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Impacts of Aerobic Exercise Interventions on the Lipid Profile of Obese Female College Students

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Abstract: This study aimed to analyze the effect of aerobic exercise interventions on the lipid profile of obese female college students. Assessed the effect of a 12-week aerobic exercise program on the lipid profile in obese female college students.The obese students (BMI ≥ 30 kg/m2) aged 18-25 years were randomized into training (N=15) and control (N=15) groups after baseline measurements. The 12-week training program consisted of 30–60 min low to moderate-intensity aerobic exercises such as brisk walking and light jogging, Aerobic dance, Zumba, jumping jacks, and skipping rope, 5 days per week. Paired sample t-test showed a significant ($P < 0.05$) difference in lipid profile in the exercise group. Pre- and post-test values is significantly different ($p< 0.05$) in the experimental/training group. The aerobic exercise program showed significant ($P < 0.05$) decreases in low-density lipoprotein, triglyceride, and total cholesterol and increased high-density lipoprotein ($P < 0.05$), but we found no significant difference in the lipid profile of the control group. These findings suggest that aerobic exercise training has a favorable effect on high-density lipoprotein, low-density lipoprotein, triglyceride, and total cholesterol in obese female college students.

Keywords: Aerobic Exercise Training, Obesity, High-density lipoprotein, Low-density lipoprotein, Triglycerides, Total Cholesterol

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Introduction

Obesity is a non-communicable illness and one of the world's greatest health challenges which caused 71 % of deaths in 2016 all over the world (Bennett *et al*., 2018). In India, obesity has affected more than 135 million people (Ahirwar and Mondal, 2019) and women are more affected by this disease globally (Ferretti and Mariani, 2017). Obesity is described as abnormal or excessive fat buildup that might harm one's health, and it is assessed using a body mass index

(BMI) of 30 kg/m^2 (Gupta *et al*., 2023).Body mass index is the ratio of weight in kilograms divided by height in meters squared (kg/m^2).Obesity has risen worldwide since 1975. In 2016, approximately 1.9 billion adults aged 18 and over were overweight and over 650 million of these people were obese. In 2016, 39% of adults aged 18 and up were overweight, and 13% were obese (Manasa and Mahadevaswamy, 2023).

Obesity is backed by both quantitative and qualitative changes in plasma lipoproteins and the main variation in the lipid profile includes a reduced level of HDL and a raised level of LDL (Vekic *et al*., 2023). Obesity is a significant risk factor for cardiovascular disease, and changes in blood lipid profiles caused by exercise may potentially lower cardiovascular disease-related events (Doewes *et al*., 2023). The lipid profile encloses parameters such as High-density lipoprotein (HDL), Low-density lipoprotein (LDL), Triglyceride (TG), and Total cholesterol (TC), which is a crucial indicator of cardiovascular health (Hangargekar *et al*., 2023). Elevated lipid levels, specifically low-density lipoprotein cholesterol are critical contributors to atherosclerosis and coronary artery disease, which leads to increased mortality globally (Galimberti *et al*., 2023). Aerobic exercise training has been exhibited, which improves lipid profile and ameliorates reverse cholesterol transport, insulin sensitivity, and antioxidant defenses in the arterial wall, which lessens atherogenesis and increases life span (Bochi *et al*., 2022).

Aerobic exercise interventions are training where the body's large muscles move rhythmically for a prolonged period. Aerobic activity or endurance activities like walking, running, skipping, jumping jacks bicycling, etc. are those that improve cardiorespiratory fitness and reduce fat deposition (Bull *et al*., 2020). Aerobic exercises promote the burning of calories, enhance metabolism, and aid weight loss which is advantageous to obese people (Oppert *et al*., 2023). The outcome of physical activity on lipid and lipoprotein metabolism and its ratio notably decreased after exercises. It is therefore important to be involved in some aerobic exercise to keep healthy and stay fit (Cetin *et al*., 2020).

The purpose of this investigation was to study the effects of aerobic exercise on Lipid profiles in obese female college students. This study was to test the hypothesis that a 12–week aerobic exercise program would impact the lipid profile of obese female college students.

Materials and Methods

To identify obese students, 120 female college students were randomly selected from the Sree Kerala Varma College, Thrissur, Kerala, India affiliated with the University of Calicut. Then their body weight and height were measured. After analyzing the BMI of the 120 students, 48 students were obese. For the study, thirty (N=30) students were purposefully selected for this study, those who meet the inclusion criteria are female college students aged between 18 to 25 years, with BMI ≥ 30, indicating obesity and no known cardiovascular or metabolic diseases. Participants were excluded if they were taking medication which had been diagnosed with a condition known to affect lipid profile, had an orthopaedic condition that would limit their ability to exercise, or had participated in structured aerobic or resistance training exercises within the previous 6 months. Before participation in the experiment, all subjects completed the physical activity readiness questionnaire (PAR-Q). Then educated about the procedure, risks, and benefits of the Aerobic exercise, and their consent was obtained. The subjects were also instructed not to engage in any other physical activity or change their nutrition during the intervention time.

