Cholesterol and Triglycerides on Cardiovascular : A Literature Review

Nabillah Nur Sadrina[1], Soebagijo Adi Soelistijo[2*], Achmad Lefi[3]

[*]email : soebagijo.adi.s@fk.unair.ac.id
[1]Faculty of Medicine, Airlangga University, Surabaya 60132, Indonesia
[2]Departement of Internal Medicine, Faculty of Medicine, Airlangga University, Surabaya 60132, Indonesia
[3]Departement of Cardiology and Vascular Medicine Faculty of Medicine, Airlangga University, Surabaya 60132, Indonesia

Abstract

Background: Cardiovascular disease is the number one cause of death throughout the world. One factor that has been proven to be influential is dyslipidemia. Dyslipidemia is a condition of abnormal lipid levels in the blood circulation, namely increased cholesterol levels and triglyceride levels. **Objective:** to provide information about cholesterol and triglycerides on cardiovascular disease. **Method:** The method used in this research is a literature review. **Results:** From this identification, 14 articles were obtained which will be reviewed in this research. **Conclusion:** Lipid profiles, such as cholesterol and triglycerides, have a significant relationship with the risk of cardiovascular disease.

Keywords : Cholesterol, triglyccerides, cardiovascular, dyslipidemia, atherosclerosis

1. Background

Cardiovascular disease is the number one cause of death worldwide. About 17 million people died from cardiovascular disease in 2015, representing 31% of all global deaths. A cardiovascular disease that has a high death rate and disability rate is coronary heart disease (CHD). Every year, it is estimated that around 620,000 Americans have a coronary heart attack (defined as the first hospitalization resulting from an acute myocardial infarction (AMI) or death due to coronary heart disease) and around 295,000 people experience a repeat attack (Aswania and Yasmin, 2020)

This disease is estimated to reach 23.3 million deaths by 2030. In Indonesia, according to data from the Ministry of Health in 2013, the incidence of CHD in Indonesia is 45% and as much as 2% occurs in the elderly, namely 65 to 74 years. Based on data from RISKESDAS in 2018, it shows that 1.5% or 1,017,290 of the Indonesian population suffers from heart disease (Ahmad et al. , 2021) .

Complications that are often encountered during the treatment of AMI patients, and are directly related to the patient's survival rate, are major cardiovascular events (KKM). Major cardiovascular events are

cardiovascular complications including congestive heart failure, shock, cardiogenic arrhythmias and death. A study stated that the KKM in AMI patients was 63.4%. In the Framingham Heart Study, cholesterol, age, gender, smoking, High Density Lipoprotein (HDL), and systolic blood pressure were risk factors for predicting future cardiovascular events (Aswania and Yasmin, 2020) .

Based on one study regarding factors that influence heart failure in AMI patients, it was stated that one of the factors that was proven to have an influence was dyslipidemia. Dyslipidemia is a condition of abnormal lipid levels in the blood circulation, namely increased cholesterol levels and triglyceride levels. (Aswania and Yasmin, 2020) .

Cholesterol is a fatty substance produced by the liver and is needed by the body. Excessive cholesterol in the blood will cause problems, especially in the blood vessels of the heart and brain. Blood contains cholesterol, with 80% of blood cholesterol produced by the body itself and only 20% coming from food. Excessive cholesterol levels have a very close relationship to the emergence of certain diseases, such as diabetes mellitus (DM), hyperlipidemia and heart disease (Permatasari and Suriani, 2022) .

Increased deposition of atherogenic cholesterol in arteries is one of the causes of endothelial dysfunction which triggers the process of atherosclerotic plaque formation. Atherosclerosis is the dominant cause of cardiovascular disease including myocardial infarction and heart failure (Aswania and Yasmin, 2020) .

High levels of cholesterol and triglycerides are the main risk of causing hypertension and heart disease. Excess cholesterol and triglycerides will react with other substances and settle in the arteries and cause blockages, namely atherosclerosis. The narrowing of the blood vessels causes the heart to work harder to meet the need for blood to all tissues, which can cause cardiovascular disease. Therefore, it is necessary to conduct research on the relationship between total cholesterol and triglycerides and blood pressure in cardiovascular sufferers. This research is important to increase knowledge and preventive measures for hypercholesterolemia and triglycerides which can increase the risk of cardiovascular disease.

2. Objective

This literature aims to provide information regarding cholesterol and triglycerides on cardiovascular disease.

3. Objective

This literature aims to provide information regarding cholesterol and triglycerides on cardiovascular disease.

