

Obesity, Physical Activity, Smoking, and Hypertension among Adult Primary-Care Outpatients: A Cross-Sectional Study

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Article Information

Submitted: 15 September 2026

Accepted: 27 September 2026

Publish: 02 October 2026

Keyword: Hypertension; Obesity; Physical Activity; Smoking Habits; Risk Factors; Primary Health Care;

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Year: 2026

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Abstract

Introduction: Hypertension is a public health problem influenced by modifiable factors, including obesity, physical inactivity, and smoking. **Objective:** This study examined the associations of obesity, physical activity, and smoking habits with hypertension among outpatients at Pulo Armin Community Health Center from October to December 2025. **Method:** This analytical observational study used a cross-sectional design and secondary medical record data. A total of 368 adults were selected through simple random sampling. Data were analyzed using univariate analysis, the chi-square test, and Cramer's coefficient. **Result and Discussion:** Among 368 respondents, 51 (13.9 percent) had hypertension, 161 (43.8 percent) had obesity, 53 (14.4 percent) had insufficient physical activity, and 142 (38.6 percent) smoked. Obesity was significantly associated with hypertension, with a chi-square value of 14.9 and a probability value below 0.001. The association was weak, with a Cramer's coefficient of 0.201. Physical activity and smoking were not significantly associated with hypertension, with probability values of 0.778 and 0.406, respectively. These findings identify obesity as the most relevant modifiable factor. **Conclusions:** Obesity was significantly associated with hypertension, whereas physical activity and smoking habits were not. Weight-control interventions should become a priority in primary health care.

Introduction

Hypertension remains a major public health problem because it increases the risk of stroke, coronary heart disease, heart failure, chronic kidney disease, and premature death (Lukitaningtyas & Cahyono, 2023); (Maulidina et al., 2023); (Iriani & Yulianti, 2025). The World Health Organization (2025) estimated that 1.4 billion adults aged 30–79 years had hypertension in 2024 approximately 33% of the global population in this age group, two-thirds of them in low- and middle-income countries yet only 23% had achieved adequate blood pressure control. In Indonesia, prevalence among adults aged 18 years and older rose from 25.8% in 2013 to 34.1% in 2018 (Kementerian Kesehatan Republik Indonesia, 2019), before the Indonesian Health Survey 2023 reported a somewhat lower but still substantial prevalence of 30.8% (Kementerian Kesehatan Republik Indonesia, 2023). These figures indicate that hypertension remains common, frequently undetected, and inadequately controlled both globally and in Indonesia, underscoring the need for stronger prevention, early detection, and risk-factor control at the primary health care level.

Hypertension develops through interactions among genetic, physiological, environmental, and behavioral factors, among which obesity, physical inactivity, and smoking the three factors examined in this study are particularly important modifiable contributors (European Society of Cardiology, 2024); (Avila & Khatimah, 2026); (Agustiani, Nauli, & Arsyati, 2023); (Muliana, Utami, & Leonaviri, 2024). Obesity prevalence has risen sharply worldwide, more than doubling between 1990 and 2022 to around 890 million adults, or 16% of the global adult population, in 2022 (World Health Organization, 2025b); in Indonesia it increased from 21.8% in 2018 to 23.4% in 2023 (Kementerian Kesehatan Republik Indonesia, 2023). Excess adipose tissue raises blood pressure through neurohormonal activation, sodium retention, insulin resistance, and vascular dysfunction, thereby increasing both the occurrence and severity of hypertension (Rahmaisyah et al., 2025)

