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ORIGINAL ARTICLE

High blood pressure is correlated with anthropometric status in adults in Gribig district, Central Java, Indonesia

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Abstract

Background: More than 17 million deaths worldwide are caused by cardiovascular disease due to high blood pressure. According to the World Health Organization (WHO), around 1.3 billion adults will have high blood pressure in 2021. Obesity is a significant factor influencing blood pressure. Waist circumference measurements and body mass index (BMI) can be used to identify obesity issues.
Objective: The aim was to analyze the correlation between BMI, waist circumference, and blood pressure among adults at Primary Health Care in Kudus, Central Java, Indonesia.
Methods: This cross-sectional study evaluated BMI, waist circumference, blood pressure, and questionnaire. Men and women aged 18-59 (healthcare staff, patient caregivers, and patients) who agreed to become study subjects were included. Participants with a history of diseases, current conditions, medication intake that affects blood pressure, and pregnancy were excluded. Samples were taken using purposive sampling and the Pearson test as a statistical analysis.
Results: The analysis showed a significant correlation between the BMI of patients with systolic blood pressure (p=0.000) and diastolic blood pressure (p=0.000). A moderate relationship was found between BMI and systolic blood pressure(r=0.473) and diastolic blood pressure (r=0.439). Moreover, waist circumference was significantly correlated with systolic blood pressure (p=0.000) and diastolic blood pressure (p=0.000).
Conclusion: A significant correlation exists between BMI and waist circumference with blood pressure among adults at the Primary Health Care in Kudus, Central Java, Indonesia.

Keywords: Body mass index, waist circumference, blood pressure

Introduction

High blood pressure is a significant risk factor for cardiovascular disease that caused more than 17 million deaths globally in 2019.1 In 2021, the World Health Organization (WHO) stated that nearly 1.3 billion adults experienced high blood pressure. It was estimated that 46% of them were unaware of this condition.2 High blood pressure also plays some roles that may cause an economic burden on the health system both in a country and society.3 The increase in the economic burden is often the result of complications of high blood pressure, and it occurs in several countries, including Indonesia.[4,5]

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In 2018, the Result of Nasional Basic Health Research (*Riskesdas*) showed that there was an increase in the prevalence of high blood pressure in Indonesian adults aged 18 years and over; it was from 25.8% in 2013 to 34.1% in 2018.[6] Based on Central Java's health profile in 2019, high blood pressure became one of the top priorities for non-infectious disease control in Central Java with the most significant proportion, which was 68.6%.[7] In 2021, the Health Service Report of Kudus Regency showed that cases of high blood pressure in Kudus Regency had the highest number compared to other non-infectious diseases, which was more than 200 thousand people.[8]

Factors that affect changes in blood pressure are divided into unmodifiable and modifiable factors.[1] Obesity is a factor that can be modified. It may affect blood pressure since it is assumed to underlie the mechanisms of altered secretion in adipose tissue. One of the most frequent examinations that are used to detect obesity is the measurement of body mass index (BMI). BMI measures a person's level of adiposity or body fat accumulation.[9] However, BMI cannot differentiate between body fat and lean muscle mass and does not discriminate the central fat or visceral fat distribution information.[10] Therefore, other measurements are needed to complete the BMI measurement, which is the measurement of waist circumference.[11] Waist circumference shows the accumulation of visceral fat, in which, when it is excessive, it may be associated with the accumulation of ectopic fat, or retroperitoneal fat in particular.[12]

A prospective cohort study of more than 4 thousand individuals in China shows that the emergence of the overweight condition at a younger age is associated with increased hypertension risk.[13] Research on adolescents in Indonesia also shows that obesity is a risk factor for prehypertension among them.[14] Treatment for hypertension must be the government's priority to prevent and control non-communicable diseases from an early age. One of the health service facilities that prioritize promotive and preventive efforts is a community health center (*Puskesmas*).[15] Therefore, preventive efforts in health centers in the form of early detection, control of modifiable risk factors, and changes in healthy lifestyle can reduce the risk of hypertension and prevent the disease from becoming more severe. This study aims to analyze the relationship between body mass index and waist circumference with adult blood pressure at the Gribig Health Center, Kudus Regency.

