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CORRELATION OF BLOOD PRESSURE WITH ABDOMINAL CIRCUMFERENCE AND LDL IN ADULT MALES

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ABSTRACT
Hypertension remains a major public health burden in Indonesia, contributing substantially to cardiovascular morbidity and mortality. Central obesity and elevated low-density lipoprotein (LDL) have been proposed as modifiable risk factors, yet empirical evidence from community settings in Kalimantan remains limited. This study aimed to examine the correlation of blood pressure with abdominal circumference and LDL levels among adult males. An observational cross-sectional study was conducted at Puskesmas Pekauman, Banjarmasin Selatan, from September to November 2023. Thirty-two adult males aged 26 to 45 years were recruited through purposive sampling. Abdominal circumference, blood pressure, and LDL were measured using standardized protocols. Data were analyzed using the Pearson correlation test following normality verification with the Shapiro-Wilk test. Pearson analysis revealed no significant correlation between systolic or diastolic blood pressure and abdominal circumference ($p = 0.516$ and $p = 0.133$, respectively). Similarly, no significant correlation was found between systolic or diastolic blood pressure and LDL ($p = 0.691$ and $p = 0.081$, respectively). Blood pressure showed no significant correlation with abdominal circumference or LDL among adult males in this community sample. Further studies with larger samples and additional confounder controls are warranted.

Keywords: abdominal circumference; adult male; blood pressure; hypertension; low-density lipoprotein

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INTRODUCTION

Hypertension represents one of the principal public health challenges in Indonesia, owing to its high prevalence and strong association with elevated cardiovascular risk. According to the Institute for Health Metrics and Evaluation in 2017, of 1.7 million deaths recorded in Indonesia, approximately 23.7 percent were attributable to elevated blood pressure. The Indonesian Basic Health Survey (Riskesdas) in 2018 further reported that South Kalimantan Province had the highest prevalence of hypertension in the country, at 44.1 percent. The Banjarmasin City Health Office documented a 12.7 percent increase in hypertension cases from the preceding year, reaching 46,803 cases in 2021 (Badan Penelitian dan Pengembangan Kesehatan, 2019; Dinkes Kota Banjarmasin, 2022; Forouzanfar et al., 2017). These figures underscore the urgency of identifying modifiable risk factors that can be targeted through community-based interventions.

Central obesity is widely recognized as one of the most prominent modifiable risk factors for hypertension. In 2017, Banjarmasin recorded the highest obesity prevalence among districts in South Kalimantan, at 32.5 percent. Excess visceral adiposity contributes to elevated blood pressure through increased peripheral resistance, sympathetic activation, and metabolic dysregulation. Abdominal circumference and low-density lipoprotein (LDL) cholesterol serve as practical and inexpensive indicators for identifying these conditions in primary care settings (Hou & Yang, 2024; Meher et al., 2023). Their routine measurement may enable early detection of cardiovascular risk among asymptomatic adults.

Abdominal circumference and LDL reflect the burden of adiposity and atherogenic lipids, both of which have been implicated in the pathophysiology of hypertension. A study by Chen & Cheng (2022) demonstrated that elevations in LDL and abdominal circumference exert significant effects on the occurrence of hypertension. The rising burden of hypertension in South Kalimantan is therefore hypothesized to parallel the high prevalence of obesity within the community. The present study aimed to examine the correlation of blood pressure with abdominal circumference and LDL levels in adult males residing in the catchment area of Puskesmas Pekauman, Banjarmasin Selatan. The findings are expected to inform screening strategies that can support the prevention and early management of hypertension in this population.

Recent evidence has strengthened the role of abdominal obesity as one of the most influential modifiable determinants of hypertension. A multicountry cross-sectional analysis involving 46 low- and middle-income countries identified obesity as the leading modifiable risk factor for elevated blood pressure, accounting for approximately 38% of the population-attributable risk (Hou & Yang, 2024). Likewise, a systematic review reported that obesity, physical inactivity, smoking, excessive salt intake, and unhealthy lifestyles consistently increase the likelihood of hypertension among adults (Alfaqeeh et al., 2023; Surya et al., 2022; Zhang et al., 2022). These findings indicate that anthropometric measurements, particularly abdominal circumference, provide a practical approach for identifying individuals at increased cardiovascular risk before the onset of clinical complications.

Although numerous studies have reported significant associations between abdominal obesity and hypertension, the available evidence remains inconsistent across populations and study settings. Several large observational studies demonstrated that waist circumference independently predicts hypertension regardless of body mass index, whereas other investigations suggested that age, physical activity, metabolic adaptation, and population characteristics may modify this relationship. Similarly, LDL cholesterol has frequently been associated with elevated systolic and diastolic blood pressure, yet these associations have not been consistently observed in all community-based studies. Evidence from South Kalimantan, particularly among adult males in primary healthcare settings, remains scarce. Therefore, further investigation is required to clarify whether abdominal circumference and LDL are significantly correlated with blood pressure in this specific population.

