Jurnal Teknologi Kesehatan Borneo Vol. **6(1)**, 1–6
(2025) doi: 10.30602/jtkb.v6i1.407

JURNAL TEKNOLOGI KESEHATAN BORNEO

ARTICLE

Relationship between High Fat Diet and Risk of Hyperlipidaemia in Primary School Children in Surabaya

Vincentia Maria Iriane [1], Yuswanto Setyawan [2,*]

[1] Patologi Klinik RSUD Lawang, Lawang, Indonesia
[2] Fakultas Kedokteran, Universitas Ciputra, Surabaya, Indonesia
*Corresponding author: yuswanto_setyawan@yahoo.com

Abstract
The prevalence of hyperlipidaemia in children in Indonesia is 84.7%, which is very high. Although the health consequences of overweight in children are still poorly studied compared to adults, overweight in children has been consistently reported as a major risk factor for future metabolic conditions, such as type 2 diabetes mellitus, metabolic syndrome, cardiovascular disease, and some cancers. This study focuses specifically on primary school children only and the research location is in Surabaya. The purpose of this study was to analyse the relationship between the level of fat consumption and blood lipid levels in primary school children. This research method is cross-sectional. In this study, data were collected using the Modified Food Frequency Questionnaire (FFQ) and measurement of total cholesterol, LDL, HDL, and triglyceride levels through blood samples and analysed using chi square test and spearman correlation using SPSS Software. The results found that elementary school children who rarely consume high-fibre foods have a 6x greater risk of hyperlipidemia than in the category of frequent consumption of high-fibre foods. Suggestions for future research are expected to analyse hyperlipidemia in children and be associated with gender in elementary school students in order to know more in-depth differences.

Keywords: Children; Hyperlipidaemia; Diet

1. Introduction

Paediatric hyperlipidaemia has become an increasingly common risk factor, as paediatric obesity increases worldwide. This condition is associated with changes in vascular endothelial function and the start of the atherosclerosis process, which can prepare children for cardiovascular disease later in life (Feingold et al., 2023). One of the causes is dietary habits, as they play an important role in the development of hyperlipidaemia. A study in 9-year-old children showed that those who consumed a "Western" diet high in fat, sugar, and low in fruit and vegetable consumption had worse lipid profiles compared to those who followed a "Traditional" diet more similar to the Mediterranean diet (Garg & Radhakrishnan, 2024).

In Southeast Asia in 2019 the total prevalence of hyperlipidaemia in children was around 30%, (Rahayu & Alim, 2024). In Indonesia, the prevalence of dyslipidaemia was 84.7%. The prevalence in Surabaya in particular shows more than 40% (Widiasari, 2017). This is an alarming rate and further research is needed. The increased prevalence of childhood obesity is in line with the increased risk of lipid profile disorders, including hypercholesterolemia and hypertriglyceridemia (Nurhidayati et al., 2022). Hyperlipidaemia is characterised by increased levels of total cholesterol (60.6%), triglycerides

 ISBN 2723-3790 (Print), 2723-3782 (Online).

(24.5%), LDL-cholesterol (47.9%), and decreased HDL-cholesterol (73.4%) (Irawati et al., 2006) which can be suffered by children who are obese or not.

One of the causes of hyperlipidaemia is overweight, although the health consequences of overweight in children are still poorly studied compared to adults, overweight in children has been consistently reported as a major risk factor for future metabolic conditions, such as type 2 diabetes mellitus, metabolic syndrome, cardiovascular disease, and several types of cancer. (NCD, 2017) (Danbuza et al., 2024). The development of overweight in children and adolescents is complex, with multiple risk factors and interrelated mechanisms (Wu et al., 2024). Among the environmental components of overweight and obesity, lifestyle habits, such as little or no good cholesterol, unbalanced eating habits, and sleep disturbances, appear to be determinants (Chandrasekhar et al., 2017).

Previous research by Mascarenhas et al, (2023) stated that consumption of foods containing saturated and trans fats, such as fast food, sweet snacks, and sugary drinks, can increase bad cholesterol (LDL) levels and reduce good cholesterol (HDL) in the blood. Research shows that children who consume high-fat foods have a higher risk of dyslipidaemia compared to those who do not. This study and the previous one have similarities, namely examining cholesterol in children who consume high-fat foods. This study focuses on primary school children only.