Methods

Study designs and participants

This research is an observational analytic study with a cross-sectional approach. The study measured the research subject's height, weight, waist circumference, and blood pressure and distributed questionnaires containing subject characteristics. The sample calculation utilized the formula developed by Sastroasmoro.[16] The minimum correlation considered significant is based on previous research17. A minimum sample of 65 subjects is idealized, assuming a significance level of 5% and a confidence interval of 95%. The population of this study were men and women aged 18-59 years at the Gribig Health Center, Kudus Regency. Ninety-two people became research subjects. The sample was collected using a purposive sampling technique. Written informed consent was obtained from all study subjects, and research protocols were approved by the Research Ethics Committee Faculty of Medicine and Health (Medical and Health Research Ethics Committee). Faculty of Medicine, Public Health and Nursing, Gadjah Mada University, Yogyakarta, with the number KE/FK/1676/EC/2022.

The study included men and women aged 18-59 who were either health center staff, patient escorts, or registered patients at the Gribig Health Center in Kudus District. They were willing to become research subjects by filling out informed consent. Exclusion criteria included respondents with a history of diabetes, cardiovascular disease, kidney disease, thyroid disorders, obstructive sleep apnea, sleeping less than <6 hours before measurement, taking medications that affect blood pressure (thiazide diuretics, Angiotensin Converting Enzyme Inhibitors (ACEI), Calcium Channel Blockers (CCB), Angiotensin Receptor Blockers

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(ARB), pseudoephedrine), and in the pregnant state.

Measurements

Blood pressure is measured at the brachial artery in the right arm in the supine position using a digital sphygmomanometer (YuWell YE680), and it is recorded as systolic blood pressure to diastolic blood pressure. The accuracy maintained in this research uses a new unit digital sphygmomanometer and is charged using a new battery. Also, the unit has been validated. Prior to blood pressure measurement, the subject should rest for at least 5 minutes, should not consume caffeine, should not smoke, and should not do sports activities for at least 30 minutes before measurement, not in the condition of holding back urination and defecation. Measure blood pressure using an appropriate cuff to the circumference of the subject's upper arm. Subjects must be seated back in a chair, arms arranged at heart level, and feet touching the floor. Blood pressure is measured twice at 1-2 minutes. Then the average is taken. Additional measurements are made if the results of the first and second measurements are different with the range of >10 mmHg.

Body mass index (BMI) is calculated from the formula of a person's weight in kilograms divided by the square of the height in meters. BMI measurement consists of body weight and height. In measuring body weight, the subject must remove his shoes and jacket, put down his bag, and remove the contents. The subject then climbs onto a digital scale (OneMed Digital Bathroom Scale EF812) in a static state, upright, with the view facing forward and the position of the feet in the middle of the weighing machine. Weight is recorded up to 1 digit after the decimal point. Measurement is performed two times, and then the average is taken. The third measurement is carried out if the difference between the two measurements is >0.2 kg. The subject should remove the footwear and cover the head at the height measurement. The subject stands upright, feet together, hands by side with palms facing the thigh, and looks straight ahead. Back of the head and shoulders, heels, and butt against the wall to which the microtoise (GEA) is attached. Microtoise horizontal iron is pulled and then pressed until it touches the crown of the head. Height is recorded up to 1 decimal place. Repeat the measurement two times and then take the average. The third measurement is taken if the difference is >0.5 cm.

Waist circumference is measured at the midpoint between the lower border of the XII costal arch and the crest iliac using a measuring tape (OneMed Waist Ruler OD 235). Measurements are taken at the end of the normal expiration in an upright standing position with parallel feet. Measurements are conducted twice, and then the average is taken. The third measurement is taken if the difference between the two measurements is> 1 cm.

Data Analysis

Data analysis is performed using the Statistical Analysis Software Package for software Windows (SPSS) version 25. Descriptive statistics such as median, mean, and standard deviation are then analyzed to evaluate the mean of systolic blood pressure, diastolic blood pressure, BMI, waist circumference, and age of the participants. Whole variables are tested for data normality. The normality of the data distribution in this study was analyzed using a Kolmogorov-Smirnov test, resulting in a p-value greater than 0.05. Therefore, the data distribution is considered normal. Bivariate analysis was conducted using the Pearson correlation test to investigate the relationship between blood pressure, BMI, and waist circumference. Correlation is deemed significant if the p-value is less than 0.05.

