



FACTORS AFFECTING CHOLESTEROL LEVELS IN THE ELDERLY

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ABSTRACT

Hypercholesterolemia is a health condition that commonly affects the elderly and has the potential to trigger cardiovascular disease. Fluctuations in cholesterol levels are generally influenced by various factors, including dietary patterns, physical activity levels, smoking habits, age, and gender. To gain a deeper understanding of the various factors correlated with cholesterol levels among the elderly in the service area of the Kartasura Community Health Center, an analytical observational study using a cross-sectional design was conducted. The sample consisted of 105 elderly respondents selected through purposive sampling. The data collection instruments included the SQ-FFQ for dietary patterns, the GPAQ for physical activity, the FTND to assess tobacco dependence, and a POCT device to measure cholesterol. The validity of the instruments showed that the SQ-FFQ ranged from 0.30 to 20.50, the GPAQ was 0.48, and the FTND was >0.451. Meanwhile, the GPAQ reliability index ranged from 0.67 to 0.73, and the FTND was greater than 0.86. Data analysis utilized the chi-square test and logistic regression models. The data showed that the majority of older adults had cholesterol levels exceeding the normal threshold. Through bivariate analysis, a significant association was found between dietary patterns, physical activity levels, and smoking behavior and cholesterol levels, whereas age and gender were found to be unrelated. Based on the results of multivariate analysis, dietary patterns and physical activity were confirmed to have a significant influence, with dietary patterns acting as the strongest determining factor. Cholesterol profiles in the elderly population tend to be more influenced by behavioral or lifestyle variables, particularly dietary management and physical fitness.

Keywords: age; cholesterol; diet; levels; older adults; physical activity; smooking

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INTRODUCTION

Cholesterol is a fat-based compound produced endogenously by the body and plays a vital role in supporting biological functions. Approximately 25% of this compound is synthesized by the liver, while the remainder is obtained through daily nutritional intake. In balanced amounts, cholesterol is essential for maintaining cellular structure stability and stimulating hormone production (Susanti, Wiyanto, et al., 2024). Generally, cholesterol is divided into two main fractions: high-density lipoprotein (HDL), commonly known as “good cholesterol,” and low-density lipoprotein (LDL), or “bad cholesterol.” HDL’s role is focused on transporting excess cholesterol from tissues back to the liver for excretion. Conversely, excessive accumulation of LDL leads to plaque formation on the walls of blood vessels, which over time triggers various serious cardiovascular diseases such as stroke and coronary heart attack (Kemenkes, 2022).

The phenomenon of rising global cholesterol levels remains an unresolved medical challenge in many countries. Looking at macro data, the prevalence rate of adults with total hypercholesterolemia reached 39% in 2019, with a more widespread concentration in low-income regions than in developed countries ((World Heart Federation (WHF), 2025). The phenomenon of rising global cholesterol levels remains an unresolved medical challenge in many countries. Looking at macro data, the prevalence rate of adults with total hypercholesterolemia reached 39% in 2019, with a more widespread concentration in low-income regions than in developed countries(Kemenkes, 2022). Estimates from the Ministry of Health, as reviewed by Ahnia et al.

(2022), confirm that the prevalence of high cholesterol in Central Java in 2016 had reached 48.1%, with the age group over 60 years old accounting for the highest percentage at 58%.

Old age places individuals in a vulnerable position regarding cholesterol fluctuations due to natural biological decline. Aging is linearly associated with a decline in physical capacity and a slowing of metabolic rate, which ultimately impairs the body's efficiency in breaking down fat (Fatma et al., 2024). In addition to age, scientific evidence indicates that nutritional status, physical activity levels, smoking habits, biological factors related to gender, and genetic factors all play a role in influencing an individual's cholesterol levels (Ahnia et al., 2022).

