Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal)

Body Mass Index and Waist Circumference as risk factor of Hypertension Among Adults in Wonosari II Primary Health Care Area, Indonesia

Hernadiyansari Manah, Siska Ariftiyana*, Yulinda Kurniasari, Veriani Aprilia

Department of Nutrition, Faculty of Medicine and Health Science, Universitas Alma Ata, Jalan Brawijaya 99, Yogyakarta, Indonesia

Abstract

Hypertension remains a major global health challenge and a leading cause of premature mortality, with more than 1.28 billion affected adults. In Indonesia, the prevalence reaches 30.8%, and is particularly high in Gunung Kidul Regency at 39.25%. Excess body weight and central obesity commonly assessed through Body Mass Index (BMI) and waist circumference are recognized contributors to HT. This study aimed to examine the roles of nutritional status and waist circumference as risk factors for HT and to identify the most influential predictors among adults. A quantitative cross-sectional study was conducted among adults aged 19–59 years (N=32,489). A total of 138 participants were selected using simple random sampling via OpenEpi. Data were obtained through questionnaires and direct measurements of BMI, waist circumference, and blood pressure. Statistical analyses included chi-square and binary logistic regression tests ($p<0.05$). Results showed that most respondents were 41–50 years old (40.5%), female (80.4%), and had a family history of HT (50.7%). The prevalence of HT was 61.6%, overweight/obesity 65.2%, and central obesity 79%. BMI ($p=0.003$) and waist circumference ($p=0.001$) were significantly associated with HT. The strongest predictors were family history (OR=4.902) and waist circumference (OR=4.896). Nutritional status and waist circumference are significantly linked to HT, with family history and central obesity emerging as the dominant contributing factors.

Keywords: Body Mass Index; HT; Obesity; Risk Factors; Waist Circumference

Introduction

Hypertension (HT) is defined as a systolic blood pressure of ≥140 mmHg and/or a diastolic pressure of ≥90 mmHg, confirmed through repeated measurements. Diastolic pressure serves as a key indicator in establishing the diagnosis. The 2023 Indonesia Health Survey (SKI) reported that the prevalence of HT among individuals aged ≥18 years reached 30.8%. At the provincial level, the Special Region of Yogyakarta ranks sixth highest in Indonesia with a prevalence of 31.8%. Data from the 2021 Yogyakarta Health Profile also indicate that Gunung Kidul Regency recorded the highest number of cases, totaling 102,960. In addition, the 2022 Gunung Kidul Health Profile reported that Wonosari II Primary Health Center had the highest prevalence among residents aged ≥15 years, with 5,732 cases. HT is influenced by non-modifiable risk factors such as age, sex, and genetics and modifiable factors including smoking, excessive salt intake, high-fat dietary patterns, physical inactivity, stress, and overweight. Individuals with elevated Body Mass Index (BMI) and increased waist circumference have a higher risk of developing HT. This increased risk is associated with greater cardiac workload and elevated arterial pressure among individuals who are overweight or obese.

Overweight reflects excessive fat accumulation, whereas obesity is a chronic condition involving substantial fat deposition that may impair physiological functions. WHO data from 2022 show that 2.5 billion adults aged ≥18 years were overweight, and more than 890 million of them were obese. Increased adipose tissue contributes to elevated adipocytokines such as leptin.

PLEASE DO NOT MOVE THIS BOX BELOW. IF YOUR INTRODUCTION EXCEEDS THIS PAGE, GO TO THE NEXT PAGE

Correspondence*: Siska Ariftiyana, Department of Medicine and Health Science, Universitas Alma Ata. Email: ariftiyanasiska@almaata.ac.id.

Received :
Accepted :
Published:

Hyperleptinemia can trigger pro-inflammatory responses and sympathetic nervous system activation, which play important roles in the development of HT. These fat accumulations are reflected in higher BMI values. Central obesity, characterized by increased waist circumference due to visceral fat accumulation, is also a major risk factor for HT. Visceral fat can activate the sympathetic nervous system, stimulate the renin–angiotensin–aldosterone system, increase insulin resistance, and promote the release of pro-inflammatory cytokines, all of which contribute to elevated blood pressure. In Indonesia, the prevalence of central obesity continues to rise alongside lifestyle and dietary changes. Although HT and central obesity are often associated with older adults, the 2025 Ministry of Health screening for non-communicable diseases indicates that these conditions are increasingly affecting younger adults as well. However, studies focusing on central obesity starting from early adulthood remain limited, particularly in mountainous regions such as Gunung Kidul. This lack of research highlights the need to further explore the relationship between central obesity and HT among younger adult populations in highland areas, in order to support more targeted prevention and control strategies for HT.2

