breastfeeding, and (2) individuals diagnosed with chronic conditions known to influence blood pressure, such as renal failure or endocrine disorders. Sixty participants were recruited using a successive sampling strategy, enrolling all eligible patients who met the inclusion and exclusion criteria consecutively until the target sample size was achieved.

Data Collection and Measurement Procedures

Demographic and clinical data, including age, sex, systolic blood pressure (SBP), diastolic blood pressure (DBP), body weight, and height, were extracted from the electronic medical records. Blood pressure was measured using a calibrated automated oscillometric blood pressure monitor (Omron HEM-7120). Blood pressure measurements were recorded as systolic and diastolic blood pressure in mmHg. Body weight was measured using a calibrated digital weighing scale (Omron HN-289). BMI was calculated as body weight in kilograms divided by the square of height in meters (kg/m^2).

BMI was classified according to the WHO Asia-Pacific BMI classification, which is considered more appropriate for Asian populations because Asian populations may experience cardiometabolic risk at lower BMI values than populations of European ancestry. Accordingly, BMI was categorized as normal ($18.5\text{--}22.9 \text{ kg/m}^2$), overweight ($23.0\text{--}24.9 \text{ kg/m}^2$), obese class I ($25.0\text{--}29.9 \text{ kg/m}^2$), and obese class II ($\geq 30.0 \text{ kg/m}^2$). This classification has been widely used for Asian populations and provides lower BMI thresholds for overweight and obesity than the conventional WHO international classification.

Hypertension was defined according to the 2024 European Society of Cardiology (ESC) Guidelines as office systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg. The 2024 ESC Guidelines retain $\geq 140/90$ mmHg as the office blood pressure threshold for hypertension (McEvoy et al., 2024).

Ethical Considerations

This study obtained ethical permission from the Health Research Ethics Committee of the Faculty of Medicine, Universitas Wijaya Kusuma Surabaya (No. 130/SLE/FK/UWKS/2024) and the Ethics Committee of Bhayangkara H. S. Samsoeri Mertojoso Hospital. Each procedure was executed in compliance with ethical research standards, and patient data was handled with rigorous attention to confidentiality and data protection guidelines.

Statistical Analysis

Data analysis was performed via IBM SPSS Statistics version 28. Descriptive statistics were employed to encapsulate the baseline characteristics of the study population. The correlation between BMI and hypertension status was evaluated using the Chi-square test of independence. A two-tailed p-value of less than 0.05 was deemed indicative of statistical significance.

RESULTS

This study involved 60 people aged 15 to 64 years, consisting of 25 males (41.7%) and 35 females (58.3%). The mean age was 56.0 years ($\text{SD} \pm 5.6$), indicating that most respondents were in the later stages of the productive age range. The average height and body weight were 159 cm and 64 kg ($\text{SD} \pm 7.9$), respectively. BMI values ranged from 22.0 to 35.4 kg/m^2 , with a mean of 22.8 ($\text{SD} \pm 7.5$). Based

on the WHO Asia-Pacific classification, 60.0% of participants had a normal BMI, 33.3% were categorized as overweight, 5.0% as obese class I, and 1.7% as obese class II (Table 1).

Table 1. Baseline characteristics of respondents

Variables		Mean ± SD / Frequency n (%)
Age (years)		56 ± 5.6
Gender	Male	25 (41.7%)
	Female	35 (58.3%)
Body height (cm)		159
Body weight (kg)		64 ± 7.9
BMI (kg/m ²)		25.18 ± 3.19
Blood pressure (mmHg)	Systolic	124 ± 15.9
	Diastolic	81 ± 5.0
BMI category	Normal (18.5 – 22.9)	36 (60.0%)
	Overweight (23 – 24.9)	20 (33.3%)
	Obesity I (25 – 29.9)	3 (5.0%)
	Obesity II (≥ 30)	1 (1.7%)

Regarding blood pressure, 38.3% (n = 23) of participants were classified as hypertensive based on JNC 8 criteria. The average systolic and diastolic blood pressures were 124 mmHg (±15.9) and 81 mmHg (±5.0), respectively. While most participants had normal blood pressure (61.7%), the prevalence of hypertension in this clinical sample remains concerning, particularly in the context of the productive age group. The demographic distribution of BMI and hypertension in this study is consistent with national epidemiological trends in Indonesia, where both overweight and hypertension prevalence are rising among younger adult populations, particularly in urbanized areas (Arifin et al., 2022; Astutik et al., 2020).

