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Original Research Paper

The effect of low-impact aerobic exercise in lowering total cholesterol levels

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Abstract
Hypercholesterolemia (HC) is a disease caused by excessive fat consumption and a lack of physical activity. It can impact the emergence of various health disorders (e.g., heart disease, hypertension, and stroke). One of the non-pharmacological therapies to treat HC is by practicing low-impact aerobic. This study aims to determine the effect of low-impact aerobic exercise on decreasing cholesterol levels. Quasi-experimental research with a two-group pretest-posttest control group design. Purposive sampling was used in this study with inclusion criteria: patients with a cholesterol value >200 mmHg, who can do physical activity and do not take medication regularly. The sample, which comprised 64 respondents, was divided into intervention and control groups. The low-impact aerobic exercise intervention was conducted over a period of 8 weeks, with sessions held 2-3 times a week, each lasting 15 minutes. A glucose, cholesterol, uric acid (GCU) meter device was used to check cholesterol levels. Data were analyzed using a paired sample t-test. The mean decrease in cholesterol levels in the intervention group reached 55.22 mg/dl (from $\bar{x}$ 245.13 mg/dl to $\bar{x}$ 189.91 mg/dl). It was found a significant effect between low-impact aerobic exercise and reducing total cholesterol levels ($p < 0.05$). Low impact aerobic exercise intervention is cost-effective, has minimal side effects, and is effective in controlling and lowering cholesterol levels if done properly and intensively. Optimizing HC management can be done by combining HC interventions, e.g., diet, medication, and adequate physical activity. Further research on the optimization of HC management needs to be conducted.

Keywords: aerobic exercise; cholesterol level; hypercholesterolemia; hyperlipidemia; low impact

1. Introduction

Non-communicable diseases have become a significant concern both nationally and globally. So far WHO noted that cardiovascular disease (CVD) remains the leading cause of death globally (WHO, 2019). The main risk factor for CVD and atherosclerosis is elevated levels of cholesterol and fat in the bloodstream, leading to narrowing or calcification of the arteries (Febriani & Besral, 2018; GBD, 2018; Grundy *et al*., 2014). Hypercholesterolemia accounts for global mortality and disability-adjusted life years (DALYs) of 4.5% and 2%, respectively (Ahn & Kim, 2020). Hypercholesterolemia is associated with an increased risk of chronic diseases: heart failure (Maddox *et al*., 2021), stroke (Chen *et al*., 2022), alzheimer's (Feringa & van der Kant, 2021), and others. According to (Pirillo & Norata, 2023), hypercholesterolemia (HC) is a major contributor to ischemic heart disease (IHD), where IHD causes 50% of deaths in patients with CVD.

Based on data issued by WHO, it is found that Europe has the highest prevalence of HC (54%), followed by the Americas, Southeast Asia and Africa with 48%, 29% and 22.6% respectively (WHO, 2020). Meanwhile, in several developing countries, the prevalence of HC varies, such as in Taiwan (43.96%) (Tsao *et al*., 2021), Nigeria (38%) (Adeloye *et al*., 2020), Iran (26.7%-42%) (Akbartabar Toori *et al*., 2018), Ethiopia (26.4%) (Belete *et al*., 2023) and Indonesia (35.9%) (Febriani & Besral, 2018). The varying prevalence of HC may be due to several factors, namely knowledge, sociodemographic and biomedical characteristics, attitudes, ethnic heterogeneity, behavioral factors and others (Al-Zahrani *et al*., 2021; Belete *et al*., 2023).

There are many factors that cause the occurrence of HC. These risk factors can be divided into 2 groups: non-modifiable risk factors and modifiable risk factors. Genetic factors and certain medical conditions such as nephrotic syndrome, hypothyroidism, cholestasis and diabetes mellitus are some of the risk factors for HC that cannot be modified (Al-Zahrani *et al*., 2021). Meanwhile, modifiable risk factors for HC are diet (lack of fruit and vegetable consumption, consumption of foods that are high in fat and cholesterol such as coconut milk, cheese, fried fatty meats and so on), obesity, smoking and alcohol consumption and lack of physical activity (Belete *et al*., 2023; Febriani & Besral, 2018).

