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RESEARCH ARTICLE

EFFECT OF VIGOROUS INTENSITY AEROBIC EXERCISE REGIMEN ON PLASMA CHOLESTEROLS OF ADULTS IN BENUE STATE UNIVERSITY, MAKURDI-NIGERIA

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Abstract

Background: Abnormal plasma cholesterols are major risk factors for stroke, coronary heart disease and peripheral vascular diseases globally. Efforts are currently ongoing to come up with the best approach for health promotion and disease prevention, as well as clinical management of abnormal plasma cholesterol. Vigorous intensity aerobic exercise regimen is presently being investigated in this direction..

Methodology: This study investigated the effect of vigorous intensity aerobic exercise regimen on plasma total cholesterol and high 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 an 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 total cholesterol ($P = 0.000<0.05$). Even though high density lipoprotein-cholesterol was found to be elevated by vigorous

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intensity aerobic exercise regimen, the level of the elevation was discovered not to be statistically significant (P = 0.110 > 0.05).
Conclusion: The study concluded that public health education experts as well as other healthcare workers should henceforth incorporate vigorous intensity aerobic exercise regimen prescription in public health awareness on health promotion and disease prevention, as well as clinical management of patients with abnormal plasma total cholesterol.

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Introduction:-

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 and >), 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.

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).

As relevant as plasma lipids are to human existence, it has been observed that, abnormal level in the blood can result to many serious medical conditions. For example, Ahmed et al., (2023), observed that abnormal lipids level is linked with a higher risk of cardiovascular diseases. In Nigeria for instance, abnormal plasma lipids are becoming a major concern to health experts. A systematic review and meta-analysis on the prevalence of abnormal lipids in Nigeria showed a discouraging trend. A pooled crude prevalence of hypercholesterolemia in Nigeria has been documented to be 38%. Reports from studies have shown a higher prevalence in women compared to men (Adeloye, et al., 2020). Geographically, the abnormal lipids level has been found to be highest in the South-south and lowest in the South-west and North-eastern parts of Nigeria (Adeloye et al., 2020). In general, Adeloye et al., (2020) further

stated that 21.9 million Nigerians have been reported to have the burden of abnormal lipids. One of the major challenges with abnormal plasma lipids is the formation of atherosclerosis.

Total Cholesterol has been described as the measure of the total amount of cholesterol in the human body (Ahmed et al., 2023). A total cholesterol level of less than 5.17 mmol/L is considered to be normal. A total cholesterol level of 5.17 to 6.18 mmol/L is considered to be borderline high, while a total cholesterol level of 6.21 mmol/L or greater is considered to be high (Lipid profile, 2023). In Benue State University Teaching Hospital, Makurdi, North Central Nigeria, a reference range for total cholesterol is 2.5 to 5.2mmol/L. When the level of total cholesterol is within the normal range in human plasma, it is pivotal to the normal physiological process in the body. However, when it is increased, it could result to several chronic medical disorders. Research findings have linked increase in plasma total cholesterol to poor diet, obesity, smoking, increasing age, diabetes and lack of exercise (Ahmed et al., 2024). According to Edward, et al.,(2015), lowering serum total cholesterol can help reduce the risk of coronary heart disease. Statin therapy has been appropriately emphasized in the current US and European guidelines as the primary treatment for increase in total cholesterol because of strong evidence of reduced safety, efficacy and events (Bishnu, et al., 2020). However, as a result of the current economic reality, many people cannot conveniently afford statins. Similarly, statins tolerance has become a big issue in clinical practice. Furthermore, clinical pharmacologists have warned pregnant women not to take statins because of the serious adverse drug reaction to the mother and baby. These have underscored the need to consider a non-invasive and a better cost-effective approach to plasma total cholesterol reduction. As a result, experts in exercise physiology, clinical medicine as well as public health education, have advocated that aerobic exercise should be explored in this direction (Swift et al., 2018). Furthermore, studies have demonstrated a reduction in total cholesterol among participants that undertake regular aerobic exercise (Zhao et al., 2021). These findings improve health, fitness and the overall quality of life.

