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# An Exploratory Study of the Prevalence and Risk Factors of Hypercholesterolemia Among the Elderly in Kelating Village, Tabanan Regency

**AA Intan Pramesti[1], Premayani Sidemen[1], I Made Suma Wirawan[1], Kadek Nova Adi Putra[2*], Indry Agatha R. P.[2]**
[1] Medical Faculty of Universitas Mahasaraswati Denpasar.
[2]Department of Internal Medicine, Wangaya General Teaching Hospital, Denpasar, Bali, Indonesia
Email: sumawirawan@unmas.ac.id

**ABSTRACT**

**Keywords:**
*Hypercholesterolemia, elderly, total cholesterol.*

Hypercholesterolemia is a prevalent yet often undiagnosed condition among the elderly, significantly contributing to cardiovascular diseases such as coronary heart disease and stroke. Despite its high national prevalence, localized data in Kelating Village, Tabanan, remains limited. This study aims to explore the prevalence and risk factors of hypercholesterolemia among older people in the Segara Santhi group. A cross-sectional design was employed, involving 31 elderly participants selected through purposive random sampling. Fasting total cholesterol levels were measured and analyzed using descriptive statistics and chi-square tests. Results showed that 51.6% of participants had hypercholesterolemia, predominantly women aged 60–74 years. No significant associations were found between cholesterol levels and factors such as age, gender, blood pressure, or fasting blood glucose. However, a significant relationship was identified between hypercholesterolemia and uric acid levels ($p<0.05$). These findings indicate a high prevalence of hypercholesterolemia in this elderly community and suggest uric acid as a potential risk factor. Future studies with larger samples, more comprehensive risk factor analysis, and longitudinal designs are recommended to validate these findings and support targeted intervention strategies for elderly populations.

## Introduction

The US National Cholesterol Education Program (NCEP) defines hypercholesterolemia as a total cholesterol level > 200 mg/dL (> 5.2 mmol/L). This definition is commonly used across many countries to provide a simple understanding of hypercholesterolemia. The condition is clinically important because cholesterol plays a significant role in the risk of cardiovascular diseases like coronary heart disease and stroke (Hirano, 2018; Langitan et al., 2025; Permatasari & Kurniawan, 2022; Wyszyńska et al., 2023). The 2023 Indonesian Health Survey reports that the prevalence of coronary heart disease in Indonesia is 0.85%. According to the WHO, 39% of individuals over the age of 25 have hypercholesterolemia, and more than a third of deaths from ischemic heart disease and ischemic stroke are linked to hypercholesterolemia (Holven & Roeters van Lennep, 2023; Kurniawan & Kamilla, 2019a; Palmisano et al., 2017a; Rahmawati et al., 2022).

According to the 2018 RISKESDAS, the prevalence of hypercholesterolemia in Indonesia among the 65-74 age group is approximately 38.2%, with a slight decrease in the age group over 75 years (32.9%)· This data shows the high prevalence of hypercholesterolemia among older people in Indonesia. This condition will undoubtedly increase the national health burden, especially in the context of the National Health Insurance (JKN), given the potential complications that can arise from hypercholesterolemia, such as coronary heart disease, stroke, and other vascular disorders. Hypercholesterolemia in older people is often undetected until symptoms or severe complications arise, which worsens the prognosis and extends the duration of medical care, requiring greater financial costs (Feingold & Blackman, 2024a; Graha, 2010a).

Generally, the etiology of hypercholesterolemia can be divided into genetic factors and acquired factors. One of the most well-known genetic disorders is familial hypercholesterolemia, which occurs due to mutations in the LDL receptor gene. As a result, the liver's ability to clear LDL from the blood circulation is impaired, leading to increased LDL levels in the plasma (Pasadena & Hadi, 2024a; Stapleton et al., 2010a; Trapani & Pallottini, 2010a). The balance of LDL levels in the blood occurs when the rate of LDL production is balanced with elimination through remaining LDL receptors or non-receptor LDL pathways. Acquired factors include a sedentary lifestyle, a diet high in saturated fats and carbohydrates, alcohol and cigarette consumption, obesity, metabolic syndrome, diabetes mellitus, hypothyroidism, chronic liver disease, and the use of medications (corticosteroids, hormonal contraceptives, thiazide diuretics) (Ibrahim & Jialal, 2025a; Kesehatan, 2019; Pirillo et al., 2021).

