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Original Article

Comparison of Dietary Modifications with and without Aerobic Exercises in Improving the Cholesterol Lipid Profile for Treatment of Hyperlipidemia-Naïve Patients

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ABSTRACT

Hyperlipidemia describes a condition in which an abnormal mass metabolism brought on by a variety of factors raises blood cholesterol levels. According to epidemiological research, there is a strong link between the lipoprotein profile and cardiovascular morbidity and mortality, and those who are physically active have a 30 to 50% lower chance of developing cardiovascular disease. **Objective:** To compare the effect of dietary modifications with and without aerobic exercises in improving the cholesterol lipid profile for treatment of Hyperlipidemia-Naïve patients. **Methods:** The random sampling technique with random allocation done through the Lottery method. Lipid Profile Test was used as measuring tool. Whole procedure went through three steps: Pre-Labs Testing, 10 - Weeks Intervention Sessions, and Post-Labs Testing. 24 patients were randomly divided into two groups i.e., Experimental Group and the Control Group, each with 12 patients. After the intervention plan, results were analyzed, organized and interpreted. **Results:** Normally distributed variables were HDL-C, Cholesterol and VLDL-C with $p > 0.05$. Whereas, Triglycerides and LDL-C were not distributed normally i.e., $p < 0.05$. After the exercise program accomplished as instructed, a statistically significant decrease was observed in the values of Cholesterol, HDL-C, and VLDL-C with the value of $p < 0.05$ for experimental group. However, values of Triglycerides and LDL-C were significantly decreased for the control group. **Conclusions:** The inclusion of aerobic exercises along with dietary changes substantially enhanced the patient's lipid profile, and exercise program's scope was adequate to produce meaningful changes in the body lipid composition of the study volunteers.

INTRODUCTION

Hyperlipidemia describes a condition in which an abnormal mass metabolism brought on by a variety of factors raises blood cholesterol or triglyceride levels [1]. This disorder can occur from food, tobacco use, or genetics, and it can cause serious problems like cardiovascular disease [2, 3]. Hyperlipidemia is one of the cardiovascular risk factors that makes up the metabolic syndrome, and people who have it frequently experience CVS morbidity and death [4]. It is marked by metabolic conditions that alter the amount of circulating lipids [5]. "Low density lipoprotein (LDL) and high-density lipoprotein (HDL) levels are low, and there are high levels of total cholesterol, triglycerides, LDL, and HDL in these anomalies." It has the potential to lead to cerebrovascular disorders like ischemic heart disease and stroke as well as atherosclerotic cardiovascular disease, which affects the arteries in the heart and blood vessels of the body [6-8]. Additionally, hyperlipidemia can harm the blood-brain barrier, which can seriously harm the brain's structures and functioning and impair "hippocampal-dependent learning and memory [1]." Because hyperlipidemia is a serious health problem in today's society, aerobic exercise has become one of the most popular ways to help patients with newly discovered cholesterol problems increase their levels of "serum high density lipoprotein cholesterol (HDL-C)" [9]. Measurements of the fat max intensity of body

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composition, "glycemic control, lipid profile, and physical ability in young and elder population" will be made with the aid of aerobic exercise training under predetermined conditions [10]. According to studies, hyperlipidemia is one of the key causes that harms the well-being of this population and is more likely to occur in middle-aged and older persons [11]. The term "Lipid Profile" refers to the various levels of lipids in the blood, with "low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, and triglycerides" being the most frequently reported ones [12]. Aerobic exercise has been utilized as one of the standard treatments for raising levels of "serum high density lipoprotein cholesterol (HDL-C)" in patients with newly identified cholesterol difficulties because hyperlipidemia is a significant health problem in today's society [10] . Any physical activity that results in an elevated heart rate and respiratory volume to meet the oxygen demands of the active muscle is referred to as aerobic exercise [13]. According to epidemiological research, there is a strong link between the "lipoprotein profile and cardiovascular morbidity and mortality, and those who are physically active have a 30 to 50% lower chance of developing cardiovascular disease or type 2 diabetes" than people who are sedentary [14]. A balanced diet and a regimen of light physical activity are thought to be essential and helpful for preventing hyperlipidemia and controlling it once it develops. According to reports, regular exercise also lowers the risk of "coronary heart disease" [5]. Additionally, compared to "LDL-C and TG, HDLC levels" have been observed to be more responsive to aerobic activity. But it's important to fully comprehend how different forms of exercise activities, as well as their degree of difficulty, length, and the rate, affect obesity and hyperlipidemia [15]. Vegetable lipids, dietary fiber, and phytonutrients like "phytosterols are specific macro- and micro-components of a diet high in plants. The effects of these ingredients on lowering blood lipids, specifically low-density lipoprotein cholesterol (LDL-C)," and on lowering the risk of cardiovascular disease were described in this review [3]. Clinical intervention trials in recent years have shown that appropriate lifestyle changes in most patients with hyperlipidemia can have a similar therapeutic effect to that of lipid-lowering drugs, and can effectively reduce the occurrence of cardiovascular events while effectively controlling blood lipids [11].

