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The Relationship Between Cholesterol Levels and Blood Pressure in the Elderly

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Abstract. *Hypertension and hypercholesterolemia are two common comorbidities in the elderly and contribute greatly to the increased risk of cardiovascular disease. The two are often found together, but local data on the direct relationship between the two in the elderly population is limited. The purpose of this study is to find out whether there is a relationship between total cholesterol levels and blood pressure in the elderly. This study uses an observational analytical design with a cross-sectional approach. The subjects of the study were 16 elderly members of the posyandu in Balecatur, Sleman, who met the inclusion criteria. Blood pressure was measured using a sphygmomanometer, and total cholesterol levels were measured using a point-of-care device. Data were analyzed using the chi-square test to determine the relationship between cholesterol levels and hypertension. Of the total 16 respondents, as many as 13 people (81.25%) had blood pressure in the hypertension category, and 13 people (81.25%) had total cholesterol levels ≥200 mg/dL. The results of the statistical test showed that there was a significant relationship between cholesterol levels and blood pressure, with a value of p = 0.018 (p < 0.05). From this study, it was found that there was a significant relationship between cholesterol levels and blood pressure in the elderly. These findings confirm the importance of integrated screening for dyslipidemia and hypertension in promotive and preventive programs in the elderly population.*

Keywords: *Hypertension, Hypercholesterolemia, Elderly, Blood pressure, Dyslipidemia*

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INTRODUCTION

Non-communicable diseases (NCDs) such as hypertension and dyslipidemia are a growing global health burden, especially in the elderly population (Dai et al., 2024). Hypertension, as a chronic condition with systolic blood pressure ≥140 mmHg and/or diastolic blood pressure≥90 mmHg, is a major risk factor for coronary heart disease, stroke, and kidney failure. Dyslipidemia, specifically hypercholesterolemia, which is characterized by increased levels of total cholesterol and/or low-density lipoprotein (LDL), also has a significant role in the process of atherosclerosis and cardiovascular complications (Gaggini et al., 2022).

According to WHO, hypertension can be diagnosed if blood pressure is consistent>140 at systolic pressure and/or >80 mmHg at diastolic pressure at two measurements with a span of time and under conditions of calm or sufficient rest (Muntner et al., 2019). Hypertension is also one of the degenerative diseases in which blood pressure increases slowly with age. Risk factors for hypertension that cannot be changed include age, gender, family history, and genetics

(Ranasinghe et al., 2015). WHO states that developing countries have a morbidity percentage of 40% while developed countries are 35%. The prevalence of hypertension in Indonesia is quite high, based on the results of the 2018 Riskesdas is 34.1% (Maharani et al., 2022). This figure is higher than in 2013, which touched the prevalence rate of 25.8%. The results are the incidence of hypertension based on the results of blood pressure measurement in Indonesians aged 18 years and older (Hussain et al., 2016).

Studies have also highlighted an interaction between hypertension and dyslipidemia in increasing arterial stiffness and worsening endothelial function. Lai et al. (2025) showed that a high LDL/HDL ratio significantly correlated with an increased risk of hypertension in middle age and the elderly in a longitudinal analysis of CHARLS (China Health and Retirement Longitudinal Study) data (Lai et al., 2025) In addition, endothelial dysfunction induced by hypercholesterolemia is known to decrease the bioavailability of nitric oxide (NO) and increase vascular resistance, which further triggers or aggravates hypertension (John & Schmieder, 2003).

The combination of hypertension and dyslipidemia (hypercholesterolemia) can lead to a much higher risk of ischemic stroke than if only one of the factors (Stokes et al., 2002). Increased levels of cholesterol in the blood and hypertension at a young age are often associated with an increase in cardiovascular disease in old age (Thomas et al., 2002) Increased blood cholesterol levels, especially the ratio between LDL and HDL, can lead to hypertension (Lai et al., 2025) and vice versa, hypertension can lead to endothelial damage to blood vessels and lead to dyslipidemia (Dąbrowska & Narkiewicz, 2023).

The elderly are an age group with a high risk of experiencing hypertension and dyslipidemia due to physiological changes related to aging, such as decreased arterial elasticity and lipid metabolism disorders (Chia et al., 2018; Ciumărnean et al., 2021). Previous research has shown that increasing age is closely related to increased blood pressure and blood cholesterol levels simultaneously, making these two conditions often found as comorbidities in the elderly (Zhang et al., 2019). Although the theoretical link between hypertension and dyslipidemia has been widely proposed, local empirical data, particularly in the elderly population at the community level, are still limited. Therefore, this study aims to evaluate whether there is a relationship between hypertension and hypercholesterolemia in elderly subjects. The results of this study are expected to contribute to the development of integrated strategies for the prevention and management of cardiovascular diseases in the elderly population.

