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Effect of Aerobic Exercise Training Programme on Blood Cholesterol Profile in Prevention of Cardiovascular Diseases among Young Adults

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ABSTRACT

This study investigated the effects of aerobic exercise training programme on blood cholesterol profile as cardiovascular disease risk factor among adolescents. The study employed the true experimental of pretest post test design with one experimental and control group. The population consisted of 745 students of Ekiti State University, Ado-Ekiti. The participants for the study were 32 students comprising 22 participants for the experimental and 10 forthecontrol groups with equal number of male and female in each case. The instruments used for sample and data collection for the study were; stadiometer, vacutainer needles, plastic vacuum tubes, vacutainer holder, tourniquet, disinfection swabs, microspore tape, adhesive dressing, rubber gloves, lithium heparin bottles and spectrophotometer. The training programme consisted of graded activities lasting for 25-40 minutes, administered three times a week for 12 weeks. The blood samples collected were subjected to chemical analysis generated for the study. The data were subjected to descriptive statistics of mean, standard deviation and range and inferential statistics of Analysis of Covariance (ANCOVA). Multiple Classification Analysis (MCA) was employed to determine how much effect the treatment had on the cholesterol profile of the students. Statistical analysis showed significant reduction of total cholesterol, low density lipoproteincholesterol, and increase high density lipoprotein cholesterol. Aerobic exercise training programme had positive effects on total cholesterol, low density lipoprotein cholesterol, and high density lipoprotein cholesterol levels of the adolescents. It is therefore recommended that behavioural counseling will goal on way re-orientating the adolescents towards aerobic exercise training programme which will help in preventing cardio vascular diseases in adult population.

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Introduction

Cardiovascular disease (CVD) has been described as one of the leading causes of morbidity and mortality worldwide and its main risk factors starting as early in childhood and young adult age (Healy, Matthews, Dunstan, Winkler, & Owen,2011*)*. However, CVD can be prevented by addressing behavioural risk factors which include eating food with high level cholesterol, low fruits and vegetables (Lee, Lee, Lee, Kim, Lee, Kang, & Cha,2014) and low participation in aerobic exercise. Elevated cholesterol level in young adults may lead to an increased risk of cardiovascular diseases. According to Jeong, Choi, Kim, Kim, Lee, Park & Park (2018), elevated cholesterol levels were linked with increase cardiovascular disease risk, while decreased cholesterol levels were associated with reduced cardiovascular risk among young adults.

Cholesterol is a fatlike substance called lipid that is found in all body cells. The liver makes all of cholesterol body needs to form cell membranes and to make hormones. Cholesterol is a fatty wax-like substance that circulates through the blood stream and is an important component of cell membranes, sex hormones, vitamin D, the fluid that coats the lungs and protective sheaths around nerves (Fahey, Insel& Roth, 2003; Kid Health, 2012). The body has enough cholesterol to run smoothly because the liver makes enough for healthy body function. Additional cholesterol to the body comes from foods such as egg yolk, meat, dairy products, saturated oil, baked foods and processed foods. All these raise blood cholesterol.

Cholesterol does not move through the body on its own. It combined with proteins to travel through the blood stream to where it is needed in small packages called lipoproteins. Lipoproteins transport cholesterol as either Low Density lipoprotein (LDL-c) or High Density lipoprotein (HDL-c) throughout the body. High levels of LDL-c and low levels of HDL-c place a person at extremely high risk of having a heart attack at a relatively young age (United States Department of Health and Human Services, 2008). Also a high level of HDL-c and a low level of LDL-c place a person at an extremely low risk. High levels of Total cholesterol (Tc), LDL-c and low levels of HDL-c increase the chances of developing cardiovascular diseases (Durstine and Thompson, 2000; Fahey et.al, 2003; deVries, Housh and Housh, 2003; Wilmore and Costil, 2004).