An unbalanced diet, particularly one high in saturated fatty acids, has been identified as a major contributor to elevated serum cholesterol levels. Excessive consumption of saturated lipids has been shown to inhibit the LDL clearance pathway, thereby leading to the retention of total cholesterol in the bloodstream (Ahnia et al., 2022). On the other hand, consistent exercise or physical activity can stimulate an increase in the HDL fraction while reducing LDL concentrations, which in turn improves the overall lipid profile (Ningtyas et al., 2025). Therefore, the combination of a balanced diet and moderate physical activity is a key preventive measure in controlling the incidence of hypercholesterolemia in the elderly.

Exposure to cigarette smoke has also been identified as an external determinant that worsens cholesterol profiles. Toxic substances such as nicotine, tar, and carbon monoxide in cigarettes accelerate endothelial damage, trigger atherosclerosis, and disrupt lipid metabolism regulation (Mawardi et al., 2024). For heavy smokers (those who smoke more than 10 cigarettes per day), this exposure triggers the secretion of catecholamine hormones, which induce lipolysis. As a result, the release of free fatty acids increases, leading to massive synthesis of circulating LDL (Rachmatullah et al., 2020).

Uncontrolled hypercholesterolemia gradually leads to a variety of chronic complications, such as hypertension, stroke, coronary heart disease, and peripheral artery disease (Arif & Sandro, 2025). These clinical manifestations stem from LDL deposition in the arterial intima, which obstructs blood flow, thereby drastically reducing the oxygen supply to target organs (American Heart Association, 2024). Additionally, hormonal changes in postmenopausal older women further increase this risk. Estrogen deficiency leads to the loss of its protective effect against LDL oxidation, making it easier for "bad" cholesterol levels to rise (Prastiwi et al., 2021; Suwarriana et al., 2022).

Although previous studies have extensively explored the relationship between age, dietary patterns, physical activity, smoking status, and gender and cholesterol profiles, the conclusions reached still vary regarding which factors exert the most dominant influence on older adults. For this reason, more specific studies are absolutely necessary to determine the actual contribution of each variable in the elderly population. .

Based on preliminary data collected at the Kartasura Community Health Center, it was found that 142 elderly individuals diagnosed with hypercholesterolemia had visited for routine checkups. Information from local healthcare practitioners indicates that this high number stems from unhealthy lifestyle behaviors, including uncontrolled eating habits, a lack of physical activity, and a lifestyle that does not support physical fitness. This phenomenon suggests that risk factor management at the community level has not been optimal, even though health screening programs have been regularly promoted.

Based on the above background, this study was designed to identify factors associated with variations in cholesterol levels among the elderly in the service area of the Kartasura Community

Health Center, with a focus on dietary patterns, physical activity, smoking behavior, age, and gender. The findings of this study are projected to serve as a scientific basis for formulating preventive intervention programs to control hypercholesterolemia rates, thereby continuously improving the quality of life for the elderly.

METHOD

This study adopts a quantitative approach using an analytical observational method and a cross-sectional study design. Field data collection was conducted at the Kartasura Community Health Center (Puskesmas), with the study period spanning May through June 2026. The target population for this study included all elderly patients aged 60 years or older who were recorded as having accessed medical services at the Kartasura Community Health Center between June and November 2025, with a total population of 142 individuals. The sample size was calculated using the Slovin formula with a 5% margin of error, resulting in a sample quota of 105 subjects. The field sampling process relied on purposive sampling aligned with the fulfillment of inclusion and exclusion criteria (Amin et al., 2023). Inclusion criteria included being aged ≥ 60 years, being registered as an active patient at the Kartasura Community Health Center, providing written informed consent, and possessing adequate communication skills. Meanwhile, exclusion criteria targeted older adults with speech impairments or physical disabilities that made it difficult to complete the questionnaire, as well as individuals who withdrew from the study.

