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# Effects of intermittent training programme on serum lipids and lipoproteins of young female adult University students in Nigeria

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**Abstract**
Excess adiposity has been associated with the incidence of chronic diseases like type 2 diabetes, cardiovascular diseases and some types of cancer. Exercise training has been used as an intervention to maintain normal adiposity in the body and thus control the incidence of chronic diseases. The purpose of this study was to find out the effects of intermittent 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 intermittent 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 intermittent training group underwent their respective 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 analysed 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 intermittent training TG (8.27%), TC (8.20%), and LDL-C (14.8%) for female subjects. There was also significant increase in HDL-C as a result of the training programmes in female subjects, (13.5%). It was concluded that, intermittent 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 intermittent 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.

**Keywords:** serum lipids, lipoproteins, cardiovascular diseases

## 1. Introduction

Cholesterol is an important dietary lipid but it does not serve as a fuel source but instead serves as the structural basis for steroid hormones, bile salt, vitamin D and plasma membranes. Cholesterol is actually conserved and it is this conserved cholesterol that circulates in the blood stream (Byrne, 1991). 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) [20]. Cullen, (2000) [8], 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) [2], Levy, *et al*, (1990) [19], 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) [5], Lindsay, & Gaw 1997) [20]. According to Martin, Browner, Hulley, Kuller & Wentworth (1986) [22], 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.

Mensink, Zock, Kester & Kattan (2003) [23]; Rebufi, Lonnroth, & Marim (1987); maintained that ethnic differences and dietary habit have been reported to be responsible for marked differences in serum lipids and lipoproteins patterns both within and between populations. For example, Taylor (1971) [33] reported low serum lipid level as a biochemical feature among Nigerian adults in the low income group irrespective of tribe. Taylor & Bamboye (1979) [34] reported a mean serum total cholesterol levels of 146mg/d and 160mg/d for male and female adults respectively in Ibadan, Nigeria. Ononogbu (1979) said that adult Nigeria subjects from Nsuka were reported to have mean serum levels of 180mg/d while in Calabar, the mean serum total cholesterol and low density lipoprotein and very low density lipoprotein cholesterol levels were found to be 170.78mg/d, 76.63mg/d and 100.62mg/d respectively.

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) [14].

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) [6]. This finding was substantiated by Lindsay & Gaw (1997) [20] 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 and Gaw, 1997) [6, 20].

Intermittent training involves a series of low to high intensity exercise bouts interspersed with rest or relief periods. Due to the nature of this training, the exercise intensity and total amount of work performed can be greater than continuous training, making intermittent training a versatile method that is widely used by athletes as well as by individuals with poor cardio-respiratory fitness (Heyward, 1998). Intermittent training involves increase and decrease in the intensity of workout between aerobic and anaerobic training. The protocol for intermittent training is to push the body past the aerobic threshold for a few moments and then return to the aerobic level (Venkateswarlu, 1982) [37].

## 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'' 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;

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

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) [21]. 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;

$$\text{LDL-C} - \text{TC} - \text{TGIS}$$

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 under-graduate Students of age 20–24 years were selected for the

study and were randomly assigned to intermittent 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.

**Intermittent Training**

Intermittent training was conducted thrice (3) a week for twelve weeks. Each training session consisted of a warming up phase, exercise training phase and the cool down phase. The warming up phase consisted of jogging, walking and stretching for 10 minutes. The intermittent training consisted of 400 metres jogging and walking at 4 minutes pace, 3 times, with 1 minute resting interval in between repetitions. This constituted one set. In each training session, 2 sets of 3 repetitions each were followed at 4 minutes pace per 400 metres, with 1 minute resting intervals in between repetitions and 2 minutes of walking between sets. This was followed for the first three (3) weeks. During the 2nd three (3) weeks, subjects followed 2 sets of jogging and walking with 3 repetitions for each set and 1 minutes of resting interval of walking in between repetitions and 2 minutes of walking between sets. Each repetition was completed in 3 minutes, 30 seconds. During the 3rd three week, the same schedule was followed with an increase in the pace from 3 minutes, 30 seconds per set to 3 minutes.

During the last 3 weeks, the same schedule was followed with an increase in the pace of each repetition from minutes to 2 minutes, 30 seconds. This is to ensure that the duration and intensity of work performed was similar to the uration of work performed by the continuous group. The intensity of the exercise training was maintained at 35 – 70b/m which is equivalent to 3 – 6 METS that is recommended for fitness training (Bragada, *et al*, 2009). This schedule was also followed on the basis of suggestion made by Brooks, Fahey and Badelal (2005), Bumpa (1999), Powers and Howley (2012), and Venkateswarlu, (2009) [38], according to which an intermittent training for beginners, only one variable should be changed at a time. In this schedule, intensity was changed because it was suggested that this kind of intensity is necessary to bring about favourable change in percent body fat and lipoproteins (American Diabetes Association, 2004).

The resting interval of 1 minute was determined on the basis of the personal observation of the researcher that each subject could recover his post exercise heart rate to almost normal level within 1 minute immediately after the repetition of the exercise. Similarly, when a subject completes 3 repetitions, 2 minutes of resting interval between tests was given on the personal observation of the researcher that the heart rate of the subjects could reach almost normal level within that period.

This pace was determined on the basis that each repetition was performed at a faster rate than in the first 3 weeks which was due to adaptation to the training stimulus. Because of the improved ability to complete the 400 metres distance within this time, the other factors of resting interval remained the same because they could recover the post heart rate to normal period.

