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Comparison of Lipid Profiles among Vegan Vegetarians, Lacto-Ovo Vegetarians and Non-Vegetarians

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Abstract

The lipid profile is a crucial indicator of cardiovascular disease risk, with elevated levels often influenced by dietary patterns. Nutrient intake and physical activity can help regulate cholesterol by reducing total cholesterol, HDL, LDL and triglyceride levels. This study aims to compare the lipid profiles among vegan vegetarians, lacto-ovo vegetarians, and non-vegetarians. This research uses a cross-sectional study design. The study population includes 60 participants from IVS and the Yogyakarta community, selected based on inclusion and exclusion criteria. The research examines diet type as the independent variable, lipid profile as the dependent variable, and physical activity as a confounding variable. Data collection involves respondent identity and a physical activity questionnaire using IPAQ. Statistical analyses include one-way ANOVA, Post Hoc tests and multivariate analysis with one-way MANCOVA. The research results show that the total cholesterol level for vegan (173.10±21.04), lacto-ovo (169.45±44.84), and non-vegetarians (194.55±31.40). HDL levels for vegan are (55.25±10.79), lacto-ovo (49.00±9.12), and non-vegetarians (45.49±9.11). LDL levels for vegan are (111.90±19.80), lacto-ovo (114.85±44.39), and non-vegetarians (134.90±30.37), showing no significant difference $p>0.05$. Triglyceride levels for vegan are (103.15±57.06), lacto-ovo (100.65±60.07), and non-vegetarians (154.15±88.63) with significant differences p-value <0.05. When controlling for physical activity, differences in total cholesterol, HDL, and triglycerides persist between diet groups. Notably, HDL levels differ significantly between vegans and lacto-ovo ($p<0.05$). The conclusion is that both vegan and lacto-ovo diets have lipid profiles within the normal range compared to non-vegetarian diets. A vegetarian diet and regular physical activity contribute to a healthier lipid profile.

Keywords: Lipid Profile, Vegan Vegetarian, Lacto-Ovo Vegetarian, Non-Vegetarian.

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1. INTRODUCTION

The lipid profile is a representation of fat levels in the blood. Lipid profile testing can be done by measuring total cholesterol, HDL, LDL, and triglyceride levels. The results of a lipid profile test are one of the indicators for detecting the risk of cardiovascular diseases (Perkeni, 2021). Research by Utama et al., (2021) states that in individuals with coronary heart disease, there is an increase in the lipid profile ratio caused by elevated levels of LDL, triglycerides, and total cholesterol, as well as a decrease in HDL levels in the body. Risk factors for dyslipidemia may be caused by lifestyle changes such as unhealthy eating habits, high job stress, and lack of physical activity (Qi et al., 2015).

Dietary patterns are one of the factors that influence lipid profiles. The habit of consuming fatty foods is also a factor contributing to high total cholesterol levels in the blood. Foods that contain saturated fats can cause cholesterol levels to rise, as there are two sources of cholesterol: endogenous cholesterol, which is produced within the body's cells, particularly in the liver, and exogenous cholesterol, which comes from the foods consumed daily (Syarfaini et al., 2020). A vegan vegetarian diet focuses on consuming plant-based foods and vegetables, while limiting or avoiding products derived from animal. On the other hand, a lacto-ovo vegetarian diet permits the consumption of animal products such as dairy and eggs. Conversely, a non-vegetarian diet encompasses a diverse range of foods from both plant and animal-based sources (Pritasari et al., 2017).

A vegetarian diet is thought to offer health advantages, aiding in the prevention of risk factors for degenerative diseases like hypertension, cancer, diabetes mellitus, and coronary artery disease (Pritasari et al., 2017; Richter et al., 2016). Study conducted by Antoniazzi et al., (2022) states that the vegetarian group has lower LDL and triglyceride levels as well as a normal body mass index compared to the non-vegetarian group. This is related to the intake of unsaturated fats, fiber, antioxidants, and low cholesterol in the vegetarian group, which contributes to reducing cardiovascular risk factors compared to the non-vegetarian group.

Excessive carbohydrate consumption in vegetarians occurs because carbohydrates are used as the primary energy source to replace the fat found in animal products. Excess carbohydrates are converted by the body into fat in the blood, which can affect the lipid profile. According to Sukmawati et al., (2021) lacto-ovo vegetarians have total cholesterol levels above 200 mg/dL due to their continued consumption of animal products, while vegans have total cholesterol levels below 200 mg/dL as they avoid animal products and meet their fat needs through plant-based sources such as corn oil and olive oil, which are used to prepare food.

