PROFESIONAL HEALTH JOURNAL
Volume 6, No. 2, June 2025 (Hal. 569-579)
Available Online at https://www.ojsstikesbanyuwangi.com
E-ISSN 2715-6249

The Influence Of Body Mass Index And Eating Patterns On Cholesterol Levels In Adolescents

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ARTICLE INFORMATION

Article history
Received (22 October 2024)
Revised (28 November 2024)
Accepted (4 December 2024)

Keywords
Body Mass Index, Eating Patterns, Cholesterol Levels

ABSTRACT

Introduction: *Unhealthy eating habits, such as the consumption of junk food that is high in salt, sugar, and low in nutrients, can lead to nutritional deficiencies and increase the risk of early cardiovascular diseases in adolescents.*
Objectives: *This research aims to analyze the relationship between dietary patterns and Body Mass Index (BMI) with cholesterol levels in adolescents.*
Methods: *This study uses a cross-sectional analytical observational design. In this study, the sample used total sampling. The population of 58 respondents means that the sample taken is 58 samples. The data was analyzed using univariate analysis for the frequency distribution of BMI, dietary patterns, and cholesterol levels. The chi-square test is used in bivariate analysis to assess the relationship between diet and BMI with cholesterol levels.*
Results: *Based on 58 respondents, the analysis using the chi-square test found that the significance level of the p-value is 0.05, as (p-value 0.464) indicates that there is no effect of BMI on cholesterol levels.*
Conclusions: *Meanwhile, the analysis using the chi-square test on diet concerning cholesterol levels yielded a (p-value of 0.001), indicating that diet affects cholesterol levels. The research results indicate that BMI does not have a significant effect on cholesterol levels, while dietary patterns do impact cholesterol levels among adolescents. This indicates that a multifactorial approach is necessary for addressing cholesterol issues in adolescents.*

Introduction

Poor eating habits, such as consuming junk food that is high in salt, sugar, and low in nutrients, can lead to various health problems. Lifestyle changes and technological advancements also influence the eating patterns of teenagers (Saputri & Novitasari, 2021). Teenagers' dietary preferences lean towards consuming protein from fast food that is high in cholesterol, resulting in poor nutritional quality and inadequate nutrition for adolescents (Yusuf & Ibrahim, 2019). High cholesterol at a young age can trigger the early development of cardiovascular diseases. High total cholesterol in youth can lead to blood vessel blockages in adulthood and old age (Arief et al., 2022).

According to the Centers for Disease Control and Prevention in the United States, twenty-five per cent of individuals over the age of twenty-one have a total cholesterol level above 240 mg/dl. In comparison, about seventeen per cent have "good" cholesterol, or high-density lipoprotein, below 40 mg/dl. In the world, founded that 2.1% of people are

diagnosed with hypercholesterolemia before age 0f 18 years (Dharmayat et al., 2024). From 2017 to 2020 in US adults for age above 20 years reached 86.4 million cases had high and borderline high cholesterol (CDC, 2022) . On a national scale in Indonesia, the prevalence of high cholesterol is 7.6% of the population, with a total of 34,820 recorded cases (Riskesdas, 2018). In 2023 the prevalence of cholesterol level examination results at the age of 15-24 years with the borderline cholesterol category reached 14.2% and for high category up to 2.8% (SKI, 2023). The prevalence of high cholesterol patients in East Java province reaches 36.1% (Kemenkes.RI, 2016). The number of cholesterol sufferers in Banyuwangi in 2021 was 1,611 people (Yunita et al., 2022).

An increase in BMI (body mass index) indicating excess weight signifies a higher amount of fat stored in the body, which also implies an increase in blood fat levels. Being overweight can lead to high cholesterol (Yusuf & Ibrahim, 2019). Unhealthy eating patterns stemming from lifestyle choices and technological advancements also affect teenagers' diets. Their dietary preferences lean towards consuming protein from fast food, which is high in cholesterol and has poor nutritional quality, leading to inadequate nutrition among adolescents. The prevalence of junk food, which is high in salt and sugar but low in essential proteins, vitamins, and minerals, also contributes to high cholesterol levels (Saputri & Novitasari, 2021). High cholesterol levels can result from abnormal lipoprotein levels in the bloodstream. Over time, this can accelerate the development of arteriosclerosis and hypertension. High cholesterol is a significant factor in the onset of ischemic heart disease and stroke (Fakhri et al., 2023).