The primary data collection instruments used were the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) to map dietary patterns (Syauqy et al., 2021), the Global Physical Activity Questionnaire (GPAQ) to assess the level of physical activity (Abduloh et al., 2025), and the Fagerström Test for Nicotine Dependence (FTND) to calculate the level of nicotine dependence (Aryanti & Priastana, 2019). Cholesterol levels were measured using the Point-of-Care Testing (POCT) method, with categories of normal (<200 mg/dL) and high (≥ 200 mg/dL) (Purwanti & Oktaviani, 2023). The research instruments have undergone validity and reliability testing. The SQ-FFQ was found to be valid with correlations ranging from 0.30 to ≥ 0.50 and reliable based on weighted kappa values ranging from 0.20 to 0.53 (Syauqy et al., 2021). The GPAQ has moderate validity ($r = 0.48$) and good reliability with a Cronbach's alpha of 0.67–0.73 (Abduloh et al., 2025). The FTND was found to be valid with a calculated $r > \text{table } r$ ($>0.451 > 0.361$) and reliable with a Cronbach's alpha > 0.86 (Aryanti & Priastana, 2019).

The data analysis was conducted in stages, including univariate, bivariate, and multivariate tests. In the bivariate stage, the Chi-square correlation test was applied to identify whether there was a relationship between the variables of age, gender, dietary patterns, physical activity, and smoking status and cholesterol levels. The next step involved logistic regression modeling to determine which factors had the most dominant influence on cholesterol fluctuations in the elderly at a 95% confidence level ($\alpha=0.05$). The ethical feasibility of this research has been verified and approved by the Health Research Ethics Committee of Dr. Moewardi Regional General Hospital, as evidenced by the issuance of document number 792/IV/HREC/2026.

RESULT

Based on the results of the univariate analysis, the majority of respondents were young older adults (58.1%) and female (55.2%). Most respondents had dietary patterns in the “poor” category (43.8%), physical activity levels in the “moderate” and “high” categories (35.2% each), and did not smoke (52.4%). In addition, the majority of respondents had cholesterol levels in the high category (58.1%), while the remaining 41.9% were in the normal.

Table 1.
Characteristics of Respondents

Characteristics	f	%
Age		
Younger Seniors	61	58.1
Middle-Aged Seniors	44	41.9
Gender		
Male	47	44.8
Female	58	55.2
Diet		
Poor	45	43.8
Adequate	30	28.6
Good	29	27.6
Physical Activity		
Low	31	29.5
Moderate	37	35.2
High	37	35.2
Smoking		
Non-smoking	55	52.4
Low	22	21
Moderate	28	26.7
High	0	0
Cholesterol		
Normal	44	41.9
High	61	58.1

Table 2.
Bivariate Analysis

Bivariate Analysis							
Description	Cholesterol Level		High		Frequency		<i>p</i> value
	Normal						
	f	%	f	%	f	%	
Age							
Younger Seniors	24	26.8	40	37.2	64		
Middle-Aged Seniors	20	17.2	21	23.8	41		
Total					105	100	0.253
Gender							
Male	21	19.7	26	27.3	47		
Female	23	24.3	35	33.7	58		
Total					105	100	0.604
Diet							
Poor	5	19.3	41	26.7	46		
Adequate	17	12.6	13	17.4	30		
Good	22	12.2	7	16.8	29		
Total					105	100	0.001
Physical Activity							
Low	4	13.0	27	18.0	31		
Moderate	15	15.5	22	21.5	37		
High	25	15.5	12	21.5	37		
Total					105		0.001
Smoking							
Low	13	7.0	9	15.0	22		
Moderate	3	9.0	25	19.0	28		
High	0	0	0	0	0		
Non-smoking					55		0.001
Total					105	100	

The results of the bivariate analysis showed that there was no significant association between age or gender and cholesterol levels ($p=0.253$ and $p=0.604$; $p>0.05$), although in terms of distribution, younger older adults and women were more likely to have high cholesterol levels. In contrast, the variables of dietary patterns and physical activity showed a significant association with cholesterol levels ($p=0.001$; $p<0.05$), with respondents having poor dietary patterns and low physical activity

levels tending to have higher cholesterol levels compared to those with better habits. A similar finding was observed for the smoking habit variable, which was significantly associated with cholesterol levels ($p=0.001$; $p<0.05$), with a higher prevalence of high cholesterol levels observed in the moderate-smoking group. Subsequently, a multivariate analysis was conducted to identify the variables with the most dominant influence on cholesterol levels.