Method

This study employed a quantitative cross-sectional design to examine the association between nutritional status, central obesity, and HT among adults. The research was conducted in the service area of Wonosari II Primary Health Center, Gunungkidul Regency, which includes the villages of Wonosari, Kepek, and Baleharjo. The study population consisted of all residents aged 19–59 years living in the area. A total of 138 participants were selected using a simple random sampling technique, with the sample size estimated through the OpenEpi application. Eligible participants were required to reside in the study area, be 19–59 years old, have adequate communication ability, and provide informed consent prior to participation. Data were collected using a demographic questionnaire and direct anthropometric measurements, including body weight, height, Body Mass Index (BMI), waist circumference, and blood pressure.

The instruments used consisted of an Idealife digital weighing scale, a Seca stadiometer, a Metline measuring tape, and an Elvasense BP635 digital sphygmomanometer. All instruments were calibrated prior to use, and measurement procedures followed standard operating guidelines to ensure accuracy and reliability. Data analysis was performed in several stages. Chi-square tests were used to examine associations between categorical variables, while binary logistic regression was applied to identify dominant predictors of HT. Statistical analyses were conducted using the latest version of SPSS software.

Results

A total of 138 adults aged 19–59 years participated in this study. The distribution of respondent characteristics is presented in Table 1. Most respondents were within the 51–59-year age group (31.9%), followed by those aged 41–50 years (31.2%). The majority were female (80.4%). More than half of the respondents (50.7%) reported having no family history of HT. Regarding education, most respondents had completed senior high school (42.8%), followed by junior high school (29.0%). In terms of occupation, the largest proportion consisted of individuals working outside the civil service or business sector (55.8%), while 5.1% were unemployed or housewives.

Table 1. Sociodemographic Characteristics of Respondents (n = 138)

Variable	n	%
Age (years)		
19–30	14	10.1
31–40	24	17.4
41–50	56	40.6
51–59	44	31.9
Sex		
Male	27	19.6
Female	111	80.4
Family History of Hypertension		
Yes	70	50.7
No	68	49.3

Variable	n	%
Educational Level		
Primary School	29	21.0
Junior High School	41	29.7
Senior High School	57	41.3
Diploma/Bachelor/Master Degree	11	8.0
Occupation		
Unemployed	77	55.8
Civil Servant	7	5.1
Private Employee	18	13.0
Entrepreneur	11	8.0
Farmer	7	5.1
Laborer	15	10.9
Other	3	2.2

Table 2 summarizes the distribution of blood pressure status, BMI categories, and waist circumference. More than half of the respondents (61.6%) were classified as hypertensive. The prevalence of overweight or obesity based on BMI reached 65.2%, indicating a high burden of excess body weight in this population. Central obesity was also highly prevalent. Overall, 79% of respondents had waist circumferences above the normal threshold. Among men, 78% were categorized as having central obesity, while the prevalence was slightly higher among women (79.0%).

Table 2. Distribution of Blood Pressure Status, Body Mass Index, and Waist Circumference

Variable	Category	n	%
Blood Pressure Status	Non-hypertensive	53	38.4
	Hypertensive	85	61.6
Body Mass Index (BMI)	Non-overweight/obese	48	34.8
	Overweight/obese	90	65.2
Waist Circumference	**Male**		
	Normal	6	22.2
	Central obesity	21	77.8
	Female		
	Normal	23	20.7
	Central obesity	88	79.3
Total Waist Circumference Categories	Normal	29	21.0
	Central obesity	109	79.0

The results of the Chi-square test revealed a statistically significant association between BMI and HT (p = 0.003), as shown in **Table 3**. The prevalence of HT was higher among respondents classified as overweight or obese compared with those with a normal BMI. The odds ratio (OR) of 0.316 (95% CI: 0.152–0.656) indicates that individuals with a normal BMI had a substantially lower likelihood of experiencing HT than those who were overweight or obese. These findings demonstrate that nutritional status plays an important role in blood pressure elevation among adults in the study area.

