

CORRELATION OF CHOLESTEROL LEVELS AND BLOOD PRESSURE IN HYPERTENSION PATIENTS AT THE KIDNEY & HYPERTENSION POLYCLINIC, TABANAN HOSPITAL

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ABSTRACT

Blood pressure can increase because the walls of blood vessels become narrow and stiff due to the accumulation of cholesterol in the body. This study aims to determine the correlation between blood pressure and cholesterol levels in hypertension patients. This study was a cross-sectional study from secondary data on hypertension patients at the Kidney & Hypertension Polyclinic at RSUD Tabanan who met the inclusion and exclusion criteria. The minimum sample size required is 51 people. Of the 51 research subjects, 26 people (51%) were women and 25 people (49%) were men, 19 patients (37.25%) had grade 1 hypertension and 32 patients (62.75%) had grade 2 hypertension. Total cholesterol and LDL levels were found to be significantly higher in patients with grade 2 hypertension compared to grade 1 hypertension with $p < 0.05$. Pearson correlation analysis showed a correlation between total cholesterol levels and systolic blood pressure ($r = 0.456$, $p = 0.001$), but no correlation was found between total cholesterol levels and diastolic blood pressure ($r = 0.036$, $p = 0.804$). Meanwhile, Spearman correlation analysis showed a correlation between LDL cholesterol levels and systolic ($r = 0.414$, $p = 0.003$) and diastolic ($r = 0.428$, $p = 0.002$) blood pressure. The results of this study show that total cholesterol levels with systolic blood pressure and LDL cholesterol with systolic and diastolic blood pressure have a positive correlation with moderate strength. However, further research is needed with prospective methods to obtain a direct relationship between cholesterol levels and blood pressure.

Keywords : Hypertension., Total cholesterol., LDL cholesterol

INTRODUCTION

Hypertension is a condition where an individual's blood pressure is 140/90 mm Hg or more and/or is using antihypertensive drugs.¹ The diagnosis of hypertension is made when a person exceeds the normal blood pressure threshold. Based on data from the World Health Organization (WHO) in 2021, it is estimated that 1.28 billion people worldwide with an age range of 30-79 years experience hypertension, of which two-thirds come from middle and low-income countries. Apart from that, data from WHO also shows that 46% of adults who suffer from hypertension are not aware that they suffer from hypertension.² The prevalence of hypertension in the world is also predicted to increase to 1.5 billion people in 2025 and 10.44 million deaths worldwide are attributed to hypertension and its complications each year.³

In 2018, the percentage of Indonesians with hypertension was 31.7%.⁴ The prevalence of hypertension in Bali is also quite high. Based on 2018 Riskesdas data, it states that the prevalence of hypertension in Bali is 30.97%. This data shows a fairly high increase compared to the Riskesdas data in 2013 which was only 21.17%. Bali is included in the 20 provinces with the highest prevalence of hypertension compared to other provinces in Indonesia.⁵

Because it has the potential to be fatal, hypertension is often known as the silent killer.⁶ When blood pressure remains high accompanied by a buildup of cholesterol on the walls of the arteries, it will cause blood vessels to be damaged. In this situation, the arteries will narrow so that the workload of the circulatory system increases and at the same time reduces its

efficiency. This increases the risk of cardiovascular complications and life-threatening conditions.⁷

Hypercholesterolemia is characterized by a condition when the cholesterol level in a person's blood is too high. High levels of LDL, or low-density lipoprotein, and total cholesterol in the blood are the result of hypercholesterolemia.⁸ Studies show that hypercholesterolemia can play a role in increasing blood pressure in patients with hypertension.⁹ Narrowing and stiffness of blood vessel walls due to cholesterol buildup plays an essential role in increasing blood pressure. Both directly and indirectly, lipids can trigger hypertension through various mechanisms.¹⁰

Research regarding the relationship between hypercholesterolemia and blood pressure is still not widely studied and shows conflicting results. A study by Umar & Mariana (2021) on the relationship between high total cholesterol levels and systolic and diastolic pressure was found to be significantly related.¹¹ However, in research conducted by Ulfah et al. (2017), this study clarified that low-density lipoprotein cholesterol may have an increased effect on AT1 receptor regulation or impede endothelial function. The results showed that there was a significant correlation with systolic blood pressure but not with diastolic blood pressure or total cholesterol levels.¹² Until now, not much research has been conducted in Bali on the relationship between cholesterol levels and blood pressure. Therefore, the author wants to conduct further research on the correlation between cholesterol levels and blood pressure in patients suffering from hypertension at the Kidney & Hypertension Polyclinic at Tabanan Hospital.