To compare the effects of Dietary Modifications with and without Aerobic Exercises in Improving the Cholesterol Lipid Profile for Treatment of Hyperlipidemia-Naïve Patients.

METHODS

The study design used for this study was randomized clinical trial. The data were collected from the Gyms, Minhaj-ul-Quran Laboratory, and offices with In-House Training Area, Avicenna Hospital and Different Training Institutes of Lahore. The study was conducted under the period of six months. Its starts from 1st January 2022 to 31st June 2022.The total sample size of this study was 24 by using EPI tool. Out of which, 12 allotted in the Group-A which is Experimental Group. Similarly, the remaining 12 allotted to Group-B, which is Control Group. The sample size was calculated by comparing the two means for the values of oil class from the literature by using EPI Tool [16]. The sampling technique used for this research study is Simple Random Sampling Technique. Moreover, the Random Allocating was done through the Lottery Method. Participants had to be able to briskly walk without help, be inclusive of both genders, not have any vision or hearing issues, and agree to be accessible for follow-ups in order to meet the study's inclusion requirements [11]. The study's exclusion criteria encompassed individuals meeting certain conditions, including those currently using lipid-lowering drugs, individuals with a history of diabetes, cardiovascular patients, pregnant females, individuals with musculoskeletal disorders affecting large muscle groups, and those experiencing hypertension or balance problems [5, 11, 17] The entire procedure consisted of three fundamental steps: Pre-Labs Testing, a 10-Week Intervention Session, and Post-Labs Testing. A total of 26 patients were randomly assigned to either the Experimental Group or the Control Group, each comprising 13 patients. The Experimental Group adhered to dietary restrictions coupled with aerobic exercise, while the Control Group followed dietary restrictions alone. For the Experimental Group, the 10-Week Aerobic Exercise Plan included specific activities during each phase. In Weeks 1-3, participants engaged in aerobic exercise four days a week, involving warm-up, on-spot jogging, basic stretches, and a 15-20 minutes walk to achieve a sub-maximal heart rate (40-60% of Max. HR). Weeks 4-6 maintained the same frequency with an increased duration of on-spot jogging and additional 5-10 minutes of jogging. In Weeks 7-10, the aerobic exercise regimen intensified, including 10-15 minutes of on-spot jogging, extended walk and jogging durations, and the incorporation of brisk walking for 5-10 minutes. Both groups followed the same dietary modification plan.

Diet Plan

The Dietary Restriction Plan/Chart was followed by both the groups during the procedure. This plan was provided by Dr. Sameera Mustafa who is working as an Assistant Professor at University of South Asia, Lahore Cantt and a registered clinical dietician. Below provided chart was followed by the control group.