Nowadays many HC patients only focus on pharmacological treatment to lower their total blood cholesterol levels. While metabolic disorders experienced by patients with high cholesterol often do not respond to these drugs, so alternative treatment can be done by natural means such as dietary modification, and increased physical activity (Yuniartika *et al*., 2023). According to Arief *et al* (2023) blood fat levels are influenced by physical activity. The more activity done, the more fat is burned. Doing intensive physical activity can help control body weight and strengthen heart health, increase blood supply to blood vessels, and improve lipoprotein profiles (Mann *et al*., 2014; Stanton & Reaburn, 2014; Syarfaini *et al*., 2020).

One of physical activities to reduce total cholesterol levels is doing aerobic exercise. Aerobic exercise is a physical activity that is organized in a coherent manner that combines several appropriate movements that have been selected and planned to achieve a goal (Dwijayanti & Ferbrianti, 2021). Fitrianingsih (2019) found that aerobic dance exercise can significantly reduce total cholesterol levels, the average total cholesterol level decreased from 221.68 mg/dL to 173.12 mg/dL. Unfortunately, this aerobic dance exercise is not necessarily suitable for all ages, especially the elderly. The research results show that hyperlipidemia, including high cholesterol levels, is more common in the elderly. Rosada *et al.* (2020) reported that 76% of elderly participants had hyperlipidemia compared to only 41% in younger individuals, including a high prevalence of hypercholesterolemia, which was diagnosed in 64% of the elderly group. Low-impact aerobics is more suitable for people with cholesterol, especially the elderly because aerobic movements are light, not too hard and tend to relax so that they can prevent heart attacks due to increased pulse and blood pressure (Nurafifah, 2021). The purpose of this study was to determine the effect of low-impact aerobic exercise on reducing total cholesterol levels in patients with high cholesterol.

2. Research Methods

This research is a quasi-experiment with two-group pretest-posttest control group design. The research was conducted in April - May 2024. The population of this study was 160 people with cholesterol in Jetis Village, Baki District, Sukoharjo Regency (Dinkes Sukoharjo, 2022). This study used Purposive sampling with inclusion criteria (total cholesterol value in the blood > 200 mg/dL, not undergoing routine treatment, able to do physical activity independently, willing to follow the course of the study until the end of the study and exclusion criteria (cholesterol patients who have comorbidities, physical activity assisted by others and not willing to participate in the study). The sample in this study amounted to 64 respondents, which were divided into two groups, namely the intervention group and the control group, which each consisted of 32 respondents.

The researcher conducted content analysis with two experts in this field. The first was a lecturer in Communication Science at University of Muhammadiyah Surakarta to assess the design (layout, color, font, etc.) used in the low-impact aerobic exercise video and booklet. The results of the content analysis showed that the booklet media had to be revised by changing the colors and enlarging the images so that they were clearly visible. After making revisions to the video media and booklet of low-impact aerobic exercise, the results showed that the media received approval and could be used. The second content analysis was conducted by gymnastics experts to assess the suitability of low-impact aerobic

exercise movements. The results of the content analysis showed that the movements to be taught had been approved by gymnastics experts and were in accordance with the principles of low-impact aerobic gymnastics movements. Reliability test was not conducted because the GCU meter device used was still in new condition.

All respondents involved in this study signed an informed consent form. Researchers conducted a pretest to measure cholesterol levels in the blood for each participant. Additionally, the data from respondents were adjusted according to the established inclusion and exclusion criteria. The selected respondents were divided into two groups: the control group and the treatment group. The researcher explained the procedure for low-impact aerobic exercise to the treatment group, which consisted of 32 participants and then performed the exercise together with them. The researcher instructed the treatment group to regularly engage in low-impact aerobic exercise, utilizing videos and booklets that had been provided. The low-impact aerobic exercise intervention was conducted over a periode of 8 weeks, whit sessions held 2-3 times a week, each lasting 15 minutes. Each respondent received a checklist sheet to complete independently after each low-impact aerobic exercise session. Throughout this process, researchers collaborated with cadres of *posyandu* (integrated health service) for monitoring purposes. The researcher visited each respondent every three days to ensure their active participation in the low impact aerobic exercise. After 8 weeks the researchers measured the total blood cholesterol levels (post-test) in both the control and intervention groups.