Cholesterol comes from two main sources: endogenous cholesterol, which is produced by the cells of the body, primarily in the liver (hepatocytes), and exogenous cholesterol, which is obtained from daily food intake (Feingold & Blackman, 2024b; Graha, 2010b; Ibrahim & Jialal, 2025b; Kurniawan & Kamilla, 2019b; Palmisano et al., 2017b). Total cholesterol reflects the blood's overall amount of Low-Density Lipoprotein (LDL), High-Density Lipoprotein (HDL), and triglycerides. Most plasma cholesterol consists of LDL, which accounts for about 75%. LDL plays a role in distributing cholesterol from the liver to various cells in the body, such as muscle, heart, and brain cells. However, LDL can adhere to the walls of blood vessels, eventually causing a buildup of lipoproteins. This accumulation narrows the lumen of the blood vessels and forms plaques, thereby increasing the risk of various diseases, including coronary heart disease, hypertension, and stroke (Civeira et al., 2022.

Physical activity is correlated with cholesterol synthesis. Physical activity increases the expression of LDL receptors in the liver, thereby enhancing the uptake of LDL from the blood and increasing lipid metabolism in muscles and other tissues, which helps reduce LDL levels. Additionally, the increased mobilization of free fatty acids during physical activity can stimulate the formation of High-Density Lipoprotein (HDL) through several physiological mechanisms (stimulation of lipoprotein lipase, increased reverse cholesterol transport, and enhanced expression of apolipoprotein A-I).

Cholesterol is an important component of the plasma membrane and a precursor of bile acids, oxysterols, and steroid hormones, including sex hormones. Differences between men and women in lipids and lipoproteins are observed in the general population's distribution and trajectory from infancy to adulthood. In early life, girls, compared to boys, have higher levels of low-density lipoprotein cholesterol (LDL-C) and total cholesterol, while high-density lipoprotein cholesterol (HDL-C) levels are similar. In early adulthood to middle age, women have lower LDL-C and higher HDL-C levels; as LDL-C levels increase, HDL-C levels decrease in men. In older age, all lipids—total cholesterol, LDL-C, HDL-C, and triglyceride levels—decrease, but this decline is more pronounced in men. Lipid levels are also influenced by certain transitions in girls/women, such as the menstrual cycle, pregnancy, breastfeeding, and menopause. Lipid levels fluctuate during the menstrual cycle. During pregnancy, there is a physiological increase in LDL-C and a greater rise in triglyceride levels. In the menopausal transition, women develop a worse lipid profile. Therefore, it is important to consider sex and the life course when assessing lipid profiles.

In elderly populations, there tends to be a decline in functional capacity, muscle strength, and mobility, which contributes to a more sedentary lifestyle (8). This condition makes older people more vulnerable to hypercholesterolemia compared to other population groups. Kelating Village, located in Tabanan Regency, Bali, has a growing elderly population, but data on the prevalence of hypercholesterolemia in this area is still limited. Given resource and population constraints, an exploratory approach was adopted. Therefore, this study is intended as a first step toward a more comprehensive investigation.

Hypercholesterolemia, characterized by elevated LDL, triglycerides, and total cholesterol levels, is a prevalent but often undiagnosed condition among the elderly. It poses significant risks for cardiovascular diseases such as coronary heart disease and stroke. Its prevalence remains high in Indonesia, particularly among the elderly aged 65–74, reaching 38.2%. However, specific data on the elderly population in Kelating Village, Tabanan Regency, remains scarce, necessitating exploratory research to identify local prevalence and associated risk factors.

The increasing elderly population in Indonesia, coupled with lifestyle factors such as sedentary behavior and unhealthy dietary habits, contributes to a growing burden of hypercholesterolemia-related complications. This trend threatens to escalate healthcare costs, particularly through the National Health Insurance (JKN), as untreated hypercholesterolemia often progresses unnoticed until severe complications emerge, necessitating prolonged and expensive medical interventions. Furthermore, early identification and management of hypercholesterolemia are crucial in preventing the onset of cardiovascular diseases. In regions like Kelating Village, where elderly populations maintain traditional high-fat diets and low physical activity, the urgency for localized data becomes more pronounced to inform targeted public health strategies and interventions.