High-density lipoprotein-cholesterol (HDL-C) is one of the five major groups of lipoproteins (CDC,2017). Lipoproteins are complex particles composed of multiple proteins which transport all lipids molecules around the body within the water outside cells. They are typically composed of 80–100 proteins per particle. High density lipoprotein-cholesterol particles enlarge while circulating in the blood, aggregating more lipids molecules) and transporting up to hundreds of lipids molecules per particle (Winifried, et al.,2017). Generally, high levels of high density lipoprotein-cholesterol ("good") cholesterol is often an indicator of a lower risk of cardiovascular disease. A level of 1.55 mmol/L or higher is excellent, while levels of less than1.03 mmol/L are considered lower than desirable (Williams, 2013). In our environment, a reference value of >0.9mmol/L has been agreed as been optimal for health. Yating, et al., (2017), explained that, some studies have focused on the relationship between aerobic exercise and high-density lipoprotein cholesterol, and have found that high density lipoprotein-cholesterol levels are more sensitive to aerobic exercise than both low-density lipoprotein-cholesterol and tryglycerides. The researchers clarified further that, some studies focusing on the effects of exercise on high density lipoprotein-cholesterol seemed to consistently indicate that there was an increase in high density lipoprotein-cholesterol more or less in human as well as in rats.

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 total cholesterol and high density lipoprotein-cholesterol. 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 regimen.
--- --- ---- 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 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 was sudden collapse leading to severe illness or even death. A large body of knowledge has identified abnormal plasma cholesterols 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 cholesterols, 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 was 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 apparently 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, as well as plasma lipids machines, was 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 total cholesterol and the plasma high density lipoprotein-cholesterol 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 cholesterols 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 Total Cholesterol Pre and Post Interventions in the Control Group.

Participants	Total Cholesterol (mmol/l)	
	Pre-test	Post-test
A	7.80	7.30
B	7.01	7.11
C	4.50	3.30
D	3.98	4.00
E	6.10	6.00
F	5,62	6.80
G	5.90	5.96
H	5.20	5.40
I	7.79	7.31
J	7.10	7.50
K	3.99	3.98
L	5.90	6.10
M	4.90	5.20
N	7.42	7.60
O	4.92	5.05
P	5.98	6.01
Q	6.44	6.12
R	7,69	7.60
S	5.01	5.03
T	6.99	6.93
U	6.85	6.78

Table 6:- Distribution of Plasma Total Cholesterol Pre and Post Interventions in the Experimental Group.

Participants	Total Cholesterol (mmol/l)	
	Pre-test	Post-test
A	6.90	3.10
B	5.40	4.69
C	5.49	3.80
D	7.20	5.00
E	5.10	4.30
F	5.30	3.60
G	6.60	4.10
H	4.99	4.19
I	5.50	4.80
J	7.01	4.70
K	7.01	3.21
L	5.78	2.81
M	4.30	4.30
N	3.80	3.00
O	7.00	3.20
P	6.71	2.91
Q	3,78	2.82
R	4.37	3.08
S	7.19	3.46
T	6.80	3.12
U	3.21	0.78

Table 7:- Distribution of Plasma High Density Lipoprotein- cholesterol Pre and Post Interventions in the Control Group.

Participants	High density lipoprotein-cholesterol (mmol/l)	
	Pre-test	Post-test
A	1.21	2.65
B	1.78	1.79
C	1.63	1.56
D	1.78	1.69
E	1.42	1.38
F	1.37	1.21
G	1.57	1.08
H	2.26	2.19
I	1.12	1.10
J	1.35	1.43
K	1.09	1.12
L	1.75	1.51
M	2.57	2.67
N	1.08	1.11
O	1.99	0.99
P	1.96	1.97

Q	0.96	0.98
R	0.99	1.01
S	1.15	1.09
T	1.18	1,16
U	1.61	1.60

Table 8:- Distribution of Plasma High Density Lipoprotein- cholesterol Pre and Post Interventions in the Experimental Group.

Participants	**High density lipoprotein-cholesterol (mmol/l)**	
	Pre-test	**Post-test**
A	1,56	1.39
B	1.24	1.74
C	1.01	2.91
D	1.89	1.56
E	1.34	1.73
F	1.26	1.62
G	1.61	1.59
H	1.29	1.89
I	1.00	1.39
J	1.79	1.49
K	1.48	1.25
L	1.75	1.05
M	1.65	1.05
N	1.59	1.59
O	1.78	1.90
P	1.48	1.59
Q	1.59	1.94
R	1.59	1.91
S	1.90	1.95
T	1.60	1.79
U	1.72	3.29

Research Question 1

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

Table 9:- Mean and standard deviation of the respondents on the effect of vigorous intensity aerobic exercise on the total cholesterol of adults.

S/N	**Group**	**Number**	**Mean**		**SD**		**Mean Diff.**
			Pre-test	**Post-test**	**Pre-test**	**Post-test**	
1	Control	21	6.05	6.00	1.22	1.26	0.05
2	Experimental	21	5.70	3.57	1.29	0.96	2.13

The result of data presented on Table 9 shows the mean and standard deviation of the respondents on the effect of vigorous intensity aerobic exercise on the total cholesterol of adults in Benue State University, Makurdi. The control group had mean pre-test score of 6.05 and a mean post-test score of 6.00 with mean difference of 0.05. The experimental group had a mean pre-test score of 5.70 and a mean post-test score of 3.57 with mean difference of 2.13. This implies that the experimental group had a better mean difference. In other words, the total cholesterol of

subjects in the experimental group reduced drastically after the vigorous intensity aerobic exercise regimen when compared to the control group. Therefore, vigorous intensity aerobic exercise regimen drastically reduced the plasma total cholesterol of sdullts.

