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Original Research Article

Effect of Lifestyle Modification on Plasma Lipids of Adults in a Part of North Central Nigeria

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Abstract

***Background*:** Plasma lipids are precursors of adrenal and gonadal steroid hormones, bile acids as well as important component of animal cell wall. However, abnormal plasma lipids are major risk factor for cardiovascular diseases globally. Researchers are currently considering lifestyle modification such as exercise, as an approach to maintaining normal plasma lipids level as well as addressing abnormal ones. ***Methodology*:** This study investigated the effect of lifestyle modification (vigorous intensity aerobic exercise regimen) on plasma triglycerides and low density lipoprotein-cholesterol of adults in Benue State University, Makurdi. The design of the study was guided by two research questions. Two hypotheses were formulated and tested at 0.05 level of significance. The study adopted two group pretest posttest quasi experimental design. The study population comprises twenty-one (21) Benue State University staff in the experimental group, and another twenty-one (21) for the control group. The proforma used for the data collection was validated by three experts, one from measurement and evaluation, one from the Department of Human Kinetics and Health Education and one from College of Health Sciences; all in Benue State University, Makurdi. Data generated were analyzed using Statistical Package for Social Sciences (SPSS Version 25). A descriptive statistics, mean and standard deviation were used to answer the research questions, and inferential statistics, Analysis of Covariance (ANCOVA) and Paired Samples Test were used to test the hypotheses at 0.05 level of significance. ***Results*:** The findings revealed that out of the 21 participants in the two groups, 12(57.14%) were males, while 9(42.86%) were females. The age range in the control group was between 28 to 65years, while that of the experimental group was between 36-68years. Vigorous intensity aerobic exercise regimen was found to have statistically significant effect on plasma low density lipoprotein-cholesterol ($P = 0.000 < 0.05$). Even though plasma triglyceride was found to be reduced by vigorous intensity aerobic exercise regimen, the level of the reduction was found not to be statistically significant ($P = 0.293 > 0.05$). ***Conclusion*:** The study concluded that healthcare workers should henceforth incorporate vigorous intensity aerobic exercise regimen prescription in public health awareness on the maintenance of plasma level of triglycerides and low density lipoprotein-cholesterol, as well as clinical management of patients with abnormal plasma low density lipoprotein-cholesterol.

Keywords: Effect, Lifestyle Modification, Plasma Lipids, Adults, Benue State University.

INTRODUCTION

Worldwide, lifestyle modification is taking a centre stage in both preventive and therapeutic medicine. According to Piyush *et al.*, (2022), lifestyle modification can be referred to the process of gradual adaptation of corrective lifestyle habits such as diet, physical activity and sleep for prevention and management of various diseases such as obesity, diabetes and hypertension.

Globally, attaining and maintaining a healthy life is a product of several factors. One of such factors is lifestyle modification. Adequate nutrition, avoidance of substance abuse, environmental management, appropriate sleep, stress management, as well as regular physical exercise are important components of lifestyle modification (Enkhmaa, *et al.*, 2018). Enkhmaa, *et al.*, (2018), stated that regular exercise is a key performance input in disease prevention and health promotion across the world; especially in people with chronic medical

diseases. For the purpose of this study, physical exercise is the lifestyle modification that is being considered.

According to World Health Organization (WHO, 2020), exercise is defined as any voluntary bodily movement produced by skeletal muscles that require energy expenditure. The World Health Organization further describes it as any bodily activity that enhances or maintains physical fitness and overall health and wellness. According to Brigitta, *et al*., (2018), exercise is a subcategory of physical activity that is planned, structured, and repetitive; and has as a final or an intermediate objective as the improvement or maintenance of physical fitness and general well-being. World Health Organization has categorized exercise into three different intensity levels. These levels include light, moderate, and vigorous; and are measured by the metabolic equivalent of task (metabolic equivalent or METs).

