



## THE RELATIONSHIP OF NUTRITIONAL STATUS WITH CHOLESTEROL LEVELS IN JUNIOR HIGH SCHOOL STUDENTS IN MALANG

Monikasari<sup>1\*</sup>, Kristiawan Prasetyo Agung Nugroho<sup>1</sup>, Chaterine Natawirarindy<sup>2</sup>, Priskila Eka Setia Esperansa<sup>1</sup>

<sup>1</sup>Nutrition Study Program, Faculty of Medicine and Health Sciences, Universitas Kristen Satya Wacana, Jl. Kartini No. 11, Sidorejo Lor, Sidorejo District, Salatiga, Central Java, 50714, Indonesia

<sup>2</sup>Nursing Study Program, Faculty of Medicine and Health Sciences, Universitas Kristen Satya Wacana, Jl. Kartini No. 11, Sidorejo Lor, Sidorejo District, Salatiga, Central Java, 50714, Indonesia

\*[monikasari.monikasari@uksw.edu](mailto:monikasari.monikasari@uksw.edu)

### ABSTRACT

Overweight and obesity are the result of excess food intake compared to energy expenditure. Overweight and obesity are health problems associated with dyslipidemia and risk factors for cardiovascular disease. Knowledge about being overweight and knowledge about nutrition are related to the practice of choosing the food consumed. The aim of this research was to determine the relationship between nutritional status and cholesterol levels in junior high school students in Malang. The method used in this research uses a quantitative descriptive research design with a cross sectional approach. The research location was carried out at Pelita Kasih Lawang Christian Middle School, Malang Regency in February - April 2021. The method used in this research was the total population, with the population in this study being 76 respondents. Respondent characteristics data was obtained based on the population at Pelita Kasih Lawang Christian Middle School, Malang Regency, aged 12-15 years who had more nutritional status and were willing to be respondents when the research was conducted. Nutritional status data was obtained using a weight measuring device using a Camry brand digital scale. Height measuring tool using a micrometer with an accuracy of 0.1 cm. Cholesterol test tool with Easy Touch brand cholesterol strips, non-powdered rubber gloves, 5L biohazard safety box, lancet needle and alcohol swabs. Conclusion: based on the research that has been conducted, it can be concluded that the nutritional status is normal for 36 respondents, the nutritional status is overweight for 11 respondents and the nutritional status for obesity is 7 respondents. There was no relationship between nutritional status and respondents' cholesterol levels. Suggestion: This research still requires further research related to nutritional status and hypercholesterolemia factors.

Keywords: adolescent; cholesterol; nutrition status

|                                                                                                                                                                                                                                                                                                                                                                                                  |                                     |                                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|-------------------------------------|
| <b>First Received</b><br>16 January 2024                                                                                                                                                                                                                                                                                                                                                         | <b>Revised</b><br>30 January 2024   | <b>Accepted</b><br>02 Februari 2024 |
| <b>Final Proof Received</b><br>08 January 2024                                                                                                                                                                                                                                                                                                                                                   | <b>Published</b><br>29 January 2024 |                                     |
| <b>How to cite (in APA style)</b><br>Monikasari, M., Nugroho, K. P. A., Natawirarindy, C., & Esperansa, P. E. S. (2024). The Relationship of Nutritional Status with Cholesterol Levels in Junior High School Students in Malang. Indonesian Journal of Global Health Research, 6(1), 179-186. <a href="https://doi.org/10.37287/ijghr.v6i1.2604">https://doi.org/10.37287/ijghr.v6i1.2604</a> . |                                     |                                     |

### INTRODUCTION

One of the factors associated with high cholesterol is body mass index. Excessive body mass index or obesity is a condition with various causes related to biological, social, socio-economic and environmental aspects that have a negative impact on health. Body Mass Index (BMI) is closely related to the percentage of body fat in the entire population. The global burden of disease caused by excess weight is 60.307.000 adults, this prevalence has doubled from 1980 to 2015 in 73 countries in the world and continues to increase. The global burden of disease is related to an increase in BMI which then results in cardiovascular disease reaching 4.000.000 deaths. Population obesity in adolescents is a global health epidemic throughout the world and continues to experience an increase in the prevalence of obesity

among adolescents. Adolescents who are overweight and obese in adulthood are at risk of developing cardiovascular disease in the future (Wardhani et al., 2023). Overweight and obesity are health problems related to abnormalities in body fat levels or dyslipidemia and risk factors for cardiovascular disease. Dyslipidemia in childhood can be caused by genetic and non-genetic problems. Children who are overweight and obese are at risk of experiencing dyslipidemia and familial hypercholesterolemia which will later develop cardiovascular disease (Eljamay, 2019; Mc Auley et al., 2020).