Previous studies have shown varying results regarding the association between hypercholesterolemia and demographic factors. Rahmawati et al. (2022) found no significant relationship between cholesterol levels and gender among elderly patients in Seyegan Health Center, Yogyakarta, despite observing a higher prevalence in females. Similarly, Fadhil et al. (2019) reported a lack of significant correlation between cholesterol and gender among teachers in West Kalimantan. Age-related studies, such as those conducted by Pasadena et al. (2024), highlighted a trend where hypercholesterolemia prevalence increases with age due to physiological decline, reduced physical activity, and hormonal changes. However, the statistical significance of these findings often remains weak due to small sample sizes or confounding factors. Other research, including Paramartha et al. (2023) and Chen et al. (2020), has focused on the relationship between hypercholesterolemia and uric acid levels. These studies found a consistent and significant positive correlation, suggesting a potential biochemical link that warrants further investigation, especially among elderly populations with high purine diets.

Despite numerous studies on hypercholesterolemia and its associated factors, there remains a lack of localized data addressing the elderly population in Kelating Village, particularly considering their unique dietary patterns and lifestyle. Moreover, the relationship between uric acid levels and hypercholesterolemia in this community has not been extensively explored, representing a critical research gap.

This study is the first to explore hypercholesterolemia's prevalence and risk factors among the elderly in Kelating Village, Tabanan Regency. It focuses particularly on the association between uric acid levels and cholesterol. The research adopts a community-based approach, providing valuable localized insights not previously documented in existing literature.

The primary objective of this study is to determine the prevalence of hypercholesterolemia and identify its associated risk factors, particularly the relationship with uric acid levels, among the Segara Santhi elderly group in Kelating Village, Tabanan Regency.

The findings of this study are expected to contribute to the early detection and prevention strategies of hypercholesterolemia in elderly populations, offering evidence-based recommendations for public health interventions. Additionally, the research will provide critical data for policymakers and healthcare providers to develop targeted programs to reduce the burden of cardiovascular diseases in rural elderly communities.

## Methods

This study uses a cross-sectional design to identify the prevalence of hypercholesterolemia and factors associated with the condition among older people in Kelating Village, Tabanan Regency. The cross-sectional design was chosen because it allows for data collection at a single point in time, providing an overview of the total cholesterol levels in the blood of older people and the risk factors that may play a role. This study was conducted in Kelating Village, Kerambitan District, Tabanan Regency. Kelating Village was selected because no similar study had been conducted there before. The sample was taken from the Segara Santhi elderly group using purposive random sampling to meet a minimum sample size of 30 people. Each member of the Segara Santhi elderly group who attended had their total blood cholesterol levels tested, evaluated, and recorded. The total blood cholesterol test was performed using a dry reagent, a stick strip test, and the brand “Accu Check.” Before testing, all research participants fasted for at least 8 hours. The cholesterol test results were recorded in a register for analysis and presented in tables.

## Results And Discussion

Of the 31 respondents from the Segara Santhi elderly group who were examined during the study, the characteristics of the respondents are as follows

**Table 1: Respondent Characteristics**

| No | Respondent Characteristics | Frequency | Percentage |
|---|---|---|---|
| **1** | **Gender** | | |
| | Male | 8 | 25.8 |
| | Female | 23 | 74.2 |
| **2** | **Age** | | |
| | 60y.o-74y.o | 27 | 87.1 |
| | 75 y.o – 90 y.o | 4 | 12.9 |
| **3** | **Total cholesterol level** | | |
| | Normal (<200mg/dL) | 15 | 48.4 |
| | Hypercholesterolemia (>200mg/dL) | 16 | 51.6 |
| **4** | **Blood pressure status** | | |
| | Normal | 21 | 67.7 |
| | Hypertension | 10 | 32.3 |
| **5** | **Blood glucose status** | | |
| | Normal | 30 | 96.8 |
| | Hyperglicemia | 1 | 3.2 |
| **6** | **Uric acid status** | | |
| | Normal | 14 | 45.2 |
| | Hyperuricemia | 17 | 54.8 |
| | **Total Respondents** | 31 | |

Most respondents were female and aged 60-74. Out of 31 respondents, 56.7% of the Segara Shanti elderly group had total cholesterol levels greater than 200 mg/dl, 12.5% male and 87.5% female. Among those with hypercholesterolemia, 87.5% were aged between 60 and 74.