Results

This study had 92 participants aged 18-59, categorized into early (26-35 years) and late adulthood (36-45 years).[18] Based on Table 1, the average of respondents aged 36-45 years as many 29 people (31.5%), and respondents aged 36-45 years as many 16 (17.4%). Respondents comprised 64 women (69.6%) and 28 men (30.4%). Most of their jobs are private, consisting of private employees, civil servant employees (PNS),

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entrepreneurs, and laborers, as many as 47 people (51.1%). Most of their educational background is High School graduates, as many as 32 people (34.8%). Those who are married are 70 people (76%). This study found that of the research subjects, 14 people (15.2%) are smokers, and the remaining 78 do not smoke (84.8%). In this study, no research subjects consume alcohol (0%). As many as 27 of the 92 study subjects have a family history of hypertension (29.3%) (**Table 1**).

The average BMI of the research subjects was 24.47 kg/m2. The average waist circumference (WC) is 84.16 cm. The average systolic blood pressure (SBP) is 129.33 mmHg. The average diastolic blood pressure (DBP) is 79.56 mmHg (**Table 1**).

The analysis of the relationship between BMI and systolic blood pressure obtains a p-value of 0.000 ($p < 0.05$), indicating a significant correlation between BMI and systolic blood pressure. A correlation strength (r) of 0.473 indicates a positive correlation between BMI and systolic blood pressure with moderate correlation strength. The correlation between BMI and diastolic blood pressure is also considered significant, as indicated by a p-value of 0.000 ($p<0.05$). The correlation value of 0.439 also shows a positive correlation between BMI and diastolic blood pressure with moderate correlation strength (**Table 2**).

The analysis of the relationship between waist circumference and systolic blood pressure obtains a p-value of 0.000 ($p<0.05$), indicating a significant correlation between waist circumference and systolic blood pressure. The correlation value 0.659 indicates a positive correlation between waist circumference and systolic blood pressure with a muscular correlation strength. The correlation between waist circumference and diastolic blood pressure is also considered significant, as indicated by a p-value of 0.000 ($p<0.05$). The correlation value obtained was 0.588, which showed a positive correlation between waist circumference and diastolic blood pressure with moderate correlation strength (**Table 2**).

Discussion

This study found a significant correlation (p=0.000) between BMI and systolic blood pressure in the study subjects at the Gribig Health Center, Kudus District, with moderate correlation strength (r=0.473). Likewise, a significant correlation (p=0.000) is found between BMI and diastolic blood pressure in the study subjects at the Gribig Health Center, Kudus Regency, with moderate correlation strength (r=0.439). A positive correlation is found between BMI and systolic and diastolic blood pressure. The results of this study mean that the higher the BMI, the higher the blood pressure. The results of this study align with those of other studies conducted by Linderman et al. This study shows a positive relationship between BMI and blood pressure.[19] Research conducted by Saguaro et al shows that BMI positively correlates with systolic and diastolic blood pressure (r=0.336 and r=0.344, respectively).[17]

Based on the results of data analysis between BMI and systolic and diastolic blood pressure, the correlation's strength is considered moderate. This result is caused by several factors, including an increase in BMI, which may result from an imbalance between diet and activity or is influenced by genetics.[20] Increased BMI, through the mechanism of the sympathetic nervous system pathway, the renin-angiotensin system, and vascular inflammation can affect and even increase blood pressure.[21]

This study gives different results from the research conducted by Khalid et al. The study states that BMI negatively correlates with men's systolic and diastolic blood pressure. There is no significant correlation in women concluding that BMI does not affect blood pressure. The study by Khalid et al used respondents with high blood pressure, while this study used respondents who both suffered from high blood pressure and did not. The different research results are also caused by differences in the number of respondents, in which the study used 337 adult respondents consisting of 52.2% male and 47.8% female. This study uses 92 respondents, 30.4% male and 69.6% female.[22]

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Table 1. Sociodemographic and clinical characteristics of research subjects

Characteristics	Total (N= 92)
Age, median (min-max)	35 (18-59)
26-35, n (%)	29 (31.5)
36-45, n (%)	16 (17.4)
Sex, n (%)	
Male	28 (30.4)
Female	64 (69.6)
Occupation, n (%)	
Unemployed	19 (20.7)
Students	9 (9.8)
Civil servant employees	17 (18.5)
Private employees	47 (51.1)
Education, n (%)	
Elementary	14 (15.2)
Junior high school	17 (18.5)
Senior high school	32 (34,8)
Diploma (D3)	10 (10.9)
Bachelor (S1)	19 (20.7)
Master's degree (S2/S3)	0
Marital status, n (%)	
Married	70 (76)
Single	22 (24)
Smoker, n (%)	
Yes	14 (15.2)
No	78 (84.8)
Alcoholic, n (%)	
Yes	0
No	92 (100)
Hypertension history, n (%)	
Yes	27 (29.3)
No	65 (70.7)
Clinical characteristics	
BMI, mean (SD), kg/m^2	24.47 (4.77)
WC, mean (SD), cm	84.16 (11.37)
SBP, mean (SD), mmHg	129.33 (20.77)
DBP, mean (SD), mmHg	79.56 (13.24)

Source: *Primary Data in Gribig Health Center year 2022*
SD: Standard Deviation.