The formulation of the problem in this study is What is the relationship between the level of fat consumption and blood lipid levels (total cholesterol, LDL, HDL, and triglycerides) in elementary school children? The purpose of this study was to determine and analyse the relationship between the level of fat consumption and blood lipid levels in elementary school children.

Materials and Methods

1.1 Research Design

This study is to assess the relationship between a high-fat diet and the incidence of hyperlipidaemia in primary school children. The type of research is cross-sectional and uses spss software as a test tool, the tests used are chi square test and spearman correlation analysis.

1.2 Participants

This study used purposive sampling technique with a sample size of 200 primary school students in Surabaya. Data were collected through a modified Food Frequency Questionnaire (FFQ) to assess the level of fat consumption, as well as measurement of total cholesterol, LDL, HDL, and triglyceride levels through blood tests.

1.3 Data Analysis

Data were analysed using the Chi-Square Test and the Spearman Correlation Test with the help of the SPSS program. The Chi-Square test was used to analyse the association between categorical variables, while the Spearman Correlation Test was used to assess the association between ordinal or scale variables. The chi square test examines high-fat diet and the incidence of hyperlipidaemia is categorical (e.g. high fat vs. no high fat; presence vs. absence of hyperlipidaemia). The Spearman correlation test measures the monotonic relationship (either linear or non-linear) between two variables.

2. Results and Discussion

Fat intake data were collected using a Food Frequency Questionnaire (FFQ) that has been modified according to the consumption characteristics of primary school-aged children. The FFQ has undergone content validity testing by nutritionists and reliability testing using test-retest techniques on similar subjects, with the results of the reliability coefficient showing a strong category ($r > 0.70$). Measurement of blood lipid levels (total cholesterol, LDL, HDL, and triglycerides) was done through blood sampling and analysed in the laboratory using standard clinical methods.

Nutritional interventions are recognised worldwide as the first step of treatment for subjects with increased cardiovascular risk and are especially important for children (Match et al., 2020). Combined dyslipidemia (CD) is now the predominant pattern of hyperlipidemia in childhood, characterised by moderately to severely elevated triglycerides (TG) and non-high-density lipoprotein cholesterol (non-HDL-C) with decreased high-density lipoprotein cholesterol (HDL-C) (Capra et al., 2021). In adolescents, CD occurs almost exclusively in obesity and is very common, seen in 30-60% of obese adolescents (Jayedi & Zargar, 2019). Here is a table about the diet of primary school children in Surabaya.

Table 1. Factors Associated with Hyperlipidaemia in Primary School Children in Surabaya

Variables	Category	n (High)	% (High)	n (Normal)	% (Normal)	p-value	OR (95% CI)
Age (years)							1.9
	10-12	70	30	30	15	1.000	(0.45-7.42)
	7-9	45	22.50	55	27.50		
High Fat Diet							2.12
	Often	80	40	40	20	0.345	(0.93-5.98)
	Rare	34	17	46	23		
High Fibre Diet							6.0
	Rare	56	28	38	19	0.055	(2.28-14.6)
	Often	24	12	82	41		

Spearman Corelation
Correlation coefficient: 0,707
Sig. (2-tailed): 0,000
Criteria: High
Notes: Significant

The analysis showed that children aged 10-12 years had a proportion of hyperlipidaemia of 30%, higher than the age group of 7-9 years at 22.5%. However, this difference was not statistically significant (p=1,000) with an Odds Ratio (OR) of 1.9 and a 95% confidence interval between 0.45 and 7.42. This suggests that age cannot be considered as a major risk factor, and there may be other factors that play a greater role in the incidence of hyperlipidaemia in primary school children.

The consumption pattern of high-fat foods shows a tendency to increase the risk of hyperlipidaemia. Children who frequently consumed high-fat foods had a proportion of hyperlipidaemia of 40%, compared to 17% in those who rarely consumed them. Although the Odds Ratio of 2.12 indicates an increased risk, the p value of 0.345 indicates that this association is not statistically significant. Nevertheless, a high-fat diet is still worth noting as a potential long-term health risk.