Maintaining a nutritious diet is very important to optimize the absorption of essential nutrients for the body, which in turn will strengthen the immune system (Saputri & Novitasari, 2021). Maintaining health with the proper diet can play a significant role in managing cholesterol levels. One crucial step is to limit the consumption of foods high in added sugars, sodium (salt), trans fats, and saturated fats. Reducing the intake of these foods can help lower the risk of high cholesterol (CDC, 2023). Patients with high cholesterol should also engage in regular physical activity and strive to maintain an ideal weight (Patala et al., 2023).

Methods

This research used analytical observation based on a cross-sectional design. In social research, cross-sectional studies are also referred to as snapshot studies or case studies—this is the most commonly used design (Pasaribu et al., 2022).

In this investigation, total sampling was used. Total sampling is a sampling technique where the sample size is equal to the population size. (Suryanhi & M, 2020). The population of 58 respondents means that the sample taken is 58 samples. This research will be conducted at the Rustida Banyuwangi School of Health Sciences.

The independent variables in this study are body mass index and dietary patterns. The dependent variable in this study is cholesterol levels. Data was collected and tabulated then

analysis using Chi-square test to identify the relationship between independent variable due to dependent variable.which it can be said if this significant if p-value ,0.05.

Results

1. Characteristics of Respondents Based on Body Mass Index

Body mass index	Frequency	Percentage
Underweight	10	17,2 %
Normal	31	53,5 %
Overweight	17	29,3 %
Total	58	100,0 %

The table shows that the body mass index of adolescents is mainly within the normal range, with 31 respondents (53.4%), ten underweight respondents (17.2%), seventen overweight respondents (29.3%).

2. Characteristics of Respondents Based on Eating Patterns

Dietary pattern	Frequency	Percentage
Lacking	5	8,6 %
Enough.	36	62,1 %
Over	17	29,3 %
Total	58	100,0 %

The table shows the distribution of respondents based on the frequency of eating patterns. The adequate eating pattern is the most common, with 44 respondents (75.9%), while the inadequate eating pattern has nine respondents (15.5%), and the excessive eating pattern has five respondents (8.6%).

3. Characteristics of Respondents Based on Cholesterol Levels

Cholesterol Levels	Frequency	Percentage
High	10	17,2%
Worrisome	15	25,9%
Normal	33	56,9%
Total	58	100,0%

The table shows the distribution of respondents based on the frequency of eating patterns, with a sufficient eating pattern being the most common at 36 respondents

(62.1%). In comparison, the inadequate eating pattern had five respondents (8.6%), and the excessive eating pattern had 17 respondents (29.3%).

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4. Cross Tabulation of Body Mass Index with Cholesterol Levels in Adolescents at Stikes Rustida

IMT value	Cholesterol Levels			
	High	Worrisome	Normal	Total
Underweight	1	4	5	10
Normal	7	7	17	31
overweight	2	4	11	17
Total	10	15	33	58

Based on the research results shown in the table, the majority of respondents experienced a normal BMI, with seven respondents (12%) having high cholesterol levels, seven respondents (12%) having concerning cholesterol levels, and 17 respondents (29%) having normal cholesterol levels.

5. Cross Tabulation of Eating Patterns with Cholesterol Levels in Adolescents at Stikes Rustida

Value of Eating ıtterns	Cholesterol Levels			
	High	Worrisome	Normal	Total
Lacking	1	3	1	5
Enough.	4	4	28	36
Over	5	8	4	17
Total	10	15	33	58

According to the table, 36 respondents (62.7%) experienced a sufficient diet, while 28 respondents (48%) had normal cholesterol levels.