Table 2. The correlation between BMI and waist circumference and blood pressure

	SBP		DBP	
	r	p	r	p
BMI	0.473	0.000	0.439	0.000
Waist Circumference	0.659	0.000	0.588	0.000

This study reports a strong correlation (r=0.659, p=0.000) between waist circumference and systolic blood pressure in the study subjects at Gribig Health Center in Kudus Regency. The correlation between waist circumference and diastolic blood pressure in study subjects at the Gribig Health Center, Kudus Regency, is also significant (p=0.000) with moderate correlation strength (r=0.588). The relationship between waist circumference and systolic and diastolic blood pressure in this study is positively correlated, and it is found that the correlation between waist circumference and systolic blood pressure is stronger than the correlation with diastolic blood pressure. The positive correlation between waist circumference and blood pressure indicates that the

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higher the waist circumference, the higher the blood pressure.

This study found results similar to those of a study conducted in Nepal by Chaudhary et al. The study shows a clear relationship between waist circumference and systolic and diastolic blood pressure. The correlation between waist circumference and systolic blood pressure is positive and significant, and the same applies to the correlation between waist circumference and diastolic blood pressure.[23] The correlation of systolic blood pressure is also found to be stronger for waist circumference than diastolic blood pressure. These results are also supported by previous research conducted by Fu, et al. The study shows that waist circumference positively correlates with systolic and diastolic blood pressure, especially in men. This result is because men are more often associated with smoking, consuming alcohol, and doing less physical activity, which affects the increase in waist circumference.[24]

This research has several limitations. First, there is inequality in the participation of men and women, where women are far more dominant. The study design only uses cross-sectional data, meaning a causal relationship between BMI, waist circumference, and blood pressure cannot be established. Third, time constraints mean this study only takes a small portion of the population as a sample. Fourth, regarding blood pressure, this study is limited to only examining BMI and waist circumference variables. Therefore, further research is needed on factors outside this study that affect blood pressure, such as diet, salt intake, stress, and genetics. In addition, future research should use a larger sample size and other research designs that can explain the causal relationship between BMI, waist circumference, and blood pressure.

Conclusion

This study establishes a significant relationship between body mass index (BMI) and waist circumference with blood pressure among adolescents in the Gribig Health Center, Kudus Regency.

Conflict of interest

The authors declare that no conflict of interest with another person or institution.

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References

1. World Health Organization. *Cardiovascular diseases*. World Health Organization. 2021. p. 277–82. Available from: https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds) [Accessed 10th October 2022]
2. World Health Organization. *Hypertension*. World Health Organization. 2021. Available from: https://www.who.int/news-room/fact-sheets/detail/hypertension [Accessed 1st September 2022]
3. Kirkland EB, Heincelman M, Bishu KG, Schumann SO, Schreiner A, Axon RN, et al. Trends in healthcare expenditures among US adults with hypertension: national estimates, 2003–2014. *Journal of American Heart Association*. 2018;7(11):1–9. doi: 10.1161/JAHA.118.008731
4. Gheorghe A, Griffiths U, Murphy A, Legido-Quigley H, Lamptey P, Perel P. The economic burden of cardiovascular disease and hypertension in low and middle-income countries: a systematic review. *BMC Public Health*. 2018;18(1):975. doi: 10.1186/s12889-018-5806-x
5. Finkelstein EA, Chay J, Bajpai S. The economic burden of self-reported and undiagnosed cardiovascular diseases and diabetes on Indonesian households. Mahal A, ed. *PLoS One*. 2014;9(6):e99572. doi: 10.1371/journal.pone.0099572
6. Kementerian Kesehatan Republik Indonesia. *Laporan hasil riset kesehatan dasar (Riskesdas) 2018*. Jakarta: Badan Penelitian dan Pengembangan Kesehatan; 2019.