4. Method

This literature review was created by collecting, reviewing, and citing related journals. These journals were obtained through searches from the Google Scholar and Pubmed search engines. Keywords used in the search include “Cholesterol”, “Triglycerides”, “Cardiovascular”, “Dyslipidemia”, “Atherosclerosis”. The journal used was published in the period 2019-2023. From the results of this search, a literature review was obtained and carried out in 14 journals.

5. Results

A literature search through the database resulted in 14 articles that will be reviewed in this research. A summary of the articles reviewed in this research can be seen in Table 1.

Table. 1 Summary of articles reviewed

No	Title	Writer	Objective	Design	Sampling	Key Findings
1.	Relationship between Blood Pressure, Total Cholesterol and Triglycerides in STEMI and NSTEMI Patients	(Pravitasari et al. , 2021)	To determine the relationship between blood pressure, total cholesterol and triglycerides in STEMI and NSTEMI patients in hospitals. PKU Muhammadiyah Surakarta.	The research design used cross sectional	N = 70 people	The results of multivariate analysis with logistic regression showed blood pressure p=0.037, total cholesterol p=0.048, triglycerides p=0.034. The conclusion from the bivariate and multivariate analysis is that there is a significant relationship.
2.	The Relationship between Total Cholesterol and Triglyceride Levels on Blood Pressure Levels	(Ikawati, Hadimarta and Widodo, 2019)	To determine the relationship between total cholesterol and triglyceride levels and blood pressure levels	This type of research is analytical observation with a cross sectional design	N = 40 people	Some of the lipid profiles are related to the degree of blood pressure in hypertension sufferers at Tugu Hospital Semarang
3.	The Relationship Between Triglyceride Levels and Hypertension in Coronary Heart Patients at Bhayangkara Tk Hospital. I R. Said Sukanto	(Aryani, Hanifah and Fitra Ritonga, 2023)	To determine the relationship between triglyceride levels and hypertension in coronary heart disease sufferers	The type of research used was a cross sectional approach	N = 63 people	There is a relationship between triglyceride levels and coronary heart disease. The p value (0.012) is smaller than α (0.05), meaning there is a significant relationship.
4.	The Relationship Between Total Cholesterol Levels and the Degree of Hypertension in Pre-Elderly Patients at Dr. Hospital. H. Abdul	(Purnama et al. , 2023)	To conduct research on the relationship between total cholesterol levels and the degree of hypertension in pre-elderly patients at	Observational analytical research with a quantitative research design and cross-sectional	N = 96 people	There is a relationship between total cholesterol levels and the degree of hypertension in pre-elderly patients at RSUD DR. H. Abdul Moeloek Lampung Province 2021 p

	Moelok, Lampung Province		RSUD Dr. H. Abdul Moeloek Lampung Province.	approach		value 0.037 (p value < 0.05)
5.	Relationship between total cholesterol levels and blood pressure in hypertensive patients aged ≥ 40 years	(Permatasari and Suriani, 2022)	To determine the relationship between total cholesterol levels and blood pressure in hypertensive patients aged ≥ 40 years at Posbindu, South Batipuh Community Health Center	This type of research is descriptive correlation with a cross sectional design	N = 30 people	Respondents who have high cholesterol levels are 37,500 times more likely to develop high blood pressure compared to respondents who have normal cholesterol levels.
6.	The Relationship between the Ratio of Total Cholesterol to High Density Lipoprotein and the Incidence of Acute Coronary Syndrome at RSUD Dr. M. Haulussy Ambon 2018-2019	(Ahmad et al. , 2021)	To determine the relationship between the ratio of total cholesterol to high density lipoprotein with the incidence of ACS at RSUD dr. M. Haulussy Ambon 2018-2019	This research is a type of observational analytical research with a cross sectional design	N = 80 people	There is a significant relationship between the ratio of total cholesterol to high density lipoprotein (HDL) and the incidence of acute coronary syndrome at RSUD dr. M. Haulussy Ambon 2018-2019.
7.	Associations of Blood Pressure and Cholesterol Levels During Young Adulthood With Later Cardiovascular Events	(Yiyi Zhang et al. , 2019)	To evaluate the independent association between exposure to risk factors in young adults and risk of CVD later in life,	Pooled data from 6 US cohorts with observations spanning the life course from young adulthood through later life	N = 36,030 people	Cumulative exposure in young adults to elevated systolic blood pressure, diastolic blood pressure, and cholesterol is associated with increased risk of cardiovascular disease in later life, independent of exposure in later life.
8.	The relationship between dyslipidemia and the incidence of hypertension in Bali in 2019	(Daughter et al , 2021)	To understand the relationship between dyslipidemia and the incidence of hypertension.	This research is an analytical research using a cross-sectional approach via a purposive sampling	N = 94 people	There is a significant relationship between total cholesterol (p=0.029) and LDL (p=0.022) with the incidence of hypertension. No significance was found between HDL (p=0.268) and triglycerides

