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Effects of Continuous Training Programme on Serum Lipids and Lipoproteins of Young Female Adult University Students in Nigeria

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Abstract: *The purpose of this study was to find out the effects of continuous training on TG, (Triglycerides) TC, (Total Cholesterol) LDL-C (Low Density Lipoprotein- Cholesterol) and HDL-C (High Density Lipoprotein Cholesterol) of healthy young female adult University students in Nigeria. A total of 32 volunteer female subjects were randomly assigned to two groups. Group (1) was continuous training group with 16 female subjects; Group (2) was control group with 16 female subjects. All the subjects were tested for serum TG, TC, LDL-C and HDL-C before starting the training. These tests were repeated on all the subjects after 12 weeks of training. The subjects for continuous training group underwent their training protocols for 30 minutes in each training session, 3 training sessions on alternate days per week for 12 weeks. The data thus collected were analyzed using one way Analysis of variance (ANOVA) for the mean effects of the training protocols and interaction of training on serum TG, TC, LDL-C and HDL-C. The result showed significant decrease in serum TG, TC, and LDL-C due to 12 weeks continuous training TG (7.36%)), TC (7.12%), LDL-C ((14.2%)) and significant increase in HDL-C (13.5%) for female subjects. It was concluded that, continuous training conducted for 30 minutes or above per session for 3 sessions on alternate days of a week at moderate intensity cause significant decrease in serum TG, TC, LDL-C and significant increase in HDL-C in young female adults. On the basis of the findings, it was recommended that continuous training programme at moderate intensity (30 - 60% vo2max) should be followed at least for 12 weeks to produce desired favourable modification in lipids and lipoproteins of young female adults in Nigeria.*

1. INTRODUCTION

It has been consistently showed that concentration of low-density lipoprotein cholesterol (LDL-C) increasing is associated with an increased risk of myocardial infarction and vascular death. High-density lipoprotein cholesterol (HDL-C) is a strong, consistent, and independent predictor of cardiovascular events, which has been confirmed by many prospective studies on different racial and ethnic groups worldwide(Toth, Barter, Rosenson, 2013 &Lewington, Whitlock, Clarke, 2007).The cholesterol level in the body of an individual goes a long way to determine the health risk factor it posed to the body. Cholesterol is actually conserved and it is this conserved cholesterol that circulates in the blood stream. Only approximately 7% of the body's total cholesterol (TC) is found in the blood and only this portion of blood cholesterol is potentially harmful (Byrne, 1991). Triglycerides are the body's most concentrated source of energy and are also known as neutral fats (Lindsay &Gaw, 1997). Cullen, (2000), Levy, Wilson, Anderson, and Casteli, (1990) warned that should LDL-C and TG levels not be lowered simultaneously, atherosclerosis may continue to progress unabated. According to Cullen (2000), Levy, et al, (1990), elevated TG levels are a better predictor of CHD than are LDL-C level. Low Density Lipoprotein Cholesterol or Beta Lipoprotein is the main cholesterol carrying lipoprotein with more than half (60-70%) of serum cholesterol being contained within LDL-C (Brubaker, Kaminsky, & Whaley, 2002, Lindsay, &Gaw 1997). According to Martin, Browner, Hulley, Kuller and Wentworth (1986), should the LDL concentration in the blood rise above 2.6 – 3.36 mmol/L (100 – 130 mg/dl) some of its cholesterol will be deposited into arterial walls as plague.

High density lipoprotein cholesterol (HDL-C) is considered the most potent independent risk factor for coronary heart disease (CHD) and is inversely correlated with CHD. High levels of HDL-C may have a protective role against coronary atherosclerosis (Spate, & Keyser, 1999) because of its role as a lipid scavenger involved in the reverse transport of cholesterol from the peripheral vascular compartment and tissues to the liver for excretion as bile. Though the mechanism for the beneficial roles of HDL-C is yet to be completely elucidated, it is thought that lecithin-cholesterol acyltransferase (L-CAT) and hepatic lipase (HL) facilitate the role of HDL-C in reverse cholesterol transport from the arterial wall (Plowman, & Smith, 2008; Williams, Albers, Krauss & Wood, 1990).

HDLC is aptly known as 'good cholesterol' since high levels of it reduces an individual's tendency to develop atherosclerosis by removing some of the deposited cholesterol from the arterial walls by slowing cholesterol entry into tissue (Grundy, 1979).

