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RESEARCH ARTICLE

Can Static Bicycle Interval Training and Calorie Restriction Affect Lipid Profile in Patients with Dyslipidaemia?

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Abstract
The purpose of this study was to determine the difference in effect between static bicycle interval training and calorie restriction diet with static bicycle interval training without diet. Static bike interval training is the independent variable, diet is the moderator variable, and lipid profile is the dependent variable. The research method applied in this study is a true experiment with a pretest-posttest research design with a control group design. Participants in this study were determined by non-probability techniques with purposive sampling, namely dyslipidemia patients consisting of 30 people divided into two groups. The first group received static bicycle interval training treatment and a calorie restriction diet called the experimental group, while the second group only received static bicycle interval training treatment called the control group. instruments in this study through laboratory tests to measure HDL, LDL, Triglyceride, and Total Cholesterol levels. The data analysis technique used the Independent Sample Test. The findings in the study were that static bicycle interval training and calorie restriction diet had a more significant effect in optimizing LDL, Triglyceride, and Total Cholesterol levels sig value (2-tailed) 0.025 <0.05). There was no significant difference between the experimental group and the control group on HDL levels (2-tailed) value of 0.127 > 0.05).There is a significant difference in LDL levels between the experimental and control groups, as indicated by the sig (2-tailed) value of 0.00 < 0.05). In conclusion; static bike interval training accompanied by a calorie restriction diet is recommended to be applied by people with dyslipidemia in optimizing lipid profiles.

Keywords
Exercise, Static Bike İnterval, Calorie Restriction Diet, Lipid Profile, Dyslipidaemia

INTRODUCTION

Dyslipidaemia is a disorder of lipid metabolism characterized by abnormal levels of fat in the blood (Sharma et al., 2016). This condition includes elevated total cholesterol, triglycerides, LDL (low-density lipoprotein), and decreased HDL (high-density lipoprotein) levels (Maki et al., 2010). Dyslipidaemia can increase the risk of cardiovascular disease (Haile & Timerga, 2020; Yao et al., 2022) and has been described as the most common cause of death worldwide (Kendir et al., 2018; Matsushita et al., 2023; Mc Namara et al., 2019; Naser & Al-Shehri, 2023; Sayols-Baixeras et al., 2014). The increasing incidence of dyslipidemia in various countries creates urgency due to its significant impact on health. Therefore, it is important to identify and control the risk factors for dyslipidemia as an effective measure in controlling

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the likelihood of cardiovascular diseases that can increase the risk of mortality.

Previous studies have highlighted several approaches to addressing dyslipidemia. Some of these involve lifestyle modifications (Riccardi et al., 2016), such as healthier dietary changes (Jacobson, Ito, et al., 2015; Jacobson, Maki, et al., 2015) and increased physical activity (Costa et al., 2018; Reljic et al., 2020; Zheng et al., 2016). Awareness-raising programs through health promotion on the importance of a healthy diet and its impact on lipid levels have also been shown to be effective in reducing the risk of dyslipidemia (De Assunção Bezerra et al., 2018; Zhang et al., 2017). In addition, the use of medications, such as statins (Okopień et al., 2017; Ross, 2016; Tarantino et al., 2017), has become standard in the treatment of dyslipidemia to lower LDL cholesterol and the risk of cardiovascular disease.

In recent years, unhealthy lifestyle trends, including unbalanced diets and lack of physical activity, have led to an increase in the number of people with dyslipidemia (Gupta et al., 2016; Hu et al., 2022; Lim, 2018). Although pharmacological treatments are available to address dyslipidemia, physical exercise has been recognized as one of the effective strategies for reducing blood lipid levels and improving cardiovascular health (Bairapareddy et al., 2018; Boidin et al., 2015; Vasconcellos et al., 2015). By exercising regularly, one can reduce abnormal levels of fats or lipids in the blood, such as total cholesterol, triglycerides, and LDL.