Aside from providing health benefits, there are still many perceptions that a vegetarian diet is prone to nutrient deficiencies, often accompanied by an unhealthy lifestyle, such as low physical activity, which can lead to obesity. This is related to the fact that nutrient intake, combined with physical activity, can help regulate cholesterol by lowering total cholesterol, LDL, and triglyceride levels in the blood. A lack of physical activity and the consumption of simple carbohydrates can lead to quicker feelings of hunger, which may increase the risk of elevated lipid profiles (Kemala et al., 2021). According to Chang et al., (2020) a vegetarian diet combined with regular physical activity results in increased HDL levels compared to a non-vegetarian diet. This is linked to the unsaturated fatty acids found in plant-based foods, which affect HDL levels. Meanwhile, saturated fats are known to be unhealthy for the body because they can increase LDL levels in the blood. Intake of saturated fats can lead to a decrease in HDL levels.

Research on vegetarian and non-vegetarian groups has been widely conducted; however, there have not been many studies specifically examining lipid profiles compared between vegan vegetarians, lacto-ovo vegetarians, and non-vegetarians, as well as investigating the impact of physical activity on lipid profiles, particularly in Yogyakarta within the Indonesian Vegetarian Society (IVS). Thus, this study aimed to compare the lipid profiles among vegan vegetarians, lacto-ovo vegetarians, and non-vegetarians, as well as the influence of physical activity factors.

2. RESEARCH METHOD

This study employs a cross-sectional research design to identify differences in lipid profiles among vegan vegetarians, lacto-ovo vegetarians and non-vegetarians, while also evaluating lipid profile comparisons by controlling for physical activity variables. The research was conducted within the Indonesian Vegetarian Society in Yogyakarta from January to March 2024. The population for this study consists of members of the IVS (Indonesian Vegetarian Society) in Yogyakarta and residents living in Yogyakarta. The sampling method uses non-probability sampling, specifically consecutive sampling. The estimated calculation for the minimum sample size used in this study follows the unpaired analytical formula (Probandari et al., 2020):

$$n = 2\left(\frac{(Z\alpha + Z\beta)s}{x^1 - x^2}\right)^2$$

Information:
N : Sample size
Zα : Confidence level at 95% significance level (1.96)
Zβ : Power test 20% (0.84)
S : Standard deviation of the difference between group values (56.54)(Nudhar et al., 2020).

Based on the calculations, a minimum sample size of 15.9, which was rounded up to 16 samples. To ensure the study had sufficient data, the total sample size for three groups was set at 48. To account for a 10% loss to follow-up, the sample size was increased to 60. These 60 samples were then evenly distributed among the three groups, resulting in 20 samples per group.

Data collection was carried out by researchers and enumerators who had undergone training and aligned perceptions. Data were collected using questionnaires to obtain information on respondents' identities and the outcomes of lipid profile tests including total cholesterol, HDL, LDL, and triglycerides. The physical activity assessment was conducted using the International Physical Activity Questionnaire (IPAQ), consisting of 7 items related to heavy, moderate, walking, and sitting activities performed in the past 7 days. The IPAQ questionnaire has been translated into Indonesian following the guidelines provided by its developers, ensuring that it retains its original meaning and remains relevant to the local cultural context. Furthermore, the Indonesian version has undergone validity and reliability testing in various previous studies conducted in Indonesia. Additionally, a blood sample of 3 cc was taken through a venous blood vessel in the morning by a laboratory analyst.

Bivariate data analysis was conducted to analyze the differences in total cholesterol, HDL, LDL, and triglyceride levels among vegan vegetarians, lacto-ovo vegetarians, and non-vegetarians. Data with a normal distribution were analyzed using one-way ANOVA, and the results indicated a significant difference, further analysis was performed using Post Hoc tests. The analysis of the differences in age, education, and occupation on total cholesterol, HDL, LDL, and triglyceride levels was conducted using the Kruskal-Wallis test, while the difference in gender was analyzed using the Mann-Whitney test. Additionally, multivariate data analysis using one-way MANCOVA was employed to analyze differences in lipid profiles among vegan vegetarians, lacto-ovo vegetarians, and non-vegetarians while controlling for physical activity. This study was conducted after obtaining ethical approval from the Research Ethics Commission of the Faculty of Medicine, Universitas Sebelas Maret (no. 12/UN27.06.11/KEP/EC/2024).