Several previous studies have shown that physical activity as an independent factor induces changes in serum lipids and lipoproteins in adults and may protect the arteries from the formation of plaque rich in triglycerides and cholesterol (Depress, Moorjani, & Lupien 1990). These authors confirmed that plague or atheroma can induce damage in the artery walls and block blood flow. They further added that several restricted blood flow in heart muscle leads to symptoms such as angina pectoris pain while smaller plaque may rupture and trigger the formation of clots on their surface leading to heart attack. Atherosclerosis is the leading cause of CHD in most Western populations and is associated with an accumulation of cholesterol in the walls of the arteries (Buist, 1995). This finding was substantiated by Lindsay and Gaw (1997) who indicated that nearly half of the variance in CHD rates is due to differences in average blood lipid levels. Cholesterol itself is a fatty substance found in all animal fat (Buist, 1995, Lindsay &Gaw, 1997).

Continuous training includes exercises that use oxygen to keep large muscle group moving continuously at an intensity that can be maintained for at least 20 minutes. Such exercises include walking, jogging, cycling and swimming (Heyward, 1998). Furthermore, Morris, (1984), McNaught, Callender, (1975) maintained that continuous activities are those physical activities which cause an increase in the transport and uptake of oxygen by the skeletal muscle. These activities appropriately performed on a regular basis, increase cardio-respiratory fitness and lead to numerous health related benefits. Generally, continuous exercise at low to moderate intensities is safer, more comfortable and better suited for individuals initiating an aerobic exercise programme (Heyward, 1998).

2. METHODOLOGY

Sample:

For the purpose of this study, a total of thirty two (32) female undergraduate students of Ahmadu Bello University, Zaria Nigeria were selected on the basis of their willingness to participate in the research. It was ensured that they did not exhibit counter indication to participate in the research. Detail explanation was given to them on the kinds of protocols they had to follow and found out from them that they did not have any illness or injury. The simple random sampling technique was used to classify subjects into experimental and control Groups. Folded pieces of papers in which 'EXP meaning ''experimental group'' and CON meaning 'control group'' were given to the subjects in single line to pick (without return). The subjects picked the paper one after the other until all the papers were picked. They were instructed not to open the paper until they were commanded to do so. On completion of the picking exercise, the subjects were instructed to open the papers which were used to classify the subjects as follows; 16 female were randomly assigned to experimental group while the remaining 16 to control group respectively.

Sequence of Assessment

During the period of the study, the following assessments and sequence were followed

Blood Sample Analysis

All lipid measurements were carried out in the department of Chemical Pathology, Ahmadu Bello University Teaching Hospital Laboratory. The pre- and post-training venous blood samples were obtained from the participants between 8.00 am and 10.00 am after a 12 hour overnight fast at the A.B.U. gymnasium, Samaru campus, Zaria. A 10 ml syringe was used for blood sample collection using the procedure described by Bachorik (1982). In the process a tourniquet was tied around each participant's upper arm to ensure a brief arrest of blood circulation to the forearm, and the participants were instructed to clench their fists to increase the prominence of the antecubital veins from which blood was drawn by the laboratory Scientist at the ABU Teaching Hospital. Blood samples (10 ml) were drawn from the antecubital vein of each subject under strict antiseptic conditions and were allowed to coagulate within 2 hours of venipuncture. Blood samples were stored in ethylene diaminetracetic acid collection tubes in the refrigerator until analysis. The serum was then analyzed within 4 hours for TG, TC, LDL-C and HDL-C values.

Total Cholesterol (TC)

This was estimated using the method described by Ziakkis and Boyle (1994). The total cholesterol values were estimated using Ferric chloride, acetic acid and sodium tatraoxosulphate as follows;

TC (mg/L)= $\frac{AT}{AS} \times CS(200mg/d)$

Where AT represents absorbance of test

AS represents absorbance of standard

CS represents concentration of standard 200mg/dl

Serum High Density Lipoprotein Cholesterol (HDL-C)

High density lipoprotein cholesterol was determined using the phosphotungstic acid magnesium chloride ($MgCl_2$) method as described by lopes-Verilla, Stone, and Colwell, (1997). In this method, very – low density lipoprotein cholesterol and low-density lipoprotein – cholesterol values were precipitated in serum by phosphotungstic $Mgcl_2$, after which HDL-C was estimated in the clear supernatant.