Atherosclerotic cardiovascular disease is a major cause of morbidity and mortality worldwide. The onset of atherosclerosis occurs in childhood and adolescence, which then becomes cardiovascular disease in young adulthood. Several risk factors for cardiovascular disease can be identified in childhood and adolescence, but hyperlipidemia along with the global obesity epidemic is the most common disease and plays an important role in the development of arteriosclerotic cardiovascular disease. Suppressing the incidence of hyperlipidemia can be helped by hyperlipidemia screening to detect children who are at high risk and are more sensitive to experiencing hyperlipidemia. Prevention and treatment of hyperlipidemia must be started as early as possible to reduce the risk of atherosclerotic cardiovascular disease in the future (Sustar et al., 2023). Over the past few decades overweight and obesity in children and adolescents has become an epidemic that represents one of the major health burdens worldwide. Currently, the prevalence of hyperlipidemia continues to increase throughout the world, according to NHANES as many as 20% of patients aged 12-19 years experience lipid disorders. Overweight children and adolescents have a higher prevalence of hyperlipidemia of up to 42%. The prevalence of dyslipidemia increases with increasing BMI with age, 15% at ages 6-11 years and 25% at ages 12-19 years (Mainieri et al., 2023).

Cholesterol is a lipophilic molecule that is useful for human life. Cholesterol has many roles that contribute to normal functioning of cells. Cholesterol is an important component of cell membranes, contributing to the structural arrangement of cell membranes and as a precursor molecule in the synthesis of vitamin D, steroid hormones such as cortisol, aldosterone and adrenal androgens as well as sex hormones such as testosterone, estrogen and progesterone. Cholesterol is a bile salt element that is used in the digestive process to help the absorption of fat-soluble vitamins A, D, E and K. Cholesterol has a good impact on health, but if it is excessive it can affect a person's health. Hypercholesterolemia can occur due to lipid metabolism disorders which are characterized by increased blood cholesterol levels (Huff T et al., 2023).

The prevalence of hypercholesterolemia in the world occurs around 45% in the world, 30% in Southeast Asia and 35% in Indonesia. Hypercholesterolemia is a world health problem because it has been proven to be associated with an increased risk of cardiovascular disease. According to WHO (World Health Organization), adolescents are divided into 3 groups, namely early adolescents aged 10-19 years, middle adolescents aged 15-24 years and late adolescents aged 10-24 years. Adolescence is an important time to lay the foundation for good health. During adolescence, they experience rapid physical, cognitive and psychosocial growth. This growth affects the way we feel, think, make decisions and interact socially. Adolescence is a healthy stage of life but there are health problems caused by injury or disease. This adolescent phase can be prevented or treated. During adolescence, behavioral patterns such as dietary choices, physical activity, drug use and sexual activity are formed, where there are choices to protect or endanger health in the future. Poor diet and low physical activity are problems in adolescence (Nudhar & Oswari, 2020).

Inappropriate food choices can have an impact on adolescent health so that hypercholesterolemia is not only a health problem in old age but can also occur in adolescence (Campbell et al., 2019). Technological developments make it easier and faster for individuals to get food. Technological advances have an impact on lifestyle changes. The activity of eating outside the home has become part of the lifestyle which has caused a shift in the culture of eating at home. Eating outside the home is defined as consuming food or drinks from outside the home or buying food or drinks made outside the home which are then consumed at home or outside the home. Adolescents are a population at risk of experiencing weight gain which is reed to decreased food quality. Consuming unhealthy foods by not consuming vegetables and fruit contributes to an increase in body mass index (Arrobas Velilla et al., 2023; Grace et al., 2021; Rahmawati et al., 2023). Based on the background above, researchers are interested in conducting research on the relationship between nutritional status and cholesterol levels in adolescents in Malang.

