International Research Journal of Human Resources and Social Sciences
ISSN(O): (2349-4085) ISSN(P): (2394-4218)
Impact Factor- 5.414, Volume 4, Issue 7, July 2017
Website- www.aarf.asia, **Email** : editor@aarf.asia , editoraarf@gmail.com

EFFECTS OF AEROBIC EXERCISE TRAINING PROGRAMME ON ELEVATE BLOOD SUGAR AND TRIGLYCERIDE LEVELS AS CARDIOVACULAR DISEASE RISK FACTORS IN CHILDREN

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ABSTRACT

Cardiovascular disease is fast becoming a problem due to unhealthy nutritional habits and an increase low level of physical activities among children. Scientific studies have provided strong evidence between reduced risk of cardiovascular disease and physical activity involvement. It is against this background that the study investigated the effects of aerobic exercise training programme on elevated blood sugar and triglyceride levels as cardiovascular disease risk factors in children. Thirty two participants were selected randomly and divided into two groups – Experimental and Control groups. Aerobic exercise training programme was administered on the experimental group three days in a week for 12 weeks. The control group was exempted from the training programme. Blood samples were collected before and after the training programme from the two groups. The blood samples were subjected to chemical analysis which generated data for the study. The data were analyzed using descriptive statistics of mean, standard deviation, range, inferential statistics of Analysis of Covariance (ANCOVA) and Multiple Classification Analysis (MCA). Statistical analysis showed significant reduction in blood glucose and triglyceride levels. Aerobic exercise training proramme had positive effects on elevated blood sugar and triglyceride levels of children. It recommended that aerobic exercise training programme should be encouraged regularly among primary school children.

Key Words: Aerobic training programme, Blood sugar, Triglyceride

Introduction

Cardiovascular Diseases (CVD) are the diseases of the heart and blood vessels. The primary cardiovascular diseases are coronary heart disease, stroke, hypertension, atherosclerosis, heart attack, peripheral vascular diseases and diabetes. They are the number one cause of death generally in the world. In the recent time, decrease in engaging in physical activity contributed in a decline in physiological functioning of the people from childhood. In the contemporary society, there are many cases of sudden death of both young and old people possibly as a result of heart attack arising from physical inactivities and unhealthy living.

Risk factors are characteristics that predict the development of certain diseases (Hoeger, 2002). Most of the risk factors that affect children can be controlled early in life, lowering the risk of CVD later in life. Other risk factors are usually passed down through family members. These risk factors usually can be controlled, children can lower their risk of getting CVD by changing or controlling the risk factors that can lead to these later in life. It is important to stress that prevention is the best way to avoid CVD problem later in life. Controlling the risk factors which may start in childhood, will help reduce child's risk of development of CVD as an adult.

Diabetes mellitus is characterized by persistent hyperglycemia and is the most prominent disease related to failure of blood sugar regulation (Walker & Rodgers, 2006). A temporarily elevated blood sugar level may also result from severe stress, such as trauma, stroke, myocardial infarction, surgery or illness and intake of alcohol. Diabetes mellitus is a group of metabolic diseases characterized by an inability to sufficiently produce or properly use insulin, resulting in hyperglycemias (American Diabetes Association, 2003). If blood sugar levels remain too high, appetite is suppressed over the short term. Long-term hyperglycemia causes many of the long health problems including heart disease, kidney and nerve damage.

National Heart, Lung and Blood Institute (NHLBI, 2012) stressed that being overweight or obese raises ones risk for type 2 diabetes (T2DM) with modest weight loss and moderate physical activity, individuals may be able to delay or prevent this and lower their risk for heart disease and heart attack. Children can develop T2DM and most of them who have this are overweight. Wilmore and Costill (2004) noted that T2DM places a person at increased risk for coronary artery disease, cerebro-vascular disease and stroke, hypertension,

peripheral vascular disease, kidney disease and eye disorders including blindness. An important risk factor for cardiovascular disease is high blood glucose level and can also have a deleterious effect on hypertension (Hurley & Hagberg, 1998)

Exercise plays a major role in glycemic control for people with T2DM. Fahey, Insel and Roth (2003) remarked that the best way to avoid T2DM is to exercise regularly and control body weight. Exercise burns excess sugar and makes cells more sensitive to insulin and improves membrane permeability to glucose. Studies of different groups (Manson et al, 1991; Mason et al, 1992; Perry, Wannamethee & Walker, 1995) demonstrated that a sedentary lifestyle may play a role in the development of T2DM. Blood glucose values after an oral glucose tolerance test were significantly higher in less active, compared with more active individuals. Aerobic exercise would provide the better catalyst for improvements in glucose metabolism and improved glucose tolerance in men (Smutok, Reece & Kokkinos 1993; Hurley & Hagberg, 1998). Frequent aerobic exercises with at least at moderate intensity enhances glucose tolerance and prevent the development of diabetes and cardiovascular diseases (Boule, Haddad, Kenny, Wells & Sigal, 2001; Tuomilehto et al, 2001; Widmaier, Raff & Strang, 2006).