Physical exercise is an important part of the approach to preventing and controlling dyslipidemia and can help reduce the risk of cardiovascular disease (Anderson et al., 2013). Based on its characteristics, physical exercise is divided into two, namely aerobic exercise and anaerobic exercise (Nugraha et al., 2021). Both types of exercise have been applied to optimize lipid profiles (Wulf & Lewthwaite, 2016). Anaerobic exercise such as weight training can increase blood fat metabolism, optimize HDL levels, and effectively reduce body fat (Castro-Vázquez, 2020; Ho et al., 2022). Meanwhile, aerobic exercise, such as brisk walking, running, cycling or swimming, has been proven to improve heart and lung function (Abdelbasset et al., 2018; Ahmed et al., 2022; Sarmento et al., 2017), and reduce triglyceride levels and LDL levels (Ouerghi et al., 2014). Additionally, interval training, which involves high-intensity sequences and short rest periods, has also been shown to be effective in rapidly optimizing blood lipid profiles (Frimpong et al., 2019 ; Racil et al., 2013 ; Rey et al., 2018). Stationary bicycle interval training involves a series of moderate to high intensities interspersed with periods of light recovery, thus before carrying out the prerequisite exercises/exercises that are intended so that later during the interval training process the person's physical condition is already good (Apró et al., 2015; Tsitkanou et al., 2015; Tsitkanou et al. al., 2017). This concept aims to increase endurance, strength and efficiency in cycling (Grace et al., 2018). Apart from physical exercise, a healthy and balanced diet is an important factor in managing lipids in the body and cardiovascular health (Ignarro et al., 2007). A proper diet can help reduce blood fat levels, improve lipid profiles, and maintain a healthy body weight (Gusnedi et al., 2022; Thomas et al., 2023). But until now, no one has applied static bicycle interval training accompanied by a calorie-restriction diet to treat dyslipidemia. This study aims to compare the effect of static bicycle interval training accompanied by a calorie restriction diet with static bicycle interval training without diet on lipid profiles.

MATERIALS AND METHODS

This research, conducted from March to April 2022, adhered to the ethical principles outlined in the Declaration of Helsinki. Ethical approval was granted by the Health Research Ethics Commission of the Faculty of Health Sciences at General Soedirman University, under project number 676/EC/KEPK/II/2022. Prior to participation, all participants were thoroughly informed about the study's details, including potential risks and benefits, and provided their consent by completing a consent form.

Research Design

The research method chosen is included in quantitative research because, in the process, there is a systematic investigation of a phenomenon by collecting data measured using statistical, mathematical, or computational techniques (Freeman et al., 2017). The type of quantitative research applied in this study is experimental research, which aims to examine the effect of a particular treatment on the symptoms of a particular group compared to other groups using different treatments. The research design used is a pretest-posttest control group design, as found in Table 1.

Table 1. Research design pretest-posttest control group design

Group	Pretest	Treatment	Posttest
Experimental Group	O1	X	O2
Control Group	O3	Y	O4

Information:
O1 and O3: Pretest (lipid profile lab test)
O2 and O4: Posttest (lipid profile lab test)
X: Static Bike interval training and Calorie Restriction Diet
Y: Static Bike interval training

Participants

Participants in this study were male students aged 18 to 21 years who had a total cholesterol level of more than 200 mg/dl, were overweight or obese with a body mass index of more than 27 kg/m2, a fat percentage of more than 25. %, waist circumference more than 85 cm, and have a stable weight for the last 6 months. All participants fill out the questionnaire voluntarily and are screened first using a predetermined flow through a questionnaire distributed via Google Forms. Of the 45 people who filled in, 15 people did not meet the predetermined criteria, leaving 30 people who met the research criteria. Next, random sampling was carried out on 30 participants who were divided into two groups, namely 15 people each in experimental group one who received static bicycle interval training treatment accompanied by a calorie restricted diet and 15 other people in the control group or experimental group two. received stationary bike interval training treatment. The demographic characteristics of the participants in this study can be seen in Table 2.