Serum Low Density Lipoprotein Cholesterol (LDL-C)

Serum low density lipoprotein- cholesterol (LDL-C) was estimated by the use of Lopes-Verilla, et al, (1997) formula that solely depends on the estimation of total cholesterol (TC), triglycerides (TG) without ultracentrifugation. The low density lipoprotein –cholesterol (LDL-C) was estimated as follows;

LDL-C – TC – TGIS

This formula was applied on the basis that the ratio of TG to that of TC in very low density lipoprotein is relatively constant, while most of TG in plasma is constant in very low density lipoprotein cholesterol when chylomicrones dectectable.

Training Programme and Protocol

A total of 32 apparently healthy young female undergraduate Students of age 20–24 years were selected for the study and were randomly assigned to continuous training group and control group respectively. All participants filled and submitted the informed consent form to participate in the study. Participants in the experimental group went through 3 training sessions per week throughout the 12 – week period of training. The training days were Mondays, Wednesdays and Thursdays respectively.

Continuous Training

Continuous training was done thrice a week for 12 weeks. Like the intermittent training, continuous training was conducted on alternate days per week, Mondays, Wednesdays and Thursdays respectively. In each training session, the subjects jogged and walked continuously without any break for 2km which is, 5 laps (round) a 400 metres track at 4 minutes pace per lap. This was followed for the first 3 weeks. During the 2^{nd} three (3) weeks, the intensity was increased by reducing the time for lap from 4 minutes per lap to 3 minutes, 30 seconds. During the 3^{rd} three weeks, the intensity was increased by decreasing the pace from 3 minutes, 30 seconds to 3 minutes per lap. During the 4^{th} three weeks, the intensity was increased by decreasing the pace from 3 minutes to 2 minutes, 30 seconds per lap. Throughout the training period, the distance covered was the same.

The continuous running/jogging was maintained at an intensity of 35-70 b/m increase in heart rate during exercise, which is the difference between the resting heart rate and exercise heart rate. This heart rate was determined by training the subjects to measure their heart rate at rest for 5 seconds and measures it again during exercise for 5 seconds. The product was multiplied by 12 to get each subject's heart rate per minute. It was assumed that the subjects would have adapted to the exercise stress by the end of the 3 weeks of training. The reduction in duration after each quarter to cover same distance was meant to increase intensity of the training.

The continuous training group followed 10 minutes of jogging and stretching exercises before the actual training, which constituted the warming up part of the training session. They also followed 10 minutes of stretching exercises which constituted cooling down part of the training session.

CONTINUOUS TRAINING

Weeks	Work Distance	Pace	Total Distance
1 – 3	5 Laps	4 Minutes	2000m
4 – 6	5 Laps	3 min, 30 sec	2000m
7 – 9	5 Laps	3 min	2000m
10 - 12	5 Laps	2 min, 30 sec	2000m

Source: *Self Developed Table*

Statistical Technique

The data collected was subjected to computer analysis using the SPSS [Version 2012 BM] statistical package at the data processing unit, IyaAbubakar Computer Centre (Ahmadu Bello University, Zaria). These include means (mean + SD) and standard deviation to know the central tendency and variability of the collected data. Changes in selected training parameters were determined by analyzing differences between pre- and post-training values. Analysis of variance (ANOVA) was used to determine significant effect of intermittent training in the selected variables on young female adults on the basis of their group (training group and control group).

3. RESULTS

Before the results are presented according to the hypotheses, the physical characteristics of the subjects (Continuous training female) is presented in table 4.2.1.

Table 4.2.1: *Physical Characteristics of the Subjects*

Group	N	Gender	Age (yrs) $\bar{X}$ ±SD	Weight (Kg) $\bar{X}$ ±SD	Height (m) $\bar{X}$ ±SD	BMI $\bar{X}$ ±SD
Continuous	16	Female	20.8±1.03	55.4±4.01	1.63±0.05	20.9±0.85
Control	16	Female	20.8±0.71	56.1±3.23	1.65±0.05	20.8±1.01

Table 4.2.1 shows less difference among the subjects (female continuous training group and female control group) in age, weight, height and Body Mass Index.

Sub-hypothesis 1: States that there is no significant effect of 12 weeks continuous training on TG, TC, HDL-C and LDL-C of young female adult university students.