				method .		(p=0.062) with the incidence of hypertension
9.	Dyslipidemia as a Predictor of Major Cardiovascular Events in Acute Myocardial Infarction Patients	(Aswania and Yasmin, 2020)	To determine the role of dyslipidemia as a predictor of major cardiovascular events in acute myocardial infarction patients during hospitalization.	research with a retrospective cohort design	N = 70 people	Dyslipidemia is a predictor of major cardiovascular events in acute myocardial infarction patients during hospitalization.
10.	Longitudinal association of remnant cholesterol with joint arteriosclerosis and atherosclerosis progression beyond LDL cholesterol	(Wu et al. , 2023)	To evaluate the relationship of residual cholesterol with joint arteriosclerosis and the trajectory of atherosclerosis development in the general population	Collected data from five biennial surveys of the Beijing Health Management Cohort from 2010 to 2019	N = 3,186 people	RC is independently associated with joint arteriosclerosis and the development of atherosclerosis beyond LDL-C. RC may be a risk factor for arteriosclerosis and atherosclerosis in the general population compared with LDL-C.
11.	Remnant Cholesterol Predicts Risk of Cardiovascular Events in Patients With Myocardial Infarction With Nonobstructive Coronary Arteries	(Side Gao et al. , 2022)	To investigate the impact of RC on long-term cardiovascular outcomes after MINOCA and explore whether RC can facilitate risk prediction in this specific population	Single -center, prospective, and observational cohort study	N = 23,460 people	Elevated RC is strongly associated with poor outcomes after MI with nonobstructive coronary arteries independent of traditional risk factors, suggesting the utility of RC for risk stratification and a rationale for trials of targeted RC reduction in patients with MI with nonobstructive coronary arteries. obstructive
12.	Low-Density Lipoprotein Cholesterol Attributable Cardiovascular Disease Risk Is Sex Specific	(Cupido et al. , 2022)	To investigate the sex-specific differential effects of genetically elevated low-density lipoprotein cholesterol on cardiovascular disease (CVD) and other lipid-related	This was a 2-sample Mendelian randomization study using individual participant data	N = 425,043 people	Genetically elevated cholesterol has sex-specific differential effects on the risk of cardiovascular disease, ischemic heart disease, heart failure, and aortic valve stenosis .

			diseases			
13.	Association between lipoprotein cholesterol and future cardiovascular disease and mortality in older adults: a Korean nationwide longitudinal study	(Kim and Son, 2021)	To assess the association between lipoprotein cholesterol and future cardiovascular and cardiovascular disease mortality in an elderly population in Korea using a large national sample	From the Korean National Health Insurance Service cohort database	N = 62,604 people	cholesterol levels were not significantly associated with future death from cardiovascular disease in elderly people aged ≥ 65 years.
14.	Adherence to lifestyle advice and its related cardiovascular disease risk among US adults with high cholesterol	(Guo et al. , 2022)	To examine the proportion of adherence to lifestyle advice and its influence on lipid profiles and CVD among people with high cholesterol	In the 1999-2010 National Health and Nutrition Examination Survey	N = 17,036 people	Lifestyle advice from health workers is received relatively high and its acceptability is increasing. Given the improved lipid profile and lower risk of CVD in adherents, health professionals should be encouraged to recommend lifestyle modifications for adults with high cholesterol in clinical practice.

6. Discussion

Pravitasari et al., (2021), in their research there was a significant relationship between blood pressure, total cholesterol and teriglycerides in STEMI and NSTEMI patients (Pravitasari et al. , 2021) .
Ikawati, Hadimarta and Widodo (2019), in this study it was found that there was no relationship between cholesterol levels and blood pressure levels in hypertension sufferers. Meanwhile, for triglyceride levels there is a strong positive relationship (Ikawati, Hadimarta and Widodo, 2019) .