Triglycerides are fats that provide energy for the muscles. They are also found in the blood. They are delivered like cholesterol, to the body's cells by lipoproteins in the bloods. Triglycerides store energy until the body needs it. If the body holds on to too many triglycerides, blood vessel can get clogged and cause health problems. Triglycerides levels are raised when food high in saturated fats or carbohydrates are taken. Elevated levels in the body lead to a greater risk of heart disease.

Childhood obesity is one of the most serious public health challenges of the 21st century. The problem is global and is steadily affecting many low and middle income countries particularly in urban settings. World Health Organization (2011) reported that in 2010 the number of overweight children under the age of five is estimated to be over 42 million globally. World Health Organization reiterated that intake of excess processed foods results into accumulation of fats measured in terms of percents body fat (%BF) and body mass index (BMI).

Fletcher, et al (2005) noted in their studies that triglyceride elicit decrease in the exercise group. Durstine et al (2001) indicated that greater changes in triglyceride level can be expected with additional increases in exercise training volume and observed after training regimens requiring much energy expenditure. For instance, Abass and Moses (2013)

reported that there were significant differences in the effect of aerobic exercise training on body mass index and that aerobic exercise training enhanced better improvement in percent body fat and body mass index among primary school children. Fahey, et. al. (2001) has earlier posited that cardiovascular disease was fact becoming a problem due to nutritional habits and an increasing low level of physical activities among children. The development of physical activity (aerobic exercise) programme to predict its effects on cardiovascular disease risk factors in children therefore becomes imperative. It is not out of place to observe that little or no research has been carried out to assess the effects of aerobic exercise training programme on elevate blood sugar and triglyceride levels as cardiovascular disease risk factors with particular reference to children in Ekiti State, Nigeria. Because of the absence of sufficient and reliable data on which generalization could be based, the present study was carried out to fill the gab.

1.2 Objectives of the Study

The specific objectives of the study are to:

1.2.1 investigate the effects of aerobic exercise training programme on Cardiovascular Disease (CVD) risk factors among primary school children;

1.2.2 determine how aerobic exercise training programme can enhance the prevention or delay the onset of CVD risk factors.

1.3 Research Hypotheses

The following null hypotheses were formulated and tested at $P<0.05$ level of significance

1.3.1 Aerobic exercise training programme will not have any significant effect on blood glucose level of primary school children.

1.3.2 Aerobic exercise training programme will not have any significant effect on blood triglyceride level of primary school children.

2. Research Methodology

2.1 Research design

The design used for this study was a true experimental research design of pretest posttest with one experimental and one control group. The experimental group went through an exercise training programme while the control group did not. The two groups were observed at the beginning before the experiment on the experimental group. The two groups were again observed at the end after the treatment period.

2.1.2 Participants

The participants consisted of 32 primary school pupils (male and female) from Ekiti State University Staff School, Ado-Ekiti, Nigeria. They were randomly assigned to experimental (22) and control (10) groups with equal number of male and female.

2.1.3 Intervention programme

The experimental group was taken through 30 – 40 minutes of aerobic exercise training programme 3 times a week between 7.30a.m – 8.30a.m for 12 weeks, low to moderate impact aerobic exercises (35 – 70% maximal aerobic capacity). Every training session was made up of three segments of general body warm up, aerobic exercise and cool down. The training took place in a room within the University Staff School.

2.1.4 Informed consent

All the participants, their teachers and parents were well informed about the nature and purpose of the measurements and blood samples taken before commencement. Participants through their teachers and parents signed the informed consent form for their permission.

2.1.5 Measurements

All measurements and blood samples taken were conducted in a room in the school between 8.00a.m – 9.00a.m. The participants' age, sex, stature, body mass and blood samples were taken before and after treatment at resting level for both groups. The participants appeared in minimum clothing for the measurements and aerobic exercise training programme.

The age of participants were obtained from the school file 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 while the height was recorded to the nearest centimeter. The stadiometer had a reliability coefficient of 0.96(Index Medicus for South – East Asia Region, IMSEAR, 2010). The body weight was measured using a (HANA Model) portable bathroom weighing 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).