**Table 2: Data Analysis**

| | Hypercholeste-rolemia | Normal cholesterol | $X^2$ | p-value | OR | 95% CI |
|---|---|---|---|---|---|---|
| **Female** | 14 (87.5%) | 9 (60%) | 3.058 | 0.08 | 4.667 | 0.767-28.40 |
| **Male** | 2 (12.5%) | 6 (40%) | | | | |
| **75-90 y.o** | 2 (12.5%) | 2 (13.3%) | 0.005 | 0.675 | 1.929 | 0.114-7.585 |
| **60-74y.o** | 14 (87.5%) | 13 (86.6%) | | | | |
| **Hypertension** | 11 (68%) | 10 (66%) | 0.015 | 0.901 | 1.100 | 0.244-4.963 |
| **Normal BP** | 5 (31%) | 5 (33 %) | | | | |
| **Hyperglicemia** | 1 (7%) | 0 (0%) | 0.969 | 0.325 | 2.00 | 1.398-2.860 |
| **Normal BS** | 15 (93%) | 15 (100 %) | | | | |
| **Hyperuricemia** | 6 (37.5%) | 11 (73%) | 0.4014 | 0.045 | 2.180 | 0.047-1.005 |
| **Normal UA** | 10 (62.5%) | 4 (26 %) | | | | |

Cholesterol levels of the respondents were grouped into two categories: hypercholesterolemia (≥200mg/dL) and normal (<200mg/dL). It was found that respondents with hypercholesterolemia were predominantly older women (87.5%). The odds ratio of 4.667 indicates that women are approximately 4.6 times more likely to have hypercholesterolemia than men, suggesting a noticeable association between gender and high cholesterol, with women having higher odds. However, despite the relatively high OR, the p-value greater than 0.05 indicates that this difference in odds is not statistically significant. This could be due to factors such as a small sample size or other confounding variables not accounted for in the analysis. This result is consistent with the study conducted by Rahmawati et al at the Seyegan Health Center in Yogyakarta· Fadhil et al also reported no significant relationship between cholesterol and gender (Pasadena & Hadi, 2024b; Stapleton et al., 2010b; Trapani & Pallottini, 2010b)

Physiologically, the decrease in estrogen levels in postmenopausal women can contribute to an increase in LDL synthesis, however, key factors such as diet and lifestyle should not be overlooked as potential biases in the study results above. Before menopause, women are less susceptible to obesity-related atherosclerotic heart disease compared to men. Sex hormones are thought to play a key role in explaining this difference in risk. Estrogens can exert their biological effects in the liver through several mechanisms. The primary mechanism of estrogen (E2) action involves E2 binding to steroid nuclear hormone receptors, Estrogen Receptor alpha (ERα) or Estrogen Receptor beta (ERβ). Upon binding to either receptor, E2 induces a conformational change that causes dissociation from Hsp90, followed by dimerization and movement into the nucleus. Once inside the nucleus, ERα and ERβ bind to specific genomic regions, recognizing DNA sequences through their binding domains. These genomic regions, known as Estrogen Response Elements (EREs), typically have an inverted repeat separated by three nucleotides (5' AGGTCAnnnTGACCT 3'). EREs are often located in the promoter or enhancer regions of liver genes regulated by estrogens. More than 1000 human liver genes exhibit sex-biased expression, with the primary biological pathways related to lipid metabolism.