Table 3.
Logistic Regression

Variables	B	Sig.	Exp(B)
Diet	-1.634	0.006	0.195
Physical Activity	-1.222	0.041	0.295
Smoking	1.231	0.171	3.425

The results of the logistic regression analysis showed that diet ($p=0.006$) and physical activity ($p=0.041$) had a significant effect on cholesterol levels, as both had p -values <0.05 . Meanwhile, smoking habits did not show a significant effect on cholesterol levels in the multivariate analysis ($p=0.171$). Among the variables analyzed, diet was the most dominant factor influencing cholesterol levels because it had the lowest p -value compared to the other variables.

DISCUSSION

Respondent Characteristics

Most respondents in this study were in the younger elderly group aged 60–69 years, who tend to be more active in participating in health services such as health posts for the elderly, including periodic cholesterol screenings. This is believed to be related to their relatively good mobility and health awareness at that age. As people age, there is a decline in the body's physiological functions, which affects metabolic capacity including fat metabolism and may consequently increase blood cholesterol levels (Giwani & Kartinah, 2026). In addition, gender differences also show that there were more female respondents than male respondents, which may be influenced by hormonal changes particularly the decline in estrogen during menopause that lead to increased LDL and a higher risk of dyslipidemia (Wulandari & Kartinah, 2026).

From a lifestyle perspective, the respondents' dietary patterns were largely still considered poor, characterized by the consumption of high-fat foods, which, if consumed continuously, can lead to lipid buildup in blood vessels and increase cholesterol levels (Siptiani et al., 2026). In addition, some respondents engaged in moderate to high levels of physical activity, such as walking and morning exercises, which they performed regularly. Adequate physical activity is known to play a role in enhancing fat metabolism and helping the body use cholesterol as an energy source, thereby helping to maintain stable cholesterol levels in the body (Susanti, Putri, et al., 2024). Thus, a balance between dietary intake and physical activity is a key factor in managing lipid profiles in older adults.

Regarding smoking habits, the majority of respondents did not smoke, while the rest fell into the moderate dependence category. Cigarettes are known to contain harmful substances that can damage blood vessels, increase the risk of atherosclerosis, and disrupt the cardiovascular system in general (Ningtyas et al., 2025). In addition, exposure to chemicals in cigarettes can also affect lipid profiles by increasing LDL and decreasing HDL, thereby increasing the risk of elevated cholesterol levels (Pudjiastuty et al., 2025). Overall, the majority of respondents in this study had high cholesterol levels, which are believed to be influenced by a combination of age, gender, diet, physical activity, and smoking habits all of which are interrelated in affecting the body's lipid metabolism.

The Relationship Among Factors Affecting Cholesterol Levels

The results of the analysis show that age and gender are not significantly associated with cholesterol levels in older adults. Although, in theory, advancing age is associated with a decline in metabolic function, this study found no significant differences in cholesterol levels because these levels are

more heavily influenced by other factors, such as diet and physical activity. Older adults who maintain a healthy lifestyle can still keep their cholesterol levels within the normal range. These findings are consistent with research showing that age is not significantly associated with cholesterol levels in older adults (Rahmawati et al., 2022). A similar pattern was observed for the gender variable, where no significant association was found with cholesterol levels, as both men and women face the same risk if they do not adopt a healthy lifestyle; thus, behavioral factors are considered more dominant than biological characteristics (Arif & Sandro, 2025).