Research Question 2

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

Table 10:- Mean and standard deviation of the respondents on the effect of vigorous intensity aerobic exercise regimen on the high density lipoprotein-cholesterol of adults.

S/N	Group	Number	Mean		SD		Mean Diff
			Pre-test	Post-test	Pre-test	Post-test	
1	Control	21	1.51	1.49	0.44	0.52	0.02
2	Experimental	21	1.53	1.74	0.26	0.57	0.21

The result of data presented on Table 10 shows the mean and standard deviation of the respondents on the effect of vigorous intensity aerobic exercise on the high density lipoprotein of adults in Benue State University, Makurdi. The control group had mean pre-test score of 1.51 and a mean post-test score of 1.49 with mean difference of 0.02(representing a decrease in high density lipoprotein-cholesterol). The experimental group had a mean pre-test score of 1.53 and a mean post-test score of 1.74 with mean difference of 0.21 (representing an increase in high density lipoprotein-cholesterol). This implies that the experimental group had a better mean difference. In other words, the high-density lipoprotein-cholesterol of subjects in the experimental group increased after the vigorous intensity aerobic exercise. High density lipoprotein-cholesterol is also called 'good cholesterol' as it is generally known to transport plasma lipids to the liver. Therefore, vigorous intensity aerobic exercise regimen increase the plasma level of high density lipoprotein-cholesterol of adults.

Research Hypothesis 1

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

Table 11:- Dependent Variable: POST cholesterol.

Tests of Between Subjects Effect

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	85.307[a]	2	42.654	62.147	.000	.761
Intercept	2.574	1	2.574	3.750	.060	.088
PREcolesterol	23.354	1	23.354	34.027	.000	.466
GROUP	**50.534**	**1**	**50.534**	**73.628**	**.000**	**.654**
Error	26.767	39	.686			
Total	1075.439	42				
Corrected Total	112.074	41				

a. R Squared = .761 (Adjusted R Squared = .749)

The result of the Analysis of Covariance presented in Table 11 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 regimen has significant effect on the total cholesterol 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 total cholesterol. A partial eta squared of 0.654 means 65.4% of the variance in the dependent variable is explained by the independent variable, indicating a medium effect size.

Table 12:- Dependent Variable PostCholesterol.

Paired Samples Test (statistical test within group)

	Paired Differences						
Group	$\bar{\chi}$	Std. Dev.	Std. Error Mean	95% Confidence Interval of the Difference	T	df	Sig. (2-tailed)

						Lower	Upper			
Experimental Group	Pair 1	Pre_TC - Post_TC	2.10524	1.29836	.28332	1.51423	2.69624	7.430	20	.000
Control Group	Pair 1	Pre_TC - Post_TC	.10190	.37798	.08248	-.07015	.27396	1.235	20	.231

For the experimental group, the result of the Paired Samples Test presented in Table 12 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 within the experimental group. The result implies that vigorous intensity aerobic exercise has significant effect on the total cholesterol among participants in the experimental group.

For the control group, the result of the Paired Samples Test presented in Table 12 shows that the P-value of 0.231 is more than 0.05 level of significant at 20 degrees of freedom. This shows that the test is not significant among the control group.

Research Hypothesis 2

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

Table 13:-

Dependent Variable: PostHDL

Tests of Between Subjects Effect

Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	1.972[a]	2	.986	3.975	.027	.169
Intercept	1.558	1	1.558	6.277	.017	.139
PreHDL	1.270	1	1.270	5.120	.029	.116
GROUP	**.662**	**1**	**.662**	**2.670**	**.110**	**.064**
Error	9.677	39	.248			
Total	121.130	42				
Corrected Total	11.649	41				

a. R Squared = .169 (Adjusted R Squared = .127)

The result of the Analysis of Covariance presented in Table 13 shows that the P-value of 0.110 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 the plasma level of high-density lipoprotein-cholesterol increased after Vigorous intensity aerobic exercise, the level of the increase was not statistically significant. As a result, vigorous intensity aerobic effect has no significant effect on high density lipoprotein-cholesterol of adults in Benue State University, Makurdi. Therefore, the null hypothesis of no significant effect is hereby accepted. A partial eta squared of 0.64 means 6.40% of the variance in the dependent variable is explained by the independent variable, indicating a small effect size

Table 14:- Dependable Variable: High density lipoprotein.