The current investigation demonstrated a statistically significant correlation between BMI and hypertension in adults of productive age (15 - 64 years), with a p-value of 0.025 derived from Chi-square analysis. Among the 23 hypertensive individuals identified, 60.9% had a BMI in the overweight or obese categories. In contrast, 73% of normotensive individuals had a BMI within the normal range. Most notably, 65% of participants with overweight BMI (23.0 - 24.9 kg/m²) were hypertensive, compared to only 25% of those with normal BMI values (Table 2). These findings underscore BMI as a robust and clinically relevant surrogate marker for elevating blood pressure risk in this population.

Table 2. Cross-tabulation of body mass index (BMI) categories and hypertension status among productive-age adults

BMI category	Hypertension, n (%)	No hypertension, n (%)	Total, n (%)
Normal	9 (25.0)	27 (75.0)	36 (60.0)
Overweight	13 (65.0)	7 (35.0)	20 (33.3)
Obesity I	1 (33.3)	2 (66.7)	3 (5.0)
Obesity II	0 (0.0)	1 (100.0)	1 (1.7)
Total	23 (38.3)	37 (61.7)	60 (100.0)
Chi-square (p-value)	0.025		

DISCUSSION

The present study demonstrated a significant association between BMI and hypertension among individuals aged 15–64 years attending the cardiology outpatient clinic at Bhayangkara H. S. Samsu Mertojoso Hospital, Surabaya (p = 0.025). Participants with higher BMI, particularly those classified as overweight, showed a higher prevalence of hypertension. This finding is consistent with previous studies reporting a positive association between excess body weight and elevated blood pressure in adult populations group (Anwar et al., 2024; Foti et al., 2022; Huang et al., 2023). The present findings extend this evidence by focusing specifically on individuals of productive age in a hospital-based setting

in Indonesia, a population that has received comparatively less attention than older adults or broader adult populations.

The observed association between higher BMI and hypertension may be explained by several physiological mechanisms. Body mass index (BMI) reflects long-term energy balance and serves as a practical proxy for evaluating nutritional status at both the individual and population levels. Elevated BMI is primarily the result of chronic positive energy balance, frequently attributable to eating habits marked by excessive consumption of saturated fats, sodium, and refined carbohydrates, combined with insufficient physical activity (Hall et al., 2022). These dietary habits promote adipose tissue expansion, particularly visceral fat accumulation, which is metabolically active and implicated in multiple hypertension-related pathways (Louca et al., 2022). Visceral obesity enhances sympathetic nervous system (SNS) stimulation, activates the renin–angiotensin–aldosterone system (RAAS), and leads to endothelial dysfunction through diminished nitric oxide bioavailability. These changes lead to increased peripheral resistance, fluid retention, and ultimately elevated arterial pressure (Abdel Ghafar, 2020; Bryan, 2022).

From a nutritional standpoint, the current findings align with global evidence emphasizing the role of diet quality, not just caloric quantity, in modulating cardiovascular risk. Consumption of diets rich in processed foods, red meats, trans fats, and added sweets leads to weight gain and metabolic dysfunction (Barbosa et al., 2022; Rivera et al., 2024; Scaranni et al., 2021). Conversely, adherence to dietary patterns like the DASH or Mediterranean diets, which prioritize fruits, vegetables, whole grains, legumes, unsaturated fats, and low-fat dairy, has been strongly linked to decreased blood pressure and enhanced vascular endothelial function (Louca et al., 2022; Magriplis et al., 2020). These protective effects are largely attributed to nutrients such as potassium, magnesium, calcium, dietary fiber, and antioxidant phytochemicals, which act through mechanisms including natriuresis, vasodilation, anti-inflammatory signaling, and insulin sensitivity enhancement (Filippou et al., 2021; Meher et al., 2023).