**Intermittent training**

**Table 1**

| Duration (Week) | Interval (Distance) | Walk Time | Rep | Resting Int. Per Lap | Sets | Resting Int. Per Set |
|---|---|---|---|---|---|---|
| | 400m | 4 min | 3 | 1 min | 2 | 2 |
| 4- 6 | 400m | 3 min 30 sec | 3 | 1 min | 2 | 2 |
| 7- 9 | 400m | 3 min | 3 | 1 min | 2 | 2 |
| 10-12 | 400m | 2 min 30 sec | 3 | 1 min | 2 | 2 |

***Source*:** A Self Developed Table

**Control Group;** the control group did not follow any structured formal training like intermittent and continuous training groups, but followed the normal routine, which was also followed by intermittent and continuous groups.

**Statistical Technique**

The data collected was subjected to computer analysis using the SPSS [Version 2012 BM] statistical package at the data processing unit, Iya Abubakar 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).

**Results**

Before the results are presented according to the hypotheses, the physical characteristics of the subjects is presented in table 2.

**Table 2:** Physical Characteristics of the Subjects

| Group | N | Gender | Age (yrs) $\overline{X}$ ±SD | Weight (Kg) $\overline{X}$ ±SD | Height (m) $\overline{X}$ ±SD | BMI $\overline{X}$ ±SD |
|---|---|---|---|---|---|---|
| Intermittent | 16 | Female | 20.9±0.99 | 56.4±2.94 | 1.65±0.05 | 20.6±1.03 |
| Control | 16 | Female | 20.8±0.71 | 56.1±3.23 | 1.65±0.05 | 20.8±1.01 |

Table 2 shows less difference among the subjects (Female intermittent 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 intermittent training on TG, TC, HDL-C and LDL-C of young female adult university students.

**Table 3:** Summary of analysis of variance (ANOVA) statistics on the difference between the control group and training groups 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 | intermittent | 16 | 4.1000 | .15954 | .04606 |
| | 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 above revealed there is significant difference between the training group (Intermittent training group and the control group) on TC of young female adult university students. The descriptive statistics showed that the mean TC readings were 4.1000mmol/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:** 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 | intermittent | 16 | .9000 | .12792 | .03693 |
| | 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 above revealed there is significant difference between the training group (Intermittent training group and the control group) on TG of young female adult university students. The descriptive statistics showed that the mean TG readings were 0.9000mmol/L, for training group and 1.1250mmol/L 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 TG of young female adult university students is hereby rejected.

**Table 5:** Summary of analysis of variance (ANOVA) statistics on the difference between the control group and training groups on HDL-C of young female 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 | intermittent | 12 | 1.4083 | .18809 | .05430 |
| | continuous | 12 | 1.4667 | .10731 | .03098 |
| | Control | 8 | 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 above revealed there is significant difference between the training group (Intermittent training group and the control group) on TG of young female adult university students. The descriptive statistics showed that the mean HDL-C readings were 1.4083mmol/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 6:** Summary of analysis of variance (ANOVA) statistics on the difference between the control group and training group on LDL-C of young female 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 | intermittent | 16 | 2.2667 | .14975 | .04323 |
| | 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 there is significant difference between the training group (Intermittent training group and the control group) on TG of young female adult university students. The descriptive statistics showed that the mean LDL-C readings were 2.2667mmol/L, for training group and 2.5879mmol/L for control. It also revealed that, the no training group (control group) has the lowest 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 for female due to 12 weeks intermittent training. It also showed significant increase in HDL-C in female due to 12 weeks' intermittent training in female subjects. The result is in agreement with those of previous studies. Huttunen, *et al*, (1997) [16] 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 physical 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.

Some investigators have suggested that the exercise induced changes in TC and LDL-C can be attributed to changes in body weight and body fat reduction (Superko, 1991). However, stated that the present exercise literature does not provide definitive evidence that body weight and fat loss are requisite for changing TC or LDL-C. First, there are several exercise training studies in which TC and LDL-C were significantly reduced in the absence of body weight or body fat changes (Kiens, *et al*, 1980; Baker, Allen, and Lei, 1986). Secondly, TC and LDL-C are often unchanged after exercise training programmes in which body weight and body fat are significantly lowered (Bassel and Baker, 1996; Schwarz, Cain and Shuman, 1992) [2]. Thirdly, when TC and LDL-C changes are reported after exercise training, they are of similar magnitude with and without loses in body weight or body fat (Schwazts, *et al*, 1992). However, lower TC and LDL-C levels are more frequently observed when significant body weight loss occurs through a combination of diet and exercise (Andersen, Wadden and Banlett, 1999; Bassell, *et al*, 1996; Schwartz *et al*, 1992) [2, 30]. It is unclear whether the reduction in TC and LDL-C after these interventions is caused by greater caloric deficit and body weight loss than what is generally reported after exercise alone, a decrease in dietary saturated fat and cholesterol intake are both strongly associated with these lipid changes. Durstine, *et al*, (2001) strongly feels that a conclusive position on these issues cannot be made from the current literature, as Schwarz, *et al*, (1992) [2] observed decrease in TC and LDL-C with diet induced but not exercise induced body weight loss. Nieman, *et al*, (2002) [3] reported similar reductions in TC and LDL-C levels with diet alone or in combination with exercise, whereas, Wood *et al*, (1991) reported comparable but insignificant reduction in TC and LDL-C levels after body weight loss by diet or by exercise.

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) [35] 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 intermittent training. This result is comparable to those of Niaki, *et al*, (2005) [24] 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 interval 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) [27], Frey, *et al*, (2003) [12], 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) [41] 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) [17] 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) [41] 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. Conclusions

On the basis of this result and in view of the limitations of the study, the following conclusions are drawn; Intermittent 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

As the study showed significant reductions in lipids and lipoproteins due to intermittent 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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