In contrast to these two variables, dietary patterns showed a significant association with cholesterol levels in older adults. Field observations revealed that most respondents still had unhealthy eating habits, particularly in their consumption of high-fat foods, which contribute to elevated blood cholesterol levels. Excessive fat intake can increase total and LDL cholesterol levels, which pose a risk of plaque buildup in blood vessels and can trigger cardiovascular disorders. Furthermore, an increase in fat consumption beyond a certain amount can also have a direct impact on daily cholesterol levels in the body, making dietary management a critical factor in controlling cholesterol levels among older adults (Susanti et al., 2024).

In addition to diet, physical activity has also been shown to have a significant association with cholesterol levels in older adults. Regular physical activity can help boost fat metabolism and optimize the use of cholesterol as an energy source, thereby helping to better control blood cholesterol levels. Older adults with low physical activity levels tend to have a higher risk of elevated cholesterol levels compared to those who are physically active. This is consistent with research showing that physical activity can increase HDL while lowering LDL and total cholesterol in the blood (Siptiani et al., 2026). Smoking is also significantly linked to cholesterol levels; harmful substances in cigarettes, such as nicotine, can increase LDL, lower HDL, and disrupt lipid metabolism, ultimately increasing the risk of cardiovascular disease (Ningtyas et al., 2025).

Factors That Affect Cholesterol Levels

The results of the multivariate analysis show that dietary patterns are the most influential factor affecting cholesterol levels in older adults. Unhealthy dietary patterns, particularly high fat and cholesterol intake, can lead to lipid accumulation in the body, which disrupts cholesterol metabolism and increases the risk of hypercholesterolemia. This condition has the potential to trigger various cardiovascular diseases such as atherosclerosis and coronary heart disease. An imbalance in nutrient intake particularly an excess of fat is a major factor influencing blood cholesterol levels because it is directly related to the body's energy metabolism (Suciawati et al., 2025). Furthermore, excessive fat consumption can also gradually increase total cholesterol levels, making dietary management crucial for maintaining a stable lipid profile (Susanti et al., 2024).

In addition to diet, physical activity also has a significant impact on cholesterol levels. Regular physical activity of moderate to high intensity helps boost the body's metabolism particularly in the fat-burning process thereby helping to control blood cholesterol levels. Physically active individuals tend to have better lipid profiles than those who are less active, as physical activity supports improved fitness and metabolic efficiency (Siptiani et al., 2026). Cholesterol control is also inseparable from the adoption of a comprehensive healthy lifestyle, including a balanced diet and consistent physical activity, as both are interrelated in maintaining the body's metabolic function (Susanti et al., 2024). Conversely, sedentary habits and an unhealthy lifestyle can worsen metabolic conditions and increase the risk of degenerative diseases (Ningtyas et al., 2025).

Unlike those two variables, smoking habits in this study did not show a significant effect on cholesterol levels in the multivariate analysis. Nevertheless, physiologically, smoking can still have a negative impact on the body's lipid profile, as it can increase LDL and decrease HDL, which play a role in cholesterol balance (Rizqiyah et al., 2023). Furthermore, the nicotine and carbon monoxide

in cigarettes are known to impair blood vessel function, increase blood viscosity, and place additional strain on the heart, thereby increasing the risk of cardiovascular disease even though they did not have a direct effect on cholesterol levels in this study (Ningtyas et al., 2025).

CONCLUSION

This study shows that cholesterol levels among older adults at the Kartasura Community Health Center are influenced by lifestyle factors, particularly diet and physical activity, while age and gender do not have a significant association. The analysis also shows that dietary patterns are the most dominant factor influencing cholesterol levels, followed by physical activity. Older adults with unhealthy dietary patterns and low physical activity tend to have higher cholesterol levels. These findings contribute to the scientific literature by strengthening the evidence that lifestyle modifications specifically, improving dietary patterns and increasing physical activity are key strategies in the prevention and management of hypercholesterolemia in the older adult population.

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