Regular physical activity likewise supports blood pressure regulation by improving vascular and metabolic function and reducing peripheral vascular resistance, whereas insufficient activity promotes weight gain and cardiovascular risk (Satriyanto, Tyas, Nataliswati, & Pujiastuti, 2026); (Arsal, Arimbi, Wahid, & Sanrebayu, 2025); (McEvoy et al., 2024). World Health Organization recommends at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic activity weekly for adults (World Health Organization, 2025), though the strength of this association may vary across populations depending on activity intensity, duration, and measurement method. Smoking raises blood pressure acutely through sympathetic activation and vasoconstriction, and contributes to endothelial damage and arterial stiffness over the long term (Arisjulyanto, Mesa, & Kusuma, 2026); (Neza, Iskandar, Hanina, Gading, & Ayudia, 2026). However, its relationship with persistent hypertension has been inconsistent across studies, possibly owing to differences in smoking duration, intensity, and cessation history (Jareebi, 2024), even though smoking may still elevate overall cardiovascular risk independent of its statistical association with hypertension. To summarize these interrelated factors, a simple conceptual framework was developed for this study, positioning obesity, physical activity, and smoking habits as independent (modifiable) variables and hypertension as the dependent variable:

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Independent Variables	Dependent Variable
Obesity Physical activity Smoking habits	→ Hypertension

This framework reflects the preceding discussion: each factor is hypothesized to relate to hypertension individually, while their combined distribution and relationships within a single primary care population remain insufficiently documented. However, national data cannot capture how these three factors are distributed and interrelated among patients at a specific primary care facility; prior studies have often examined them separately or relied on inconsistent self-reported measures, and evidence from routine outpatient records remains particularly limited including at Pulo Armyn Community Health Center, where local evidence is needed to identify the most relevant modifiable factor and support targeted prevention. This study therefore aimed to determine the relationships of obesity, physical activity, and smoking habits with hypertension among outpatients at Pulo Armyn Community Health Center from October to December 2025, by describing the distribution of each variable and analyzing its relationship with hypertension; the findings are expected to support risk-based screening, health education, and targeted prevention programs in primary health care

Method

This study used an analytical observational method with a cross-sectional design. The study examined secondary data from the medical records of outpatients who received health services at Pulo Armyn Community Health Center from October to December 2025. Data collection and analysis were conducted from December 2025 to January 2026. The study population comprised 4,500 outpatients registered at Pulo Armyn Community Health Center during the study period. The sample size was calculated using the Slovin formula with a 5% margin of error, resulting in 368 respondents. Medical records were selected through simple random sampling. The inclusion criteria were patients aged 18 years or older with complete information on body weight, height, physical activity, smoking habits, and blood pressure. Pregnant or breastfeeding women and patients with severe chronic conditions that could affect the study variables, including kidney failure, heart failure, and severe endocrine disorders, were excluded.

The independent variables were obesity, physical activity, and smoking habits, while hypertension was the dependent variable. Hypertension was defined as systolic blood pressure of at least 140 millimeters of mercury, diastolic blood pressure of at least 90 millimeters of mercury, or a documented medical diagnosis of hypertension. Obesity was defined as a body mass index of at least 30 kilograms per square meter. Physical activity was classified as sufficient or insufficient, while smoking status was classified as smoking or non-smoking based on information recorded in the medical records. Data were analyzed using univariate and bivariate analyses. Univariate analysis described the frequency distribution of each variable. The chi-square test assessed the relationship between each independent variable and hypertension. Cramer's coefficient measured the strength of statistically identified relationships. A probability value below 0.05 indicated statistical significance. All analyses were performed using the Statistical Package for the Social Sciences.

Result and Discussion

1. Result

General Characteristics of the Respondents

This study involved 368 outpatients at Pulo Armyn Community Health Center from October to December 2025 who met the inclusion criteria. The variables analyzed included hypertension status, obesity status, physical activity level, and smoking habits. The chi-square test was used to examine the associations between variables, while Cramer's V was used to determine the strength of these associations. To complement these measures, crude (unadjusted) odds ratios with 95% confidence intervals were also calculated for each association, as p-values and Cramer's V alone do not convey the precision of the estimated effect size.