Table 4.2.2: *Summary of analysis of variance (ANOVA) statistics on the difference between the control group and training group on TC of young female adult university students*

Variations		Sum of Squares	df	Mean Square	F
TC	Between Groups	.583	2	.292	9.726
	Within Groups	.869	29	.030	
	Total	1.452	31		

INTERACTION

TC		N	Mean	Std. deviation	Std. Error
TC readings	Continuous	16	3.9083	.16214	.04680
	Control	16	4.2500	.20702	.07319
	Total	32	4.0656	.21644	.03826

***f(31) = 2.60 p<0.05*

Result of the analysis of variance (ANOVA) statistics and the descriptive statistics on table 4.2.2 revealed that, there is significant difference between the training group (Continuous training group and the control group) on TC of young female adult university students. The descriptive statistics showed that the mean TC readings were 3.9083mmol/L, for training group and 4.2500 for control. It also revealed that, the no training group (control group) has the highest TC value. Therefore the null hypothesis which states that there is no significant difference between the control group and training group on TC of young female adult university students is hereby rejected.

Table 4.2.3: *Summary of analysis of variance (ANOVA) statistics on the difference between the control group and training groups on TG of young female adult university students*

Variations		Sum of Squares	df	Mean Square	F
TG	Between Groups	.267	2	.134	10.708
	Within Groups	.362	29	.012	
	Total	.629	31		

INTERACTION

TG		N	Mean	Std. Deviation	Std. Error
TG readings	continuous	16	.9333	.08876	.02562
	Control	16	1.1250	.11650	.04119
	Total	32	.9688	.14242	.02518

***f(31) = 2.60 p<0.05*

Result of the analysis of variance (ANOVA) statistics and the descriptive statistics on table 4.2.3 revealed that, there is significant difference between the training group (Intermittent training group and the control group) on TG of young male adult university students. The descriptive statistics showed that the mean TG readings were.9333mmol/L,for training group and 1.1250mmol/L for control group. It also revealed that, the no training group (control group) has the highest TC value. Therefore the null hypothesis which states that there is no significant difference between the control group and training group on TG of young female adult university students is hereby rejected.

Table 4.2.4: *Summary of analysis of variance (ANOVA) statistics on the difference between the control group and training groups on HDL-C of young male adult university students*

Variations		Sum of Squares	df	Mean Square	F
HDL-C	Between Groups	.606	2	.303	12.369
	Within Groups	.711	29	.025	
	Total	1.317	31		

INTERACTION

HDL-C		N	Mean	Std. Deviation	Std. Error
HDL-C readings	continuous	16	1.4667	.10731	.03098
	Control	16	1.1250	.16690	.05901
	Total	32	1.3594	.20613	.03644

***f(31) = 2.60 p<0.05*

Result of the analysis of variance (ANOVA) statistics and the descriptive statistics on table 4.2.4 revealed that, there is significant difference between the training group (Intermittent training group and the control group) on HDL-C of young male adult university students. The descriptive statistics showed that the mean HDL-C readings were 1.4667mmol/L, for training group and 1.1250mmol/L for control. It also revealed that, the no training group (control group) has the lowest HDL-C value. Therefore the null hypothesis which states that there is no significant difference between the control group and training group on HDL-C of young female adult university students is hereby rejected.

Table 4.2.5: *Summary of analysis of variance (ANOVA) statistics on the difference between the control group and training group on LDL-C of young male adult university students*

Variations		Sum of Squares	Df	Mean Square	F
LDL-C	Between Groups	1.615	2	.808	60.906
	Within Groups	.385	29	.013	
	Total	2.000	31		

INTERACTION

LDL-C		N	Mean	Std. Deviation	Std. Error
LDL-C readings	continuous	16	2.0083	.02887	.00833
	Control	16	2.5875	.13562	.04795
	Total	32	2.2500	.25400	.04490

$^{**}f(31) = 2.60$ $p<0.05$

Result of the analysis of variance (ANOVA) statistics and the descriptive statistics above revealed that, there is significant difference between the training group (Intermittent training group and the control group) on LDL-C of young male adult university students. The descriptive statistics showed that the mean LDL-C readings were 2.0083mmol/L, for training group and 2.5875mmol/L for control. It also revealed that, the no training group (control group) has the highest LDL-C value. Therefore the null hypothesis which states that there is no significant difference between the control group and training group on LDL-C of young female adult university students is hereby rejected.

4. DISCUSSION

The results of this study showed significant decrease in TG, TC, and LDL-C forfemale due to 12 weeks continuous training. It also showed significant increase in HDL-C in female due to 12 weeks training. The result is in agreement with those of previous studies byHuttunen, et al, (1997) who reported effects of mild to moderate physical activity on serum lipoproteins on 100 asymptomatic middle aged , who underwent a four month exercise programme of 3 – 4 times per week. The result of the study showed significant decrease in serum TG from 1.54 to 1.27 mmol (P<O.01) and LDC-C .