Aryani, Hanifah and Fitra Ritonga (2023), based on research conducted at Bhayangkara TK.I Raden Said Sukanto Hospital on 63 respondents, it can be concluded that the results of the chi-square analysis test to see the relationship between triglyceride levels and coronary heart disease obtained a p value (0.012) is smaller than (0.05), which means there is a significant relationship. Apart from that, the results of the chi-square analysis to see the relationship between hypertension and coronary heart disease showed that the value (0.002) was smaller than (0.05), meaning there was a significant relationship. Thus, there is a significant relationship between triglyceride levels and hypertension and coronary heart disease at Bhayangkara TK.I Raden Said

Sukanto Hospital (Aryani, Hanifah and Fitra Ritonga, 2023) .

Purnama et al (2023), Based on research that has been carried out, it can be concluded that: The frequency distribution of respondents with grade 1 hypertension is 37 respondents (43.5%), while those with Grade II hypertension are 30 respondents (35.3 %) and 18 respondents (21.2%) had pre-hypertension. Frequency distribution of respondents with high total cholesterol levels, namely 47 respondents (55.3%). There is a relationship between total cholesterol levels and the degree of hypertension in pre-elderly patients at Dr H Abdul Moeloek Hospital, Lampung Province (p value 0.037) (Purnama et al. , 2023) .

Permatasari and Suriani (2022), there is a relationship between cholesterol levels and blood pressure in hypertension. Respondents with high cholesterol levels had high blood pressure, while respondents with normal cholesterol levels had normal blood pressure. Respondents who have high cholesterol levels are 37,500 times more likely to develop high blood pressure compared to respondents who have normal cholesterol levels (Permatasari and Suriani, 2022) .

Ahmad et al. , (2021), in his research the results showed that there was a significant relationship between the ratio of total cholesterol to high density lipoprotein (HDL) and the incidence of acute coronary syndrome at RSUD dr. M. Haulussy Ambon in 2018-2019 (Ahmad et al. , 2021) .

Yiyi Zhang et al. , (2019), This combined US cohort study involving more than 36,000 participants found that exposure of young adults to elevated levels of DBP and LDL was associated with risk of CHD later in life, and SBP and DBP in young adults was associated with risk of heart failure later in life, independent of later adult exposure. These findings suggest that investing now in programs to control modifiable risk factors during young adulthood has the potential to reduce the future burden of CVD (Yiyi Zhang et al. , 2019) .

Putri et al , (2021), based on this research, the prevalence of almost all lipid profiles, namely total cholesterol and LDL, has a significant relationship with hypertension cases in patients at Sanjiwani Hospital, Gianyar Regency in 2019. Meanwhile, HDL and triglyceride levels do not have a significant relationship with cases. hypertension in similar patients (Putri, Suyasa and Budiapsari, 2021) .

Aswania and Yasmin, (2020), A retrospective cohort study was conducted to prove dyslipidemia as a predictor of KKM in AMI patients at Sanglah General Hospital. Based on the research results, it can be concluded that: dyslipidemia is a predictor of KKM in AMI patients during hospital treatment (Aswania and Yasmin, 2020) .

Wu et al. , (2023), This longitudinal study shows that RC is an early risk factor for the development of joint arteriosclerosis and atherosclerosis independent of LDL-C in the general population, providing new evidence of the need for RC monitoring to improve cardiovascular health. RC may serve as a target for the prevention and intervention of arteriosclerosis and atherosclerosis, even in people with optimal LDL-C levels (Wu et al. , 2023) .

Side Gao et al. , (2022), Increased RC is associated with increased risk of MACE in patients with MINOCA. In daily practice, RC assessment can improve risk stratification and further facilitate decision making in the real-world management of MINOCA. Our data also provide a rationale for making RC a preferential antiatherogenic target. Randomized controlled trials with hard endpoints are needed to identify the benefits of targeted RC-lowering treatment in this population, especially when LDL-C targets have been achieved (Side Gao et al. , 2022) .

Cupido et al. , (2022), found that genetically elevated LDL-C has a sex-specific differential causal effect on the risk of CVD, ischemic heart disease, heart failure, and AVS. These observations imply that women are less susceptible to LDL-C-related CVD and more susceptible to LDL-C-related AVS than men. Our

observations may be useful for analyzes for treatment guidelines, clinical trial design, and dose-finding studies and warrant more sex-specific evaluation of the relative contribution of cardiovascular risk factors to disease (Cupido et al. , 2022) .

Kim and Son, (2021), in their research said that cholesterol levels were not significantly associated with future death from cardiovascular disease in elderly people aged ≥ 65 years, except for high LDL-C levels, which were significantly associated with a low incidence of ischemic brain disease. In a stratified analysis, high LDL-C levels were associated with an increased risk of death from cardiovascular disease in older adults with diabetes (Kim and Son, 2021) .