## METHOD

This research is a quantitative descriptive study with a cross sectional approach. The research location was carried out at Pelita Kasih Lawang Christian Middle School, Malang Regency in February – April 2021. This research has passed ethics number 040/KOMISITIK/EC/X/2020. The method used in this research is total population, with the population in this study being 76 respondents. Respondent characteristics data was obtained based on the population at Pelita Kasih Lawang Christian Middle School, Malang Regency, aged 13-15 years who had more nutritional status and were willing to be respondents when the research was conducted. Nutritional status data was obtained using a weight measuring device using a Camry brand digital scale. Height measuring tool using a micrometer with an accuracy of 0.1 cm. Cholesterol test tool with Easy Touch brand cholesterol strips, non-powdered rubber gloves, 5L biohazard safety box, lancet needle and alcohol swabs.

## RESULTS

### Respondent Characteristics

The sample for this research is a population of students who meet the inclusion and exclusion criteria, The criteria for inclusion in this research were all students of Pelita Kasih Lawang Chistian Middle School aged 12-15 years and were willing to be research respondents. Nutritional status data was taken after students signed informed consent as a form of availability to be involved in the research being conducted. After collecting data on nutritional status, the respondent's blood was then taken to check the respondents cholesterol levels. The exclusion criteria in this study were all students who were unwilling to become research respondents or withdrew at the time the research was conducted. The sampe in this study was all students of Pelita Kasih Lawang Christian Middle School aged 12-15 years.

Tabel 1.  
Age Distribution of Respondents (n=56)

| Age      | f  | %  |
|----------|----|----|
| 12 years | 7  | 11 |
| 13 years | 25 | 40 |
| 14 years | 23 | 37 |
| 15 years | 6  | 9  |

Table 1, it can be seen that the age distribution of respondents shows that there are 7 respondents aged 12 years (11%), 13 years old as many as 25 respondents (40%), 14 years old as many as 11 respondents (20%), 15 years old as many as 6 respondents (9%).

Table 2.  
Distribution of Respondent's Nutritional Status (n=56)

| Category   | f  | %  |
|------------|----|----|
| Normal     | 36 | 67 |
| Overweight | 11 | 20 |
| Obesity    | 7  | 13 |

Table 2, it can be seen that the distribution of respondents' nutritional status shows that there are normal nutritional status of 37 respondents (67%), overweight nutritional status of 11 respondents (20%) and obese nutritional status of 7 respondents (13%). Based on the results of the Kolmogorov-Smirnov normality test, it shows that nutritional status and cholesterol levels are not normally distributed. A test for homogeneity of nutritional status and cholesterol data was carried out showing the same data variance ( $p>0.05$ ), so the test used to see the relationship between nutritional status and cholesterol levels was the Spearman Test.

Table 3.  
Spearman Test of the Relationship between Nutritional Status and Cholesterol Levels (n=56)

| Nutritional Status | Cholesterol Levels |
|--------------------|--------------------|
|                    | $p=0,624$          |

\* $p<0,005$  = significant

The Spearman test results showed that there was no significant relationship between nutritional status and cholesterol levels.

## DISCUSSION

Nutritional status is an individual's health condition which is influenced by the body's intake and utilization of nutrients. Optimal nutritional status can be achieved by consuming sufficient food intake that is not excessive as a source of energy, important nutrients, other food components such as dietary fiber and does not contain toxins or contaminants. Nutritional status is the relationship between the food intake consumed and individual nutritional needs. Food consumption is related to the utilization of nutrients to maintain energy reserves and compensate for nutrient losses. A person's nutritional status can be determined by anthropometric measurements and then the results will be compared with standard or reference values. The Body Mass Index/Age (BMI/A) index is used for respondents in the categories of poor nutrition, undernutrition, good nutrition, at risk of overnutrition, overnutrition and obesity. Nutritional status assessment is carried out as a way to improve nutritional status. A person can be said to have good nutritional status if their nutritional intake meets their needs. Insufficient nutritional intake can cause malnutrition and conversely, excessive nutritional intake can cause overnutrition. Being overweight can cause hypercholesterolemia. Body mass index can be used to measure body fat deposits. Increased cholesterol levels can occur due to the reduced ability of HDL to transport excess peripheral cholesterol back to the liver, including cholesterol found in atherosclerotic plaque (IQWiG., 2024; Lütjohann et al., 2023; Reduce Your Risk of ASCVD, n.d.; Schröder et al., 2023).