MATERIALS AND METHODS

This analytical study used a cross-sectional methodology. Secondary data from the patient's medical records was used for the research. This research was conducted at the Kidney & Hypertension Polyclinic, Tabanan Regional Hospital, which was carried out from April to June 2023. The study's participants were individuals with hypertension in Tabanan Regency. The samples were hypertension patients who were controlled at the Kidney & Hypertension Polyclinic at Tabanan District Hospital and fulfilled the inclusion and exclusion criteria. Inclusion criteria were patients aged 18 - 60 years, systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg, or on anti-hypertensive drug treatment, and had data on total cholesterol and LDL cholesterol levels from medical records. Meanwhile, the exclusion criteria were patients with Chronic Kidney Disease (CKD) stage 4 or 5 or regular hemodialysis CKD, suffering from diabetes mellitus, obesity, smoking, parental history of hypertension, use of birth control pills, and alcohol drinkers. The minimum sample size required were calculated using the sample size formula for correlation with a one-way hypothesis. Based on that calculation, the minimum sample required were 51 people and determined consecutively.

The collected data was then analyzed for normality of data on cholesterol levels and blood pressure levels using the Kolmogorov-Smirnov normality test. The Pearson correlation test is used for data that is normally distributed, and the Spearman correlation test is used for data that is not normally distributed. This research has received ethical feasibility before data collection is carried out, with ethical feasibility numbers are 103/UN14.2.2.VII.14/LT/2023.

RESULTS

Of the 96 research subjects who attended the Kidney and Hypertension Polyclinic during the period April – June 2023, 51 people met the inclusion criteria. A total of 51% (26/51) were women and 49% (25/51) were men. Based on comorbidities, only 27.5% (14/51) were accompanied by disorders other than hypertension, namely CKD stage 3 (6/14), CKD stage 2 (2/14), osteoarthritis (2/14), benign prostatic hyperplasia (1/14), gastroesophageal reflux (1/14), nasopharyngeal malignancy (1/14), and kidney stones (1/14). The study's respondents were 50 years old on average with the youngest being 32 years old and the oldest being 60 years old. The average systolic blood pressure of respondents was 158.98 mmHg (min 140, max 190). Meanwhile, the average diastolic blood pressure of the respondents was 96 mmHg (min 85, max 110). The characteristics of the respondents can be seen in **Table 1**.

Table 1. Characteristics of Respondents

Variable	Value
Age (years)	50.68 (min 32, max 60)
BMI (Kg/M ²)	23.73 (min 18.4, max 24.9)
Systolic blood pressure (mmHg)	158.98 (min 140, max 190)
Diastolic blood pressure (mmHg)	96.07 (min 85, maks 110)
Hemoglobin (g/dL)	14.15 \pm 1.67
Leukocytes (10 ³ /uL)	7.45 \pm 1.93
Platelets (10 ³ /uL)	272.3 \pm 85.08
Blood urea nitrogen (mg/dl)	15.91 (min 6, maks 88)
Serum creatinine (mg/dl)	1.05 (min 0.44, maks 2.8)
Uric acid (mg/dl)	6.33 \pm 1.38

Based on the levels of systolic and diastolic blood pressure in patients, 37.25% (19/51) of patients had grade 1 hypertension and 62.75% (32/51) had grade 2 hypertension. The lipid profile of patients can be grouped according to their hypertension grade as shown in **Table 2**.

Table 2. Lipid Profile Overview

Lipid Profile	Hypertension Grade 1	Hypertension Grade 2
Total Cholesterol (mg/dl)	254.47 \pm 31.71	278.15 \pm 36.42
LDL (mg/dl)	129.89 \pm 28.80	154.28 \pm 37.35
HDL (mg/dl)	42.31 \pm 10.01	47.31 \pm 12.27
Triglycerides (mg/dl)	210.26 \pm 107.15	190.75 \pm 108.79

Based on the correlation test carried out, a significant positive correlation was obtained between total cholesterol levels and systolic blood pressure levels ($p < 0.05$ and $r = 0.456$). The higher the total cholesterol level, the higher the systolic blood pressure level. However, there was no correlation between total cholesterol levels and diastolic blood pressure levels ($p = 0.804$ and $r = 0.036$).

In addition, this study found a significant positive correlation between LDL cholesterol levels and systolic blood pressure levels ($p < 0.05$ and $r = 0.414$). The higher the LDL cholesterol level, the higher the systolic blood pressure level. Likewise, a significant positive correlation was found between LDL cholesterol levels and diastolic blood pressure levels ($p < 0.05$ and $r = 0.428$). The higher the LDL cholesterol level, the higher the diastolic blood pressure level. The correlation between total and LDL cholesterol levels with systolic and diastolic blood pressure levels is shown in **Table 3**.