In contrast, consumption of a high-fibre diet was shown to have a protective influence on hyperlipidaemia. Children who rarely consumed fibre had a six times greater risk of developing hyperlipidaemia than those who frequently consumed it (OR = 6.0; 95% CI: 2.28-14.6; p = 0.055). This result was corroborated by the high Spearman correlation of 0.707 with a significance of 0.000. This suggests that a high-fibre diet is significantly associated with a reduced risk of hyperlipidaemia, and is strongly recommended as part of a child's healthy lifestyle.

Biologically, high consumption of saturated and trans fats contributes to increased LDL and triglyceride levels and decreased HDL, which is the typical profile of dyslipidaemia in children (Zhang et al., 2021). Saturated fat stimulates cholesterol synthesis in the liver, while excess calories from junk food are stored as triglycerides in adipose tissue. The accumulation of body fat, especially visceral fat, triggers a chronic low-grade inflammatory response through an increase in proinflammatory cytokines such as TNF-α and IL-6. This response can disrupt lipid metabolism and contribute to the development of insulin resistance. Insulin resistance decreases the body's ability to inhibit lipolysis, resulting in an

increase in free fatty acids in the circulation, which in turn exacerbates dyslipidaemia (Garg, 2024; Winer et al., 2016). In addition, low fibre intake exacerbates this condition. Soluble fibre plays a role in reducing cholesterol absorption by binding bile acids in the gut and increasing faecal excretion. Fibre also has a prebiotic effect that can improve gut microbiota composition, reduce systemic inflammation, and improve insulin sensitivity. Fibre consumption can reduce the risk of hyperlipidemia.

Dietary fibre, particularly soluble fibre, plays an important role in maintaining gastrointestinal integrity and preventing metabolic inflammation. According to Turnbaugh et al. (2006), a high-fat diet that is low in fibre can disrupt the balance of the gut microbiota, increase intestinal permeability, and trigger metabolic endotoxemia-the entry of lipopolysaccharide (LPS) into the blood circulation. LPS triggers activation of the innate and adaptive immune systems in the gut and adipose tissue, producing proinflammatory cytokines (such as TNF-α and IL-6) that inhibit insulin signalling pathways. In contrast, soluble fibre supports the growth of beneficial gut microbes and produces short-chain fatty acids (SCFAs), such as butyrate, which has anti-inflammatory effects. SCFAs also increase tight junction expression in the intestinal epithelium, strengthen the intestinal barrier, and reduce the risk of systemic inflammation and insulin resistance. Thus, fibre serves as a preventive agent against dyslipidemia and metabolic disorders from an early age.

This study makes an important contribution by focusing the analysis on primary school-aged children (7-12 years), a group that has not been highlighted much in hyperlipidaemia studies. Unlike previous studies that have generally examined adolescents or adults, this study shows that the risk of dyslipidaemia can be present early in life. By combining validated FFQ instruments and direct measurement of blood lipid levels, as well as Chi-Square and Spearman analyses, these findings provide stronger empirical evidence of the relationship between diet and lipid profile in primary school children.

These findings are in line with the study by Shinozaki et al. (2015) in Japan, which showed that increased fibre intake reduced the risk of obesity and high cholesterol levels in children. Research by Zhang et al. (2021) and Mainieri et al. (2023) also support the finding that combined dyslipidaemia is now a common pattern in obese children. Meanwhile, studies from Fogacci et al. (2024) and Cicero et al. (2021) showed the effectiveness of soluble fibre in reducing LDL cholesterol in children with dyslipidemia.

Limitations of the Study This study has several limitations. Firstly, the cross-sectional design limits the ability to infer causal relationships. Secondly, the use of FFQ, although validated, still carries the risk of recall bias. Third, other factors such as physical activity, pubertal status, and genetic predisposition have not been comprehensively analysed.

Policy and Intervention Implications These results emphasise the importance of early nutrition interventions. Governments and schools need to strengthen nutrition education for primary school-aged children and limit access to fast food in the school environment. Healthy canteen policies, teacher training, and collaboration with parents are strategic steps to reduce the risk of hyperlipidaemia and cardiovascular disease early on.

3. Conclusion

This study showed that a high-fat and low-fibre diet was significantly associated with an increased risk of hyperlipidaemia in primary school children in Surabaya. Early nutrition interventions and healthy eating education are needed to prevent the risk of metabolic diseases in the future.

Acknowledgements

The authors would like to thank the primary school students in Surabaya who participated in the study and thank the parents of the primary school students for allowing their children to participate.

