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Plasma Homocysteine and Serum Uric Acid Biochemical Changes during Aerobic Exercise Trainning Programme in Children

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Abstract: *Aerobic exercise training programme is beneficial to all ages but its effects on plasma homocysteine and serum uric acid as cardiovascular disease risk factors in children are not completely known. This study investigated the effects of aerobic exercise training programme on plasma homocysteine and serum uric acid levels of children. Plasma homocysteine and serum uric acid concentrations were determined in 32 children after a programme of moderate aerobic exercise training for 12 weeks (three days per week). They were randomly assigned into controlled (n=10) and experimental (n=22) groups. Blood samples were taken from the participants before and after the 12 weeks training. Statistical analysis showed significant reduction of homocysteine and uric acid after training in the experimental group (p< 0.05). Aerobic exercise training programme was capable of reducing plasma homocysteine and serum uric acid levels of children. The reduction of plasma homocysteine and serum uric acid levels can be effective in reduction of atherosclerosis as CVD risk factor in children. Aerobic exercise training programme should be included in primary school programme to prevent or delay the onset of CVD as these track from childhood to adulthood.*

Keywords: *Aerobic, training, homocysteine, uric acid.*

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I. Introduction

Cardiovascular disease is not the major cause of death among children but it is the largest cause of death among adults (Texas Heart Institute, 2009). Risk factors often have their roots in childhood and most of these risk factors can be controlled early in life, lowering the risk of CVD later in life. Decreasing the risk factors for cardiovascular diseases can either prevent or delay its unset (Wilmore and Costil, 2004). Controlling as many risk factors such as elevated levels of plasma homocysteine and serum uric acid as much as possible, starting in childhood will help to reduce child risk of developing CVD as an adult. Involving the children in physical activities intervention to reduce the risk factors for CVD is important (Washington, 1999).

Homocysteine is an amino acid that is produced by the body usually as a byproduct of consuming meat. It is a sulfur-containing amino acid that occurs naturally in all humans. Elevated level of homocysteine (>10 micromoles/liter) in the blood may be associated with atherosclerosis, that is, hardening and narrowing of the arteries, as well as an increase risk of heart attack, stroke and blood clot formation (Nabili & Shiel,2012). Studies have shown (McCully, 1999; McLean & Robert, 2005; Morrey & Sharon, 2005; Washington, 2005) that individuals who have high levels of homocysteine in the blood are at increased risk of developing atherosclerosis even at a very early age.

McCully (2002) stressed that homocysteine causes the most common form of heart disease. Studies have shown that moderate elevation of plasma homocysteine is an independent risk factor for CVD (Tonstad, Refsum & Ueland, 1997; Strong, Deckelbaum & Williams, 2001; Gangly & Alam, 2015). Homocysteine levels should be determined in children because if risk factors from CVD are altered in a child's life, it is likely that the onset of coronary arteries disease will be delayed or prevented. Inactivity raises homocysteine levels. A regular exercise programme helps to lower high blood levels of homocysteine (Bruce, 2002; Mirkin, 2007). Regular aerobic exercise has been found to have favourable effects on individuals with hyperhomocysteinemia (Okura et al, 2006). Zuehlsdorff (2003) reported that twelve weeks daily exercise can significantly reduce the homocysteine levels in sedentary men and women.

Uric acid is a product of the metabolic breakdown of purine (chemical found in some foods and drinks). It forms in the body as an end product of purine metabolism and a number of conditions affecting the metabolism or excretion of uric acid can cause abnormal levels in children (Sulzer, 2010). If the body produces too much of uric acid or does not remove enough of it, it can cause someone to get sick (Renee, 2011; Dugdale, 2011). Normal uric acid levels are 2.4- 6.0mg/dl (female) and 3.4- 7.0mg/dl (male) (Scot, 2012).