3. RESULTS AND DISCUSSION

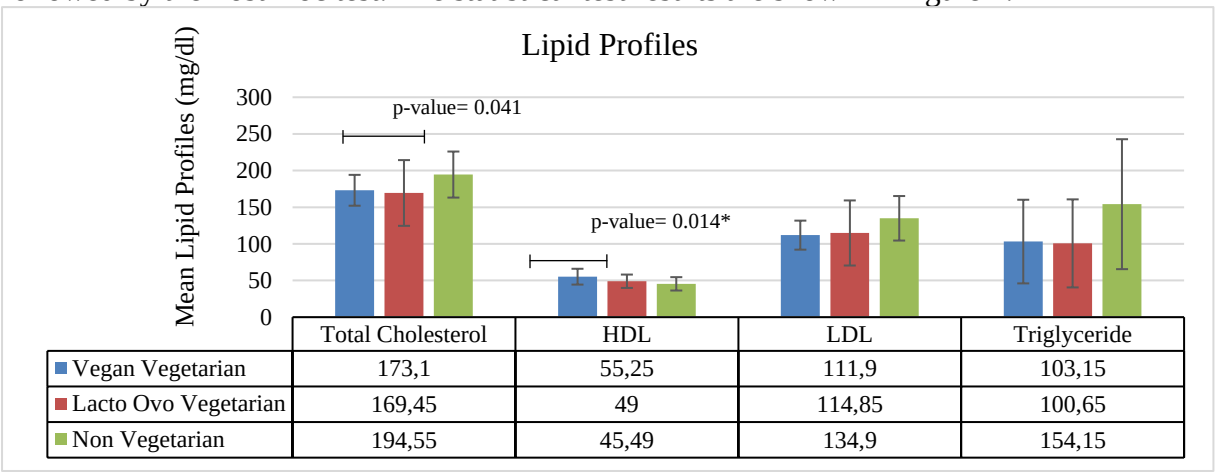
The analysis results present the characteristics of the study subjects, including gender, age, occupation, and education background. The characteristics of the study subjects are displayed in Table 1.

Table 1. Characteristics of Study Subjects (N=60)

Subject	Total Cholesterol	HDL	LDL	Triglyceride
				Mean Rank
Gender				
Male (18)	33.25	22.97	36.56	34.03
Female (42)	29.32	33.73	27.90	28.99
p-value	0.425	0.029*	0.079	0.306
Age (years)				
19-20 (39)	28.37	34.00	27.17	25.81
30-49 (20)	33.63	23.08	36.13	38.48
50-64 (1)	51.00	42.50	48.00	54.00
p-value	0.273	0.059	0.105	0.012*
Occupation				
Housewife (6)	40.42	34.75	38.58	41.17
Government Employe (2)	29.75	16.75	40.75	32.00
Private Employee (24)	31.04	29.90	31.33	29.75
Student (25)	27.20	32.04	26.76	26.62
Others (3)	34.33	23.17	32.00	46.50
p-value	0.558	0.671	0.525	0.195
Education				
Grade school (3)	0.0	0.0	0.0	0.0
Intermediate school (1)	8.00	37.00	8.50	9.00
High school (5)	38.60	33.20	36.30	43.00
University (54)	30.17	30.13	30.37	29.74
p-value	0.252	0.868	0.343	0.124

Based on Table 1, the number of female subjects is higher than that of male subjects, with a p-value of 0.029 for HDL levels, indicating a significant difference in HDL levels between genders. The most common age range is 19-29 years, with a p-value of 0.012 for triglyceride levels, indicating a significant difference in triglyceride levels based on age. The majority of the study subjects are students, while the most common level of education is university.

The statistical test to determine the differences in total cholesterol, HDL, LDL and trygliseride between vegan, lacto-ovo and non-vegetarians is the one-way ANOVA test, followed by the Post Hoc test. The statistical test results are shown in Figure 1.