This study used univariate analysis to display data descriptively in the form of frequency distribution of each variable studied such as respondent characteristics and pre-test and post-test results, while bivariate analysis uses the Paired Sample T-test test because the data are normally distributed. This research has obtained an ethical feasibility letter with number No. 5203/B.1/KEPK-FKUMS/III/2024.

3. Results and Discussion

3.1.Characteristics of Respondents

It was found in this study that in the intervention and control groups, the majority of respondents were female (90.6% vs 87.5%), in the age range of 61-70 years (40.6 vs 28.1%), housewives (75% vs 62.5%). As for the education of the respondents, the intervention group had the most elementary school education (68.8%), while the control group had the most elementary and junior high school education (37.5%). The overall characteristics of respondents are presented in Table 1 below.

Table 1. Characteristics of Respondents

Characteristics	Intervention Group		Control Group	
	N	%	N	%
Gender				
Male	3	9.4	4	12.5
Female	29	90.6	28	87.5
Total	**32**	**100**	**32**	**100**
Age				
21-30 years	1	3.1	3	9.4
31-40 years	2	6.2	3	9.4
41-50 years	3	9.4	4	12.5
51-60 years	8	25	8	25
61-70 years	13	40.6	9	28.1
71-80 years	3	9.4	4	12.5
81-90 years	2	6.2	1	3.1
Total	**32**	**100**	**32**	**100**
Occupation				

Characteristics	Intervention Group		Control Group	
	N	%	N	%
House Wife	24	75	20	62.5
Farmer	1	3.1	2	6.2
Labor	4	12.5	4	12.3
Trader	1	3.1	3	9.4
Self-employed	1	3.1	3	9.4
Retired employee	1	3.1	0	0
Total	**32**	**100**	**32**	**100**
Education				
Elementary School	22	68.8	12	37.5
Junior High School	6	18.8	12	37.5
Vocational High School	0	0	1	3.1
Upper Secondary School	3	9.4	7	21.9
Diploma-3	1	3.1	0	0
Total	**32**	**100**	**32**	**100**

Source: Primary Data 2024

Based on the total number of respondents, it was found that 57 (89%) were female. The intervention and control groups also showed similar results, where the majority of respondents were female 90.6% and 87.5% respectively. This finding is in line with a study in Nigeria which showed that HC is more prevalent among women than men (42% vs 38%) (Adeloye *et al*., 2020). Other studies reported the opposite finding that the prevalence of HC was higher in men, namely in Saudi Arabia (56.7% vs 43.3%) (Al-Zahrani *et al*., 2021) and in Ethiopia (54.5% vs 45.5%) (Belete *et al*., 2023). Age, hormonal influences, habits and lifestyle, genetics, health conditions are factors that influence HC (Belete *et al*., 2023; CDC, 2024; Ibrahim *et al*., 2024; Patel *et al*., 2024). These factors automatically affect the difference in HC prevalence between men and women. Hormonal changes, especially estrogen in women, affect the prevalence of HC. Before menopause, women generally have higher levels of high-density lipoprotein (HDL) cholesterol, often referred to as "good" cholesterol, due to the protective effects of estrogen. However, after menopause, estrogen levels decrease, leading to an increase in low-density lipoprotein (LDL) cholesterol, or "bad" cholesterol and a decrease in HDL levels. This shift can lead to higher total cholesterol levels in women compared to men after the age of 50 years (Patel *et al*., 2024).