The subjects were equally divided into two groups (Table 1), the experimental and the control group. The experimental group (N=15) did aerobic exercise, while the control group (N=15) did not do any activity. The structured

Table 1: Aerobic Training Program Overview

12 week	Types of exercise	Duration of exercise	Intensity
1st week	Warm-up, brisk walking and light jogging, Aerobic dance and cool-down	30 min	40-50 % of HR Max
2nd week			
3rd week			
4th week			
5th week	Warm-up,jogging, Aerobic dance, Zumba, jumping jacks, skipping rope (15 repetitions x 2 sets) and cool-down	45 min	50- 60 % of HR Max
6th week			
7th week			
8th week			
9th week	Warm-up, Running, Aerobic dance, Zumba, jumping jacks and skipping rope (20 repetitions x 3 sets)Stationary cycling, and cool-down	60 min	50- 60 % of HR Max
10th week			
11th week			
12th week			

training program was scheduled for a duration of 12 weeks progressively. The frequency of this program was 5 days per week with one section per day.

Participants' lipid profiles such as High-density lipoprotein (HDL), Low-density lipoprotein (LDL), Triglyceride (TG), and Total cholesterol (TC) were measured using fasting blood samples before the first day of the training. Lipid profiles were reassessed using fasting blood samples after the 12 weeks of aerobic training and took place 24–48 h after the final training session to minimize the acute effects of the last training bout on lipid profiles. Participants repeated the previous week's training regimen between these two procedures to minimize detraining effects.

After disinfection, Venous blood was collected from the elbow vein, and the collected blood was in a clot activator tube. Then serum was separated by centrifugation at 3000 rpm for 5 min and then the test was performed. The levels of High-density lipoprotein (HDL), Low-density lipoprotein (LDL), Triglyceride (TG), and Total cholesterol (TC) were tested with the fully automatic analyzer.

Independent sample t-tests were used to assess baseline group differences. Intervention effects were examined by paired sample t-tests to determine within the group of the Lipid profile parameters such as High-density lipoprotein (HDL), Low-density lipoprotein (LDL), Triglyceride (TG), and Total cholesterol (TC).The level of significance was set at 0.05 level.

Results

There were no significant differences concerning lipid profile parameters such as High-density lipoprotein (HDL), Low-density lipoprotein (LDL), Triglyceride (TG), and Total cholesterol (TC) between the trained and control groups before training (Table 2). The average HDL level of Experimental group and Control group was 52.20 mg/dl and 53.26 md/dl, the Average LDL level of Experimental group and Control group

Table 2: Output of independent t-test for identifying Baseline group difference of experimental and control group on lipid profiles

Lipid profiles	Group	Mean (mg/dl)	Std. Deviation	t- value	P Value
HDL	Experimental	52.20	3.27	0.953	0.349
	Control	53.26	2.84		
LDL	Experimental	132.00	17.3	1.423	0.166
	Control	123.86	13.75		
TG	Experimental	144.66	14.55	0.472	0.640
	Control	146.86	10.64		
TC	Experimental	213.13	15.18	1.207	0.237
	Control	207.13	11.82		

Level of significance=0.05, df=28; Data are presented as Mean. HDL- high-density lipoprotein, LDL-low-density lipoprotein, TG- triglyceride, TC- total cholesterol.

Table 3: Output of paired t-test for analyzing Lipid Profiles Before and After the Intervention of Experimental and Control Groups

Lipid profile	Group	Before Intervention	After intervention	P Value
HDL	Experimental	52.20	54.33	0.00
	Control	53.26	52.86	0.16
LDL	Experimental	132.00	119.26	0.001
	Control	123.86	123.60	0.33
TG	Experimental	144.66	129.80	0.001
	Control	146.86	145.93	0.10
TC	Experimental	213.13	200	0.001
	Control	207.13	206.33	0.07

Level of significance=0.05, df=14; Data are presented as Mean. HDL- high-density lipoprotein, LDL, low-density lipoprotein, TG- triglyceride, TC- total cholesterol.

was 132.00 mg/dl and 123.86 mg/dl, the Average Triglyceride level of Experimental group and Control group was 144.66 mg/dl, and 146.86 mg/dl, and the total cholesterol level of Experimental group and Control group was 213.13 mg/dl, and 207.13 mg/dl, respectively. All the p-values are greater than 0.05 (p=0.349, 0.166, 0.640 and 0.237; > 0.05). The output of the independent t-test result showed that there is no significant difference between these two groups. The lipid profiles of the experimental group (n=15) and control group (n=15) were similar before training.