Adolescents have the potential to be affected by high cholesterol. Cholesterol is considered a health problem that often occurs in adults. Another thing that influences teenagers' awareness of their health is the lack of information about cholesterol (Wardhani et al., 2023). Cholesterol is produced in the liver as much as 80% and 20% comes from food. Cholesterol that sticks to it will slowly accumulate and then settle in the form of plaque on the walls of blood vessels. Cholesterol deposits that settle on the walls of blood vessels can cause the blood vessel cavity to narrow, disrupting blood circulation and causing the risk of diseases such as stroke,

coronary heart disease and so on (Setyawati & Lasroha, n.d.). Cholesterol can enter the bloodstream through the digestion of dietary fat. Cholesterol has an important role in cellular function, cholesterol can also be synthesized directly by body cells. The process of producing cholesterol in the body is in the liver. Cholesterol is mostly a lipophilic molecule, cholesterol does not dissolve well in the blood. Cholesterol is part of lipoproteins which have the properties of phospholipids and apolipoproteins (Schade et al., 2020).

Lipoproteins consist of a lipid core containing cholesterol esters and triglycerides and a hydrophilic outer membrane consisting of phospholipids, apolipoproteins and free cholesterol, thereby allowing lipid molecules to move throughout the body via the blood circulation and be transported to the cells that need them. Cholesterol has several important functions in the body. Some of the main uses of cholesterol are related to cell membranes. Cholesterol is a normal structure of the membrane that contributes to its fluidity. Fluidity can affect the ability of some small molecules to diffuse through the membrane which will ultimately change the internal environment of the cell. Apart from that, in cell membranes, cholesterol plays a role in intracellular transport. Cholesterol is found in cell membranes, cholesterol has several other biological functions such as important precursor molecules for the synthesis of vitamin D, cortisol, aldosterone, progesterone, estrogen, testosterone, bile salts and others (Dietary Cholesterol and Cardiovascular Risk: A Science Advisory From the American Heart Association, n.d.; Huff T et al., 2023).

Hypercholesterolemia is a disorder of fat metabolism which can be characterized by increased blood cholesterol levels. Hypercholesterolemia increases the risk of diseases such as coronary heart disease, diabetes mellitus, stroke and other diseases. Hypercholesterolemia is diagnosed if the blood cholesterol level is  $>200$  mg/dL. Hypercholesterolemia can occur due to excessive nutritional status and obesity. This can happen because fat accumulation can cause adipose cells to be unable to store fat, thereby increasing blood fat levels. It does not rule out the possibility that excess nutritional status and obesity are related to hypercholesterolemia. This can occur due to factors decreasing LDL receptor activity, interactions between age, lifestyle and environmental factors. Increased cholesterol levels are not always related to conditions of excessive nutritional status and obesity. Hypercholesterolemia can occur in all age groups. Factors that cause hypercholesterolemia include physical activity, age, environment and inappropriate eating patterns (Li et al., 2022; Tang et al., 2022).

Excess weight and obesity are associated with increased disease and death due to diabetes mellitus, various cancers, digestive diseases and coronary heart disease. The main cause of overweight and obesity is excessive energy consumption leading to a positive energy balance which results in the accumulation of body fat. Another factor that contributes to weight gain is a lifestyle of lack of physical activity. BMI is used as an indirect index of adiposity and is strongly associated with cardiovascular disease risk. BMI is directly related to total and LDL cholesterol levels. Reducing fat intake is beneficial for health by lowering cholesterol levels (McGowan et al., 2019; Pondagitan et al., 2020; Schade et al., 2020; Sustar et al., 2023).

Obesity is a state of irregular fat metabolism caused by the accumulation of intracellular fat and lipoproteins as a result of increased free fatty acid synthesis and decreased free fatty acid oxidation. This process causes cellular dysfunction in various tissues including cardiac myocytes, hepatocytes and pancreatic beta cells. Mechanisms underlying the pathogenic effects of adipocyte hypertrophy in response to excessive caloric intake on the cardiovascular system and metabolism. Increased adipose tissue and dysregulation of adipokines leads to sodium retention, reninangiotensin-aldosterone system (RAAS) activity, hypertension, insulin

resistance and increased inflammation. Obesity is a cardiovascular risk factor. Excess fat levels in childhood are strongly associated with the development of atherosclerosis and hypertension. The atherogenic fats associated with childhood obesity consist of a combination of elevated cholesterol levels (Dündar & Akıncı, 2022; Sopiah et al., 2021; Khil et al., 2023).