The elevated hypertension prevalence observed even among overweight individuals, not just those classified as obese, reinforces the notion that metabolic risk can occur at BMI thresholds previously considered non-critical, particularly in Asian populations. Asians generally build greater visceral fat at lower BMI levels compared to their Caucasian counterparts, which translates into earlier onset of hypertension, type 2 diabetes, and dyslipidemia (Tham et al., 2023; Williams & Periasamy, 2020). This warrants reconsideration of BMI cutoffs and greater emphasis on early, targeted nutritional interventions before obesity manifests clinically.

Notably, 9 participants with normal BMI were classified as hypertensive. Some of these participants were receiving antihypertensive treatment, which may have influenced their measured blood pressure and indicates that hypertension status may not be fully explained by BMI alone. Nonetheless, this subset illustrates that while BMI is an important determinant, hypertension is multifactorial (Drozd et al., 2021; Meher et al., 2023). High dietary sodium intake, low potassium consumption, alcohol use, smoking, sedentary behavior, stress, and genetic susceptibility all interact with nutritional status to influence blood pressure regulation (Astutik et al., 2020; Debora et al., 2023). Nutritional inadequacies in these individuals, such as micronutrient deficiencies or pro-inflammatory dietary patterns, may act independently of body weight to elevate cardiovascular risk (Foti et al., 2022; Weir & Jan, 2023).

This study has several limitations that should be considered when interpreting the findings. First, its cross-sectional and retrospective design prevents determination of a causal relationship between BMI and hypertension. Second, the study included a relatively small number of participants from a single hospital, which may limit the generalizability of the findings to the broader Indonesian population. Third, because the study relied on medical record data, information on potential confounding factors, including dietary intake, physical activity, smoking, alcohol consumption, family history, socioeconomic status, and anti-hypertensive treatment details, may not have been consistently available. In addition, BMI does not distinguish between fat mass and lean mass or directly reflect visceral adiposity. Future multicenter prospective studies with larger samples should

incorporate these potential confounding factors and additional measures of adiposity, such as waist circumference or waist-to-height ratio, to better characterize the relationship between body composition and hypertension among productive-age adults.

These findings have significant implications for clinical practice and public health policy, especially in informing preventive interventions for hypertension control. In clinical settings, BMI and dietary assessment should be integrated into routine screening protocols for hypertension, particularly in outpatient clinics serving working-age adults. Nutritional counseling, focusing on sodium reduction, portion control, balanced macronutrient intake, and culturally appropriate meal planning, should be a core component of hypertension management. On a broader scale, population-level interventions, such as food labeling policies, subsidies for healthy foods, school-based nutrition education, and restriction of ultra-processed food marketing, are urgently needed to shift dietary behaviors and curb the dual burden of obesity and hypertension.

Therefore, the association between increased BMI and hypertension identified in this study is based on both physiological and dietary factors. Addressing this issue requires a multidisciplinary approach that combines nutritional education, food environment reform, clinical intervention, and community health promotion. The findings affirm the role of nutrition not only in preventing excessive weight gain but also in mitigating cardiovascular risk independent of BMI, particularly in younger adult populations undergoing rapid dietary and lifestyle transitions.

Overall, the present study supports a significant association between BMI and hypertension among individuals aged 15–64 years in a hospital-based Indonesian population. The findings emphasize the importance of early identification of elevated BMI and routine blood pressure assessment during productive years, while recognizing that hypertension may also occur among individuals with normal BMI. Further prospective and multicenter research is warranted to confirm these findings and clarify the contribution of behavioral, metabolic, and socioeconomic factors to hypertension risk in this population.

CONCLUSION

This study demonstrated a significant association between BMI and hypertension among individuals aged 15–64 years attending a cardiology outpatient clinic in Surabaya, with a higher prevalence of hypertension observed among participants with higher BMI. These findings contribute to the limited evidence on the relationship between BMI and hypertension in the productive-age population in Indonesia and support the use of BMI assessment alongside routine blood pressure monitoring for early identification and lifestyle counseling. This study was limited by its cross-sectional retrospective design, relatively small sample size, and single-center setting, which restrict causal inference and generalizability. Future studies involving larger, multicenter populations and prospective designs are needed to confirm these findings and account for potential confounding factors, including dietary habits, physical activity, smoking, and socioeconomic characteristics.

CONFLICT OF INTEREST

No conflict of interest.

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