The blood sample collection and analysis for this study were done with the assistance of the Medical Laboratory Technology Unit of Ekiti State University Health Centre, Ado – Ekiti, Nigeria. Blood samples were collected for blood glucose and triglyceride levels measurement. The individual tested fasted for 9-12 hours permitted only to take water before

the blood was drawn. The blood was kept safe in the plastic tubes and put in the refrigerator before it was analyzed to produce the data used for the research.

2.1.6 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 at 0.05 level of significance. Multiple Classification Analysis (MCA) was used for specific difference in ANCOVA results.

3. Results

3.1. Descriptive of Physical characteristics of the Participants

The experimental group had age mean value of 10.18 ± 1.18 years with a range of 9 – 13 years while the control group mean value was 10.70 ± 0.95 years with a range of 9 – 12 years. The experimental group mean value for stature was 1.39 ± 0.13m with a range of 1.26 – 1.69m while the control group mean value was 1.45 ± 0.06m with a range of 1.35 – 1.53m. The age and stature mean differences in the groups were 0.52 years and 0.06m respectively. These showed that the two groups were homogenous in age and stature.

The experimental group pretest mean value of body mass was 31.55 ± 9.46kg with a range of 22 – 65kg and 31.18 ± 9.22 with a range of 22 – 65kg for the posttest. The control group pretest mean value was 35.10 ± 11.13kg with a range of 25 – 64kg and a posttest mean value of 35.80 ± 11.13kg with a range of 25 – 66kg. The mean difference of body mass was 0.37kg and 0.70kg for the experimental and control groups respectively. The control group showed more increase in body mass than the experimental group.

The blood glucose pretest mean value of the experimental group was 5.42 ± 0.38 with a range of 4.50 – 5.90mmol/L and 5.15 ± 0.44 with a range of 4.30 – 5.80mmol/L for the posttest. The blood glucose pretest mean value for the control group was 4.97 ± 0.49mmol/L with a range of 4.00 – 5.60mmol/L and a posttest mean value of 5.22 ± 0.57 with a range of 4.30 – 5.90mmol/L. The difference in the pretest and posttest mean values of blood glucose in the control group showed an increase of 0.25mmol/L while the experimental group showed a reduction of 0.27mmol/L. It showed that the experimental group had a reduction in blood glucose level than the control group.

Triglyceride pretest mean value for the experimental group was 0.55 ± 0.33 with a range of 0.05 – 1.14mmol/L and 0.45 ± 0.31 with a range of 0.6 – 1.10mmol/L for the posttest. The control group had a pretest mean value of 0.69± 0.47mmol/L with a range of 0.14 -

1.38mmol/L. The posttest mean value was 0.79 ± 0.50 with a range of 0.25 – 1.37mmol/L. The difference in the pretest and posttest mean values of triglyceride in the control group showed an increase of 0.10mmol/L while the experimental group showed a reduction of 0.10mmol/L. It is important to note that the experimental group showed a lower triglyceride level than the control group.

3.2 Testing the Null Hypotheses

3.2.1 Hypothesis 1: Aerobic exercise training programme will not have any significant effect on blood glucose level of primary school children.

In order to test the hypothesis, mean scores of participants (primary school pupils) exposed to aerobic training programme and those who did not expose to blood glucose level were obtained and compared for statistical significance using Analysis of Covariance (ANCOVA). The results is presented in table 1

Table 1: Summary of Analysis of Covariance on blood glucose level of participants by treatment

Source	SS	df	MS	F_{cal}	P
Corrected model	3.828	2	1.914	17.178*	.000
Covariate (pretest)	3.799	1	3.799	34.091*	.000
Group	1.115	1	1.115	10.010*	.004
Error	3.232	29	0.111		
Corrected Total	7.060	31			
Total	864.040	32			

*** p<0.05**

Data in Table 1 shows that the effect of aerobic exercise training programme on blood glucose level is statistically significant at 0.05 level (F = 10.010, P<0.05). The null hypothesis is rejected. This implies that aerobic exercise training programme had a significant effect on blood glucose level of primary school children. The Multiple Classification Anaylsis (MCA) showing the effect of aerobic exercise training programme on blood glucose of the participants is presented in Table 2

Table 2: Summary of Multiple Classification Analysis (MCA) of blood glucose level Of experimental and control groups

Grand Mean=5.18					
Variable + Category	**N**	**Unadjusted Devn'**	**Eta^2**	**Adjusted For Independent + Covariate**	**Beta**
Experimental	22	-0.03	0.64	-0.12	0.62
Control	10	0.04		0.24	
Multiple R				0.620	
Multiple R^2				0.384	

Table 2 shows that primary school pupils exposed to aerobic exercise training programme had adjusted mean score of 5.06 (5.18+(-0.12) while those in the control group had an adjusted mean score of 5.42 (5.18+0.24). It was observed that the treatment accounted for 38.4% reduction in blood glucose of primary school children. This implies that the treatment constituted a way for enhancing a reduction in blood glucose level of children.