The effects of exercise are different at each intensity level. These are light intensity exercise, moderate intensity exercise and vigorous intensity exercise. Light intensity exercise requires the least amount of effort, compared to moderate and vigorous exercise. Some examples of light intensity exercise include: walking slowly (i.e. shopping, walking around the office), sitting at your computer, making the bed, eating, preparing food, and washing dishes. In light intensity physical activity, the energy expenditure is 3 metabolic equivalents (METS) or less. Moderate intensity exercise is defined as activity ranging between 3 < 6 METS (WHO, 2020). These activities require more oxygen consumption than light intensity exercise. Some examples of moderate intensity exercise include: sweeping the floor, walking briskly, slow dancing, vacuuming, washing windows, shooting a basketball. Vigorous intensity exercise is defined as activities ≥6 METS (WHO, 2020). Vigorous activities require the highest amount of oxygen consumption to complete the activity. Examples of vigorous intensity exercise include, running (5 mph >), swimming, shoveling, soccer, jumping rope, carrying heavy loads (i.e. bricks). From World Health Organization point of view, moderate and vigorous intensity exercise are aerobic exercise. Yating and Danyan, (2017), defined aerobic exercise as any form of physical activity that produces an increased heart rate and respiratory volume to meet the oxygen requirements of the activated muscle. Aerobic exercise can be undertaken in many different ways: walking, cycling, sports and active forms of recreation. It can also be undertaken at work and around the home. This research work will focus on vigorous intensity aerobic exercise because scientific studies have not reached consensus on its beneficial effect on plasma lipids levels. However, evidence from scientific body of knowledge has shown that the beneficial effect of exercise correlates closely with the level of aerobic exercise undertaken (WHO, 2020). For example, there may be no significant change in the plasma lipids level if moderate intensity aerobic exercise is performed. Similarly, WHO, (2020) opined that vigorous intensity aerobic exercise done regularly may produce significant beneficial changes in plasma lipids.

The 2018 Physical Activity Guidelines for Americans, issued by the Department of Health and Human Services (HHS) in an effort to provide evidence-based guidelines for appropriate physical activity levels, are of paramount importance. These guidelines provide recommendations to Americans aged three and older about how to improve health and reduce chronic disease risk through physical activity. This highly publicized guideline emphasizes that adults should move more and sits less throughout the day. The guideline explained that it is better to be involved in some level of physical activity than not to participate in none at all. Some adults who sit less and do any amount of moderate-to-vigorous aerobic physical activity have been noted to gain some health benefits. For example, weight loss, reduction in total cholesterol and triglyceride, prevention of cardiovascular diseases and stroke. The guideline clarified that, for substantial health benefits, adults should do at least 150 minutes (2 hours and 30 minutes) to 300 minutes (5 hours) per week of moderate-intensity aerobic activity, or 75 minutes (1 hour and 15 minutes) to 150 minutes (2 hours and 30 minutes) per week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity. This reputable American guideline advised that, preferably, aerobic activity should be spread throughout the week. It further stated that, engaging in physical activity beyond the equivalent of 300 minutes (5 hours) of moderate-intensity physical activity per week can result in additional health benefits.

In addition, the American guideline further explained that increased exercise lowers the risk of heart disease, stroke, high blood pressure, Type 2 diabetes, colon, breast, and lung cancer, falls and fractures, depression, and early death. The guideline opined that increased physical activity do not only reduce disease risk, but it also improves overall health by increasing cardiovascular and musculoskeletal fitness, increasing bone density and strength, improving cognitive function, and assisting in weight loss and weight maintenance. Furthermore, in addition to the multiple health benefits of aerobic exercise, societies that are more active can generate additional returns on investment including a reduced use of fossil fuels, cleaner air and less congested, safer roads (Global Action Plan on Physical Activity, 2018). These outcomes are interconnected with achieving the shared goals, political priorities and ambition of the Sustainable Development Goals (GAPPA, 2018-2030). Despite these overwhelming benefits of physical activities, Agenda 2030 (GAPPA, 2018-2030) has observed that the global progress to increase physical activity has been slow, largely due to lack of awareness and investment.

Worldwide, 1 in 4 adults, and 3 in 4 adolescents (aged 11–17 years), do not currently meet the global recommendations for physical activity set by World Health Organization. As countries develop economically, levels of inactivity increase. According to Global Action Plan on Physical Activity, the level of inactivity in some countries can be as high as 70%. This is principally due to changing patterns of transportation, increased use of technology and urbanization. The end result of this is increase in mortality and morbidity occasioned by non-communicable diseases like stroke, peripheral vascular disease and coronary heart diseases (GAPPA, 2018). These medical disorders are linked to abnormal plasma lipids.

Plasma lipids are any of a class of organic compounds that are fatty acids or their derivatives that are insoluble in water. The plasma lipids include fats, waxes, oils, hormones, and certain components of membranes. They function as energy-storage molecules and chemical messengers (Ahmed, *et al*., 2023). Ahmed, *et al.*, (2023) explained further that, together with proteins and carbohydrates, lipids are one of the principal structural components of living cells. Normal plasma lipids levels are important constituents of the lipid fraction of the human body. Some plasma lipids are unsaturated alcohol of the steroid family of compounds; they are essential for the normal function of all animal cells and is a fundamental element of their cell membranes. Lipids are also precursors of various critical substances such as adrenal and gonadal steroid hormones and bile acids (Ahmed, *et al*., 2023).