Table 3. Association Between Blood Pressure Status and Body Mass Index (BMI)

BMI Category	Non-Hypertensive		Hypertensive		Total		p-value	OR	95% CI
	n	%	n	%	n	%			
Not Overweight/Obese	27	50.9	21	24.7	48	34.8			
Overweight/Obese	26	49.1	64	75.3	90	65.2	0.003*	0.316	0.152–0.656
Total	53	100	85	100	138	100			

p-value < 0.05 indicates statistical significance

Table 4 presents the association between waist circumference and HT. A significant relationship was found (p = 0.011). Respondents with normal waist circumference had a lower prevalence of HT compared with those categorized as having central obesity. The OR of 0.383 (95% CI: 0.184–0.798) indicates that non–centrally obese individuals had a reduced risk of HT. These findings highlight the importance of abdominal fat distribution as a major risk factor that contributes to

elevated blood pressure.

Table 4. Association Between Waist Circumference and Hypertension

Waist Circumference	Non-Hypertensive		Hypertensive		Total		p-value	OR	95% CI
	n	%	n	%	n	%			
Normal	19	35.8	10	11.8	29	21.0			
Central Obesity	34	64.2	75	88.2	109	79.0	0.001*	4.191	1.762–9.967
Total	53	100	85	100	138	100			

p-value < 0.05 indicates statistical significance

The logistic regression model examining factors associated with HT is presented in **Table 5**. After adjusting for potential confounders, waist circumference remained a statistically significant predictor of HT. Central obesity markedly increased the likelihood of HT, with respondents exhibiting enlarged waist circumference showing higher odds of elevated blood pressure compared with those within normal limits. Although BMI showed a trend toward an association with HT, waist circumference emerged as the strongest and most consistent predictor in the model. These findings suggest that abdominal obesity may be a more sensitive indicator of HT risk than general adiposity.

Table 5. Multivariate Logistic Regression Analysis of Factors Associated With Hypertension

Variables	p-value	Adjusted OR	95% CI (Lower–Upper)
Family History of HT	0.000	4.902	2.128–11.294
Educational Level	0.001	0.446	0.269–0.739
Waist Circumference	0.003	4.896	1.719–13.944
Constant	0.035	0.068	—

Discussion

This study sought to identify the principal determinants of HT among adults aged 19–59 years within the Puskesmas Wonosari II catchment area, focusing on central obesity, family history of HT, and educational attainment. The findings reaffirm the central role of visceral adiposity and genetic predisposition in the pathogenesis of elevated blood pressure, while underscoring the importance of social determinants of health. Each significant factor demonstrated in this study is congruent with established physiological pathways and substantiated by recent high-quality epidemiological evidence. Central obesity emerged as the most influential predictor of HT. This is biologically plausible, as visceral adipose tissue is highly metabolically active and drives a cascade of adverse biological processes, including low-grade chronic inflammation, insulin resistance, heightened sympathetic activity, and upregulation of The Renin–Angiotensin–Aldosterone System (RAAS)[1–3]. These mechanisms collectively elevate vascular tone and impair pressure regulation. Consistent with prior regional and global research, waist circumference a direct proxy of visceral fat outperforms body mass index in predicting HT risk.

Large-scale cohort studies across Asia have demonstrated that incremental increases in waist circumference substantially elevate incident HT risk[1], while Zhang et al.[2] and Lee et al.[3] further highlight the robust and mechanistically grounded association between visceral adiposity and blood pressure elevation. These findings reinforce the value of waist circumference measurement as an actionable and cost-effective screening tool in primary care, particularly in low- and middle-income settings. Family history of HT was also strongly associated with elevated risk. This aligns with contemporary genomic and epidemiologic evidence indicating that heritable components influence endothelial function, renal sodium handling, vascular smooth muscle tone, and autonomic regulation[4]. Mboumba et al. reported that individuals with a family history of HT exhibit a two- to fourfold increased risk[5], while Tanaka et al.[6] demonstrated the contribution of polygenic risk scores and vascular regulatory gene variants to HT susceptibility. Although environmental exposures remain important, the present findings affirm that family history serves as a critical early marker of risk and should be incorporated into routine cardiovascular risk assessments. Educational attainment functioned as a protective factor, reflecting the broader influence of social determinants on cardiometabolic health. Individuals with higher education generally possess stronger health literacy, facilitating healthier dietary choices, greater engagement in physical activity, and earlier utilization of preventive healthcare services. Consistent with this, Satria et al. found that low educational attainment doubled HT risk in Indonesian adults[7], while Glynn et al.[8] highlighted the global relevance of education in shaping health behaviors and treatment adherence. Our findings underscore that addressing HT requires not only biomedical strategies but also interventions that mitigate social and behavioral inequities. Collectively, these results

demonstrate that HT in this population arises from the interplay of biological vulnerability, lifestyle patterns, and socioeconomic context.