METHOD

An observational analytic study with a cross-sectional design was conducted from September through November 2023 at Puskesmas Pekauman, Banjarmasin Selatan District, Banjarmasin City. The study population comprised 32 adult males aged 26 to 45 years residing in the catchment area of the health center. Subjects were selected using purposive sampling according to predefined inclusion criteria, which included willingness to participate, absence of antihypertensive medication use, and no history of smoking. Sample size was determined based on feasible enrollment within the study period and consistent with prior community-based investigations in similar settings.

The instruments used included a calibrated weighing scale, waist ruler, digital sphygmomanometer, Dirui CS-T180 clinical chemistry analyzer, plain blood collection tubes, alcohol swabs, tourniquet, and 3 mL syringes. Abdominal circumference was measured at the level of the umbilicus using a waist ruler, with the subject standing and at the end of a normal expiration. LDL was measured indirectly from venous blood samples analyzed with the Dirui CS-T180 analyzer, and values were derived using the Friedewald formula based on total cholesterol, triglycerides, and high-density lipoprotein (HDL) cholesterol. Blood pressure was measured twice using a digital sphygmomanometer on the right arm, with an interval of at least five minutes between readings; the average of the two measurements was used for analysis. All measurements were performed by trained health professionals following standardized protocols.

Data normality was assessed using the Shapiro-Wilk test. Because LDL values were not normally distributed, they were log10-transformed prior to analysis. The Pearson correlation test was then applied to evaluate the relationship between blood pressure (systolic and diastolic) and both abdominal circumference and LDL. A p value of less than 0.05 was considered statistically significant. Ethical clearance was obtained from the relevant institutional review board, and written informed consent was secured from all participants prior to data collection.

RESULT

The characteristics of the 32 adult male respondents, stratified by age group, are summarized in Table 1. The sample was equally distributed across the younger (26 to 35 years) and older (36 to 45 years) adult subgroups, with a mean age of 35.9 ± 6.41 years. Abdominal circumference measurements revealed that 31 respondents (96.9 percent) had values of 90 cm or greater, with a mean of 102.75 ± 7.09 cm. LDL levels were elevated, with 19 respondents (59.4 percent) recording values of 100 mg/dL or greater, and a sample mean of 124.0 ± 45.03 mg/dL. Despite these elevated adiposity and lipid markers, mean systolic and diastolic blood pressure values remained within the normal range at 135.0 ± 15.22 mmHg and 87.07 ± 11.82 mmHg, respectively.

Older respondents (36 to 45 years) tended to have larger abdominal circumference and higher LDL, whereas younger respondents (26 to 35 years) maintained relatively normal blood pressure readings. The results of the Pearson correlation analysis are presented in table 2 and table 3.

Table 1.
Respondent characteristics by age group (N = 32)

Characteristic	Category	26 to 35 y, n (%)	36 to 45 y, n (%)	Total, n (%)	Mean ± SD
Age	26 to 35 y	16 (50.0)	0 (0.0)	16 (50.0)	35.9 ± 6.41
	36 to 45 y	0 (0.0)	16 (50.0)	16 (50.0)	
Abdominal circumference	< 90 cm	0 (0.0)	1 (3.1)	1 (3.1)	102.75 ± 7.09
	≥ 90 cm	15 (46.9)	16 (50.0)	31 (96.9)	
LDL	< 100 mg/dL	5 (15.6)	8 (25.0)	13 (40.6)	124.0 ± 45.03
	≥ 100 mg/dL	8 (25.0)	11 (34.4)	19 (59.4)	
Systolic blood pressure	< 140 mmHg	13 (40.6)	10 (31.3)	23 (71.9)	135.0 ± 15.22
	≥ 140 mmHg	3 (9.4)	6 (18.8)	9 (28.1)	
Diastolic blood pressure	< 90 mmHg	11 (34.4)	10 (31.3)	21 (65.6)	87.07 ± 11.82
	≥ 90 mmHg	5 (15.6)	6 (18.8)	11 (34.4)	

As shown in table 1, the younger age group (26 to 35 years) exhibited a higher proportion of normal abdominal circumference and LDL values, while the older age group (36 to 45 years) demonstrated a greater concentration of elevated values. Nevertheless, mean blood pressure in both subgroups remained within the normal range, which diverges from the expected theoretical relationship in which higher abdominal circumference and LDL should correspond to higher blood pressure. This pattern may be explained by lower fat accumulation in younger adults due to higher physical activity, as well as preserved capacity for blood pressure regulation that compensates for metabolic changes. The Pearson correlation analysis presented in Table 2 indicates that neither systolic nor diastolic blood pressure was significantly correlated with abdominal circumference ($p = 0.516$ and $p = 0.133$, respectively).