Low-density lipoprotein-cholesterol (LDL-C) is one of the five major groups of lipoproteins which transport all cholesterol molecules around the body in the extracellular water (CDC, 2017). Low density lipoprotein-cholesterol is involved in atherosclerosis, a process in which it is oxidized within the walls of arteries. According to Kenneth, (2021), low density lipoprotein particles are formed when triglycerides are removed from very low density lipoprotein-cholesterol (VLDL) by the lipoprotein lipase enzyme (LPL) and they become smaller and denser (i.e. fewer lipids molecules with same protein transport shell), containing a higher proportion of cholesterol esters. Research findings have shown that less than 5.5mmol/L of low-density lipoprotein is considered optimal. 5.5 to 7.1mmol/L are considered near or just above optimal. 7.2 to 8.8mmol/L is borderline high, while 8.9 to 10.5mmol/L is high (Cleveland Clinic, 2022). In Benue State University Teaching Hospital, Makurdi, North Central Nigeria, a reference value of <3.4mmol/L for low density lipoprotein-cholesterol is considered optimal for health. The laboratory investigations for low density lipoprotein-cholesterol commonly show the quantity of cholesterol that is estimated to be contained with low density lipoprotein-cholesterol particles (Kenneth, 2021). The researcher explained that, in clinical context, the calculated low-density lipoprotein-cholesterol are commonly used as an estimate of how much low-density lipoproteins is driving progression of atherosclerosis. As such, low density lipoprotein-cholesterol is described as "bad" cholesterol in several medical research. The fasting high-level low-density lipoprotein-cholesterol is strongly associated with an increased risk of coronary artery disease (CAD), so it is necessary to make clear the effect of aerobic exercise on low density lipoprotein-cholesterol (Wang & Xu, 2017). Unlike high density lipoprotein-cholesterol, the effect of exercise on low density lipoprotein is inconsistent in human and there are even completely contrary result (Wang & Xu, 2017). The results of these different studies may be due to variations in people's weight. Some studies showed that aerobic exercise alone did not change the fasting blood low density lipoprotein-cholesterol levels, unless the weight during this period also changed. (Yating & Danyan, 2017).

A triglyceride (TG) is an ester derived from glycerol and three fatty acids, and are the main constituents of body lipids in humans and other vertebrates, as well as vegetable fat (Nelson, & Cox, 2000).They are also present in the blood to enable the bidirectional transference of adipose fat and blood glucose from the liver, and are a major component of human skin oils (Nelson, & Cox, 2000). Many types of triglycerides exist. One specific classification focuses on saturated and unsaturated types. Saturated lipids lack C=C groups. Unsaturated lipids feature one or more C=C groups. Unsaturated lipids tend to have a lower melting point than saturated analogues; as a result, they are often liquid at room temperature (Nelson, & Cox, 2000). A tryglyceride level of less than 8.3 mmol/L is considered to be normal. A triglyceride level of 8.4-11.1 mmol/L is considered to be borderline, a triglyceride level of 11.2—27.7mmol/L is considered to be high, while a triglyceride level of 27.8mmol/L or above is considered to be very high (Mayo Clinic Press, 2022). In our environment for example, elevated plasma triglycerides level are not common findings. Perhaps, that may be one of the reasons why Benue State University Teaching Hospital, Makurdi, North Central Nigeria, has a reference value for plasma triglycerides as > 1.7mmol/L. In the human body, high levels of triglycerides in the bloodstream have been linked to atherosclerosis, heart disease and stroke (Beatriz & Frank, 2011). The risk can be partly accounted for by a strong inverse relationship between triglyceride level and high-density lipoprotein cholesterol (HDL-C) level (Packard *et al*., 2020). But the risk is also due to high triglyceride levels increasing the quantity of small, dense low density lipoprotein-cholesterol (LDL-C) particles (Beatriz & Frank, 2011). According to Beatriz, *et al*., (2011), several lifestyle modification strategies have been reported to reduce high triglycerides level in human plasma. These include; weight loss, dietary modification and moderate exercise. Many studies have shown that sedentary individuals have no change in TG levels after a single exercise session (Yating & Danyan,

2017). Yating, *et al*., (2017), have observed that the plasma triglyceride level did not change significantly in non-active subjects even after participating in aerobic exercise. The researchers went further to clarify that, when participants had lower baseline levels of triglyceride, there was only a slight decrease in triglyceride after exercise. They noted that, when triglycerides baseline levels were high, there was a significant reduction during aerobic exercise. Thus, the triglyceride baseline level may be the key factor influencing the effect of exercise on the triglyceride response.