Ethics approval and consent to participate

This study has received approval from the Ethics Committee of the Faculty of Medicine, Ciputra University. All participants have given written consent before participating in this study. This study did not receive funding from any organisation.

References

Capra, M. E., Pederiva, C., Viggiano, C., De Santis, R., Banderali, G., & Biasucci, G. (2021). Nutritional approach to prevention and treatment of cardiovascular disease in childhood. Nutrients, 13(7), 2359. [Crossref], [Publisher]

Chandrasekhar, T., Suchitra, M. M., Pallavi, M., L N Srinivasa Rao, P. V., & Sachan, A. (2017). Risk factors for cardiovascular disease in obese children. Indian Pediatrics, 54(9), 752–755. [Crossref], [Publisher]

Cicero, A. F. G., Fogacci, F., Patrono, D., Mancini, R., Ramazzotti, E., Borghi, C., D'Addato, S., & BLIP Study group. (2021). Application of the Sampson equation to estimate LDL-C in children: Comparison with LDL direct measurement and Friedewald equation in the BLIP study. Nutrition, Metabolism, and Cardiovascular Diseases: NMCD, 31(6), 1911–1915. [Crossref], [Publisher]

Dambuza, A., Rungqu, P., Oyedeji, A. O., Miya, G., Oriola, A. O., Hosu, Y. S., & Oyedeji, O. O. (2024). Therapeutic potential of pectin and its derivatives in chronic diseases. Molecules (Basel, Switzerland), 29(4), 896. [Crossref], [Publisher]

Feingold, K. R., Ahmed, S. F., Anawalt, B., Boyce, A., & Endotext Editorial Board. (2023). Nutritional management of pediatric dyslipidemia. In Endotext. MDText.com, Inc. [Publisher]

Ference, B. A., Kastelein, J. J. P., Ray, K. K., Ginsberg, H. N., Chapman, M. J., Packard, C. J., ... & Catapano, A. L. (2019). Association of triglyceride-lowering LPL variants and LDL-C-lowering LDLR variants with risk of coronary heart disease. JAMA, 321(4), 364–373. [Crossref], [Publisher]

Fogacci, F., ALGhasab, N. S., Di Micoli, V., Giovannini, M., & Cicero, A. F. G. (2024). Cholesterol-lowering bioactive foods and nutraceuticals in pediatrics: Clinical evidence of efficacy and safety. Nutrients, 16(10), 1526. [Crossref], [Publisher]

Garg, A., & Radhakrishnan, S. (2024). Pediatric hyperlipidemia. Indian Heart Journal, 76(Suppl 1), S104–S107. [Crossref], [Publisher]

Han, Y., Jang, K., Kim, U., Huang, X., & Kim, M. (2023). The possible effect of dietary fiber intake on the metabolic patterns of dyslipidemia subjects: Cross-sectional research using nontargeted metabolomics. The Journal of Nutrition, 153(9), 2552–2560. [Crossref], [Publisher]

Irawaty, E., Ardin, M. A., & Yosafat, F. (2006). Gambaran darah lengkap dan profil lipid pada anak sekolah dasar dengan obesitas di Denpasar. Sari Pediatri. [Crossref], [Publisher]

Jayedi, A., & Zargar, M. S. (2019). Intake of vitamin B6, folate, and vitamin B12 and risk of coronary heart disease: A systematic review and dose-response meta-analysis of prospective cohort studies. Critical Reviews in Food Science and Nutrition, 59(16), 2697–2707. [Crossref], [Publisher]

Johnson, L., Mander, A. P., Jones, L. R., Emmett, P. M., & Jebb, S. A. (2008). Energy-dense, low-fiber, high-fat dietary pattern is associated with increased fatness in childhood. The American Journal of Clinical Nutrition, 87(4), 846–854. [Crossref], [Publisher]

Juliaty, A., & Kurniasih, D. (2021). Inflammatory markers and lipid profiles in obese children. Paediatrica Indonesiana, 61(5), 271–276. [Crossref], [Publisher]

Mascarenhas, P., Furtado, J. M., Almeida, S. M., Ferraz, M. E., Ferraz, F. P., & Oliveira, P. (2023). Pediatric overweight, fatness and risk for dyslipidemia are related to diet: A cross-sectional study in 9-year-old children. Nutrients, 15(2), 329. [Crossref], [Publisher]