World Nutrition Journal 2024, 8(1). DOI: 10.25220/WNJ.V08.i1.0012

7. Dinas Kesehatan Provinsi Jawa Tengah. *Profil kesehatan Provinsi Jawa Tengah tahun 2019*. Dinas Kesehatan Provinsi Jawa Tengah; 2020.
8. Dinas Kesehatan Kabupaten Kudus. *Profil kesehatan Kabupaten Kudus tahun 2021*. Kudus: Dinas Kesehatan Kabupaten Kudus; 2022.
9. Nuttall FQ. Body mass index. *Nutrition Today*. 2015;50(3):117–28. doi: 10.1097/NT.0000000000000092
10. Buss J. Limitations of body mass index to assess body fat. *Workplace Health Safety*. 2014;62(6):264–264. doi: 10.1177/216507991406200608
11. Ross R, Neeland IJ, Yamashita S, Shai I, Seidell J, Magni P, et al. Waist circumference as a vital sign in clinical practice: a consensus statement from the IAS and ICCR working group on visceral obesity. *Nature Reviews Endocrinology*. 2020;16(3):177–89. doi: 10.1038/s41574-019-0310-7
12. Chandra A, Neeland IJ, Berry JD, Ayers CR, Rohatgi A, Das SR, et al. The relationship of body mass and fat distribution with incident hypertension. *Journal of American College of Cardiology*. 2014;64(10):997–1002. doi: 10.1016/j.jacc.2014.05.057
13. Li W, Fang W, Huang Z, Wang X, Cai Z, Chen G, et al. Association between age at onset of overweight and risk of hypertension across adulthood. *Heart*. 2022;108(9):683–8. doi: 10.1136/heartjnl-2021-320278
14. Sudikno S, Mubasyiroh R, Rachmalina R, Arfines PP, Puspita T. Prevalence and associated factors for prehypertension and hypertension among Indonesian adolescents: a cross-sectional community survey. *BMJ Open*. 2023;13(3):e065056
15. Kementerian Kesehatan Republik Indonesia. *Peraturan Menteri Kesehatan Republik Indonesia Nomor 43 Tahun 2019 tentang Pusat Kesehatan Masyarakat*. Kementerian Kesehatan Republik Indonesia; 2019
16. Sastroasmoro S, Ismael S. *Dasar-dasar metodologi penelitian klinis*. 5th ed. Vol. 5. Jakarta: Sagung Seto; 2016.
17. Sagaro GG, Di Canio M, Amenta F. Correlation between body mass index and blood pressure in seafarers. *Clinical Experimental Hypertension*. 2021;43(2):189–95. doi: 10.1080/10641963.2020.1836193
18. Ministry of Health Indonesia. Indonesian Health Profile 2009. 2009.
19. Linderman GC, Lu J, Lu Y, Sun X, Xu W, Nasir K, et al. Association of body mass index with blood pressure among 1.7 million Chinese adults. *JAMA Network Open*. 2018;1(4):e181271. doi: 10.1001/jamanetworkopen.2018.1271
20. Adegoke O, Ozoh OB, Odeniyi IA, Bello BT, Okubadejo NU. Prevalence of obesity and an interrogation of the correlation between anthropometric indices and blood pressures in urban. *Scientific Report*. 2021;1–12. doi: 10.1038/s41598-021-83055-w
21. Saxton SN, Clark BJ, Withers SB, Eringa EC, Heagerty AM. Mechanistic links between obesity, diabetes, and blood pressure: role of perivascular adipose tissue. *Physiological Reviews*. 2019;99(4):1701–63. doi: 10.1152/physrev.00034.2018
22. Khalid F, Siddique A, Siddiqui JA, Panhwar G, Singh S, Anwar A, et al. Correlation between body mass index and blood pressure levels among hypertensive patients: a gender-based comparison. *Cureus*. 2020;12(10):e10974. doi: 10.7759/cureus.10974
23. Chaudhary S, Alam M, Singh S, Deuja S, Karmacharya P, Mondal M. Correlation of blood pressure with body mass index, waist circumference and waist by hip ratio. *Journal of Nepal Health Research Council*. 2019;16(41):410–3. doi: 10.33314/jnhrc.v16i41.1560
24. Fu W, Cao S, Liu B, Li H, Song F, Gan Y, et al. Association of general and central adiposity with blood pressure among Chinese adults. *Journal of Hypertension*. 2018;36(12):2406–13. doi: 10.1097/HJH.0000000000001852