RESEARCH METHOD

The quasi-experimental design was employed in this study. Specifically, the design was the pre-test post-test non-randomized control group design. A quasi-experimental design is a research design that aims to establish a cause-and-effect relationship between an independent and dependent variable. In this study, between vigorous intensity aerobic exercise regimen and plasma low density lipoprotein-cholesterol and triglycerides, the design was used because it permits non-random assignment of subjects to the treatment group as well as the control group. The specific design can be diagrammatically represented as follows:

E 01 x 02
---- --- ----
C 01 02

Where E was the experimental group
C was control group
01, 01 represented the pre-test for the experimental and control groups respectively
02, 02 represented the post-test for the experimental and control groups respectively
X stood for treatment with the exposure to vigorous intensity aerobic exercise
--- --- ---- dotted lines indicated the two groups were not equivalent before treatment in the random sense.

Area of the Study

The study was conducted in Benue State University, Makurdi. Benue State University, Makurdi, is located in a part of North Central Nigeria. The University was established by the Benue State Government with the enactment of the Benue State University Edict No. 1 of 1991. Benue State University (BSU) Makurdi, was the first state owned University in Northern Nigeria. The University took off in the 1992/93 academic year with four Faculties, namely: Arts, Education, Science and Social Sciences. Two Faculties, Law and Management Sciences came on stream in the 1993/94 academic session and Faculty of Environmental Sciences in the 2014/2015 session.

The staff of Benue State University was basically classified into two: Teaching and Non-Teaching Staff. A major medical challenge among the staff of the University and its environs is sudden collapse leading to severe illness or even death. A large body of knowledge has identified abnormal plasma lipids to be a leading risk factor contributing to the sudden collapse. Hence the need to research into the most cost effective approach to managing abnormal plasma low density lipoprotein-cholesterol and triglycerides, and to also maintaining the health of individuals with normal levels.

Population of the Study

The population of the staff of Benue State University is about 1,928. As at January, 2024, the teaching staff was 731 while the non-teaching staff was 798. The data was obtained from the establishment/personnel unit of the university (BSUM Establishment Unit, 2024).

The choice of Benue State University, Makurdi for this study was informed by the fact that it is a confluence institution for Benue State citizens. Secondly, majority of the staff in the institution are well educated, as such, it was easy to pass across the concept of the study to them. Since all the respondents were from the State University, there was no misconception about the blood samples that was taken from them before and after the exercise.

Sample and Sampling

The sample size for this study was 42 participants who volunteered and consented to take part in the study. From the empirical review, all the previous studies indicated that, only the subjects who volunteered to participate in the study were recruited. To the best of the researchers search, the researcher is not aware of any previous studies in this direction that calculated the minimum sample size and used the same for the study. The reason being that it involves the collection of human samples (in this case blood sample of participants were collected twice). As such, it is often very difficult to see participants that will volunteer to be part of the study.

The minimum number of the respondents who volunteered and met the inclusion criteria from the previous similar research was eight. The current study employed non-probability (convenience) sampling method to recruit forty two (42) respondents who volunteered and met the inclusion criteria to participate in the study. The eligibility criteria for the subjects were staff of Benue State University, nonsmoker, non-obese, non-alcoholic, and healthy respondents. All those individuals on hypolipidemic drugs, with history of familial hyperlipidaemia, hypertension, diabetes mellitus and chronic obstructive pulmonary disease were excluded from the study. Based on the baseline total cholesterol and high density lipoprotein-cholesterol the subjects were randomly assigned to experimental and control group. Each group had twenty-five subjects. However, four subjects dropped out of the experimental group, citing their inability to cope with vigorous intensity exercise as the reason for dropping out of the research work. As a result, four subjects with similar characteristics were excluded from the control group.

The biodata and chart proforma/inventory form was subjected to face and content validation by three experts. One of the experts is from Measurement and Evaluation, one from the Department of Human Kinetics and Health Education and one from College of Health Sciences, all from Benue State University, Makurdi. The experts were asked to scrutinize the biodata and chart proforma in terms of clarity of language and relevance of the items to the objective of the study. The observations that were made by the experts were strictly adhered to and were used to modify the final copy of the instrument. However, the validation of the various technologies such as sphygmomanometre, standiometre, weighing scales, glucometer, C-reactive protein machine as well as plasma lipids machines, were already done by the manufacturers.