Respondents' ages were grouped into two categories: elderly aged 75-90 years and elderly aged 60-74. Hypercholesterolemia was predominantly found in elderly individuals aged 60-74 years. An odds ratio (OR) of 1.929 suggests that with each unit increase in age, the odds of developing hypercholesterolemia nearly double (about 1.93 times higher). This indicates a potential association between age and hypercholesterolemia, with older individuals being more likely to have high cholesterol. However, the p-value greater than 0.05 suggests this association is not statistically significant. In other words, while the OR suggests a possible link, the data does not provide strong enough evidence to say that age significantly influences the likelihood of hypercholesterolemia confidently. This result is also consistent with the study conducted by Pasadena et al at RSUD Nyi Agung Serang Kulon. Aging is characterized by a series of degenerative changes resulting in a gradual physiological decline. As age increases, the risk of developing hypercholesterolemia tends to rise. This is due to the tendency of older people to be less physically active. In addition, muscle mass in older people typically decreases, while fat mass increases. These changes occur due to the decline in metabolic hormones such as insulin, growth hormone, and androgens, which leads to the body's inability to break down cholesterol, resulting in increased cholesterol levels in the blood. Some evidence suggests that the disruption of lipid homeostasis associated with aging can be attributed to several factors, including a gradual decline in the fractional clearance of LDL as people age, a reduced ability to eliminate cholesterol through conversion to bile acids, and decreased activity of the rate-limiting enzyme in bile acid synthesis, cholesterol 7α-hydroxylase (C7αOH)

Respondents' blood pressure was classified into hypertension (≥140/90mmHg) and normal blood pressure. Hypercholesterolemia was predominantly found in elderly individuals with hypertension (68%). The odds ratio of 1.100 suggests a slight increase in the likelihood of hypercholesterolemia with higher blood pressure. However, the p-value greater than 0.05 indicates this association is not statistically significant. This result contradicts the findings of a study by Permatasari et al, which reported a strong correlation between cholesterol levels and blood pressure. Hypercholesterolemia can be related to hypertension through several mechanisms. Atherosclerosis caused by lipid disturbances can lead to structural changes in large arteries, decreasing their elasticity. Additionally, endothelial dysfunction caused by hypercholesterolemia can reduce the production, release, and activity of nitric oxide, as well as cause abnormal vasomotor activity, which can ultimately develop into hypertension. Renal microvascular disturbances influenced by lipids can also contribute to the onset of hypertension.

Respondents' blood sugar levels were divided into two categories: hyperglycemia (FPG ≥126) and non-hyperglycemia (FPG <126). Hypercholesterolemia was predominantly found in elderly individuals without hyperglycemia (93%). The odds ratio of 2.00 indicates that individuals with hyperglycemia are twice as likely to have hypercholesterolemia. However, the p-value greater than 0.05 suggests that this association is not statistically significant, therefore, we cannot confidently conclude that hyperglycemia is a significant predictor of hypercholesterolemia in this dataset. This result is consistent with the study conducted by Langitan et al on the relationship between cholesterol and fasting blood sugar levels in patients at RSUD ODSK. Dyslipidemia is commonly observed in people with hyperglycemia. In those with impaired glucose tolerance, the decrease in regular insulin sensitivity results in compensatory hyperinsulinemia and increased VLDL-TG secretion. In type 2 diabetes, marked by a relative lack of insulin, elevated free fatty acid (FFA) levels lead to increased secretion of hepatic VLDL-TG. Cholesterol balance in the body is carefully regulated through de novo biosynthesis, intestinal absorption, biliary, and fecal excretion. Niemann-Pick C1-Like 1 (NPC1L1) plays a role in cholesterol absorption in the intestine and aids cholesterol transport within the liver. The expression of intestinal NPC1L1 was elevated in individuals with diabetes. ATP-binding cassette (ABC) proteins G5/G8 promote the elimination of cholesterol from the intestine. Diminished expression of ABCG5/G8 was noted in the intestines of individuals with diabetes