Table 2. Demographic characteristics

Characteristics	Mean ± SD
Gender	Male (100%)
Age	19,3±1,4
Weight	82,3±8,4
Height	172,5±7,4
BMI	29,3±2,1
Fat Percentage	28,9±3,3
Waist Size	89±3

Treatments

Treatments were given for eight weeks (Teong et al., 2021) at the time after the pretest and before the posttest; the treatments given in this study were divided into two groups: experimental group one received static bicycle interval training and calorie restriction diet, while experimental group two received static bicycle interval training. Static bike interval training was carried out three times a week, with the duration of training in the first week to the second week for 30 minutes, in the third week to the sixth week for 45 minutes, and in the seventh week to the eighth week for 60 minutes. While the calorie restriction treatment participants are limited to their calorie intake by reducing 500 - 700 calories after calculating the Basal Metabolic Rate (BMR) using the harris-benedict formula (Luy & Dampil, 2018), namely:

BMR = 66.5 + (13.75 * body weight (kg) + (5.003 * height (cm) - (6.75 * age)

Furthermore, to determine the number of daily calories when not training is (BMR x 1.2) - (500 to 700 calories), while the number of calories on training days is (BMR x 1.55) - (500 to 700 calories). In addition to the limited number of calories, participants must fulfill macronutrient intake consisting of 40% carbohydrates, 35% protein, and 25% fat, which is monitored through the fat secret application.

Instrument

The instrument used in this study was a blood sampling laboratory test to check the levels of HDL, LDL, Triglycerides, and total Cholesterol conducted by experts at UPTD Laboratorium Kesehatan Kota Bandung. The laboratory test procedure in taking participants' blood to check the levels of HDL, LDL, triglycerides, total cholesterol, and blood sugar:

The medical personnel in charge of taking blood will perform the following steps:

Wrapping an elastic band around the upper arm to stop the blood flow. This makes the blood vessels under the ties dilate, making it easier to inject the needle into the vessels. Cleaning the body part that will receive the injection with alcohol. Injecting the needle into the vein with a blood draw of 2.7 ml. Blood that has been drawn on the syringe is put into a 5 ml pipette. Removing the ties from your arm when the blood draw feels like enough. Putting gauze or cotton on the injection site, after the medical professional has finished giving the injection. Apply pressure to the area and then apply a bandage.

Results of laboratory measurements of HDL, LDL, Triglyceride, and Total Cholesterol levels can be obtained approximately one day after blood sampling is done.

Statistical Analysis

Data analysis was carried out using IBM SPSS version 25.0. Results are presented as mean ± standard deviation (SD). Independent t-test was used to analyze the mean differences between the two groups. The level of statistical significance was set at $p < 0.05$.

RESULTS

Lipid profile data was obtained from the pretest and posttest laboratory test results, and then the gain score was calculated, as shown in Table 3. To compare the effect of static bicycle interval training accompanied by a calorie restriction diet with static bicycle interval training alone on lipid profiles, first the normality test and homogeneity test were carried out. The results of the calculation of the normality test of the lipid profile of the experimental group 1 and experiment 2 using SPSS were declared normal, then the homogeneity test was declared homogeneous, so to find out the average comparison of the two unpaired groups can use the independent samples test calculation.

Table 3. Average gain score of lipid profile

Lipid Profile Mean	Mean ± SD Experiment	Mean ± SD Control
HDL	3,07±2,1	2,6±1,8
LDL	16,13±3,3	12,87±3,1
Trigliserida	11,60±3,2	10,80±2,9
Total Cholesterol	13,93±2,8	11,67±2,9

Table 4. Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
HDL	Equal variances assumed	1.525	.227	1.571	28	.127
	Equal variances not assumed			1.571	24.210	.129
LDL	Equal variances assumed	.010	.921	10.217	28	.000
	Equal variances not assumed			10.217	27.759	.000
Trigliserida	Equal variances assumed	6.469	.017	2.366	28	.025
	Equal variances not assumed			2.366	22.993	.027
CT	Equal variances assumed	2.442	.129	4.829	28	.000
	Equal variances not assumed			4.829	26.124	.000