Reliability of the Instrument

The technologies that were used for the measurement of the various parameters in this study have been standardized by the manufacturers. As a result, the biodata and chart proforma/inventory form did not require any reliability.

Intervention Procedure

The Department of Human Kinetics and Health Education has an established Exercise Class called Benue State University Physical Fitness Club (BSU PFC) The Benue State PFC was established in 2016 with the primary aim of ensuring healthy and fit staff of the University. The Physical Fitness Club is coordinated by a Professor of Sport Psychology and a Ph.D holder in Exercise Physiology, both in the Department of Human Kinetics and Health Education. The exercise training holds thrice in a week (Mondays, Wednesdays and Fridays). It starts by 6:00am and ends by 7:00am. The researcher leveraged on BSU PFC existing structure to carry out the research.

Method of Data Collection

Pre-intervention measurements were taken from the respondents. These include clinical correlates such as weight, and height, body mass index, cardiovascular examination and respiratory examination. Similarly, the plasma low density lipoprotein-cholesterol and triglycerides were measured using ***Chemia 100; Chemistry Autoanalyzer Manufactured by Genrui Biotech. Inc., in 2004***

An exercise physiology expert was engaged for the exercise training sessions. The exercise training was conducted three times a week at Benue State University Stadium. The exercise training held in the mornings from 6:00am to 7:00am on Mondays, Wednesdays and Fridays of each week of the 8 weeks that the study lasted. The days were alternated to allow for rest and recovery.

The exercise instructor demonstrated the exercises to the subjects on each of the exercise day while they watched and later joined. The exercise was carried out in group to make it more interesting and challenging. Each exercise session started with 10 minutes warm up exercises comprising of brisk walking and jogging. The main vigorous aerobic exercise workout involved exercises to the pelvic floor muscles (Pelvic floor muscle contractions), abdominal muscles (Simple abdominal muscle contractions), back muscles (cat and camel, pelvic tilts), and muscles of the legs (ankle pump, quadriceps and hamstrings contraction etc). Breathing exercise was incorporated intermittently throughout the sessions. All these exercises were performed in each session.

In order to ensure that vigorous intensity aerobic exercise was attained, pulse rates of respondents were measured at the climax of the exercise training. The Heart Rate Maximum (HRMax) of 70% and above during exercise connotes vigorous intensity aerobic exercise.

Data generated for this study were analyzed using both descriptive and inferential statistics. The research questions were answered using mean and standard deviation while the hypotheses formulated were tested using Analysis of Covariance (ANCOVA) between groups. The choice of ANCOVA was due to the fact that ANCOVA helps to take care of the initial difference in plasma biomarkers level before the application of treatment. The researcher analyzed the differences between the experimental groups and the control group on the independent variables based on the pre-test and post-test scores.

RESULTS

Table 1: Sociodemographics-Age Distribution of the Experimental Group

Age	Frequency	Percentage
36-40	5	23.8
41-45	6	28.5
46-50	1	4.7
51-55	4	19.0
56-60	2	9.5
61-65	2	9.5
66-70	1	4.7
Total	21	100

Table 2: Sociodemographics Sex Distribution of the Experimental Group

Sex	Frequency	Percentage
Males	12	57.1
Females	9	42.9
Total	21	100

Table 3: Sociodemographics Age Distribution of the Control Group

Age	Frequency	Percentage
25-30	1	4.8
31-35	1	4.8
36-40	2	9.5
41-45	6	28.6
46-50	4	19.0
51-55	2	9.5
56-60	3	14.3
61-65	2	9.5
Total	21	100

Table 4: Sociodemographics Sex Distribution of the Control Group

Sex	Frequency	Percentage
Males	12	57.1
Females	9	42.9
Total	21	100

Table 5: Distribution of Plasma Low Density Lipoprotein-Cholesterol Pre and Post Interventions in the Control Group

Participants	Low Density Lipoprotein Cholesterol (mmol/l)	
	Pre-test	Post-test
A	6.20	4.40
B	4.65	4.68
C	1.80	1.20
D	1.78	1.69
E	3.77	3.87
F	3.00	3.08
G	4.27	4.11
H	2.40	2.80
I	4.61	4.12
J	2.68	2.61
K	1.79	1.68
L	3.70	4.00
M	2.41	2.41
N	5.87	5,81
O	1.79	1.89
P	2.01	2.01
Q	2.06	2.07
R	5.97	5.98
S	4.27	4.10
T	5.98	6.00
U	4.81	4.89