6. Analysis of Chi-Square Test on the Effect of Body Mass Index on Cholesterol Levels

	Chi-Square Tests		
	Value	Df	Asymptotic gnificance (2-sided)
Pearson Chi-ıuare	2.339a	4	.674
Likelihood Ratio	2.277	4	.685
Linear-by-Linear ssociation	.318	1	.573
N ofValid Cases	58		

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Based on Table 6 above, the Chi-Square test results show a p-value of 0.674, which is greater than α. This means there is no effect of body mass index on cholesterol levels in adolescents at Rustida School of Health Sciences.

7. Analysis of Chi-Square Test on the Effect of Eating Patterns on Cholesterol Levels

	Chi-Square Tests		
	Value	Df	Asymptotic gnificance (2-sided)
Pearson Chi-ıuare	17.784α	4	.001
Likelihood Ratio	18.343	4	.001
Linear-by-Linear ssociation	2.859	1	.091
N of Valid Cases	58		

According to Table 7 above, the Chi-Square test results show a p-value of 0.001, which is smaller than α, indicating that dietary patterns influence cholesterol levels among adolescents at Rustida Health Science College.

Discussion

1. Body Mass Index in Adolescents

The analysis results show that among the first-year students at STIKes Rustida, out of 58 respondents, the highest body mass index category is Normal, with a percentage of 31 (53.4%). The number of underweight respondents is 10 (17.2%), overweight respondents is 17 (29.3%).

BMI (Body Mass Index) is considered a measure or representation of body fat levels. Although BMI does not directly measure body fat, it uses its findings to determine nutritional status levels. (Sulistyoningsih, 2020). Body weight measurement can be used to estimate body mass. The amount of food consumed, the onset of infectious conditions, or a decrease in appetite can all lead to sudden changes in body mass. (Novita & Fitriyani, 2022). Height is an anthropometric parameter that explains issues related to bone growth. Unlike body weight, height growth is relatively less vulnerable to acute malnutrition. (Nugroho, 2018).

Teenagers, especially in environments like STIKes Rustida, generally have a BMI in the normal category. This can be linked to several social and psychological factors. Especially women are often more aware of their physical appearance and strive to maintain their bodies to look attractive, which leads them to pay more attention to their diet and keep their weight within the normal range. In contrast, men tend to have higher physical activity levels, such as playing soccer, volleyball, badminton, or going to the gym, which are part of their lifestyle. These activities help them maintain their weight, keeping men's BMI within the normal range.

2. Eating Patterns in Adolescents

Based on the results of the analysis, the distribution of respondents according to the frequency of eating patterns shows that the adequate eating pattern is the most common, with 44 respondents (75.9%). In comparison, the insufficient eating pattern has nine respondents (15.5%), and the excessive eating pattern has five respondents (8.6%).

A proper and nutritious diet consists of eating the same foods every day at the same time, avoiding excessive food, eating according to a schedule, and limiting foods that contain preservatives. (Astuti et al., 2022). The Menu Guidelines for 4 Healthy and 5 Perfect refer to the four basic principles of the United States, which consist of main dishes, side dishes, fruits, and vegetables, with milk as a complement to the menu. (Aznani, 2020). If all age groups are to experience good growth, physical development, and intelligence, optimal nutrition is essential. Poor health correlates with suboptimal nutrition. (Mufidah, 2021).

The adolescents in this study tend to consume an adequate diet, as can be seen from several factors. First, awareness of the importance of maintaining health among teenagers may have increased due to more accessible access to information about balanced nutrition and its impact on health. In this digital era, information about healthy diets and the risks of poor eating habits is more easily accessible to teenagers through social media, schools, or family. Secondly, the possibility of formal education in schools regarding the importance of a healthy diet also plays a role in shaping adequate and balanced eating habits. Thirdly, encouragement from the social environment, such as family and friends, is also significant. Many teenagers tend to follow the eating patterns of their family or community. If their environment supports healthy eating habits, then their tendency to adopt a sufficient diet becomes greater. Lastly, the awareness of the importance of maintaining physical appearance and health may be one of the motivations for teenagers to avoid overeating. With these various factors, the implementation of an adequate diet among the majority of respondents can be linked to a combination of education, environmental influences, and their awareness of the importance of balanced nutrition.