Further support to the results of this study may be seen in a review of 66 training studies in which, Trans, et al, (2007) reported a significant reduction in TC of 10ml/dl (P<0.01), TG by 15.8ml/dl (P<0.00) and significant increase in HDL-C by 1.2ml/dl. The decrease in LDL-C was 5.1ml/dl and TC/HDL-C ratio, showed a large decrease of 0.48 (PC0.01). Initial levels of TC, TG, HDL-C, and TC/HDL-C ratio were strongly correlated with the respective changes due to training, regardless of data partitioning. Higher initial levels of TC and TG and TG/HDL-C ratio resulted in greater decrease post training and lower initial level of HDL-C resulted in greater post exercise increases (r = 0.50] P<0.01). Overall, the result of the meta–analysis of previous studies showed that continuous training seemed to produce beneficial changes in blood lipids and lipoproteins. However, it was cautioned that researchers must be careful when examining the relationship between physical training and serum lipids and lipoprotein because initial levels, age, length of training, intensity, Vo2max, body weight, percent body fat, have been shown in this meta–analysis to interact with exercise and serum lipid and lipoprotein changes.

Regarding the influence of variation in intensity of training on training induced changes in lipids and lipoproteins, Depress and colleagues (1990) reported significant reduction in TC and LDL-C with low intensity and high volume training regiments. Others have compared the effects of training intensity ranging from 42-85% of Vo2max and did not find an intensity effect on TC and LDL – C. Thomas, et al, (1985) and Stein, et al, (1990) reported greater reduction in TC and LDL-C levels with high vs. moderate intensity training. However, the failure to control for the exercise volume in these studies makes it difficult to interpret these results. In the present study, only moderate intensity of 30 to 60% of vo2max was maintained throughout the 12 week period of intervention.

The results of this study showed significant reductions in TG, TC, and LDL – C and increase in HDL-C due to 12 weeks continuous training. This result is comparable to those of Niaki, et al, (2005) who reported a significant decrease in TG, TC, and LDL-C, TC/HDL-C, LDL-C/HDLC ratio and a significant increase in serum HDL-C after 14 weeks of progressive aerobic training. The decrease was from 87.8 to 58.5mg/dl ($P<0.05$) in TG. The increase in HDL-C was from 4.66 to 53.28mg/dl ($P=.05$). Such significant decreases were reported earlier by Farrell and Baboniak, (1980);,Park et al, (2003), Frey, et al, (2003), Lemura, et al, (2001) and Grandjean, et al, (1998). In these studies, aerobic training was conducted 3 days/week for 30 minutes or more per session at 30-60% Vo2max. The findings of this study on the effect of continuous training on lipids and lipoprotein variables are very similar to those just mentioned.

The result of this study is not in complete agreement with those reported by Williams, (1997) where he maintained that cross sectional studies over the last several years provide compelling evidence for the positive influence of physical activity and training on blood lipids and lipoprotein levels. In general, blood lipid and lipoprotein profiles of trained groups reflect a reduced risk for the development of cardiovascular disease when compared with their inactive counterparts. Williams, (1998) further maintained that there is limited evidence to suggest that those who are physically active or trained exhibit lower levels of total cholesterol (TC) and low density lipoprotein cholesterol (LDL-C) than those who are less active. Other studies with similar results reviewed by (Williams, 1997; Laka, et al, 1992; Kokkinos, 1995) reported a TC and LDL-C values lowered by 14 to 31mg/dl (7 to 21%) in the trained group suggesting that regular physical exertion has a dramatic influence on these lipid variables. Other studies not in complete conformity with these findings are those reported by (Laka and Sakomen, 1992; Williams, 1998) who stated that most cross sectional studies indicate smaller, non-significant differences in TC and LDL-C level between exercise trained and inactive and controlled groups.

5. CONCLUSION

On the basis of this result and in view of the limitations of the study, the following conclusion is drawn;

1. Continuous training conducted for 30 minutes or above per session, for 3 sessions on alternate days of a week at moderate intensity caused significant decrease in TG, TC, and LDL-C and significant increase in HDL-C in young female adults.

6. RECOMMENDATIONS

i. As the study showed significant reductions in lipids and lipoproteins due to continuous training, it was suggested that training programme at moderate intensity (30 - 60% vo2max) should be followed at least for 12 weeks to produce desired, favourable modification in lipids and lipoproteins of young female adults in Nigeria.

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