Table 3. Correlation of Cholesterol Levels with Blood Pressure Levels

Cholesterol	Blood Pressure		Correlation Test
	Systolic	Diastolic	
Total Cholesterol	r =0.456 p =0.001	r =0.036 p =0.804	Pearson
LDL	r =0.414 p =0.003	r =0.428 p =0.002	Spearman's

DISCUSSION

In this study, women were found to have hypertension more than men. These results are similar to the demographic characteristics in research by Umar & Mariana (2021). In this research, it was found that the majority of the research sample were women, namely 70.1%. Women in general are more alert to the symptoms of disease and have more awareness of getting themselves checked, so that more women suffer from hypertension who come to the hospital to get checked.¹¹ One of the risk factors for hypertension is age, because a decrease in the elasticity of peripheral blood vessels causes peripheral vascular resistance to increase, which ultimately causes hypertension.¹³

The description of the lipid profile in patients with hypertension showed that the levels of total cholesterol, LDL cholesterol and HDL cholesterol were higher in the group of patients with grade 2 hypertension compared to the group of patients with grade 1 hypertension. The results of this description of the lipid profile showed similar results to research by Nayak et al., (2016). Dyslipidemia plays a role in endothelial dysfunction which plays a central role in the pathogenesis of atherosclerosis, thrombosis, insulin resistance and hypertension. Triglyceride-rich lipoproteins and LDL cholesterol have been shown to be toxic to endothelial cells, whereas HDL cholesterol is protective.¹⁴ High total cholesterol levels are a common lipid profile feature in hypertensive patients. An increase in total cholesterol levels in the blood will result in plaque buildup in the blood vessels. The faster the heart beats, the higher the blood pressure because this plaque buildup can narrow the blood vessels.¹³

A significant positive correlation was found in this study between total cholesterol levels and systolic blood pressure levels. The correlation value of 0.456 indicates a positive correlation with moderate correlation strength. These results are similar to several previous studies. Research by Chen et al., (2021) and Umar & Mariana (2021) shows that there is a significant correlation between total cholesterol levels and systolic blood pressure with correlation coefficients of 0.33 and 0.509.^{11,15} When the body has both high blood pressure and high cholesterol at the same time, the two can interact and accelerate the deterioration of the heart and blood vessels. Many mechanisms, including atherosclerosis due to lipid accumulation, alter the structure of blood vessels, affecting total cholesterol values and systolic blood pressure. Hypertension can be caused by fat through various mechanisms, both directly and indirectly, and diet and high fat intake are the main factors. This is associated with reduced elasticity of large arteries, which plays a role in the main pathophysiology of arterial hypertension in the elderly. In addition, increased blood pressure

due to changes in vasomotor activity mediated by nitric oxide and hyperinsulinemia are impacts of dyslipidemia.¹⁶

There was no correlation found in this study between diastolic blood pressure and total cholesterol. This result shows contradictory results to other research by Yusvita et al., (2022) which obtained a significant correlation with the strength of the correlation was relatively high ($r = 0.768$; $p = 0.001$).¹⁷ Several factors may explain these differences in results. Differences in age and gender distribution of populations between studies may influence the results.¹⁸ Biological interactions between risk factors may also influence these differences in outcomes. In addition, diastolic blood pressure can be influenced by many factors. These factors include resistance to arterial blood flow, blood volume, arterial elasticity, autonomic nervous system function, and many other factors. Therefore, although cholesterol can cause cardiovascular disease, cholesterol is not the only factor that influences diastolic blood pressure. Each person also has different genetic factors and their response to cholesterol levels and blood pressure can vary greatly. This can produce inconsistent results in population studies.¹⁹

Additional findings from this investigation also demonstrated a strong positive association between systolic and diastolic blood pressure with LDL cholesterol levels. Correlation values of 0.414 and 0.428 indicate a positive correlation with moderate correlation strength. Hypertension can be caused by atherosclerosis. Atherosclerosis is a hardening of the arteries characterized by fat deposits. The initial process of atherosclerosis begins when arterial endothelial cells are damaged due to excess free radicals (oxidative stress). Oxidized LDL is formed due to the reaction between free radicals and LDL. Then, monocytes together with oxidized LDL move towards the subendothelium. Monocytes turn into macrophages and then phagocytize oxidized LDL to form foam cells. This causes a buildup of foam cells on the walls of blood vessels. Later, vascular smooth muscle develops caused by macrophages and forms plaque, causing blood vessels to narrow.²⁰

Research by Umar & Mariana et al., (2021) found a significant relationship between increasing blood pressure levels and LDL cholesterol levels. This study clarified that low-density lipoprotein cholesterol may have an increased effect on AT1 receptor regulation or impeded endothelial function.¹¹ Apart from that, the atherosclerosis process can also play a role in the relationship between LDL levels and diastolic blood pressure. Atherosclerotic plaque can narrow arteries and increase resistance to blood flow.²¹

CONCLUSION

Patients with grade 2 hypertension were shown to have considerably higher average levels of total cholesterol, LDL, and HDL than those with grade 1 hypertension. Meanwhile, the average triglyceride level was higher in patients with grade 1 hypertension than grade 2 hypertension. The results showed that hypertension patients had a positive correlation between total cholesterol levels and systolic blood pressure, but there was no correlation between total cholesterol levels and diastolic blood pressure. In addition, in hypertension patients, LDL cholesterol levels have a positive correlation with moderate correlation strength.

Further research is needed with prospective methods using primary data to obtain a direct relationship between cholesterol levels and blood pressure. In addition, blood pressure measurements should be taken three times with a gap of 5 minutes and the results of the three measurements are included in the patient's medical record so that the results can be used as an average of the three measurements.

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