(*)p-value<0,05 between vegan vegetarian and non-vegetarian

Figure 1. Differences in Mean Lipid Profiles among Vegan, Lacto-Ovo, and Non-Vegetarians

Figure 1 shows a significant difference in total cholesterol and HDL levels, with a p-value of <0.05. In contrast, no significant differences were observed in LDL and triglyceride levels across the three groups. Based on Figure 1, the mean total cholesterol levels for vegan vegetarians, lacto-ovo vegetarians, and non-vegetarians fall within the normal category (<200 mg/dl) according to the classification of plasma lipid levels by Perkeni, (2021). The mean total cholesterol levels for each group are as follows: vegan 173.10 ± 21.04 mg/dl, lacto-ovo 169.45 ± 44.84 mg/dl, and non-vegetarians 194.55 ± 31.40 mg/dl. These results indicate that the non-vegetarian group has a higher total cholesterol level compared to both the vegan vegetarian and lacto-ovo vegetarian groups. The difference in total cholesterol between vegetarian and non-vegetarian groups is due to vegetarian diets, which is typically low in cholesterol, total fat, and saturated fatty acids, thus reducing cholesterol absorption in the blood (Matsumoto et al., 2019; Saintila et al., 2021).

Based on the post hoc test, the difference in total cholesterol levels between the vegan vegetarian group and the non-vegetarian group is statistically significant (p=0.041). The mean total cholesterol level in vegan vegetarians is lower compared to non-vegetarians. The vegan vegetarian diet tends to be high in fiber, which plays an important role in reducing total cholesterol levels in the body (Müller et al., 2018). The lower the total cholesterol value, the stricter the vegan vegetarian diet (Jedut et al., 2023).

The mean HDL levels in all three groups fall within the normal range (40-59 mg/dl), with the mean HDL level for vegan vegetarians (55.25 ± 10.79 mg/dl) being higher than that of lacto-ovo vegetarians (49.00 ± 9.12 mg/dl) and non-vegetarians (45.49 ± 9.11 mg/dl), as shown in Figure 1. This is linked to vegetarian diets being rich in fiber and unsaturated fats, resulting in higher HDL levels. This result is backed by the study conducted by Gogga et al., (2021), which states that high HDL levels are influenced by diets rich in unsaturated fatty acids, such as nuts, fiber, and antioxidants that contribute to increased HDL levels.

Based on the post hoc test, the difference in HDL levels between the vegan vegetarian group and the non-vegetarian group was statistically significant (p=0.014). The mean HDL level in vegan vegetarians was higher compared to non-vegetarians, indicating that the vegan vegetarian diet positively contributes to lipid profiles. Increased HDL levels are associated with a reduced risk of cardiovascular disease, as HDL facilitates the transport of cholesterol from the arteries to the liver, where it is processed and removed from the body (Perkeni, 2021; Pritasari et al., 2017). The findings of this study are consistent with research by Dybvik et al., (2023), which shows that vegan vegetarians consume low-saturated fat foods that can help maintain heart health. This is further supported by Pimentel et al., (2019), who state that high HDL levels in vegetarian groups are linked to regular exercise and a lack of smoking habits.

This study found no significant difference in LDL levels between vegan vegetarians, lacto-ovo vegetarians, and non-vegetarians (p=0.066). The mean LDL levels for vegan vegetarians (111.90 ± 19.80 mg/dl) and lacto-ovo vegetarians (114.85 ± 44.39 mg/dl) fall within the near-optimal category (100-129 mg/dl), as illustrated in Figure 1. In contrast, the mean LDL level for non-vegetarians (134.90 ± 30.37 mg/dl) is slightly elevated (130-159 mg/dl). This finding relates to the vegetarian diet, which tends to be high in fiber and low in saturated fats, contributing to the management of cholesterol levels.

However, the results of this study differ from those of Jedut et al., (2023), which indicated that LDL levels were higher in the vegetarian group compared to the non-vegetarian group. This discrepancy was attributed to the vegetarian diet being high in carbohydrates, which can lead to increased triglyceride levels. High triglyceride levels are often associated with elevated LDL levels (Jo & Park., 2023). Conversely, the findings of this study align with those of Dawczynski et al., (2022), which reported that LDL levels were higher in the non-vegetarian group compared to vegetarians, attributed to a fiber-rich diet. Consuming high-fiber foods can directly bind LDL cholesterol and inhibit its absorption in the intestines, leading to lower

plasma cholesterol levels. Fiber also binds bile acids, facilitating the excretion of LDL through feces, resulting in decreased LDL levels (Kwiatkowska et al., 2023)

The mean triglyceride levels for vegan vegetarians (103.15 ± 57.06 mg/dl) and lacto-ovo vegetarians (100.65 ± 60.07 mg/dl) fall within the normal range (<150 mg/dl), as illustrated in Figure 1. In contrast, the mean triglyceride level for non-vegetarians (154.15 ± 88.63 mg/dl) is slightly elevated (150-199 mg/dl). This indicates that vegan vegetarians and lacto-ovo vegetarians have a positive effect on triglyceride levels compared to non-vegetarians. This study also included a multivariate analysis to evaluate differences in total cholesterol, HDL, LDL, and triglyceride levels after controlling for physical activity among vegan vegetarians, lacto-ovo vegetarians, and non-vegetarians, as shown in Table 2.