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Table 1: Table 1: Diet plan

Days	Breakfast	Mid-morning	Lunch	Evening Snack	Dinner
Monday	Omelet \ egg (1) vegetable ½ Chapati (1) 6inches Low fat milk (1 c)	Fruit any one	Salad (1 bowl) Roti (2) Dal (1 bowl thin)	Nuts (almonds 6-7)	Steamed/ Sautéed vegetable Salad (1 bowl) Roti (1) Dal (1 bowl thin)
Tuesday	Porridge (oats) (1/2 + 1/2c low fat milk) 6-7 almonds/ fruit	Bean salad 1 bowl	Salad (1 bowl) Roti (2) Chicken Curry (1 bowl Thin 1oz chicken piece)	Shami Kabab	Chicken soup (1 bowl) Salad (1 bowl) Roti (1) Chicken Curry (1 bowl thin 1oz chicken piece)
Wednesday	Shami Kabab 2 Brown Bread Slices 2	Corn on cob	Multigrain roti (1) Palak (1 bowl) + Egg/Paneer (1 bowl), 500 gm of steam chicken	Chana Chaat (1 bowl)	Vegetables (2), Red beans (1 bowl) with 1 chapati. 500 gm of steam chicken
Thursday	Omelet \egg (1) vegetable ½ Chapati (1) 6 inches. Low fat milk (1 c)	Pop-corn	Salad bowl (white beans, nuts, cucumber + Vegetables + Beans) (1 big bowl)	Fruits	Rice (1 small bowl) + Dal (1 bowl) + Raita (1 bowl)
Friday	Porridge (oats) (1/2 + 1/2c low fat milk) 6-7 almonds /fruit	2 plain cookies	Rice (1 bowl) * Mix vegetable stir fn,1 (1 bowl) + Beans/Egg/ Chicken (1 bowl)	Pop-corn	Salad (1 bowl) + Soup (1 bowl) * Grilled chicken /fish/paneer (1 bowl)
Saturday	Scrambled egg whites (2) with Chapati (1) Low fat paneer roll (1)		Phulka (2) + Musli ½ cup Cabbage (1 bowl) + Paneer/Dal + Curd (1 bowl)	Plain Rusk/ Cookies	500 gm of steam chicken

The research data were gathered through a questionnaire distributed across various gyms, call centers with in-house training areas, and training institutes in Lahore, targeting young adults as the population of interest. Every participant provided informed consent, and those meeting the inclusion criteria underwent a simple questionnaire covering demographic details (name, age, height, BMI, gender, etc.). Pre-lab testing was conducted to allocate participants to their respective groups, and there was no blinding of the participants. Randomization occurred using the Lottery Method. Adherence to diet modifications was monitored through documentation charts provided to all participants, enabling them to record their dietary choices. Heart rate measurements were taken using a pulse oximeter. After the complete intervention period, post-lab testing for the lipid profile of the patients was carried out.

Lipid Profile Test

Following steps were taken to complete this test:

Get informed Consent from the patient.

Have the Blood-Samples taken for Lipid Profile Test.

Availability of required services.

Variables	Normal Range
Triglycerides	80-150 mg/dl
Cholesterol	Up to 200 mg/dl
HDL-C	35-55 mg/dl
LDL-C	100-140 mg/dl
VLDL-C	10-30 mg/dl

Data were analyzed using Statistical package for social sciences a windows software SPSS, version 25.0.

RESULTS

In this study, 50 participants were tested. Participants that fulfilled inclusion criteria were 32. Out of which, 6 participants excluded themselves from the study. Out of the remaining participants, two did not show up for pre-lab testing and 2 of the participants withdrew in between the study. Data was entered in the software SPSS version 25 was used for analysis. Frequency table, graphs and charts measured descriptive categorical data. Table 2 shows that the mean and standard deviation of 24 participants is 27.13±2.70 years. The mean and standard deviation of weight of total number (24) of participants is 74.46±8.96 kg. Moreover, same for the height of total number of participants is 5.64±0.31 feet.

Table 2: Distribution of Age, Weight, & Height

Variables	Mean±S.D
Age	27.13±2.692
Weight	74.46±8.964
Height	5.6467±0.31332

Out of 24 participants, frequency of males was 20 with 83.3% and frequency of females were 4 with 16.7%. Descriptive statics showed frequency of smokers was 13(54.2%), frequency of married participants was 9(37.3%), frequency of normally weighted participants was 14(58.3%), frequency of participants getting sleep less than 8 hours was 12(50%) and frequency of participants belonging to middle class socioeconomic status were 23(95.8%) as shown in table 3. Table shows that there were 20 (83.3%) male participants and 4 (16.7) female participants and 11 participants were non-smokers and 13 participants were smokers. Moreover, out of a total of 24 participants 1(4.2%) was under weight (<18), 14(58.3%) were normal (18.5-22.9), 5 (20.3%) were overweight (23-24.9), 3 (12.5%) were obese 1 (25-29.9) and 1 (4.2%) was obese 2(>30). It was noted that 9 participants were married and 15

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participants were unmarried and out of these participants, 23 belonged to middle class background and 1 of lower class. On the other hand, 12 participant's sleep duration was less than 8 hours and 12 participant's sleep duration was more than 8 hours. Out of all the participants, 12 participant's sleep duration was less than 8 hours and 12 participant's sleep duration was more than 8 hours with having an education level i.e., 4 participants were of matriculation, 3 participants were of intermediate, 6 participants were of under-graduate programs and 11 participants were of graduate programs Table 3.