Paired Samples Test

			Paired Differences							
Group			$\bar{x}$	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper	T	Df	Sig. (2-tailed)
Experimental Group	Pair 1	Pre_HDL_C - Post_HDL_C	-.10857	.39464	.08612	-.28821	.07107	-1.261	20	.222
Control Group	Pair 1	Pre_HDL_C - Post_HDL_C	-.00714	.38640	.08432	-.18303	.16874	-.085	20	.933

For the experimental group, the result of the Paired Samples Test presented in Table 14 shows that the P-value of 0.222 is less 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 high-density lipoprotein-cholesterol increased after vigorous intensity aerobic exercise, the level of the increase was not statistically significant among adults in Benue State University, Makurdi.

For the control group, the result of the Paired Samples Test presented in Table 14 shows that the P-value of 0.933 is more than 0.05 level of significant at 20 degrees of freedom. This shows that the test is not significant.

Discussion:-

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 total cholesterol level and that this reduction is statistically significant 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 total cholesterol level compared to those who did not participate in the exercise. The finding agrees with Jovita, et al., (2021). The researchers conducted a study on Aerobic Training Impacts on Blood Cholesterol of Women with Gestational Diabetes**.** Thirty-four (34) women who met the inclusion criteria for this study were randomized into Exercise and Control groups. The result of data analysis showed significant changes in the total cholesterol ($F[2, 28]) = 268.316$, $P = 0.001$), of the Exercise group compared to the control. Independent t-test was used to compare the lipid profile of the Experimental and Control groups, which showed significant difference between the means of the 2 groups at week 8.

The finding of this study also supports earlier finding by Adogu, et al., (2015) who conducted a study on Albumin and Lipid Profiles Following Treadmill Exercise among Student Volunteers of Nnamdi Azikiwe University, Nnewi, Nigeria and found that following exercise, total cholesterol reduced significantly ($P < 0.01$). Similar findings have been reported by Suman et al.,(2015), and Oranwa et al., (2017).

In health, the statistically significant reduction in total cholesterol following vigorous intensity aerobic exercise regimen is of great importance because total cholesterol is a measure of overall cholesterol in human body. It is the most important parameter in cholesterol physiology. Total cholesterol is one of the most important factors in the formation of atherosclerosis. When most people are talking about their cholesterol level, they are in most cases referring to the plasma level of total cholesterol. The implication of this reduction is that, incidences of stroke, coronary heart disease as well as peripheral vascular disease will decline considerably in such participants. In other words, the quality of life and overall health of people that engage in vigorous intensity aerobic exercise regimen improve remarkably.

The findings of the study on the effect of vigorous intensity aerobic exercise on plasma lipids of adults based on research question two and research hypothesis two revealed that there was an increase in high density lipoprotein-cholesterol in favour of the experimental group, and that this increase was not statistically significant. Many studies have focused on the relationship between aerobic exercise and HDL-C, and have found that HDL-C levels are more sensitive to aerobic exercise than other pasma lipids(Yating et al., 2017). Furthermore, some studies focusing on the effects of exercise on HDL-C seemed to consistently indicate that there was an increase in HDL-C more or less, no matter in human or in rats. This agrees with the current finding. In an attempt to find out the extent of the increase, researchers performed a meta-analysis of 25 randomized controlled trials of people that only exercised, that is, without medications or dietary therapy. Still, they found HDL-C increased by 0.067mmol/L when aerobic exercise was 5.3 MET (Yating, et al., 2017). In the current study, the increase in high density lipoprotein-cholesterol was 0.21mmol/L in favour of the experimental group. This finding is highly favourable for healthy living as high density lipoprotein has been described as a “good cholesterol” based on the fact that it carries “bad” cholesterols from circulations to the liver for onward excretion from the body.

However, when the increase in high density lipoprotein-cholesterol in the experimental group was compared with that of the control group, it was found not to be statistically significant. The finding of this study is not consistent with what Lamia, et al., (2020), observed in their Short -term aerobic exercise study. The researcher concluded that aerobic exercise had statistically significant effect on high density lipoprotein-cholesterol. This finding is similar to what Oluseye, et al., (2012) found when they conducted a study on the Effect of Physical Activity Level on Lipid Profile of Adults Working in Tertiary Institutions in Abeokuta, South-Western Nigeria and found that Men in the intense physical activity group had a significantly ($p<0.05$) higher high density lipoprotein than those in the low physical activity group.

The disparity noted in the current study could be attributed to a more objective instrument (proforma) that was used by the researcher. The researcher adopted a supervised exercise training regimen, unlike self-reported instruments that is often used by many other researchers in the field of plasma lipids studies.

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