3. Cholesterol Levels in Teenagers

The results of the analysis show that normal cholesterol levels were found in the majority of respondents, with 33 individuals (56.9%). In contrast, 15 respondents (25.9%) had concerning levels, and 10 respondents (17.2%) had high levels.

Cholesterol, a type of lipid, is necessary for the body to synthesize substances such as folic acid in the liver and hormones. Free cholesterol forms deposits or reserves in the plasma, and then lipoproteins transport these two forms. High-density lipoprotein (HDL), low-density lipoprotein (LDL), very low-density lipoprotein (VLDL), and chylomicrons are the four different forms of lipoproteins. (Setiani, 2022). In general, cholesterol helps the body's cells (cell membranes) form walls.

Additionally, cholesterol is necessary for the synthesis of vitamin D and sex hormones and for the proper functioning of nerves and the brain. (Karminingtyas et al., 2021) High cholesterol in teenagers can trigger the early development of cardiovascular diseases. High total cholesterol in teenagers can lead to blood vessel blockages in adulthood and old age. (Arief et al., 2022).

Several factors support normal cholesterol levels in adolescents. Genetic factors play an important role, where a genetic background supports normal cholesterol levels. Teenagers also tend to be more physically active, which helps increase good cholesterol (HDL) and lower bad cholesterol (LDL). In addition, a more balanced diet rich in fibre, fruits, and vegetables, along with the influence of estrogen hormones in teenage girls, helps reduce cholesterol levels. A healthy Body Mass Index (BMI) in adolescents also reduces the risk of high cholesterol levels. A higher awareness of the importance of a healthy lifestyle and adequate health education also contribute to the majority of teenagers having normal cholesterol levels. The combination of these factors contributes to the majority of teenagers having normal cholesterol levels, thereby reducing the risk of cardiovascular diseases in the future.

4. The Influence of Body Mass Index on Cholesterol Levels in Adolescents

Based on the data analysis results using the chi-square test, a p-value of 0.674 was obtained, which is greater than α. This means that body mass index has no effect on cholesterol levels among adolescents at Rustida Health Science College. Body mass index does not significantly influence cholesterol levels. The statement that Body Mass Index (BMI) does not affect cholesterol levels in adolescents at STIKES Rustida can be explained by data showing that the majority of these adolescents have a BMI within the normal range. A normal BMI indicates that their weight is balanced with their height, thus preventing excessive fat accumulation that could affect cholesterol levels.

Malnutrition and overnutrition are also related to the measurement and assessment of BMI. The risk of degenerative diseases increases due to overnutrition combined with excessive body fat storage, while the risk of infectious diseases rises due to malnutrition. (Nugroho, 2018). When the BMI results indicate that someone is overweight or obese, this is the most commonly raised issue. One of the symptoms of overnutrition that requires attention is obesity (Kaparang et al., 2022). Type 2 diabetes, high blood pressure, and cardiovascular disease are all more likely to occur as a result of obesity and being overweight (Hasibuan & A, 2021). The application of body mass index as a diagnostic technique to determine an individual's weight classification - normal, underweight, overweight, or obese (Rasyid, 2021).

The body produces 80% of complex fat molecules, specifically cholesterol (mainly from the liver), with the remaining 20% coming from food. Fat (cholesterol) has various functions in the body, including forming cell membranes (Utama, 2021). Research reveals that an abnormal increase in cholesterol levels is usually a cause of coronary heart disease (Karminingtyas et al., 2021). An increase in BMI (body mass index) indicating overweight

signifies the accumulation of body fat, which also indicates a rise in fat levels in the blood, leading to high cholesterol levels (Yusuf & Ibrahim, 2019).