Table 3: Distribution of Gender, Marital Status, BMI, Smoking Status, Education, Socioeconomic Status, and Sleep Duration

Variable	Category	Exercise + Dietary Modification (Group A)	Dietary Modification (Group B)	Total
Gender	Male	11	9	20
	Female	0	4	4
Marital Status	Married	2	7	9
	Unmarried	9	6	15
BMI	Underweight	1	0	1
	Normal Weight	7	7	14
	Overweight	2	3	5
	Obese 1	1	2	3
	Obese 2	0	1	1
Smoker	Yes	8	5	13
	No	3	8	11
Education	Matriculation	1	3	4
	Intermediate	1	2	3
	Undergraduate	4	2	6
	Graduate	5	6	11
Socioeconomic Status	Upper Class	0	0	0
	Middle Class	10	13	23
	Lower Class	1	0	1
Sleep Duration	< 8 hours	5	7	12
	> 8 hours	6	6	12

Between group comparison for normally distributed variables

Normally distributed variables were HDL-C, Cholesterol and VLDL-C with p > 0.05. Whereas, Triglycerides and LDL-C were not distributed normally i.e., p < 0.05. "After the exercise program accomplished as instructed, a statistically significant decrease" was observed in the values of Cholesterol, HDL-C, and VLDL-C with the value of p <0.05 for experimental group. However, values of Triglycerides and LDL-C were significantly decreased for the control group. "After the exercise program accomplished as instructed, a statistically significant decrease was detected in the values of Cholesterol with the value of p <0.000 for experimental group and that for control group was p <0.001, and HDL-C (p <0.033) for experimental group and (p <0.786) values of the control group showing no significant change in it," while no significant change was observed for VLDL-C values (p> 0.05) for the control group and for experimental group (p <0.01). The table Independent T test summarized the comparison of variables which are Cholesterol, HDH-C, and VLDL-C across both groups as shown in table 4.

Table 4: Between group comparison for normally distributed variables

Variables	Groups	Mean±SD	p-Value
Cholesterol Post-Test Lab Values	Experimental Group	187.91±15.706	0.239
	Control Group	174.77±34.965	
HDL(Cholesterol) Post-Test Lab Values	Experimental Group	35.27±5.274	0.278
	Control Group	41.08±5.235	
VLDL Post-Test Lab Values	Experimental Group	31.18±4.045	0.261
	Control Group	28.38±7.534	

Within group comparison for normally distributed variable

This table summarized the comparison of variables which are Cholesterol, HDH-C, and VLDL-C across both groups. Independent Sample T-test was applied as a parametric test which showed significant distribution for the above three variables.

"Normality of data was tested by Shapiro-Wilk test, it showed that data was normally distributed (p >0.05)." Independent Sample T-test was applied as a parametric test which showed significant distribution for the above three variables. Comparison of the normally distributed variables at pre-treatment and post- treatment level in between groups was done by using paired t test. Parametric Independent sample t test was applied to compare between group analysis on outcome variable. The comparison of variables which are Triglycerides and LDL-C across both groups was done through the non-parametric test as these values were not distributed significantly as shown in table 5. Paired t test was applied to compare between group analysis on outcome variable. Comparison of the normally distributed variables at pre-treatment and post- treatment level in between groups was done by using paired t test.

Table 5: Within group comparison for normally distributed variable

Groups	Variables	Mean±SD	p-Value
Experimental Group	Cholesterol (Pre / Post - Test Lab Values)	16.545±10.634	0.000
Control Group		25.231±21.378	0.001
Experimental Group	HDL-C (Pre / Post - Test Lab Values)	-2±2.683	0.033
Control Group		0.154±1.994	0.786
Experimental Group	VLDL-C (Pre / Post - Test Lab Values)	1.091±1.136	0.010
Control Group		-0.385±7.03	0.847

Between group comparisons for variables which are not normally distribute

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Table 6 summarized the between group comparison of variables which are Triglycerides and LDL-C across both groups. Mann-Whitney test was applied as these values were not distributed significantly.