Association Between Smoking Habits and Hypertension

The analysis produced a chi-square value of 0.690 and a p-value of 0.406 ($p > 0.05$). These results indicated no statistically significant association between smoking habits and hypertension among the respondents. The Cramer's V value of 0.043 indicated a very weak and negligible association. The crude odds ratio for smokers versus non-smokers was 0.768 (95% CI: 0.411–1.434). The confidence interval was wide and included values above 1, indicating that a modest positive association could not be statistically ruled out given the present sample size.

Tabel 1 Association Between Smoking Habits and Hypertension			
Hypertension Status	Non-Smoker	Smoker	Total
No hypertension	192	125	317
Hypertension	34	17	51
Total	226	142	368

Association Between Physical Activity and Hypertension

The chi-square test examining the association between physical activity level and hypertension produced a chi-square value of 0.079 and a p-value of 0.778 ($p > 0.05$). These findings indicated no statistically significant association between physical activity and hypertension. The Cramer's V value of 0.015 indicated a very weak association. The crude odds ratio for insufficient versus sufficient physical activity was 1.125 (95% CI: 0.496–2.548). This wide interval, extending to more than a twofold increase in odds, indicates limited precision and should temper any interpretation of this finding as evidence of a true null effect

Tabel 2 Association Between Insufficient Physical Activity and Hypertension			
Hypertension Status	Sufficient Physical Activity	Insufficient Physical Activity	Total
No hypertension	272	45	317
Hypertension	43	8	51
Total	315	53	368

Association Between Obesity and Hypertension

The analysis of the association between obesity status and hypertension produced a chi-square value of 14.9 and a p-value below 0.001. This result indicated a statistically significant association between obesity and hypertension. The Cramer's V value of 0.201 indicated a weak association, although it remained clinically relevant. The crude odds

ratio for obesity was 3.316 (95% CI: 1.761–6.244). Although the interval excluded 1, consistent with statistical significance, its width spanning roughly a 1.8-fold to 6.2-fold increase in odds reflects considerable imprecision in the point estimate and should be interpreted cautiously. This odds ratio is also unadjusted for other variables, including age, and therefore does not isolate the independent effect of obesity

Tabel 3

Association Between Obesity and Hypertension

Hypertension Status	Normal Weight	Obesity	Total
No hypertension	191	126	317
Hypertension	16	35	51
Total	207	161	368

2. Discussion

Association Between Smoking Habits and Hypertension

This study found no significant association between smoking habits and hypertension. This finding aligns with several cross-sectional studies reporting that the effects of smoking on blood pressure are acute and transient. Therefore, these effects may not always appear in a single clinical blood pressure measurement. Nicotine can temporarily cause vasoconstriction and increase sympathetic nervous system activity. However, chronic smokers may develop physiological adaptations that obscure these effects.

Furthermore, smoking status in this study was not classified according to smoking duration, number of cigarettes smoked per day, or Brinkman Index score. This limitation may have caused misclassification bias. Other factors, such as age, central obesity, and metabolic comorbidities, may have contributed more strongly to elevated blood pressure than smoking alone. This finding is consistent with reports from the European Society of Cardiology and the European Society of Hypertension, which identify smoking as an important general cardiovascular risk factor rather than a direct determinant of chronic hypertension.

Association Between Physical Activity and Hypertension

Several factors may explain the absence of a significant association between physical activity and hypertension in this study. Foremost among these is limited statistical precision: the 95% confidence interval (0.496–2.548) was wide enough to be compatible with both a protective effect and a more than twofold increase in risk, so the present data cannot distinguish a true null effect from an underpowered analysis. First, physical activity data were obtained from medical records. Consequently, underreporting or inaccurate classification of physical activity intensity and duration may have occurred. Second, most respondents had relatively homogeneous physical activity levels. The limited variation may have reduced the ability of the statistical analysis to detect differences in hypertension risk, which is also reflected in the width of the confidence interval above.