Uric acid is an independent risk factor for cardiovascular disease (Renee, 2011). High uric acid levels in children may be associated with incidence of hypertension (Conen et al, 2004; Feig, Kang & Johnson, 2006; Medline Plus, 2012). A high level of correlation was detected between increases in blood pressure and blood uric acid levels. High serum uric acid is associated with higher risk of type 2diabetes, independent of obesity, dyslipidemia and hypertension. Exercise is very important to good health. Exercising the body five to seven days per week for at least thirty minutes each time will help keep serum uric acid level normal (Conen et al, 2004; Oyama, 2006; Tekin, 2010). This study therefore aimed at investigating the effects of aerobic exercise training programme on plasma homocysteine and serum uric acid levels of children.

II. Methodology

Research Design:

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 experimental research strategy required comparison of observations of the dependent variable across different levels of the independent variables. In the experiment, it compared the experimental with the control group along a baseline condition and still observed the same set of individuals in both the experimental and control groups.

Subjects:

The sample consisted of a total of thirty two pupils (male and female) of Ekiti State University Staff School drawn from primaries three, four and five. The samples 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 classroom within Ekiti State University Staff School, Ado-Ekiti, Nigeria. The participants' age and stature were taken and their blood samples collected before and after treatment at resting level.

Intervention programme (treatment procedure):

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, that is, 65 -75% of maximum heart rate using metronome cadence.

Ethical permit:

An ethical permit was obtained from Ethical Committee headed by the Provost of Medical School, Ekiti State University, Ado-Ekiti, Nigeria.

Informed consent form:

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

Measurement procedure:

The participants appeared in minimum clothing for the measurements, sample collection and aerobic exercise training programme. The age of participants were obtained from the school file and recorded in years 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 blood samples collection and analysis for this research were carried out at the Medical Laboratory Technology Department, Ekiti State University Clinic and Department of Immunology, University College Hospital, University of Ibadan, Ibadan, Nigeria. Blood samples collected were analyzed using chemistry auto analyzer for blood plasma total homocysteine and serum uric acid levels measurements. For total homocysteine, blood plasma was used while blood serum was used for uric acid level measurement in preference to plasma to avoid the diluting effect of anticoagulants. The individual tested fasted for 9-12 hours before the blood was drawn; only water was permitted.

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. P-value less than 0.05 were considered significant ($p< 0.05$). Multiple classification analysis (MCA) was used for specific differences in ANCOVA result. The statistical analysis were done using SPSS version.

III. Results

The control group means value for age was 10.70± 0.95 years with a range of 9-12 years while the experimental group had a mean value of 10.18± 1.18 years with a range of 9-13 years. 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 a 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 0.52years and 0.06m respectively and the mean difference for body mass were 0.70kg and 0.37kg for the control and experimental groups respectively. These results indicated that the two groups were homogenous in age and stature.

Hypothesis1: Aerobic exercise training programme will not have significant effect on blood plasma homocysteine level of children.

Table 1: Blood Plasma Homocysteine Level of Children by Treatment.

Source	**SS**	**Df**	**Ms**	**F_{cal}**	**P**
Corrected model	1031.343	2	514.672	4311.865*	.000
Covariate (pretest)	1000.479	1	1000.479	8365.651*	.000
Group	1.543	1	1.543	12.900*	.001
Error	3.468	29	0.120		
Corrected Total	1034.812	31			
Total	4051.709	32			

***p<0.05**

Statistical analysis on Table 1 showed significant reduction of homocysteine level in the experimental group (p= 0.001< 0.05) at 0.05 level of significance.

Aerobic training programme had significant effect on blood plasma homocysteine level of children. It implied that aerobic exercise training programme was capable of reducing high blood plasma homocysteine level in children.

Table 2: Multiple Classification Analysis of homocysteine level of children by treatment

Grand Mean=9.71					
Variable + Category	**N**	**Unadjusted Devn'**	**Eta**	**Adjusted For Independent + Covariate**	**Beta**
Experimental	22	0.66	0.99	-0.15	0.99
Control	10	0.20		1.97	
Multiple R					0.998
Multiple R^2					0.995

Table 2shows that the experimental group had adjusted mean score of 9.56 (9.71+-0.15) while the participants in the control obtained an adjusted mean score of 11.68 (9.71 + 1.97). The treatment accounted for 99.5% reduction in homocysteine level of primary school children. The treatment constituted a potent strategy for enhancing a reduced homocysteine level in primary school children.