Limiting consumption of saturated fat, maintaining body weight, doing regular physical activity, consuming more fruit, not smoking and managing stress play an important role in directly preventing hypercholesterolemia and preventing cardiovascular risks (Belete et al., n.d.). This prevention effort is carried out because the human body has a limited ability to catabolize cholesterol, so cholesterol easily accumulates in the body when there is an excess diet or genetic disorders. Cholesterol accumulation is the main cause of atherosclerosis. On the other hand, a lack of cholesterol in blood circulation can result in an inability to distribute vitamins K and E to vital body organs (Schade et al., 2020).

## CONCLUSION

Based on the research that has been conducted, it can be concluded that the nutritional status is normal for 36 respondents, the nutritional status is overweight for 11 respondents and the nutritional status for obesity is 7 respondents. There was no relationship between nutritional status and respondents' cholesterol levels.

## REFERENCES

- American Heart Association. 2022. Reduce Your Risk of ASCVD (Artherosclerotic Cardiovascular Diseases)
- Amy. Ar. 2021. LDL Cholesterol: Causes, Risk Factors and Treatment. Institute for Quality and Efficiency in Health Care (IQWiG, Germany). <https://www.ncbi.nlm.nih.gov/books>
- Arrobas Velilla, T., Guijarro, C., Campuzano Ruiz, R., Rodríguez Piñero, M., Valderrama Marcos, J. F., Pérez Pérez, A., Botana López, M. A., Morais López, A., García Donaire, J. A., Obaya, J. C., Castilla Guerra, L., Pallares Carratalá, V., Egocheaga Cabello, I., Salgueira Lazo, M., Castellanos Rodrigo, M. M., Mostaza Prieto, J. M., Gómez Doblas, J. J., & Buño Soto, A. (2023). Consensus document for lipid profile determination and reporting in Spanish clinical laboratories. What parameters should a basic lipid profile include? *Neurology Perspectives*, 3(2), 100126. <https://doi.org/10.1016/j.neurop.2023.100126>
- Belete, A. K., Kassaw, A. T., Yirsaw, B. G., Taye, B. A., Ambaw, S. N., Mekonnen, B. A., & Sendekie, A. K. (n.d.). Prevalence of Hypercholesterolemia and Awareness of Risk Factors, Prevention and Management Among Adults Visiting Referral Hospital in Ethiopia. *Vascular Health and Risk Management*.
- Campbell, E. T., Franks, A. T., & Joseph, P. V. (2019). Adolescent obesity in the past decade: A systematic review of genetics and determinants of food choice. *Journal of the American Association of Nurse Practitioners*, 31(6), 344–351. <https://doi.org/10.1097/JXX.000000000000154>
- Dietary Cholesterol and Cardiovascular Risk: A Science Advisory From the American Heart Association. (n.d.).
- Dündar, İ., & Akıncı, A. (2022). Frequency of Dyslipidemia and Associated Risk Factors Among Obese Children and Adolescents in Turkey. *Iranian Journal of Pediatrics*, 32(3). <https://doi.org/10.5812/ijp-122937>