Theoretically, regular physical activity reduces peripheral vascular resistance, improves insulin sensitivity, and decreases sympathetic nervous system activity. However, its protective effects are generally more apparent after sustained, long-term participation. The cross-sectional design of this study could not establish a causal relationship or assess the cumulative effects of physical activity on blood pressure. These

findings are similar to those of several community-based studies conducted in primary health care settings that also reported statistically non-significant associations.

Association Between Obesity and Hypertension

This study identified a significant association between obesity and hypertension, although the strength of the association was weak**, and the crude odds ratio of 3.316 carried a wide 95% confidence interval (1.761–6.244), indicating that the magnitude of this association is estimated with limited precision.** This finding supports previous evidence identifying obesity as a major risk factor for hypertension. Pathophysiologically, obesity contributes to elevated blood pressure through activation of the renin-angiotensin-aldosterone system, increased sympathetic nervous system activity, insulin resistance, and endothelial dysfunction. Excess adipose tissue also produces pro-inflammatory adipokines, including tumor necrosis factor alpha and interleukin 6. These adipokines contribute to chronic low-grade inflammation and increased vascular stiffness. Visceral fat has a greater effect on elevated blood pressure than subcutaneous fat because it is closely associated with portal metabolism and hormonal regulation. The weak Cramer's V value indicates that obesity was not the sole determinant of hypertension. Nevertheless, obesity remains an important modifiable risk factor.

Importantly, this association was derived from a bivariate analysis and was not adjusted for other variables, particularly age. Age is independently associated with both increasing hypertension risk and changes in body composition, including a tendency toward greater adiposity and visceral fat redistribution in older adulthood. If the obese group in this sample was, on average, older than the normal-weight group, part of the observed association between obesity and hypertension may reflect confounding by age rather than a purely independent effect of obesity. Without multivariable adjustment, the crude odds ratio reported here cannot distinguish between these possibilities, and the true independent effect of obesity may be smaller than though is not necessarily eliminated by this crude estimate. These findings emphasize the importance of weight-management interventions as a primary strategy for preventing and controlling hypertension in primary health care settings, particularly at community health centers.

Study Limitations

Two methodological limitations warrant particular emphasis. First, the original analysis relied on chi-square tests and Cramer's V alone; because these statistics quantify significance and association strength but not the precision of the underlying effect estimate, crude odds ratios with 95% confidence intervals were additionally calculated and reported above. The confidence intervals for smoking and physical activity were wide enough to include both null and clinically meaningful effects, indicating that the non-significant findings for these variables reflect limited statistical power as much as an absence of true association. Second, all associations in this study, including the significant obesity–hypertension association, were assessed using bivariate analysis without adjustment for potential confounders such as age, sex, or comorbid conditions. Because age in particular is strongly associated with both obesity and hypertension, the unadjusted odds ratio for obesity may be partly inflated by age confounding. Future analyses of this dataset or subsequent studies in this population should therefore apply multivariable logistic regression to obtain adjusted effect estimates that more accurately isolate the independent contribution of obesity, physical activity, and smoking to hypertension risk.

Conclusion

This study concluded that obesity was the only factor significantly associated with hypertension among 368 outpatients at Pulo Armyn Community Health Center from October to December 2025. Of the respondents, 51 (13.9%) had hypertension, 161 (43.8%) had obesity, 53 (14.4%) had insufficient physical activity, and 142 (38.6%) were smokers. Obesity showed a statistically significant association with hypertension, with a chi-square value of 14.9, a p-value below 0.001, and a Cramer's V value of 0.201, indicating a weak association. In contrast, physical activity was not significantly associated with hypertension, with a chi-square value of 0.079, a p-value of 0.778, and a Cramer's V value of 0.015. Smoking habits were also not significantly associated with hypertension, with a chi-square value of 0.690, a p-value of 0.406, and a Cramer's V value of 0.043. These findings justify prioritizing routine nutritional screening, weight-management interventions, and blood pressure monitoring among outpatients with obesity. However, physical activity promotion and smoking prevention should remain part of comprehensive cardiovascular risk-reduction programs.

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