Meanwhile, the high prevalence of HC in men may be due to lifestyle factors and lack of HC screening in women. Compared to women, men often engage in risky lifestyle behaviors that contribute to HC, such as higher smoking and alcohol consumption and lower levels of physical activity (Hailemariam *et al*., 2021). The results of previous studies have confirmed these findings where unhealthy lifestyles such as poor diet, smoking and alcohol consumption, lack of physical activity increase the risk of HC (Belete *et al*., 2023; Febriani & Besral, 2018; Wakabayashi, 2021). These behaviors can exacerbate conditions such as obesity, which is closely associated with elevated cholesterol levels. Hypercholesterolemia generally does not cause symptoms, so many do not realize if they have this condition. Therefore, it is necessary to increase awareness about HC, one of which is through screening. Unfortunately, according to Patel *et al.* (2024), screening and services related to HC in women are still lacking. This lack of screening can cause many cases of HC in women to be missed because they are not optimally detected and indirectly cause the prevalence of HC in men to be higher.

It was known that most of the respondents in the intervention group and control group were 61-70 years old, 40.6% and 28.1% respectively. A study in Berlin showed similar results where 64% of HC prevalence occurred in the elderly (Rosada *et al*., 2020). Several previous studies reported that age was a significant risk factor for HC; for both genders, older age has been associated with an increased risk

of HC (Al-Hassan & Fabella, 2017; Basulaiman *et al*., 2014). As we age, physiological changes occur that can lead to increased cholesterol levels. The elderly often has higher levels of total cholesterol, LDL cholesterol (bad cholesterol), and triglycerides compared to younger adults. Age-related changes in cholesterol levels show different patterns in men and women due to physiological differences, hormonal influences, and lifestyle factors. Cholesterol levels in men, especially total cholesterol and LDL cholesterol, tend to peak at the age of 30-39 years. After that, cholesterol levels can decline gradually at the age of > 65 years (Downer *et al*., 2014; Gupta *et al*., 2016). In women, cholesterol levels are generally lower during the reproductive period. However, after menopause, cholesterol levels increase, especially in LDL cholesterol, triglycerides and total cholesterol (Holven & Roeters van Lennep, 2023).

It was a fact that the majority of respondents in this study were housewives (68.75%). The number of housewives in the intervention group and control group were 75% and 62.5% respectively. The results of this study were reinforced by research (Rosmaini *et al*., 2022) which compared several types of occupations with the incidence of hyperlipidemia, by classifying occupations based on physical activity: heavy, moderate, light, and not working. Although the difference in the type of work itself did not show a significant comparison between groups, the non-working group tended to have a less active lifestyle with an average duration of more than 4 hours per day. This sedentary lifestyle with low activity has a significant correlation with increased cholesterol levels. According to Ahn & Kim (2020), low physical activity causes a lack of energy expenditure compared to food intake, so that food substances will be stored and stored as fat. Lack of physical activity will increase LDL cholesterol levels and reduce HDL cholesterol levels. High cholesterol levels cause more cholesterol to stick to the walls of blood vessels.

More than half of the respondents (53.1%) in this study had an elementary education. In the intervention group, most had elementary education (68.8%), while in the control group, most had elementary and junior high school education, 37.5% each. The results of this study are in line with the results of research by Renityas, (2019) which reported that 53.6% of people with high cholesterol had low education. This is because cholesterol sufferers with low education have less knowledge about health compared to those with higher levels of education. Education has a very important role in shaping human quality. Through education, a person can gain knowledge and information. The higher the level of education a person has, the better their quality of life. People who have higher education will have easier access to information, including healthy eating patterns. People with higher levels of education are more likely to maintain their diet by consuming low-fat foods and increasing vegetables and fruits. Previous research found interesting findings related to education and total cholesterol levels in men and women. The higher the education of a woman, the lower the total cholesterol level, on the other hand, the higher the education of men, the higher the total cholesterol level (Espírito Santo *et al*., 2019).