This research is similar to the results of previous studies conducted by Fakhri et al. (2023). It shows that there is no relationship between total cholesterol and body mass index among students because the respondents' BMI is in a normal state; they lead a healthy lifestyle and have a healthy diet, thus maintaining their BMI within the normal range, whereas according to Yusuf & Ibrahim, (2019). BMI influences cholesterol levels, with a substantial correlation value of p = 0.0160. This is related to the respondents' excessive eating patterns, which can lead to obesity, increase body mass index, and result in fat accumulation that raises cholesterol levels.

A normal BMI reflects a balance between weight and height, which means there is no excessive fat accumulation that could affect cholesterol levels. Several factors that may contribute to this outcome include the healthy lifestyle practised by the respondents, a balanced diet, and a heightened awareness of the importance of maintaining health, which may be more prevalent among the adolescents of STIKES Rustida. A healthy lifestyle and good dietary habits play a significant role in keeping BMI within the normal range and preventing increased cholesterol levels. This research provides the perspective that other factors such as lifestyle, genetics, environment, gender, and diet may have a more dominant role in the increase of cholesterol levels.

5. The Influence of Eating Patterns on Cholesterol Levels in Adolescents

Based on the results of the data analysis using the chi-square test, a p-value of 0.001 was obtained, which is smaller than α, indicating that there is an influence of dietary patterns on cholesterol levels among adolescents at Rustida Health Sciences College.

A diet aims to control the amount and types of food consumed to achieve various goals, including maintaining health and nutritional status, as well as preventing or treating diseases (Villanueva, 2020). According to the Ministry of Health (2023). A sufficient portion of the diet consists of 1/6 of the plate for side dishes containing animal or plant protein, 1/3 of the plate for staple foods containing complex carbohydrates, and 1/3 of the plate for vegetables. Unhealthy eating patterns, such as frequently consuming foods high in saturated fats, can lead to increased cholesterol levels. Saturated fats are commonly found in animal products such as meat, yoghurt, milk, eggs, fish, and cheese (Setiani, 2022).

This research is similar to the results of previous studies conducted by Syarfaini et al (2020). There is a relationship between diet and cholesterol with a p-value of 0.030, which is linked to the respondents' eating patterns. The respondents have a diet that is high in fat, which contributes to increased cholesterol levels in the blood, according to Yoeantafara and Martini (2020). There is no relationship between diet and cholesterol, with a p-value of 0.285 (p>0.05). According to the researchers, there is no relationship between diet and cholesterol because the respondents follow a high-fat diet that does not raise cholesterol levels.

From a scientific perspective, a diet high in saturated fats, such as those found in meat and other animal products, can trigger an increase in LDL cholesterol, commonly known as bad

cholesterol. Meanwhile, a balanced diet that includes portions of animal or plant protein, complex carbohydrates, and vegetables, according to the Ministry of Health guidelines (2023), can help keep cholesterol levels within normal limits. Awareness of the importance of a healthy diet, as well as participation in regular physical activity, also plays a role in managing cholesterol levels by increasing HDL (good) cholesterol and lowering LDL cholesterol. (bad). Genetic factors, metabolism, and regular health monitoring also contribute to these outcomes. Thus, it can be concluded that diet is one of the essential components in managing cholesterol levels.

Conclusion

Research involving 58 respondents at Rustida Banyuwangi Health Sciences College examined the influence of Body Mass Index (BMI) and dietary patterns on cholesterol levels in adolescents. The results show that the majority of respondents have a normal BMI (53.4%), while 17.2% are underweight, 29.3% are overweight. Most respondents have a sufficient eating frequency (62.1%), with overeating patterns (29.3%) and under-eating (8.6%). Normal cholesterol levels were found in 56.9% of respondents, while 25.9% fall into the concerning category, and 17.2% are high. Based on the chi-square test, BMI does not affect cholesterol levels (p-value 0.464), but diet shows a significant impact. (p-value 0,001).

Ethics approval and consent to participate

Researchers have also carried out an ethical test with number 282/03/KEPK-STIKESBWI/VII/2024 from Sekolah Tinggi Ilmu Kesehatan Banyuwangi health research ethics committee.

Acknowledgments

We would like to thank the respondents who were willing to give their time and were willing to contribute to this research.

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