Young adolescents can have high blood cholesterol especially if they are overweight. An increase in childhood obesity leads to high cholesterol levels at earlier ages. Elevated cholesterol levels early in life, Washington (1999) noted, play a role in the development of adult atherosclerosis and reducing cholesterol levels in children and adolescents will be beneficial in reducing the risk of atherosclerosis. Regular exercise can have a positive impact on cholesterol. Not getting enough exercise, American Heart Association (AHA, 2012) reiterated can lead to high cholesterol level in both children and adolescents. In his remark, Rodriguez (2011) noted that exercise does not use up the cholesterol in the blood, it helps the liver change some bad cholesterol into good cholesterol.

The American Council on Exercise (2011) recommended exercise at a moderate intensity for about 30 minutes several days per week for individuals to have effect on cholesterol level. Studies have shown that regular exercise reduces or have positive alterations in the blood lipid and lipoprotein profile in children and adolescents (Blessing, Keith & Williford, 1995; Williford & Blessing, 1996; Tolfrey, Cambell & Batterham, 1998; Stergioules & Filippou, 2006). Blessing, Keith and Willford (1995) conducted a 16 week study with 25 males and females who range in age from 13-18 years to examine exercise effect on lipid profile. The 16-week training programme involved 40minutes of various aerobic activities at a high intensity. The results showed a positive alteration in Tc, LDL-c and HDL-c levels after the 16 weeks of exercise

training. Williford and Blessing,(1996) examined exercise training effects in black male adolescents. Twelve boys completed a 15-week, 5 day per week exercise training programme. This resulted in significant decrease in LDL-c and no change in Tc. Stergioulas and Filippou (2006) conducted a study with 10-14 years old boys examining effect of exercise on lipid profile. All the subjects completed peak exercise tests, 4 training sessions per week at 80% of their peak HR for 8 weeks. Significant positive alterations were observed for all variables at the end of the 8 weeks.

Aerobic exercise is any activity that gets the blood pumping and large muscle groups working. It is also known as cardiovascular activity. Examples of aerobic exercise include; brisk walking, swimming, running, cycling, heavy cleaning and playing soccer (Marcin, 2018). Most, people consider aerobic training as sheer time wasting exercise without recourse to its numerous health and physical benefits. Getting people to appreciate numerous advantages of the exercise will require re-orientation and behavioural counseling to change their non-challant or opposing view as regards aerobic training. Behavioural counseling is needful in eradicating or changing the maladapted behaviors towards aerobic training among adults especially the university undergraduates. The counseling may be inform of constant talks and therapy offered to all students at every level to their final years to ensure that exercise culture is well incorporated and ingrained in young adults.

Problem Statement

The incidence and prevalence of the clinical manifestations of cardiovascular diseases is on the high side in recent time, the alarming rate of this heart problem has caused the healthcare professional to look beyond medications in the prevention and maintenance of the health scourge.

Aerobic exercise training is one of the ways that researches have proven to be effective in managing cardiovascular disease risk factors challenges among adolescents and adults. This study shows that aerobic exercise training which is not appreciated by many because of its routine activities could be adopted by these adults through behavioural counseling, which will help in re-orientating them towards the benefits of aerobic exercise training

Materials and Method

The study was a true experimental of pretest posttest control group design with one experimental and one control group. The experimental group went through an exercise training programme while the control group did not. The sample consisted of 32 participants (male and female) drawn from undergraduates in 200, 300 and 400 levels of Ekiti State University, Ado-Ekiti. The participants were drawn from students that first submitted their informed consent forms from each level to take care of attrition. They were randomly assigned to experimental and control groups with equal number of male and female. The experimental group had 22 while the control group had 10 participants. All measurements, blood sample collection and aerobic exercise training programme were conducted in a lecture room in Ekiti State University, Ado-Ekiti, Nigeria. The participants' age, stature and body mass were taken and blood samples collected before and after treatment at resting level.The experimental group was taken through thirty minutes of aerobic exercise training programme three times a week between 7.30a.m and 8.30a.m at moderate intensity.

Ethical Permit:

An ethical permit was obtained from Ethical Committee, Medical School, Ekiti State University, Ado-Ekiti, Nigeria.