Table 6: Distribution of Plasma Low Density Lipoprotein-Cholesterol Pre and Post Interventions in the Experimental Group

Participants	LowDensity Lipoprotein-Cholesterol (mmol/l)	
	Pre-test	Post-test
A	4.80	1.30
B	3.00	1.30
C	3.99	2.40
D	4.70	2.90
E	3.30	1.90

F	3.90	1.50
G	4.70	2.30
H	3.29	1.89
I	4.20	2.70
J	4.59	2.61
K	4.76	1.26
L	3.68	1.51
M	1.89	1.21
N	1.50	1.50
O	4.68	1.18
P	4.76	1.26
Q	1.49	1.00
R	1.78	1.01
S	4.65	1.15
T	4.68	1.18
U	1.60	0.39

Table 7: Distribution of Plasma Triglycerides Pre and Post Interventions in the Control Group

Participants	Triglycerides (mmol/l)	
	Pre-test	Post-test
A	0.90	1.10
B	1.40	1.31
C	2.30	1.20
D	1.45	1.89
E	0.80	0.78
F	1.00	0.99
G	1.40	1.39
H	1.20	0.80
I	2.79	3.10
J	1.57	1.41
K	2.37	2.31
L	1.00	1.20
M	0.89	0.86
N	1.08	1.11
O	2.29	2.38
P	0.91	0.81
Q	0.99	1.01
R	1.01	1.61
S	3.47	3.38
T	0.98	1.08
U	1.57	1.51

Table 8: Distribution of Plasma Triglycerides Pre and Post Interventions in the Experimental Group

Participants	Triglycerides (mmol/l)	
	Pre-test	Post-test
A	1.10	1.10
B	1.52	1.50
C	0.59	0.51
D	1.40	1.30
E	0.80	1.00
F	1.30	1.00
G	1.60	0.50
H	0.79	0.99
I	0.60	1.50
J	1.35	1.15
K	1.20	1.20
L	1.01	1.01
M	1,01	1.01
N	1.29	1.90

O	1.39	1.39
P	1.08	1.01
Q	1.26	1.16
R	1.15	1.01
S	1.41	1.31
T	1.59	1.02
U	0.28	1.32

Research Question 1

What is the effect of vigorous intensity aerobic exercise regimen on low density lipoprotein-cholesterol of adults in Benue State University, Makurdi?

Table 1: Mean and standard deviation of the respondents on the effect of vigorous intensity aerobic exercise regimen on the low density lipoprotein-cholesterol of adults

S/N	Group	Number	Mean		SD		Mean Diff
			Pre-test	Post-test	Pre-test	Post-test	
1	Control	21	3.58	3.50	1.57	1.50	0.08
2	Experimental	21	3.58	1.59	1.25	0.65	1.99

The result of data presented on Table 1 shows the mean and standard deviation of the respondents on the effect of vigorous intensity aerobic exercise on the low density lipoprotein of adults in Benue State University, Makurdi. The control group had mean pre-test score of 3.58 and a mean post-test score of 3.50 with mean difference of 0.08. The experimental group had a mean pre-test score of 3.58 and a mean post-test score of 1.59 with mean difference of 1.99. This implies that the experimental group had a better mean difference. In other words, the low-density lipoprotein-cholesterol of subjects in the experimental group reduced drastically after the vigorous intensity aerobic exercise.

Research Question 2

What is the effect of vigorous intensity aerobic exercise regimen on triglycerides of adults in Benue State University, Makurdi?

Table 2: Mean and standard deviation of the respondents on the effect of vigorous intensity aerobic exercise on the triglyceride of adults

S/N	Group	Number	Mean		SD		Mean Diff
			Pre-test	Post-test	Pre-test	Post-test	
1	Control	21	1.49	1.48	0.73	0.73	0.01
2	Experimental	21	1.14	1.10	0.36	0.26	0.04

The result of data presented on Table 2 shows the mean and standard deviation of the respondents on the effect of vigorous intensity aerobic exercise on the triglycerides of adults in Benue State University, Makurdi. The control group had mean pre-test score of 1.49 and a mean post-test score of 1.48 with mean difference of 0.01. The experimental group had had mean pre-test score of 1.14 and a mean post-test score of 1.10 with mean difference of 0.04. This implies that the experimental group had a better mean difference. In other words, the triglycerides of subjects in the experimental group reduced more than those in the control group.

Research Hypothesis 1

Vigorous intensity aerobic exercise regimen has no significant effect on the low-density lipoprotein-cholesterol of adults in Benue State University, Makurdi?