The results of calculating the average comparison of lipid profile score gains using the independent samples test statistical test are presented in Table 4. Independent samples test showed no significant difference in HDL levels between the experimental and control groups with a sig (2-tailed) value of 0.127 > 0.05. When viewed from the average gain score in Table 3, the average HDL in the experimental group increased by 3.07, greater than the control group average of 2.6. There is a significant difference in LDL levels between the experimental and control groups, as indicated by the sig (2-tailed) value of 0.00 < 0.05. The average gain score in Table 3 shows that the experimental group is more optimal at 16.13 than the control group at 12.87. There is a significant difference in triglyceride levels between the experimental group and the control group, as indicated by the sig value (2-tailed) 0.025 <0.05. The average gain score in Table 3 shows that the experimental group is more optimal at 11.6 compared to the control group at 10.8. There is a significant difference in total cholesterol levels between the experimental group and the control group, as indicated by the sig value (2-tailed) 0.00 <0.05. The average gain score in the experimental group is more optimal at 13.93, greater than the control group of 11.67.

DISCUSSION

This study aims to explore and compare the effects of two interventions, namely stationary bicycle interval training with a calorie-restricted diet and stationary bicycle interval training without diet on lipid profiles in individuals with dyslipidemia. The main finding of this study is that there is a significant difference between static bike interval training accompanied by a calorie restriction diet and static bike interval training without a diet on changes in LDL, Triglyceride, and total cholesterol levels of static bike interval training accompanied by a diet, but there is no significant difference in HDL levels. The average gain score showed that the experimental group was more able to optimize HDL, LDL, Triglyceride, and Total Cholesterol levels compared to the control group. The findings in this study are in line with research conducted previously by Rumapea and Theodora in 2017, which states that aerobic interval training, including static bikes is a physical activity that if done regularly and according to the capacity of each individual, will be beneficial in regulating blood lipid profiles, one example of which can reduce total cholesterol levels (Hengkengbala et al., 2013; Maryusman et al., 2020; Rachman et al., 2023; Utomo et al., 2012; Wahyuningsih et al., 2018). Similarly, research conducted by (Putri & Herawati, 2018) proves that aerobic exercise effectively reduces cholesterol, LDL, and triglyceride levels while increasing HDL levels in people with hypertension.

Then there are also studies that examine the effect of exercise or physical activity combined with diet on lipid profiles, including research conducted by (Hutchison et al., 2019), which shows the results that diet and exercise interventions for 8 weeks reduce body mass index and lipid profiles. Supported by research conducted by (Maryusman et al., 2020) shows that the combination of diet and aerobic exercise can reduce total cholesterol, LDL cholesterol, and triglyceride levels and increase HDL cholesterol. This study also mentioned that the group given treatment, namely diet and exercise, had a decrease in cholesterol levels compared to the control group. Similarly, research conducted by (Khalafi et al., 2023) examines which is more efficient: diet alone, physical activity/exercise alone, or a combination of the two. The results show that diet and exercise are significantly more efficient in regulating lipid profiles and reducing body fat levels in overweight and obese patients.

Conclusion

The conclusion of this study is that the combination of static bike interval training and calorie restriction diet has a more significant effect in optimizing LDL, Triglyceride, and Total Cholesterol levels. The combination is considered more significant and efficient than if it is not combined. Then, the combination of static bicycle interval training along with a calorie restriction diet is recommended for dyslipidemia patients to optimize lipid profiles. So the results of this research can contribute to being used as a reference for people with obesity and dyslipidemia.

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Conflicts of Interest

The authors have no conflicts of interest to declare.

Ethical Statement

Research ethical approval was obtained from the Health Research Ethics Commission, Faculty of Health Sciences, Jendral Soedirman University with project number 676/EC/KEPK/II/2022. All participants provided their opinions in writing and informed consent.

Author Contributions

Study Design, RN, RDS, S, MNBN, RH, NDD; Data Collection, RN, S, EE, R, MNBN, RH, NDD, AF. MSFNP, NNFK; Statistical Analysis, RN, R, AF, MSFNP, NNFK Data Interpretation, RN, R, AF, MSFNP, NNFK; Manuscript Preparation, RN, RDS, EE; Literature Search, RN, RDS, EE. All the authors agreed on the final draft of the manuscript before submitting it for publication.

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