Informed Consent Form:

All the participants and their lecturers were well informed about the nature and purpose for the test before commencement. Participants through their lecturers signed the inform consent form for their permission.

Measurement and Blood Sample Collection:

In the study, the two groups were observed at the beginning before the experiment on the experimental group and at the end after the experiment both the experimental group and control group were again observed.

The participants appeared in minimum clothing for the measurements, sample collection and aerobic exercise training programme. The age of participants' were obtained to the nearest birthday. A calibrated stadiometer was used to measure the height of the participants. They were asked to stand erect with both feet on the floor without shoes. Arms and shoulder were in a relaxed manner, looking straight ahead (Frankfort plane) while the height was recorded to the nearest centimeter, the stadiometer had a reliability coefficient of 0.96. The body weight was measured using a (HANA Model) portable bathroom weighed scale. Each participant was weighed while in light sport dress and without foot wears and cap. Measurement was recorded to the nearest 0.1kg. The weighing scale had a reliability coefficient of 0.96 (Watson, 1993).

Chemical Analysis of Blood Sample:

The blood sample collection and analysis for this research were done with the assistance of the Medical Laboratory Technology Unit of Ekiti State University and Department of Immunology, University College Hospital, University of Ibadan, Ibadan Nigeria. Blood samples were collected for blood cholesterol profile levels measurement. The individual tested fasted for 9-12 hours before the blood was drawn but only water was permitted. For blood sample drawing, the following equipment were used; vacutainer needles size 20g to 22g, plastic vacuum tubes, vacutainer holder, tourniquet, disinfection swabs, microspore tape, dental rolls adhesive dressing, rubber gloves, pillow and other support, separate stoppers for opened vacuum tubes, and non-vacuum tubes and needle disposal box. All these equipment were used to take blood sample from a vein. After the skin surface was cleaned with antiseptic, an elastic band (tourniquet) was placed around the upper arm to apply pressure and cause the veins to swell with blood. A needle was inserted into a vein (usually in the arm inside of the elbow or the back of the hand) and blood was withdrawn and collected in an airtight vial or syringe. During the procedure, the elastic band was removed. Once the blood was collected, the needle was gently removed and the puncture site covered with cotton wool or bandage to stop bleeding. The blood was kept safe in the plastic tubes before it was analyzed to produce data used for the research.

Intervention Programme:

The experiment group was taken through thirty minutes of aerobic exercise training programme three times a week between 7.30a.m and 8.30a.m at moderate intensity.

Statistical Analysis:

The data collected were analyzed using the descriptive statistics of range, mean and standard deviation while inferential statistics of Analysis of Covariance (ANCOVA) was used to test the hypotheses formulated at 0.005 level of significance. Multiple Classification Analysis (MCA) was used for specified differences in ANCOVA results.

Results

Question 1: Are the groups homogenous in terms of age and stature?

Table1: Mean, Standard Deviation and Range values of the Age and Stature of the Control and Experimental Groups.

Variables	Group	Mean	SD	Range
Age (yr)	Control	10.70	0.95	9 – 12
	Experimental	10.18	1.18	9 – 13
Stature (cm)	Control	1.45	0.06	1.35 - 1.53
	Experimental	1.39	0.13	1.26 - 1.69

Table 1 presents the means, standard deviation and ranges of age and stature of the control and experimental groups. The control group means value for age was 10.70 – 0.95 years with a range of 17-20 years while the experimental group had a mean value of 10.18 ± 1.18 years with a range of 17-21years. The control group means value for stature was 1.45± 0.06m with a range of 1.35-1.53m while the experimental group had mean value of 1.39 ± 0.13m with a range of 1.26 – 1.69m. The age and stature mean differences in the two groups were 0.52 years and 0.06m respectively. These results indicated that the two groups were homogenous in age and stature.

Question 2: Are there differences in the pre and post-test mean values of the body mass of the groups?

Table 2 presents the mean, standard deviation and ranges of body mass of the control and experimental groups.