3.2.The Effect of Low-Impact Aerobic Exercise in Lowering Total Cholesterol Levels

Table 2. Results of Measuring Total Cholesterol Levels Pre-Test And Post-Test

Category	Intervention Group		Control Group	
	N	%	N	%
Pre-Test				
200 – 239 mg/dL	14	43.8	17	53.1
≥ 240 mg/dL	18	56.2	15	46.9
Total	**32**	**100**	**32**	**100**
Post Test				
<200 mg/dL	23	71.9	4	12.5
200 – 239 mg/dL	8	25	18	56.2
≥ 240 mg/dL	1	3.1	10	31.2

Category	Intervention Group		Control Group	
	N	%	N	%
Total	**32**	**100**	**32**	**100**

Source: Primary Data 2024

Table 3. The Effect of Low-Impact Aerobic Exercise in Lowering Total Cholesterol Levels

Category	*Paired Sample T-test* analysis results			
	Description	N	*Mean* ± *SD*	P-Value
Intervention	Pre-test	32	245.13 ± 31.894	0.001*
	Post-test	32	189.91 ± 22.813	
Control	Pre-test	32	242.28 ± 25.254	0.056
	Post-test	32	229.69 ± 27.829	
Uji Paired Sample T-test				

Source: Primary Data 2024

Based on Table 2, the pre-test results in the intervention group showed that more than half of the respondents (56.2%) had total cholesterol levels ≥ 240 mg/dL. After being given the intervention of low-impact aerobic exercise, the total cholesterol levels of the respondents dropped significantly. It was found that 71.9% of respondents had cholesterol levels < 200 mg/dL and only 3.1% had total cholesterol levels ≥ 240 mg/dL. The results of the Paired Sample T-test (Table 3) show that there is a significant effect between low-impact aerobic exercise on reducing total cholesterol levels ($p < 0.05$). The mean decrease in cholesterol levels in the intervention group reached 55.22 mg/dL, from the mean cholesterol level of 245.13 mg/dL to 189.91 mg/dL. While in the control group, although there was a decrease in the average cholesterol level of 12.59 mg/dL, the decrease was not significant ($p> 0.05$).

The average decrease in total cholesterol levels in the intervention group in this study (55.22 mg/dL) was higher than the results of previous research on the effect of aerobic dance exercise on lowering cholesterol levels. The study reported a decrease in the average total cholesterol level by 48.56 mg/dL from 221.68 mg/dL to 173.12 mg/dL (Fitrianingsih, 2019). Oxidative enzyme production in the mitochondria increases during aerobic exercise because it helps accelerate and increase adenosine triphosphate (ATP) production. At the beginning of aerobic exercise, energy is obtained from the breakdown of carbohydrates into ATP. Subsequently, energy is obtained from the breakdown of fat. Fatty acids produced from the breakdown of fat move from adipose tissue to muscle cells via the bloodstream. This fat breakdown is associated with weight loss and cholesterol profile improvements (increased HDL cholesterol, decreased LDL cholesterol and triglycerides) (Franczyk *et al*., 2023; Wang & Xu, 2017; Zhao *et al*., 2021). A study reported that a 5-10% weight loss can significantly reduce LDL cholesterol, triglycerides and total cholesterol, resulting in a reduced risk of CVD (Brown *et al*., 2016).

Low-impact aerobic exercise intervention is a cost-effective intervention with minimal side effects, which, if done correctly and intensively, will be very effective in controlling and lowering cholesterol levels. Aerobic exercise can be combined with music to provide a relaxing effect on the body and create a feeling of happiness (Yuniartika & Mutiah, 2021) This will impact preventing stress, anxiety, anxiety or depression that often occurs, especially in those who have hypertension, diabetes mellitus, cholesterol and others.

4. Conclusion

The average decrease in cholesterol levels in the intervention group reached 55.22 mg/dL, from the average cholesterol level of 245.13 mg/dL to 189.91 mg/dL. There is a significant effect between aerobic exercise on reducing total cholesterol levels ($p < 0.05$). Low-impact aerobic exercise intervention is a cost-effective intervention and minimal side effects, which, if done correctly and

intensively, will be very effective in controlling and reducing cholesterol levels. Optimizing HC management can be done by combining HC interventions, such as diet, medication, and adequate physical activity to reduce the prevalence of HC and improve the quality of life of HC patients. This study did not control the diet and diet of the respondents, so it is hoped that this study can be the basis for further research on the effect of total cholesterol levels in the blood before and after the intervention of aerobic exercise and diet.

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