Respondents' uric acid levels were categorized into hyperuricemia (uric acid ≥7) and non-hyperuricemia (uric acid <7). The chi-square test showed a significant relationship between cholesterol and uric acid levels (p-value < 0.05). An OR of 2.180 suggests that individuals with hyperuricemia are 2.18 times more likely to have elevated cholesterol levels compared to individuals without hyperuricemia. This indicates a moderate to strong positive association between high uric acid levels and high cholesterol. The p-value of less than 0.05 indicates that this result is statistically significant. This result is consistent with the study by Paramartha et al on the relationship between cholesterol levels and uric acid in patients with acute coronary syndrome at RSUD Sanjiwani Gianyar and the meta-analysis study by Chen et al on the relationship between uric acid and lipid profile at Zhenhai Lianhua Hospital. The physiological mechanism regarding the relationship between uric acid levels and cholesterol is still unclear. The combination of hyperuricemia and hypercholesterolemia can increase the risk of cardiovascular disease (CVD) several times over. In this study, in addition to the factors related to the decline in organ function in the elderly population, it can also be suspected that a diet high in fat and purines from traditional Balinese food is one of the risk factors contributing to the increase in uric acid and cholesterol levels in the respondents. Several hypotheses have been proposed regarding the effect of uric acid on cholesterol (Chen et al., 2020; Kuwabara et al., 2018; Paramartha & Dewi, 2023). Although uric acid is generally considered an antioxidant, at high concentrations, uric acid acts as a pro-oxidant molecule. Increased intracellular uric acid levels induce the translocation of mitochondria from the nicotinamide adenine dinucleotide phosphate (NADPH) oxidase subunit, leading to increased mitochondrial oxidative stress, mitochondrial dysfunction, and the release of citrate into the cytosol for de novo lipogenesis and triglyceride synthesis. Soluble and crystallized uric acid also inhibit AMP-activated protein kinase (AMPK) activity, reducing the ability to oxidize fatty acids and causing triglyceride accumulation. Higher serum uric acid (SUA) levels significantly correlate with inhibiting lipoprotein lipase activity (an enzyme that breaks down triglycerides into free fatty acids and glycerol), leading to increased triglyceride levels.

## Conclusion

This preliminary study found that the prevalence of hypercholesterolemia in the Segara Santhi elderly group in Kelating Village, Kerambitan, Tabanan, was relatively high at 51.6%, with a greater proportion observed in older women aged 60–74 years. Although no significant associations were identified between cholesterol levels and factors such as age, gender, blood pressure, or fasting blood sugar, a significant relationship was found between cholesterol levels and uric acid levels. Given the small sample size, these findings are exploratory and should be interpreted with caution. For future researchers, it is recommended to conduct studies with larger and more diverse populations to validate these findings, employ longitudinal study designs to observe causality over time, and consider additional variables such as dietary intake, physical activity levels, genetic predispositions, and socio-economic factors that may influence cholesterol metabolism and uric acid levels. Broader geographic coverage and more advanced biochemical markers are also suggested to understand hypercholesterolemia risk factors in elderly populations better.

## References


Chen, S., Yang, H., Chen, Y., Wang, J., Xu, L., Miao, M., & Xu, C. (2020). Association between serum uric acid levels and dyslipidemia in Chinese adults: A cross-sectional study and further meta-analysis. *Medicine*, *99*(11), e19088.

Civeira, F., Arca, M., Cenarro, A., & Hegele, R. A. (2022). A mechanism-based operational definition and classification of hypercholesterolemia. *Journal of Clinical Lipidology*, *16*(6), 813–821.

Feingold, K. R., & Blackman, M. R. (2024a). *Introduction to Lipids and Lipoproteins*. Endotext [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK305896/

Feingold, K. R., & Blackman, M. R. (2024b). *Introduction to Lipids and Lipoproteins*. Endotext [Internet]. https://www.ncbi.nlm.nih.gov/books/NBK305896/

Graha, K. C. (2010a). *Kolesterol*. PT Elex Media Komputindo.

Graha, K. C. (2010b). *Kolesterol*. PT Elex Media Komputindo.

Hirano, T. (2018). Pathophysiology of Diabetic Dyslipidemia. *J Atheroscler Thromb*, *25*(9), 771–782.

Holven, K. B., & Roeters van Lennep, J. (2023). Sex differences in lipids: A life course approach. *Atherosclerosis*, *384*.

Ibrahim, M. A., & Jialal, I. (2025a). *Hypercholesterolemia*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK459188/?utm_source=chatgpt.com

Ibrahim, M. A., & Jialal, I. (2025b). *Hypercholesterolemia*. StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK459188/?utm_source=chatgpt.com

Kesehatan, B. P. dan P. (2019). *Laporan Nasional Riset Kesehatan Dasar (Riskesdas) 2018*. Kementerian Kesehatan Republik Indonesia.

Kurniawan, F., & Kamilla, L. (2019a). Hubungan Umur, Jenis Kelamin dan Kegemukan dengan Kadar Kolesterol Total Guru SMAN 1 Sei Raya. *Journal Laboratorium Khatulistiwa*, *2*.