Table 2. Results of One-Way MANCOVA Test

Multivariate Tests

Effect		Value	F	Hypothesis df	Error df	p-value
Types of Diets	Wilks' Lambda	0.655	3.116	8	106	0.003*

Based on Table 2, there are significant differences in total cholesterol, HDL, LDL, and triglycerides among the vegan, lacto-ovo, and non-vegetarian groups after controlling for physical activity variables (p=0.003). Further analysis using the Test of Between-Subject Effects was conducted to determine which variables are responsible for the differences between the vegan, lacto-ovo, and non-vegetarian groups, as shown in Table 3.

Table 3. Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum Of Squares	df	Mean Square	Partial Eta Squared	Power	Sig
Types of Diets	Total Cholesterol	7739.894	2	3869.947	0.108	0.618	0.040*
	HDL	908.414	2	454.207	0.146	0.776	0.012*
	LDL	6396.562	2	3198.281	0.094	0.543	0.064
	Triglyceride	40447.498	2	20223.749	0.144	0.768	0.013*

Based on Table 3, there are significant differences in total cholesterol levels (p=0.040), HDL levels (p=0.012), and triglyceride levels (p=0.013) among the vegan, lacto-ovo, and non-vegetarian groups. Subsequently, Post Hoc Pairwise Comparisons were conducted on the total cholesterol, HDL, and triglyceride variables to identify which groups differ significantly, as shown in Table 4.

Table 4. Post Hoc Pairwise Comparisons Test

Group 1 (n)	Group 2 (n)	Mean1-Mean2	SE	p-value
Total Cholesterol				
Vegan (20)	Lacto Ovo (20)	4.412	10.678	0.681
Vegan (20)	N Vegetarian (20)	-21.622	10.661	0.047*
Lacto Ovo (20)	N Vegetarian (20)	-26.034	10.687	0.018*
HDL				
Vegan (20)	Lacto Ovo (20)	6.407	3.080	0.042*
Vegan (20)	N Vegetarian (20)	9.314	3.075	0.004*
Lacto Ovo (20)	N Vegetarian (20)	2.907	3.083	0.350
Triglyceride				
Vegan (20)	Lacto Ovo (20)	6.149	20.736	0.768

Group 1 (n)	Group 2 (n)	Mean1-Mean2	SE	p-value
Vegan (20)	N Vegetarian (20)	-51.825	20.704	0.015*
Lacto Ovo (20)	N Vegetarian (20)	-57.975	20.754	0.007*

Based on Table 4, the Post Hoc Pairwise Comparisons between the vegan vegetarian and lacto-ovo vegetarian groups indicate a significant difference in HDL levels (p=0.042). Additionally, comparisons between the vegan vegetarian and non-vegetarian groups show significant differences in total cholesterol levels (p=0.047), HDL levels (p=0.004), and triglyceride levels (p=0.015). Furthermore, there are significant differences between the lacto-ovo vegetarian and non-vegetarian groups regarding total cholesterol levels (p=0.018) and triglyceride levels (p=0.007).

Physical activity is one of the factors that influences lipid profiles. Nutrient intake in a vegetarian diet combined with physical activity can aid in regulating cholesterol by reducing total cholesterol, LDL, and triglyceride levels in the blood (Kemala et al., 2021). According to Table 3, there is no significant difference in LDL levels (p=0.064) among the vegan vegetarian, lacto-ovo vegetarian, and non-vegetarian groups. This indicates that in this study, diet type does not affect LDL levels after controlling for physical activity variables. Insufficient physical activity and excessive energy intake can lead to nutritional problems. The more active a person is in physical activities, the more energy is expended (Khoerunisa & Istianah, 2021). Moreover, the combination of consistent physical activity and a balanced diet is associated with a reduced risk of developing metabolic syndrome (Lee et al., 2022).