Guo et al. , (2022), This study shows promising results that people with high cholesterol have relatively high adherence to lifestyle modifications recommended by health professionals. Additional support and more intensive prevention should be provided to communities with low levels of compliance, for example younger communities. Additionally, our findings support the push of health professionals to recommend even non-intensive lifestyle improvements in both clinical practice and public health, which may be beneficial for improving lipid profiles and reducing CVD risk and mortality (Guo et al. , 2022) .

7. Conclusion

Lipid profile, such as cholesterol and triglycerides has a significant relationship with the risk of cardiovascular disease. However, the complexity of this relationship may require a more specific and personalized approach in the preventive management of cardiovascular disease. In addition, the importance of risk factor control at a young age and awareness of the role of cholesterol in various types of cardiovascular disease are also emphasized in the results of this study.

References

Ahmad, NHDF et al. (2021) "Relationship between the ratio of total cholesterol to high density lipoprotein and the incidence of acute coronary syndrome at RSUD Dr. M. Haulussy Ambon 2018-2019," 3, p. 42–54.

Aryani, D., Hanifah, N. and Fitra Ritonga, A. (2023) "Relationship between triglyceride levels and hypertension in coronary heart disease sufferers at Bhayangkara Tk Hospital. I R. Said Sukanto," Journal of Medika Hutama , 04(02), p. 3359–3365. Available at: http://jurnalmedikahutama.com.

Aswania, GM and Yasmin, AAADA (2020) "Dyslipidemia as a Predictor of Major Cardiovascular Events in Acute Myocardial Infarction Patients," Journal of Medika Udayana , 9(11), p. 91–100. Available at: https://ocs.unud.ac.id/index.php/eum/article/view/71028.

Cupido, A.J. et al. (2022) "Low-Density Lipoprotein Cholesterol Attributable Cardiovascular Disease Risk Is Sex Specific," Journal of the American Heart Association , 11(12). doi: 10.1161/JAHA.121.024248.

Guo, J. et al. (2022) "Adherence to lifestyle advice and its related cardiovascular disease risk among US adults with high cholesterol," Clinical Nutrition ESPEN , 51, p. 267–273. doi: 10.1016/j.clnesp.2022.08.017.

Ikawati, K., Hadimarta, FP and Widodo, A. (2019) "The Relationship between Total Cholesterol and Triglyceride Levels on Blood Pressure Levels," Scholar Journal of Pharmacy , 3(1), p. 53–59. doi: 10.31596/cjp.v3i1.44.

Kim, SH and Son, KY (2021) "Association between lipoprotein cholesterol and future cardiovascular disease and mortality in older adults : a Korean nationwide longitudinal study," 0, p. 1–11.

Permatasari, R. and Suriani, E. (2022) "TOTAL BLOOD PRESSURE IN HYPERTENSION PATIENTS AT AGE ≥ 40," 6, p. 16–21.

Pravitasari, H. et al. (2021) "The Relationship between Blood Pressure, Total Cholesterol and Triglycerides in STEMI and NSTEMI Patients," UMS Scientific Publications , p. 243–256. Available at: https://publikasiilmiah.ums.ac.id/xmlui/handle/11617/12632.

Purnama, D. et al. (2023) "The Relationship Between Total Cholesterol Levels and the Degree of Hypertension in Pre-Elderly Patients at Dr. Hospital. H. Abdul Moelok Lampung Province," Journal of Medical and Health Sciences , 10(5), p. 1971–1977. doi: 10.33024/jikk.v10i5.9558.

Putri, MPD, Suyasa, IPGEA and Budiapsari, PI (2021) "The relationship between dyslipidemia and the incidence of hypertension in Bali in 2019," Aesculapius Medical Journal | , 1(1), p. 8–12.

Side Gao, M. et al. (2022) "Remnant Cholesterol Predicts Risk of Cardiovascular Events in Patients With." doi: 10.1161/JAHA.121.024366.

Wu, Z. et al. (2023) "Longitudinal association of remnant cholesterol with joint arteriosclerosis and atherosclerosis progression beyond LDL cholesterol," BMC Medicine , p. 1–12. doi: 10.1186/s12916-023-02733-w.

Yiyi Zhang, P. et al. (2019) "Associations of Blood Pressure and Cholesterol Levels During Young Adulthood With Later Cardiovascular Events," 74(3), p. 330–341. doi: 10.1016/j.jacc.2019.03.529.Associations.