Table 2: Pre-test and Post-test mean values of the body mass of the Control and Experimental Groups. (n=10, 22).

Group	Pre-test value			Post-test values			Mean Diff.
	Mean	S.D	Range	Mean	SD	Range	
Experimental	31.55	9.46	22-65	31.18	9.22	22-65	0.37
Control	35.10	10.69	25-64	35.80	11.13	25-66	0.70

The control groups mean pretest value of body mass was 35.10 ±11.13 Kg with a range of 25-66 Kg. The experimental group had a pretest means value of 31.55 ± 9.46 with a range of 22 – 65kg for the posttest. The mean difference of body mass was 0.70kg and 0.37kg for the control and experimental groups respectively. It is important to highlight that the control group showed more increase in body mass than the experimental group.

Research Hypothesis: Aerobic exercise training programme will not have any significant effect on blood cholesterol profile levels of adolescents.

Mean scores of experimental and control groups on blood cholesterol profile levels were compared for statistical significance using Analysis of Covariance (ANCOVA) at 0.05 level of significance. The results are presented in the following Tables.

Table 3: Summary ofANCOVA showing effect of aerobic exercise on Blood total cholesterol of adolescent by the treatment.

Source	SS	Df	MS	F_{cal}	P
Corrected model	2.354	2	1.177	3.372	.48
Covariate (Pretest)	0.956	1	0.956	2.738	.109
Group	1.664	1	1.664	4.768*	.037
Error	10.123	29	0.349		
Corrected Total	12.476	31			
Total	285.321	32			

* p<0.05

Statistical analysis on Table 3 showed significant reduction in total cholesterol level in the experimental group P = 0.037<0.05 at 0.05 level of significance. Aerobic exercise training programme had significant effect on total cholesterol level of adolescent. Aerobic exercise training programme had positive impact on total cholesterol level of adolescent.

Table 4: Multiple Classification Analysis of total cholesterol level of adolescent by treatment.

Grand Mean=2.92					
Variable + Category	N	Unadjusted Devn'	Eta^2	Adjusted For Independent + Covariate	Beta
Experimental	22	-0.14	0.20	-0.15	0.24
Control	10	0.31		0.34	
Multiple R				0.235	
Multiple R^2				0.055	

In Table 4, the experimental group had an adjusted mean score of 2.77 (2.92+ (-0.15) the control group had an adjusted mean score of 3.26 (2.92+0.3). It was observed that the treatment accounted for 5.5% reduction in total cholesterol level of adolescent. This implied that the treatment constituted a way for enhancing reduction in total cholesterol level in adolescent.

Table 5: Summary of ANCOVA showing effect of aerobic exercise on LDL-c of adolescent by the treatment.

Source	SS	Df	MS	F$_{cal}$	P
Corrected model	0.512	2	0.256	3.161	0.057
Covariate (pretest)	0.194	1	0.194	2.402	0.132
Group	0.392	1	0.392	4.849*	0.036
Error	2.347	29	0.081		
Corrected total	2.859	31			
Total	61.206	32			

* p<0.05

Table 5 shows that in LDL-c P =0.036<0.05 at 0.05 level of significance. Aerobic exercise training programme had significant effect on LDL-c level of adolescent. The MCA showing the effect of the treatment on LDL-c of participants is presented in Table 6.

Table 6: Multiple Classification Analysis of LDL-c of adolescent by treatment.

Grand Mean=1.35					
Variable + Category	**N**	**Unadjusted Devn'**	**Eta^2**	**Adjusted For Independent + Covariate**	**Beta**
Experimental	22	-0.07		-0.08	
			0.12		0.20
Control	10	0.15		0.17	
Multiple R				0.204	
Multiple R^2				0.042	

Table 6 shows that the control group had higher adjusted mean score of 1.50(1.35+ 0.17) on LDL-c than the experimental group exposed to aerobic exercise training programme with an adjusted mean score of 1.27 (1.35+ (-0.08). It implied that children not exposed to aerobic exercise training programme had higher LDL-c level than those exposed to aerobic exercise training programme. The treatment accounted for 4.2% decrease in LDL-c level in children. Aerobic exercise training programme impacted on lowering LDL-c level in adolescent.