The implications for public health policy and intervention design are substantial. Prioritizing routine screening for central obesity, strengthening health education particularly among populations with limited formal education and providing targeted counseling to individuals with a family history of HT are critical steps. Community-based programs integrating these elements may produce meaningful reductions in HT prevalence and improve long-term cardiovascular outcomes. At the global level, this study reinforces the growing consensus that central obesity is a highly modifiable yet increasingly prevalent risk factor, especially in low- and middle-income countries undergoing rapid nutrition and lifestyle transitions. Nevertheless, the cross-sectional design limits causal inference. Longitudinal research is needed to clarify temporal relationships between changes in visceral adiposity and blood pressure trajectories. Future investigations should also assess behavioral mediators such as sodium intake, physical inactivity, and psychosocial stress that may link educational disadvantage to HT risk.

Conclusion

this study provides rigorous evidence that central obesity, genetic susceptibility, and educational status are key determinants of HT in Indonesian adults. Integrated prevention strategies that simultaneously target visceral adiposity, strengthen health literacy, and account for familial risk are essential for sustainable improvements in population cardiovascular health.

Abbreviations

HT: Hypertension; BMI: Body Mass Index; RAAS: The Renin–Angiotensin–Aldosterone System;

Ethics Approval and Consent to Participate

This study received ethical approval from the Health Research Ethics Committee under approval number KE/AA/V/10112466/EC/2025.

Competing Interest

The authors declared no conflict of interest to be disclosed

Availability of Data and Materials

Data and materials are available upon request

Authors' Contribution

SA designed the study, HM conducted data collection, SA, HM, YK analysis data, SA, HM, YK, VA interpreted the data and wrote the manuscript.

Acknowledgment

This study was supported by Primary Health Center Wonosari II, who has given permission to obtain data.

References

1. Tiara UI. Hubungan Obesitas dengan Kejadian Hipertensi. J Heal Sci Physiother. 2020;2(2):167– 71.
2. Survei Kesehatan Indonesia. Survei Kesehatan Indonesia. Kementeri Kesehat Republik Indones. 2023;01:1–68.
3. Dinas Kesehatan DIY. Dinas Kesehatan D.I Yogyakarta tahun 2022. Dinas Kesehat Drh Istimewa Yogyakarta tahun 2022 [Internet]. 2022;76. Tersedia pada: http://www.dinkes.jogjaprov.go.id/download/dow nload/27.
4. GunungKidul DKK. Profil Kesehatan Kabupaten GunungKidul 2013. 2023;3–4.
5. Agus lukitaningtyas D dan CE. Hipertensi. J Pengemb Ilmu dan Prakt Kesehat. 2023;4(1):88– 100.
6. Kartika J, Purwaningsih E. Hubungan Obesitas pada Pra Lansia dengan Kejadian Hipertensi di Kecamatan Senen Jakarta Pusat Tahun 2017-2018. J Kedokt dan Kesehat. 2020;16(1):35.
7. WHO. Obesity and Overweight [Internet]. hal. 2024. Tersedia pada: https://www.who.int/news- room/fact-sheets/detail/obesity-and-overweight
8. Kemenkes RI. Pedoman Umum Pengendalian Obesitas. Vol. 1, Gastronomía ecuatoriana y turismo local. 2020. 5–24 hal.
9. Noer ER, Dieny FF, Margawati A-, Florencia D-. Conicity Index, Lingkar Pinggang, Dan Rasio Lingkar Pinggang-Tinggi Badan Dengan Kadar Glukosa Darah Puasa Pada Dewasa. Gizi Indones. 2023;46(1):99–108.
10. Mulyasari I, Afiatna P, Maryanto S, Aryani AN. Body Mass Index as Hypertension Predictor: Comparison between World Health Organization and Asia- Pacific Standard. Amerta Nutr. 2023;7(2SP):247– 51.
11. Adwinda MD, Srimiati M. Hubungan lingkar perut, konsumsi gula dan lemak dengan kadar glukosa darah pegawai direktorat Poltekkes Kemenkes Jakarta II. Nutr Diaita J Gizi - Diet. 2020;11(1):7–17.
12. Sihotang U. Hubungan Indeks Massa Tubuh (IMT) dan Lingkar Pinggang Kelurahan Dataran Tinggi