Table 3: Dependent Variable: PostLDL

Tests of Between Subjects Effects						
Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	72.021[a]	2	36.011	72.854	.000	.789
Intercept	.252	1	.252	.509	.480	.013
PreLDL	34.021	1	34.021	68.829	.000	.638
GROUP	**37.876**	**1**	**37.876**	**76.629**	**.000**	**.663**
Error	19.277	39	.494			
Total	363.130	42				
Corrected Total	91.298	41				
a. R Squared = .789 (Adjusted R Squared = .778)						

The result of the Analysis of Covariance presented in Table 3 shows that the P-value of 0.000 is less than 0.05 level of significant at 1 degree of freedom. This shows that the test is significant. The result implies that Vigorous intensity aerobic exercise has significant effect on the low-density lipoprotein of adults in Benue State University, Makurdi. Therefore, the null hypothesis of no significant effect is hereby rejected. In other words, vigorous intensity aerobic exercise can be employed to reduce the level of abnormal low-density lipoprotein-cholesterol.

A partial eta squared of 0.663 means 66.30% of the variance in the dependent variable is explained by the independent variable, indicating a small effect size

Table 4: Dependable Variable: Low density lipoprotein

Paired Samples Test (test within group)										
Group			Paired Differences					T	Df	Sig. (2-tailed)
			$\bar{\chi}$	Std. Dev.	Std. Error Mean	95% Confidence Interval of the Difference				
						Lower	Upper			
Experimental Group	Pair 1	Pre_LDL_C - Post_LDL_C	2.00810	1.11237	.24274	1.50175	2.51444	8.273	20	.000
Control Group	Pair 1	Pre_LDL_C - Post_LDL_C	.12667	.49254	.10748	-.09753	.35087	1.179	20	.252

For the experimental group, the result of the Paired Samples Test presented in Table 4 shows that the P-value of 0.000 is less than 0.05 level of significant at 20 degree of freedom. This shows that the test is significant. The result implies that Vigorous intensity aerobic exercise has significant effect on low density lipoprotein of adults in Benue State University, Makurdi.

For the control group, the result of the Paired Samples Test presented in Table 15 shows that the P-value of 0.252 is more than 0.05 level of significant at 20 degrees of freedom. This shows that the test is not significant.

Research Hypothesis 2

Vigorous intensity aerobic exercise regimen has no significant effect on the triglyceride of adults in Benue State University, Makurdi

Table 5: Dependent Variable posttriglycerides

Tests of Between-Subjects Effects Dependent Variable: POSTtriglyceride						
Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	8.468[a]	2	4.234	33.273	.000	.630
Intercept	.736	1	.736	5.783	.021	.129
PREtriglyceride	6.952	1	6.952	54.631	.000	.583
GROUP	**.144**	**1**	**.144**	**1.135**	**.293**	**.028**
Error	4.963	39	.127			
Total	83.272	42				
Corrected Total	13.431	41				
a. R Squared = .630 (Adjusted R Squared = .612)						

The result of the Analysis of Covariance presented in Table 5 shows that the P-value of 0.293 is more than 0.05 level of significant at 1 degree of freedom. This shows that the test is not statistically significant. The result implies that, even though vigorous intensity aerobic exercise reduced the plasma level of triglycerides, the level of the reduction is not statistically significant among adults in Benue State University, Makurdi. Therefore, the null hypothesis of no significant effect is hereby accepted.

A partial eta squared of 0.28 means 2.80% of the variance in the dependent variable is explained by the independent variable, indicating a small effect size.

Table 6: Paired Samples Test (test within statistics)

Group			Paired Differences					T	df	Sig. (2-tailed)
			$\bar{\chi}$	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
						Lower	Upper			
Experimental Group	Pair 1	Pre_TG - Post_TG	.10857	.37569	.08198	-.06244	.27958	1.324	20	.200
Control Group	Pair 1	Pre_TG - Post_TG	.03905	.30747	.06710	-.10091	.17901	.582	20	.567

For the experimental group, the result of the Paired Samples Test presented in Table 6 shows that the P-value of 0.200 is more than 0.05 level of significant at 20 degrees of freedom. This shows that the test is not significant. The result implies that, even though the plasma level of triglycerides reduced after vigorous intensity aerobic exercise, the level of the reduction was not statistically significant among adults in the experimental group.

For the control group, the result of the Paired Samples Test presented in Table 10 shows that the P-value of 0.569 is more than 0.05 level of significant at 20 degrees of freedom. This shows that the test is not significant.

DISCUSSION OF FINDINGS

Based on the analyzed data the following findings are thus discussed.