Hypothesis 2: Aerobic exercise training programme will not have significant effect on serum uric acid level of children.

Table 3: ANCOVA Summary of serum uric acid of children by treatment.

Source	**SS**	**df**	**Ms**	**F_{cal}**	**P**
Corrected total	26.450	2	13.225	5.527	.009
Covariate (pretest)	2.955	1	2.955	1.235	.276
Group	26.450	1	26.450	11.055*	.002
Error	69.386	29	2.393		
Corrected Total	95.836	31			
Total	586.073	32			

***p<0.05**

Table 3 shows that p=0.002<0.05 at 0.05 level of significance. This implied that aerobic exercise training programme had significant effect on serum uric acid level of primary school children. The MCA showing the effect of the treatment on serum uric acid of participants is presented in Table 4.

Table 4: Multiple classification Analysis of Serum Uric Acid level of children by treatment

Grand Mean=3.91					
Variable + Category	**N**	**Unadjusted Devn'**	**Eta**	**Adjusted For Independent + Covariate**	**Beta**
Experimental	22	-0.57	-0.00	-0.21	0.00
Control	10	0.10		0.10	
Multiple R					0.001
Multiple R^2					0.000

Table 4 shows that adjusted mean score of primary school children on serum uric acid when exposed to aerobic exercise training programme was 3.70(3.91+(-0.21) while those in the control group had adjusted mean score of 4.01(3.91+0.10). This implied that the treatment enhanced better serum uric acid level of children.

IV. Discussion

The findings from this study indicated that the difference in pre and posttest mean values of homocysteine in the control group showed an increase while the experimental group showed a reduction. The mean scores of the experimental and control groups revealed that aerobic exercise training programme had significant effect on blood plasma homocysteine level of primary school children. This finding is in agreement with the findings of Okura et al (2006) in their study that regular aerobic exercise could affect plasma total homocysteine in individuals found with homocysteinemia. This result also support the findings of Zuehlsdorff (2003) who reported that twelve weeks daily exercise can significantly reduce the homocysteine levels in sedentary men and women. In the same vein, Bruce (2002) and Mirkin(2007) reported that regular aerobic exercise lower high blood levels of homocysteine. The findings from this study also indicated that the difference in the mean values of serum uric acid level showed an increasing tendency in the control group pre and posttest values while the experimental group showed a declining tendency in pre and posttest values. The mean scores of the experimental and the control groups revealed that aerobic exercise training programme had a significant effect on serum uric acid level of primary school children. The effect of the treatment on serum uric acid level of primary school children using MCA showed that the experimental group had a lower adjusted mean score compared to the control group with higher adjusted mean. This implied that aerobic exercise training programme constitutes a potent strategy for enhancing better serum uric acid level in primary school children. This corroborates the report of Tekin (2010) that exercising the body five to seven days per week for at least thirty minutes each time will help keep serum uric acid levels normal. This claim was also supported by Conen et al, (2004) and Oyama (2006) that exercise intensity rather than total work output is a crucial factor mediating increases in blood uric acid concentration.

V. Conclusion

Based on the finding of this study, aerobic exercise training programme is capable of causing improved changes on plasma homocysteine and serum uric acid levels of primary school children. It was concluded that aerobic exercise training programme is beneficial in improving plasma homocysteine and serum uric acid levels of primary school children taking into cognizance the decreases that are beneficial to the health and fitness of the children. However, structured aerobic exercise training programme should be part of primary school programme to elicit desired effects in plasma homocysteine and serum uric acid levels of the children.

Suggestions for future studies

Further research should focus on the effect of aerobic exercise training programme on adolescents and youths than the age group used in this study and more parameters in the cellular area of research can be added for further investigation.

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