Kurniawan, F., & Kamilla, L. (2019b). Hubungan Umur, Jenis Kelamin dan Kegemukan dengan Kadar Kolesterol Total Guru SMAN 1 Sei Raya. *Journal Laboratorium Khatulistiwa*, *2*.

Kuwabara, M., Borghi, C., Cicero, A. F. G., Hisatome, I., Niwa, K., Ohno, M., & al., et. (2018). Elevated serum uric acid increases risks for developing high LDL cholesterol and hypertriglyceridemia: A five-year cohort study in Japan. *International Journal of Cardiology*, *261*, 183–188.

Langitan, E. J., Tiho, M., & Purwanto, D. S. (2025). Hubungan Kadar Kolesterol Total dengan Kadar Gula Darah Puasa pada Pasien Diabetes Melitus Tipe 2 di RSUD ODSK Provinsi Sulawesi Utara. *Health & Medical Sciences*, *2*.

Palmisano, B. T., Zhu, L., & Stafford, J. M. (2017a). Role of Estrogens in the Regulation of Liver Lipid Metabolism. In *Adv Exp Med Biol* (Vol. 1043, pp. 227–256).

Palmisano, B. T., Zhu, L., & Stafford, J. M. (2017b). Role of Estrogens in the Regulation of Liver Lipid Metabolism. In *Adv Exp Med Biol* (Vol. 1043, pp. 227–256).

Paramartha, I. G. N. B., & Dewi, S. R. (2023). Hubungan antara Kadar Asam Urat dengan Profil Lipid pada Pasien Sindrom Koroner Akut di RSUD Sanjiwani Gianyar. *Aesculapius Medical Journal*, *3*.

Pasadena, R., & Hadi, W. S. (2024a). Hubungan Kadar Kolesterol dengan Usia Lanjut dan Jenis Kelamin Pada Pasien Hipertensi di RSUD Nyi Ageng Serang Kulon Progo. *Journal Pendidikan Tambusai*.

Pasadena, R., & Hadi, W. S. (2024b). Hubungan Kadar Kolesterol dengan Usia Lanjut dan Jenis Kelamin Pada Pasien Hipertensi di RSUD Nyi Ageng Serang Kulon Progo. *Journal Pendidikan Tambusai*.

Permatasari, R. E. S., & Kurniawan, K. (2022). Hubungan Kadar Kolesterol Total Dengan Tekanan Darah Pada Pasien Hipertensi Pada Usia ≥ 40 Tahun. *Jurnal Labora Medika*, *6*.

Pirillo, A., Casula, M., Olmastroni, E., Norata, G. D., & Catapano, A. L. (2021). Global epidemiology of dyslipidaemias. *Nat Rev Cardiol*, *18*(10), 689–700.

Rahmawati, Y., Rahmawati, F., & Perwitasari, E. (2022). Hiperkolesterolemia Pada Pasien Lanjut Usia : Studi Kasus Puskesmas Seyegan. *Jurnal KEsehatan Tumbusai*.

Stapleton, P. A., Goodwill, A. G., James, M. E., Brock, R. W., & Frisbee, J. C. (2010a). Hypercholesterolemia and microvascular dysfunction: interventional strategies. *J Inflamm (Lond)*, *7*, 54.

Stapleton, P. A., Goodwill, A. G., James, M. E., Brock, R. W., & Frisbee, J. C. (2010b). Hypercholesterolemia and microvascular dysfunction: interventional strategies. *J Inflamm (Lond)*, *7*, 54.

Trapani, L., & Pallottini, V. (2010a). Age-Related Hypercholesterolemia and HMG-CoA Reductase Dysregulation: Sex Does Matter (A Gender Perspective). *Curr Gerontol Geriatr Res*, 420139.

Trapani, L., & Pallottini, V. (2010b). Age-Related Hypercholesterolemia and HMG-CoA Reductase Dysregulation: Sex Does Matter (A Gender Perspective). *Curr Gerontol Geriatr Res*, 420139.

Wyszyńska, J., Łuszczki, E., Sobek, G., Mazur, A., & Dereń, K. (2023). Association and Risk Factors for Hypertension and Dyslipidemia in Young Adults from Poland. *Int J Environ Res Public Health*, *20*(2).