METHODS

This study employed a descriptive quantitative design with a cross-sectional analytic approach. The cross-sectional design was chosen because it allows for the simultaneous measurement of exposure (cholesterol levels) and outcome (hypertension status) in a defined population at one point in time, thereby providing a snapshot of the relationship between the two variables without intervention. The research was carried out at the elderly *posyandu* (community health post) located in Balecatur, Sleman, Yogyakarta, Indonesia. The *posyandu* serves as a routine monthly health service for older adults, where health cadres and health workers provide simple examinations such as blood pressure and cholesterol checks. The study population consisted of elderly individuals aged 60 years and above who were active members of the *posyandu*. Sixteen respondents participated in this study, consisting of men and women aged between 60 and over 70 years. A consecutive sampling technique was used, meaning that all elderly members present during the data collection period who met the eligibility criteria were included. The total number of participants reflected the number of elderly individuals available and willing to undergo the examinations on the day of the study.

Inclusion criteria were: (1) elderly participants aged 60 years and older, (2) registered members of the *posyandu*, and (3) willingness to take part in the study procedures. Participants were excluded if they declined examination, were acutely unwell at the time of measurement, or were unable to complete the assessment process. Blood pressure was measured using a standard manual sphygmomanometer. Measurements were carried out by trained health workers with the

participants seated comfortably, their back supported, and their arm placed at heart level. Participants were asked to rest for several minutes before measurement to minimize temporary increases in blood pressure due to physical activity or stress. Both systolic and diastolic pressures were recorded, and hypertension was defined according to WHO guidelines as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg. Total cholesterol levels were measured using a point-of-care device with a capillary blood sample obtained by finger prick. This method was chosen because it is simple, practical, and feasible for use in community-based settings such as the *posyandu*. A cholesterol level of ≥200 mg/dL was categorized as hypercholesterolemia.

All data collected were first checked for completeness and accuracy before being entered into a spreadsheet for processing. Descriptive statistics were used to present the distribution of demographic characteristics, cholesterol status, and hypertension prevalence in frequency and percentage. To test the relationship between hypercholesterolemia and hypertension, the chi-square test was applied. The strength of association was presented as an odds ratio (OR) with 95% confidence intervals (CI). Statistical significance was determined at a p-value <0.05.

RESULT AND DISCUSSION

The total 16 elderly respondents involved in the study, the majority were women, namely 12 people (75%), while there were only 4 men (25%). Most of the respondents (13 people or 81.25%) had hypertension, while only 3 people (18.75%) had normal blood pressure. Likewise, in the cholesterol level parameters, 13 respondents (81.25%) were classified as hypercholesterolemic, and only 3 respondents (18.75%) had normal cholesterol levels. This data shows the dominance of elderly women in the study, as well as the high prevalence of hypertension and hypercholesterolemia in this population (Table 1).

Table 1. Subjects Characteristics

No	Variable	n (%)
1	Male	4 (25)
2	Female	12 (75)
3	Hypertension	13 (81,25)
4	Hypercholesterolemia	13 (81,25)

The results of blood pressure measurement showed that only 3 respondents (18.75%) had normal blood pressure, while most respondents, namely 13 people (81.25%), were in the hypertension category. This suggests that hypertension is a major health problem that is very common in the elderly, who were the study respondents (Table 2).

Table 2. Distribution of Blood Pressure Frequency in Subjects

Blood pressure	Total	(%)
Normal	3	18.75
Hypertension	13	81.25
Total	16	100.0

As many as 13 out of 16 respondents (81.25%) were known to have total cholesterol levels ≥200 mg/dL, which is classified as hypercholesterolemia. Only 3 respondents (18.75%) had cholesterol levels within normal limits. These findings reinforce the impression that hypercholesterolemia is a very common condition in the elderly and has the potential to be a risk factor for the high incidence of hypertension in this population (Table 3).