- Eljamay, S. M. (2019). *Relationship between Obesity and Hypercholesterolemia*. 2(1).
- Grace, Ga., Edward, S., & Gopalakrishnan, S. (2021). Dietary habits and obesity among adolescent school children: A case control study in an urban area of kancheepuram district. *Indian Journal of Community Medicine*, 46(4), 637. [https://doi.org/10.4103/ijcm.IJCM\\_1013\\_20](https://doi.org/10.4103/ijcm.IJCM_1013_20)
- Huff T, Boyd B, Jialal I. (2024) Physiology, Cholesterol. <https://www.ncbi.nlm.nih.gov/books/NBK470561/>
- Khil, J., Kim, S. M., Chang, J., Choi, S., Lee, G., Son, J. S., Park, S. M., & Keum, N. (2023). Changes in total cholesterol level and cardiovascular disease risk among type 2 diabetes patients. *Scientific Reports*, 13(1), 8342. <https://doi.org/10.1038/s41598-023-33743-6>
- Li, H., Ge, M., Pei, Z., He, J., & Wang, C. (2022). Associations of environmental factors with total cholesterol level of middle-aged and elderly people in China. *BMC Public Health*, 22(1), 2423. <https://doi.org/10.1186/s12889-022-14922-y>
- Lütjohann, D., Klör, H.-U., & Stellaard, F. (2023). Measurement of Serum Low Density Lipoprotein Cholesterol and Triglyceride-Rich Remnant Cholesterol as Independent Predictors of Atherosclerotic Cardiovascular Disease: Possibilities and Limitations. *Nutrients*, 15(9), 2202. <https://doi.org/10.3390/nu15092202>
- Mainieri, F., La Bella, S., & Chiarelli, F. (2023). Hyperlipidemia and Cardiovascular Risk in Children and Adolescents. *Biomedicines*, 11(3), 809. <https://doi.org/10.3390/biomedicines11030809>
- Mc Auley, M. T. (2020). Effects of obesity on cholesterol metabolism and its implications for healthy ageing. *Nutrition Research Reviews*, 33(1), 121–133. <https://doi.org/10.1017/S0954422419000258>
- McGowan, M. P., Hosseini Dehkordi, S. H., Moriarty, P. M., & Duell, P. B. (2019). Diagnosis and Treatment of Heterozygous Familial Hypercholesterolemia. *Journal of the American Heart Association*, 8(24), e013225. <https://doi.org/10.1161/JAHA.119.013225>
- Nudhar, L., & Oswari, L. (2020). Mean Differences of Total Cholesterol Levels Among Vegetarians and Nonvegetarians at Maha Vihara Maitreya Duta Palembang.56(3).
- Pondagitan, A. S., Mayulu, N., & Lestari, H. (2020). Korelasi antara asupan serat, asupan lemak, dan status gizi dengan kadar kolesterol total remaja usia 18-20 tahun. *Jurnal Biomedik:JBM*, 12(2), 94. <https://doi.org/10.35790/jbm.12.2.2020.29429>
- Rahmawati, R., Nurwati, I., & Wiboworini, B. (2023). Does Eating Out Cause in Overweight and Obesity in Adolescence? *Proceedings of the International Conference on Nursing and Health Sciences*, 4(1), 281–288. <https://doi.org/10.37287/picnhs.v4i1.1816>
- Schade, D. S., Shey, L., & Eaton, R. P. (2020). Cholesterol Review: A Metabolically Important Molecule. *Endocrine Practice*, 26(12), 1514–1523. <https://doi.org/10.4158/EP-2020-0347>
- Schröder, H., Marrugat, J., Elosua, R., & Covas, M. I. (2023). Relationship between body mass index, serum cholesterol, leisure-time physical activity, and diet in a

- Mediterranean Southern-Europe population. *British Journal of Nutrition*, 90(2), 431–439. <https://doi.org/10.1079/BJN2003899>
- Setyawati, R., & Lasroha, M. (n.d.). *Overview of HDL, LDL, Triglycerides, and Total Cholesterol in Obese Patients*. 39.
- Sopiah, P., Haryeti, P., Sukaesih, N. S., Nuryani, R., & Lindasari, S. W. (2021). Total Cholesterol Levels and Degress of Hypertension in the Elderly Hypertension. *Journal of Nursing Care*, 4(1). <https://doi.org/10.24198/jnc.v4i1.29756>
- Sustar, U., Kordonouri, O., Arens, S., Kovac, J., Sedej, K., Battelino, T., & Groselj, U. (2023). Evaluation of Body Mass Index, Overweight and Obesity Status, and Cholesterol Levels in Younger Children. *JAMA Network Open*, 6(4), e238141. <https://doi.org/10.1001/jamanetworkopen.2023.8141>
- Tang, N., Ma, J., Tao, R., Chen, Z., Yang, Y., He, Q., Lv, Y., Lan, Z., & Zhou, J. (2022). The effects of the interaction between BMI and dyslipidemia on hypertension in adults. *Scientific Reports*, 12(1), 927. <https://doi.org/10.1038/s41598-022-04968-8>
- Wardhani, K., Sihombing, M., & Syahputra, S. (2023). Diagnosis Of Cholesterol Disease In Adolescence Using Certainty Factor Method. *Journal of Artificial Intelligence and Engineering Applications (JAIEA)*, 3(1), 53–60. <https://doi.org/10.59934/jaiea.v3i1.258>