The findings of the study on effect of vigorous intensity aerobic exercise on plasma lipids of adults based on research question one and research hypothesis one revealed that there is a reduction in plasma low density lipoprotein-cholesterol level and that this reduction is statistically significant when participants in vigorous intensity aerobic exercise regimen group were compared to those that did not participate in structured exercise programme in favour of those that participated in the exercise. This implies that respondents who participated in vigorous intensity aerobic exercise had a statistically significant reduction in low density lipoprotein level than those who did not participate in vigorous intensity aerobic exercise. This finding is highly favourable for healthy living as low density lipoprotein has been described as "bad cholesterol" based on the fact that it carries other cholesterols from the liver to other vital organs of the body. The finding agrees with Adogu, *et al.*, (2015) who reported significant reduction in low density lipoprotein ($p<0.01$) following exercise. Similarly, Lamia, *et al.*, (2020), supported the current study with their findings that Short -term aerobic exercise for 8 weeks significantly decrease serum level of low density lipoprotein-cholesterol ($p<0.05$). The finding of this study also supports earlier finding by Oluseye, *et al.*, (2012) who concluded that respondents who were in the intense physical activity group had a significantly ($p<0.05$) lower low density lipoprotein.

In health and disease, low density lipoprotein-cholesterol is always a major concern to experts in clinical medicine. While the normal plasma level is always encouraged in healthy living, increase plasma level of low density lipoprotein-cholesterol is a health disaster because of its pivotal role in the formation of atherosclerosis. In this context, the solution to those with increase plasma level of low density lipoprotein-cholesterol is vigorous intensity aerobic exercise regimen. This approach has been found to be cost effective and accessible.

The findings of the study on vigorous intensity aerobic exercise on plasma lipids of adults based on research question two and research hypothesis two revealed that there is a reduction in plasma triglycerides level in favour of the experimental group. This finding agrees with an extensive systematic review by Yating *et al.*, (2017) on Effects of aerobic exercise on lipids and lipoprotein. In the systematic review, the researchers observed that the plasma triglyceride level did not change significantly in non-active subjects with aerobic exercise. The researchers went further to clarify that, when participants had lower baseline levels of triglyceride, there was only a slight decrease in triglyceride after exercise. They noted that, when TG baseline levels were high, there was a significant reduction during aerobic exercise. The researchers then concluded that, the triglyceride baseline level may be the key factor influencing the effect of exercise on the triglyceride response. From this study, majority of the participants were previously not involved in moderate or vigorous intensity aerobic exercise and their pretest data for triglycerides were not high.

The current study concluded that there is no statistically significant difference in triglycerides of the respondents that participated in vigorous intensity aerobic exercise and those that did not participate in vigorous intensity aerobic exercise. This implies that, even though the plasma triglycerides of participants who took part in vigorous intensity aerobic exercise reduced, however, the level of the reduction was not statistically significant. Other studies have disagreed with the finding in this study, For example, Jovita *et al.*, (2021), who conducted a study on Aerobic Training Impacts on Blood

Cholesterol of Women with Gestational Diabetes**.** Independent t-test was used to compare the lipid profile of the Experimental and Control groups showed significant difference between the means of the 2 groups at week 8 (triglyceride t(28) 5.534, P = 0.001).The finding of this study is also not consistent with the finding of Oranwa, *et al*., (2017), who conducted a study on the lipid profile of people engaged in regular exercise among Nigerians living in South-East State of Anambra; in a town called Nnewi, who found a statistically significant decrease ($p<0.05$) in plasma level of tryglycerides.

The reason(s) for these inconsistencies is not clear. However, the researcher will go with the explanation offered by Yating *et al.*, (2017) that the baseline triglycerides level is a major factor when considering the response of triglycerides to exercise training regimen, which in this case accounted for the current finding.

The health implication of this current finding is worth discussing. Triglycerides are not cholesterols. It is one of the plasma lipids that has been found to be very useful in healthy living as well as diseases. Even though the reduction in plasma triglycerides in this study is not statistically significant, it is important to embrace the little gains shown in the study. This is very important in health promotion.

CONCLUSION

The study concluded that vigorous intensity aerobic exercise regimen has significant effect on plasma low density lipoprotein-cholesterol.

Recommendation

It was therefore recommended that clinicians and other healthcare workers should henceforth incorporate vigorous intensity aerobic exercise regimen prescription in public health awareness on the maintenance of plasma level of triglycerides and low density lipoprotein-cholesterol, as well as clinical management of patients with abnormal plasma low density lipoprotein-cholesterol.

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