3.2.2 Hypothesis 2: Aerobic exercise training programme will not have any significant effect on triglyceride level of primary school children.

In order to test the hypothesis, mean scores of primary school children exposed to aerobic exercise training programme on triglyceride and those not exposed to treatment were compared for statistical significance using Analysis of Covariance (ANOVA) at 0.05 level. The result is presented in Table 3

Table 3: Analysis of Covariance on triglyceride level of primary school children by treatment.

Source	**SS**	**df**	**MS**	**F_{cal}**	**P**
Corrected model	4.324	2	2.162	74.420*	0.000
Covariate (pretest)	3.513	1	3.513	120.912*	0.000
Group	0.300	1	0.300	10.321*	0.003
Error	0.843	29	0.029		
Corrected total	5.167	31			
Total	14.946	32			

*** p<0.05**

Table 3 shows that p = 0.003 < 0.05 at 0.05 level of significance. The null hypothesis was rejected. Therefore, aerobic exercise training programme had a significant effect on triglyceride level of primary school children. Aerobic exercise training programme had effect in reducing elevated triglyceride level of children. Table 4 presents the Multiple Classification Analysis on triglyceride level by treatment.

Table 4: Summary of Multiple Classification Analysis on triglyceride by treatment

Grand Mean=0.55					
Variable + Category	**N**	**Unadjusted Devn'**	**Eta^2**	**Adjusted For Independent + Covariate**	**Beta**
Experimental	22	-0.10	0.96	-0.06	0.88
Control	10	0.23		0.13	
Multiple R				0.883	
Multiple R^2				0.779	

Table 4 shows that primary school children in the experimental group had adjusted mean score of 0.49(0.55+ (-0.06) while those in the control group was 0.68(0.55+0.13). It was also observed that the treatment accounted for 77.90% reduction in triglyceride level of the primary school children. This implies that aerobic exercise constituted a potent strategy for enhancing better triglyceride level of primary school children.

4. Discussion

The findings of this study corroborated the findings of Manson, et al, (1991): Manson, et al, (1992); and Perry, Wannamethee & Walker (1995) who reported that blood glucose level values after an oral glucose tolerance test were significantly higher in less active, compared with more active individuals. Similarly, Brooks and Fahey (1995) revealed that the maintenance of blood glucose levels at normal range is crucial and that aerobic exercise causes increased glucose uptake from the blood. Also the authors further ascertained that prolonged aerobic exercise is accompanied by decrease in body's skeletal muscle and liver glycogen stores.

This study is also in agreement with the findings of other researchers, such as Boule, et. al. (2001); Tuomilehto, et. al.(2001); Willey and Singh (2003) who revealed that a large amount of regular, moderate intensity aerobic exercise increases insulin sensitivity and

enhances glucose tolerance. Widmaier, Raff and Strang (2006) noted that aerobic exercise training programme is very important to lowering high blood glucose level because insulin sensitivity is increased by engaging in frequent aerobic exercise, independent of changes in body weight because of a substantial increase in the total number of plasma membrane glucose transporters in skeletal muscles.

The findings of this study indicated that the difference in the pre-training and post-training mean values of triglyceride in the control group showed an increase of 0.10mmol/L while the experimental group showed a reduction of 0.10mmol/L. The mean scores of participants exposed to aerobic exercise training programme on triglyceride and those not exposed to treatment showed that $p = 0.003 < 0.05$ at 0.05 level of significance. The reduction observed in the experimental group was statistically significant. Therefore, aerobic exercise training programme had significant effect on the triglyceride level of the participants. The findings of Fletcher *et al* (2005) agreed with the findings of this study with triglyceride eliciting a decrease in the exercise group. However, Durstine, et al (2001) indicated that greater changes in TG level can be expected with additional increases in exercise training volume.

Conclusion

Based on the findings of this study, aerobic exercise training programme was capable of causing improved changes on blood glucose and triglyceride levels of primary school children. It was therefore concluded that aerobic exercise training programme is beneficial in improving the blood glucose and triglyceride levels of the primary school children taking into account the decreases that are beneficial to the health of the children.

Acknowledgement

The authors appreciated the participants used in this study, the staff and management of the school used and also grateful to the staff of Ekiti State University Health Centre particularly the Nurses and Medical Laboratory Technologists.

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