Table 3. Frequency Distribution of Cholesterol Levels in Subjects

Cholesterol	Total	(%)
Normal	3	18.75
Hypercholesterolemia	13	81.25
Total	16	100.0

From the data collection, it was obtained that there were 3 subjects with normal cholesterol levels, consisting of 2 people (12.5%) with normal blood pressure, and only 1 person (6.25%) with hypertension. A total of 13 subjects with high cholesterol levels (hypercholesterolemia), consisting of 12 people (75%) suffering from hypertension, while only 1 person (6.25%) had normal blood pressure. There was a significant relationship between cholesterol levels and blood pressure in the elderly (p = 0.018). Odds *ratio* (OR) calculations of these data showed that elderly individuals with hypercholesterolemia had a 24-fold higher risk of developing hypertension compared to those with normal cholesterol levels (OR = 24.0; 95% CI due to small samples). This suggests a strong positive association, although the precision is limited (Table 4).

Table 4. The Relationship Between Cholesterol Levels and the Degree of Hypertension

Variables	Normal blood pressure (n/%)	Hypertension (n/%)	Total (n/%)	p	OR (95% CI)
Normo-cholesterol	2/12,5	1/6,25	3/18,75	0,018	24,0 (1,03–560,21)
Hypercholesterolemia	1/6,25	12/75	13/81,25		
Total	3/18,75	13/81,25			

This study showed a significant relationship between cholesterol levels and blood pressure in the elderly, with a value of p = 0.018. These results show that the elderly with high cholesterol levels have a greater chance of developing hypertension than those with normal cholesterol levels. These findings are in line with a study by Lai et al. that evaluated data from the China Health and Retirement Longitudinal Study (CHARLS) which stated that an increase in the LDL/HDL ratio significantly increases the risk of hypertension, both cross-sectionally and longitudinally, with odds ratios increasing proportionally to abnormal lipid ratios (Lai et al., 2025) The prevalence of hyperlipidemia is also increasing with age and less attention (Rosada et al., 2020)in addition to the risk of hypertension in the elderly (Egan et al., 2024).

Several biological mechanisms have explained the link between hypercholesterolemia and hypertension. First, hypercholesterolemia, especially high LDL levels, can cause vascular endothelial damage, lowering the production of nitric oxide (NO), which plays an important role in vasodilation. Damaged endothelium tends to increase vascular resistance, causing blood pressure to rise (Dąbrowska & Narkiewicz, 2023). Secondly, the accumulation of cholesterol in the walls of the arteries accelerates the process of atherosclerosis. Atheromatous plaques cause a decrease in the elasticity of blood vessels and an increase in systemic peripheral resistance, which is the basis of hypertension (Murakami, 2023). Third, high cholesterol can induce systemic inflammation and increase the activity of the renin-angiotensin-aldosterone (RAAS) system, aggravate vasoconstriction and sodium retention, and amplify blood pressure spikes (Brown, 2008; Vekic et al., 2023).

Fourth, a study from BMC Cardiovascular Disorders showed that the combination of hypertension and hypercholesterolemia significantly increased the risk of ischemic stroke (combined OR = 3.37). The combination of these two factors accelerates the clinical incidence of cardiovascular disease (Wang et al., 2022). This study states that hypercholesterolemia plays a significant role in the development of hypertension through several biological mechanisms that can be explained physiologically and have been proven in the global scientific literature. Early detection and management of these two conditions simultaneously are essential, especially in the elderly age group, to prevent more severe cardiovascular complications. Screening and joint management of hypertension and dyslipidemia is important to be carried out, especially in the elderly population.

Combination therapy, such as a low-saturated fat diet, regular physical activity, and the administration of statins and antihypertensives, has been shown to lower the risk of cardiovascular events. Guidelines from the European Society of Cardiology (ESC) recommend a multimodal approach in patients with this dual risk. This study has several important limitations,

such as a small sample size (n = 16) substantially limits statistical power, inflates proportion estimates, and widens confidence intervals. The high prevalence rates observed here may be exaggerated compared to larger populations. Despite these limitations, the observed association if confirmed in larger samples supports integrated screening for dyslipidemia and hypertension in elderly community settings. Management strategies should combine dietary counseling, physical activity promotion, and pharmacologic therapy where indicated, consistent with ESC guidelines for multimodal cardiovascular risk reduction.

CONCLUSION

Based on the results of data analysis in the study, it can be concluded that there is a statistically significant relationship between cholesterol levels and blood pressure in the elderly. The results of the chi-square test showed a value of p = 0.018 (p < 0.05), which indicates that the elderly with high cholesterol levels (hypercholesterolemia) have a greater risk of developing hypertension compared to the elderly who have normal cholesterol levels.

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