There are significant differences in total cholesterol levels (p=0.040), HDL levels (p=0.012), and triglyceride levels (p=0.013) among the vegan vegetarian, lacto-ovo vegetarian, and non-vegetarian groups, as shown in Table 3. This indicates that diet type affects total cholesterol, HDL, and triglyceride levels. Vegetarian diets typically emphasize complex carbohydrates, especially from plant-based sources like legumes, whole grains, vegetables, and fruits. In contrast, non-vegetarian diets tend to include simple carbohydrate sources from processed foods (Segovia-Siapco et al., 2019). Additionally, regular physical activity has a positive impact on lipid metabolism (total cholesterol, HDL, and triglycerides) (Storz et al., 2023). This is further supported by research from Lombardo et al., (2024), which indicates that a vegetarian diet combined with endurance exercises such as jogging, cycling, and swimming can influence the reduction of body fat percentage.

Based on Table 4, there is a significant difference in the average HDL levels (p=0.042) between the vegan vegetarian and lacto-ovo vegetarian groups after controlling for physical activity through post hoc pairwise comparisons. The average HDL level in vegan vegetarians is significantly higher than that in lacto-ovo vegetarians. The impact of physical activity on the vegan vegetarian group is more favorable in terms of increasing HDL levels compared to the non-vegetarian group. In this study, the vegetarian diet, particularly that of vegan vegetarians, regularly includes vegetables in the form of legumes and analog meats made from mung beans. Analog meats contain protein, fiber, and several vitamins and minerals essential for health (Mentari et al., 2016). In contrast, the lacto-ovo vegetarian group generally includes animal protein in their diet, mainly from milk and eggs, consuming these foods about 4 to 5 times a week.

There is a significant difference in the average levels of total cholesterol (p=0.047), HDL (p=0.004), and triglycerides (p=0.015) between the vegan vegetarian and non-vegetarian groups after controlling for physical activity through post hoc pairwise comparisons. The average total cholesterol and triglyceride levels in vegan vegetarians are significantly lower than those in non-vegetarians, while the HDL level in vegan vegetarians is higher compared to non-vegetarians. Research by Zaki et al., (2023) Indicates that moderate to high-intensity physical activity can boost HDL levels and reduce triglyceride levels. This is supported by findings from Bondge et al., (2021), which indicate that total cholesterol levels tend to be lower in individuals

who engage in regular physical activity. Physical activity plays a crucial role in lipid metabolism, and insufficient activity can result in elevated LDL levels and reduced HDL levels, increasing the risk of cardiovascular diseases (Widiastuti et al., 2023). Additionally, dietary factors also contribute to cholesterol regulation. Foods rich in fiber, such as fruits, vegetables, and whole grains can lower cholesterol levels by attaching to cholesterol in the digestive system, thereby reducing its absorption into the bloodstream (Fontes et al., 2024). The combination of between physical activity and dietary habits can have a beneficial effect on total cholesterol and triglyceride levels (Bondge et al., 2021).

There are significant differences in the average levels of total cholesterol (p=0.018) and triglycerides (p=0.007) between the lacto-ovo vegetarian and non-vegetarian groups after controlling for physical activity through post hoc pairwise comparisons. The average levels of total cholesterol and triglycerides in lacto-ovo vegetarians are significantly lower than those in non-vegetarians. This is related to the lacto-ovo vegetarian diet, which tends to include foods high in fiber and lower in simple carbohydrates (Wang et al., 2023). This is further supported by Ramadhani et al., (2022), which states that the quality of carbohydrates from fruits, vegetables, and whole grains provides more energy and is rich in fiber, vitamins, and minerals. Conversely, carbohydrate intake from processed sources, such as added sugars and fast food, can cause energy fluctuations and affect physical performance. Moreover, research by Kemala et al., (2021) indicates that triglyceride levels are affected by insufficient physical activity and the consumption of foods high in simple carbohydrates from fruits and vegetables. However, high levels of physical activity combined with a balanced diet that includes low saturated fat and high fiber foods can positively affect lipid profiles in the blood, including triglyceride levels (Chang et al., 2020).

4. CONCLUSION

This study found that both vegan vegetarians and lacto-ovo vegetarians have lipid profiles within the normal range, compared to non-vegetarians. In general, a vegetarian diet combined with regular physical activity leads to a healthier lipid profile. The results of this study are expected to serve as input for both vegetarian and non-vegetarian groups to always pay attention to the type and amount of nutrients that positively affect the body. Furthermore, additional research can be conducted on the influence of other factors on the lipid profiles between vegetarians and non-vegetarians.

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