Table 3 (output of paired sample t-test) presents the mean of pre- and post-training values for the High-density lipoprotein (HDL), Low-density lipoprotein (LDL), Triglyceride (TG), and Total cholesterol (TC) of experimental and control groups. There were statistically no significant differences in pre- and post-training values in the control group (p=0.16, 0.33, 0.10, 0.07; > 0.05). There were statistically significant differences in pre- and post-training values of all lipid profile parameters only in the training group (p< 0.05). In the Experimental/ Training group, Low-density lipoprotein (before intervention = 132, after intervention = 119.26), Triglyceride (before intervention = 144.66, after intervention= 129.80),) and Total cholesterol (before

intervention = 213.13, after intervention = 200) decreased and High-density lipoprotein (before intervention = 52.20, after intervention = 54.33), increased with aerobic training.

Discussion

The objective of the study was to determine if 12-week aerobic training would be effective for maintaining lipid profile status in obese college female students. It is well-established that engaging in physical activity reduces an individual's risk for obesity and cholesterol level, however, to the best of our knowledge, it is unknown if anaerobic intervention training consisting of 12 weeks or 60 session scan favourably modify the lipid profile such as High-density lipoprotein (HDL), Low-density lipoprotein (LDL), Triglyceride (TG) and Total cholesterol (TC) in obese female college students.

To the best of our knowledge this study is the first randomized or even controlled study of sufficient sample size (total=30, experimental group=15 and control group=15) assessing the effect of structured aerobic exercise on the lipid profile in obese female college students. The 12-week aerobic exercise program produced favourable changes in lipid profiles such as High-density lipoprotein, Low-density lipoprotein, Triglyceride, and Total cholesterol in obese females.

The most pronounced change observed in our study was the relative increase in HDL in the training group, LDL, TG, and TC also decreased significantly during the training period only in the training group. Small changes appeared in the control group but this change was not significant when comparing pre- and post-test values on lipid profiles ($p > 0.05$). A study by Mathunjwa *et al*. (2013) have reported similar findings with LDL-C decreasing by almost 20%. This drop, together with reductions in TG, TC, and increases in HDL are all significant in that it favourably alters the participant's lipoprotein profile throughan aerobic exercise program. Ouerghi *et al*. (2014) conducted a 12-week high-intensity intermittent training program on aerobic capacity and lipid profile in trained subjects and also found low-density lipoprotein cholesterol levels had decreased (by about 2%) in experimental group 1 (EG1) but increased in the control group (CG). High-density lipoprotein cholesterol levels increased in EG1 and EG2 but decreased in CG. Plasma triglycerides decreased by 8% in EG1 and increased by about 4% in CG.

Dunn *et al*. (1997), Examined the impact of a 6-month aerobic exercise regimen and reported similar findings that gradually increased from 50% to 85% of maximum aerobic power, with sessions lasting 20 to 60 min three times per week. The study observed notable reductions in total cholesterol (-0.3 mmol/l, $p<0.001$) and the total-to-HDL cholesterol ratio (-0.3, $p<0.001$). Notably, the intervention spanned a relatively extended duration, and the exercise intensity was relatively vigorous.

Leon and Sanchez (2001) performed a meta-analysis encompassing 51 interventions lasting 12 weeks or longer, with a total participant count of 4,700 individuals. The analysis revealed that, on average, there was a 4.6% increase in HDL cholesterol, a 3.7% reduction in triglyceride levels, a 5% decrease in LDL cholesterol, and no significant change in total cholesterol levels.

The present study also has some important limitations. The intervention period is very short and incomplete dietary data of the participants is another limitation of the study. Lipid profiles were measured only before exercise training and after exercise training. Categorization and identification of obese female college students were based on their BMI value. BMI was estimated by calculator by manually using weight in kg and height in m^2.

The findings of this study revealed that aerobic training in obese female college students had a positive influence on their lipid profile. It also showed that aerobic training has a positive effect on HDL C, LDL C, TG C, and TC. According to our results, it is necessary to involve any structured

aerobic exercise training for maintaining total lipid profiles at a desired level.

Conclusion

The results of this study provide persuasive evidence that a 12-week aerobic intervention training program can result in appreciable improvements in the lipid profiles of obese female college students. These benefits consist of decreasing the levels of triglycerides, LDL cholesterol, and total cholesterol, as well as increasing the levels of HDL cholesterol. These modifications to the lipid profile characteristics point to a decreased risk of cardiovascular disease in obese female students. These findings highlight the significance of regular aerobic exercise in the management of obesity and the potential advantages for lipid profile improvement in this population. The long-term consequences of such training interventions could be studied in more detail in the future, as well as other variables that affect cardiovascular health. Nevertheless, this study offers important new information about how exercise might help obese people with their lipid profiles, which ultimately improves their general health and lowers their risk of cardiovascular disease.

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