Table 6: Mann-Whitney Test

Variable	Groups	Median (IQ)	p value
Triglycerides Post-Test Lab Values	**Experimental Group**	166.5 (26)	0.542
	Control Group		
LDL-C Post-Test Lab Values	**Experimental Group**	160.5 (16.25)	0.622
	Control Group		

Within group comparison for variables which are not normally distributed:

Wilcoxon Test was applied to compare the within group, post treatment plan lab values across the groups for the above-mentioned two variables Table 7.

Table 7: Wilcoxon Test

Groups	Variable	p value
Experimental group	Triglycerides (Post / Pre -Test Lab Values)	0.003
Control group		0.001
Experimental group	LDL(Cholesterol) (Post / Pre -Test Lab Values)	0.004
Control group		0.000

DISCUSSION

As per the results calculated in the study accomplished, significant results were calculated for the experimental group for the values of HDL-C, VLDL-C and Cholesterol with the value of p <0.05. However, the control group did not show much significant changes. However, in the past study in 2021 calculated that no significant changes were represented for the experimental group following the exercise plan [10]. This study demonstrated significant results were calculated for the experimental group for the values of HDL-C, VLDL-C and Cholesterol with the value of p <0.05. "After the exercise program accomplished as instructed, a statistically significant decrease was detected in the values of Cholesterol" with the value of p <0.000 for experimental group and that for control group was p <0.001, and HDL-C (p <0.033) for experimental group and (p <0.786) values of the control group showing no significant change in it, while no significant change was observed for VLDL-C values (p> 0.05) for the control group and for experimental group (p <0.01). On the other hand, in a study, 2012 results achieved "statistically significant exercise minus control group decrease in non-HDL-C was found for DE (7 ESs, 389 participants, x = −11.1 mg/dL, 95% CI = −21.7 to −0.6, P = 0.04, Q = 2.4, P = 0.88, I2 = 0%), a trend for the D group (7 ESs, 402 participants, x = −8.5 mg/dL, 95% CI = −18.6 to 1.6, P = 0.10, Q = 0.76, P = 0.99, I2 = 0%), and no change for the Exercise group (7 ESs, 387 participants, x = 3.0 mg/dL, 95% CI = −7.1 to 13.1, P = 0.56, Q = 0.78, P = 0.99, I2 = 0%). Overall, there was no statistically significant between-group differences were found (Qb = 4.1, P = 0.12). The present study results showed a significant decrease of Cholesterol to High Density Lipoprotein Ration (Chl/HDL)" [18]. This study has shown that changes were significant for the control group regarding the values for Triglycerides and LDLs, both having the p value of less than 0.05. But significant changes for HDLs, Total Cholesterol and VLDLs were demonstrated in the experimental group following the exercise plan along with the modified dietary plan and representing the value of all having p <0.05. On the other hand, in a past study, it was found that dietary modifications were accepted for accomplishing significant changes for the values of total cholesterol and not for Triglycerides and LDLs having p <0.05 without changes on HDLs and VLDLs [19]. Our study showed that regular exercises had significantly high effects on the levels of total cholesterol, LDL-C and HDL-C with a representation of a significant value of p <0.05. However, in a previous study completed in 2007, it was showed that the aerobic exercises had significant changes on HDL-C levels and aerobic exercise increases HDL-C level when performed regularly. It was noted that a minimum volume of exercise is capable of achieving a significant increase in HDL-C level. However, the most important element to have this change determined was considered to be exercise duration per session of an exercise prescription. Interestingly, it was found in the same study that people with high baseline total "cholesterol levels, low BMIs, or patients who were younger had the best changes in HDL-C levels" [13]. According to the findings of our study, there was a significant difference between the levels of HDL-C before and after the intervention plan, with a value of p 0.05, and the same was true for the levels of total cholesterol and very low-density lipoproteins. However, the changes for the pre and post values for the levels of triglycerides and low-density lipoproteins were not highly significant for the experimental groups. However, a 1998 study found that the therapy group did not experience any appreciable increases in "HDL cholesterol and triglyceride" levels. However, with a value of p 0.05, the serum level of "LDL cholesterol" was dramatically decreased [20].

CONCLUSIONS

The integration of aerobic exercises along with dietary changes substantially enhanced the patient's lipid profile, and it was observed that the physical activity program's scope was adequate to produce meaningful changes in the body lipid composition of the study volunteers.

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Authors Contribution

Conceptualization: QZ
Methodology: QZ, AJ, ZBI
Formal analysis: SN, MIA, UM
Writing, review and editing: FH, AJ, HRMA

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The author declares no conflict of interest.

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