Table 7: Summary ofANCOVA showing effect of aerobic exercise on HDL-c of adolescent by the treatment.

Source	SS	df	MS	F$_{cal}$	P
Corrected model	0.204	2	0.102	5.317*	0.011
Covariate (pretest)	0.148	1	0.148	9.876*	0.004
Group	0.087	1	0.87	4.529*	0.042
Error	0.557	29	0.019		
Corrected total	0.762	31			
Total	8.048	32			

* p<0.05

Table 8: Multiple Classification Analysis of HDL-c level of adolescent by treatment.

Grand Mean=0.48					
Variable + Category	**N**	**Unadjusted Devn'**	**Eta^2**	**Adjusted For Independent + Covariate**	**Beta**
Experimental	22	0.03		0.04	
			0.44		0.39
Control	10	-0.06		-0.07	
Multiple R				0.392	
Multiple R^2				0.154	

Table 7 shows that in HDL-c P=0.042<0.05 at 0.05 level of significance. Aerobic exercise training programme had significant effect on HDL-c level of adolescent. Aerobic exercise training programme impacted on HDL-c level of adolescent. The MCA showing the effect of the treatment on HDL-c of participants is presented in Table 8.

Table 8 shows that participants in the experimental group had an adjusted mean score of 0.52(0.48+0.04) while those in the control group was 0.41(0.48+ (-0.07). The treatment accounted for 15.4% increase in HDL-c level of adolescent. This implied that aerobic exercise training programme impacted on increasing HDL-c level of adolescent

Discussions

The findings of this study indicated that aerobic exercise training programme was capable of reducing total cholesterol, low density lipoprotein cholesterol and increasing high density lipoprotein cholesterol levels in children. The findings of this study therefore compared favourably with the finding of other researchers. Studies have shown that regular exercise reduces or have positive alterations in the blood lipid and lipoprotein profile in adolescent (Blessing et al, 1995; Williford & Blessing, 1996; Tolfrey, Campbell & Batterham, 1998; Stergioulas & Filippou, 2006). Blessing et al, (1995) in their study, conducted a 16-week aerobic training programme with 25 males and females who range in age from 13-18years to examine exercise effect on lipid profile. The results showed a positive alteration in TC, LDL-c and HDL-c levels after the l6 weeks of exercise training. Tolfrey, Campbell and Batterham, (1998) also corroborated this in their study with 28 boys and girls on cycle ergometer three times per week for 12 weeks. Stergioulas and Filippou (2006) concluded in their study that regular exercise reduce or have positive alterations in the blood lipid and lipoprotein profile in adolescent.

Conclusion and Recommendations

Based on the findings of this study, it was concluded that aerobic exercise training programme is capable of causing improved changes on total cholesterol, LDL-c and HDL-c levels of adolescent. Therefore, aerobic exercise training programme is beneficial in improving Tc, LDL-c and HDL-c taking into cognizance the decreases and increase that are beneficial to the health and fitness of the adolescent. It may also be useful in improving the functions of the heart, blood vessels and preventing and or delaying the onset of CVD during ageing period. It is therefore recommended that instructors, coaches and other caregivers should use structured aerobic exercise training programme to elicit desire effects in blood cholesterol profile levels of adolescent. It should also be encouraged in as it can be performed making use of limited space at this time when many institutions have little space for physical activities.

Aerobic exercise training programme (fitness education) should be incorporated in the university curriculum and made mandatory or compulsory for all undergraduates as this will reduce CVD risk factors or help in preventing cardiovascular diseases in their latter life.All enrollees of university education should be made to go through behavioural counseling to enlighten them about the benefits of aerobic exercise training programme which keep them fit at their young adulthood stage and also help in preventing or delaying the onset of CVD in the nearest future.

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