Table 2.
Pearson correlation analysis of blood pressure and abdominal circumference (N = 32)

Variables	p value
Systolic blood pressure and abdominal circumference	0.516
Diastolic blood pressure and abdominal circumference	0.133

Similarly, table 3 demonstrates that systolic and diastolic blood pressure showed no statistically significant correlation with LDL ($p = 0.691$ and $p = 0.081$, respectively).

Table 3.
Pearson correlation analysis of blood pressure and LDL (N = 32)

Variables	p value
Systolic blood pressure and LDL	0.691
Diastolic blood pressure and LDL	0.081

Overall, the correlation analyses yielded p values greater than 0.05 for all four variable pairs, indicating that blood pressure was not significantly associated with either abdominal circumference or LDL in this sample of adult males.

DISCUSSION

The absence of a significant correlation between blood pressure and abdominal circumference in the present study diverges from the findings of Sun et al. (2021, 2024) reported a significant association between these variables. A plausible explanation for this discrepancy relates to the functional integrity of lipid transfer from the vascular lumen to subcutaneous adipose tissue, particularly among younger adults. The enzyme lipoprotein lipase, which converts triglycerides into free fatty acids for storage within subcutaneous adipocytes, continues to operate optimally in this age group. Excess fat therefore tends to accumulate in the abdominal subcutaneous compartment rather than within the vascular lumen, helping to preserve vascular compliance and limit changes in peripheral resistance that would otherwise elevate blood pressure (El Meouchy et al., 2022; Hou & Yang, 2024; Parvanova et al., 2023).

In older adults, the progressive aging of the metabolic regulatory system contributes to a decline in the activity of lipoprotein lipase, which reduces the conversion of triglycerides into free fatty acids and thereby impairs lipid uptake into adipocytes. As a consequence, circulating LDL levels rise and accumulate within the vascular lumen, increasing peripheral resistance. Concurrently, excess fat is deposited in the abdominal subcutaneous layer, leading to enlargement of abdominal circumference (Su et al., 2024; Sun et al., 2024). Despite these age-related changes, the present sample did not demonstrate a statistically significant correlation, possibly because the magnitude of these changes was not yet sufficient to produce measurable effects on blood pressure within the limited sample size.

Regarding LDL, the present findings contrast with the study by Chen & Cheng (2022), which identified a significant correlation between LDL and both systolic and diastolic blood pressure in a sample of 62,957 Chinese adults. This discrepancy is most likely attributable to differences in sample size and respondent characteristics. Larger samples yield more stable means and standard deviations and are more representative of true population parameters, whereas smaller samples are more susceptible to random variation and may fail to detect modest but genuine associations.

According to the American Heart Association, LDL values below 100 mg/dL are considered optimal, whereas higher values increase the risk of atherosclerosis and subsequent cardiovascular events. In the present study, mean LDL exceeded the recommended threshold, a pattern largely driven by older respondents whose LDL receptor activity is reduced, leading to impaired hepatic clearance of circulating LDL (Li et al., 2021; Shams et al., 2022). Despite elevated LDL, mean blood pressure remained within normal limits, primarily due to the influence of younger respondents whose regulatory mechanisms for blood pressure compensation remain intact. In younger adults, vessels retain elasticity, allowing smooth muscle relaxation to reduce peripheral resistance and maintain stable blood pressure.

Furthermore, none of the respondents were active smokers and none reported a family history of hypertension, two factors known to elevate blood pressure through nicotinic receptor-mediated vasoconstriction and inherited genetic variants, respectively (Alinaitwe et al., 2024; Debora et al., 2023; Meher et al., 2023). The absence of these risk factors may have contributed to the preservation of normal blood pressure values despite the presence of elevated abdominal

circumference and LDL. Several limitations of the present study should be acknowledged. Factors including physical activity, dietary patterns, alcohol consumption, and detailed family history were not assessed and may have confounded the observed associations. Information bias may also have occurred during confirmation of fasting status prior to blood sampling, potentially affecting the accuracy of LDL computation through the Friedewald formula.

CONCLUSION

Based on the analyses conducted, no statistically significant correlation was observed between systolic and diastolic blood pressure and abdominal circumference ($p = 0.516$ and $p = 0.133$, respectively) or LDL ($p = 0.691$ and $p = 0.081$, respectively). These findings suggest that, within this community sample of adult males, blood pressure, abdominal circumference, and LDL do not appear to influence one another in a measurable way. Community members are encouraged to maintain healthy lifestyles and dietary habits and to undergo regular health screening and consultation, particularly with regard to blood pressure. Future studies should recruit larger samples and incorporate additional confounding factors, such as physical activity, dietary patterns, alcohol consumption, and family history, to provide a more comprehensive understanding of the relationships among these variables.

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