Mach, F., Baigent, C., Catapano, A. L., Koskinas, K. C., Casula, M., Badimon, L., ... & ESC Scientific Document Group. (2020). 2019 ESC/EAS guidelines for the management of dyslipidaemias: Lipid modification to reduce cardiovascular risk. European Heart Journal, 41(1), 111–188. [Crossref], [Publisher]

Mainieri, F., La Bella, S., & Chiarelli, F. (2023). Hyperlipidemia and cardiovascular risk in children and adolescents. Biomedicines, 11(3), 809. [Crossref], [Publisher]

Martino, F., Niglio, T., Martino, E., Paravati, V., De Sanctis, L., & Guardamagna, O. (2024). Apolipoprotein B and lipid profile in Italian children and adolescents. Journal of Cardiovascular Development and Disease, 11(2), 44. [Crossref], [Publisher]

NCD Risk Factor Collaboration (NCD-RisC). (2017). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: A pooled analysis of 2416 population-based measurement studies in 128.9 million children, adolescents, and adults. The Lancet, 390(10113), 2627–2642. [Crossref], [Publisher]

Nielsen, T. R. H., Lausten-Thomsen, U., Fonvig, C. E., Bøjsøe, C., Pedersen, L., Bratholm, P. S., ... & Holm, J. C. (2017). Dyslipidemia and reference values for fasting plasma lipid concentrations in Danish/North-European White children and adolescents. BMC Pediatrics, 17(1), 116. [Crossref], [Publisher]

Nurhidayati, N., Irawan, I. R., & Sudikno, S. (2022). Hubungan obesitas dengan profil lipid pada remaja di Indonesia. Penelitian Gizi dan Makanan, 45(1), 35–46. [Crossref], [Publisher]

Rahayu, N. E., & Alim, M. D. M. (2024). Gambaran penggunaan obat dan karakteristik pasien hiperlipidemia di Rumah Sakit Samarinda Medika Citra [Tugas akhir, Universitas Muhammadiyah Kalimantan Timur]. DSpace Universitas Muhammadiyah Kalimantan Timur. [Publisher]

Shinozaki, K., Okuda, M., Sasaki, S., Kunitsugu, I., & Shigeta, M. (2015). Dietary fiber consumption decreases the risks of overweight and hypercholesterolemia in Japanese children. Annals of Nutrition & Metabolism, 67(1), 58–64. [Crossref], [Publisher]

Strand, M. F., Fredriksen, P. M., Hjelle, O. P., & Lindberg, M. (2018). Reference intervals for serum lipids and prevalence of dyslipidaemia in 6–12-year-old children: The Health Oriented Pedagogical Project (HOPP). Scandinavian Journal of Public Health, 46(21_suppl), 21–27. [Crossref], [Publisher]

Turnbaugh, P. J., Ley, R. E., Mahowald, M. A., Magrini, V., Mardis, E. R., & Gordon, J. I. (2006). An obesity-associated gut microbiome with increased capacity for energy harvest. Nature, 444(7122), 1027–1031. [Crossref], [Publisher]

Widiasari, P. A. W. (2017). Profil lipid pada anak overweight dan obesitas di RSUD Dr. Soetomo Surabaya [Skripsi sarjana, Universitas Airlangga]. Universitas Airlangga Institutional Repository. [Publisher]

Winer, D. A., Luck, H., Tsai, S., & Winer, S. (2016). The intestinal immune system in obesity and insulin resistance. Cell Metabolism, 23(3), 413–426. [Crossref], [Publisher]

Wu, F., Jacobs, D. R., Jr, Daniels, S. R., Kähönen, M., Woo, J. G., Sinaiko, A. R., ... & Magnussen, C. G. (2024). Non-high-density lipoprotein cholesterol levels from childhood to adulthood and cardiovascular disease events. JAMA, 331(21), 1834–1844. [Crossref], [Publisher]

Zhang, Y., Pletcher, M. J., Vittinghoff, E., Clemons, A. M., Jacobs, D. R., Jr, Allen, N. B., ... & Moran, A. E. (2021). Association between cumulative low-density lipoprotein cholesterol exposure during young adulthood and middle age and risk of cardiovascular events. JAMA Cardiology, 6(12), 1406–1413. [Crossref], [Publisher]