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Original Research Article

Effect of moderate-intensity training on cardiovascular risk factors in secondary school-age adolescent males in Khartoum

Kamal M. Awad[1]*, Asim A. Osman[1], Makawi A. A. Osman[2], Haj M. M. Elhaj[3]

[1]Department of Physiology, Faculty of Medicine and Health Sciences, University of Gadarif, Gadarif, Sudan
[2]Department of Physiology, Faculty of Medicine and Health Sciences, University of Dongola, Dongola, Sudan
[3]Department of Physiology, Faculty of Medicine, Africa International University, Khartoum, Sudan

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***Correspondence:**
Dr. Kamal M. Awad,
E-mail: kamalmhmd@hotmail.com

ABSTRACT

Background: The health benefits of regular physical activity are irrefutable; and everybody can benefit from being active. The evidence is overwhelming with risk reductions of at least 20% to 30% for more than 25 chronic medical conditions and premature mortality. Even higher risk reductions (i.e., ≥ 50%) are observed when objective measures of physical fitness are taken. International physical activity guidelines generally recommend 150 minutes per week of moderate-to vigorous-intensity physical activity for physical fitness and reduction of risk of chronic diseases. This study was designed to evaluate the effect of moderate intensity exercise on cardiovascular risk factors in secondary school-age adolescent males.
Methods: In this interventional study 47 secondary school age adolescent males with age range from 16 to 19 years were recruited. All subjects underwent moderate intensity exercise program for two months. Heart rate (HR), blood pressure (BP), waist circumference (WC), body mass index (BMI), and lipid profiles were assessed before and after going through the course of moderate intensity exercise training. Risk of cardiovascular diseases (CVD) was determined by Framingham, ASSIGN and British national formulary scoring systems.
Results: this study showed a significant reduction in heart rate ($p \leq 0.001$), blood pressure, lipid accumulation product ($p=0.01$) and visceral adiposity index ($p=0.012$) after moderate intensity exercise also moderate intensity exercise training reducing the risk of MI ($p=0.042$). On the other hand, showed there is no significant effect on weight, BMI, waist circumference and lipid profile,
Conclusions: The moderate intensity exercise training reducing the incidence of hypertension and reducing the risk of MI.

Keywords: Heart rate, Blood pressure, Waist circumference, Body mass index

INTRODUCTION

The health benefits of regular physical activity are irrefutable, and everybody can benefit from being active. The evidence is overwhelming with risk reductions of at least 20% to 30% for more than 25 chronic medical conditions and premature mortality.[1] Even higher risk reductions (i.e., ≥50%) are observed when objective measures of physical fitness are taken. International physical activity guidelines generally recommend 150 minutes per week of moderate- to vigorous-intensity physical activity for physical fitness and reduction of risk of chronic diseases.[1]

Over 2,500 years ago, Hippocrates noted that the potential health benefits of daily moderate intensity exercise such as a simple walk.[2] In the last six decades, and since the landmark work by Morris and coworkers,

the plethora of epidemiologic evidence accumulated supports unequivocally an inverse, independent, and graded association between physical activity, health, and cardiovascular and overall mortality in apparently healthy individuals and in individuals with documented cardiovascular disease. The exercise-induced health benefits are in part related to favorable modulations of cardiovascular risk factors that have been observed with increased physical activity patterns or structured exercise programs.[2]

The sedentary lifestyle reduces vagal tone, whereas a physically active lifestyle, resulting in enhanced aerobic fitness, increases vagal tone and may have cardiovascular health implications.[3]

Exercise has significant impact on all aspects of breathing.[4] Breathing-rate slows down and breathing muscles, intercostal and diaphragm become stronger and there is an increase in capillary density at alveoli to allow greater diffusion of O_2 and CO_2 into blood.[4]

Coronary atherosclerosis has its origin in childhood. Though certain factors cannot be controlled such as heredity, sex, race and age, but some other factors can be controlled through formation of positive habits from childhood. Vigorous exercise will serve as a natural defense of the body and protective measure against incidence of coronary heart disease, through well planned programs as early as possible.[4]

Most important effect of exercise on human beings is on metabolism especially lipid metabolism including-cholesterol, phospholipids and triglycerides.[5] It is well accepted that high levels of total cholesterol, triglycerides, LDL-C and low levels of HDL-C are the risk factors for coronary heart disease. Physical exercise performed with sufficient frequency and intensity is effective in lowering the levels of TG and LDL-C and raising the levels of HDL-C.[6]

A physically active life-style may help to prevent the age-related rise in triglyceride. Participation of male athletes in the sports of wrestling, volleyball, rugby and other fields such as throwing, jumping and running 100 and 200m, showed improved lipids and lipoproteins profile.[7]

Cardiovascular disease is one of the leading causes of death worldwide. There are many ways to reduce the risk of CVD. The effective and cheaper therapeutic option is exercise and we assess the effect of moderate-intensity exercise on cardiovascular risk factors in Secondary school-age males in Khartoum state, Sudan.

METHODS

Study design and population

This pre-post interventional study included 47 male adolescents (16-19 years old) from Ebad-Alrahman secondary school in Khartoum state, Sudan. Participants were selected based on inclusion criteria (free of cardiovascular and respiratory disease) and exclusion criteria (smokers, pre-existing cardio-pulmonary problems, and physical disability).

The study measured various parameters, including: Anthropometric measurements: height, weight, waist circumference, and BMI. Cardiovascular parameters: heart rate, arterial blood pressure, and lipid profile (serum triglycerides, LDL, HDL, and total cholesterol). VAI and lipid accumulation product (LAP) were calculated through following equations.

VAI=(waist circumference/39.68+"1.88× BMI)×(TG/1.03)×(1.31/HDL).[8]

LAP calculated as (waist circumference [cm]-65) × (Fasting triglyceride concentration{mmol/l}).[9]

Cardiovascular risk was assessed using a scoring system based on Framingham, ASSIGN, and BNF equations.[10]

Exercise program

Participants underwent a 60-day exercise program consisting of rapid walking and slow running for 30-40 minutes per day. Exercise intensity was monitored using a stethoscope and pulse oximeter to ensure moderate intensity (50-70% of maximum heart rate).

Data collection and analysis

Data were collected using a structured questionnaire and analyzed using PASW software (version 24.0). Results are presented as mean±standard deviations, and Student's t-test was used to compare between groups. $P<0.05$ was considered significant.

RESULTS

A total of 47 secondary school male students were included in this study. The participants were assessed before and after going through the course of moderate intensity exercise training. The mean weight before the moderate intensity training (MIT) was 64.9±5.1 compared to after the training course which decreased to 61.1±5.0, the mean BMI changed from 25.8±2.7 to 25.1±2.8 after MIT and waist circumference reduction from 82±3 cm to 81±3 cm. there is no significant effect of moderate intensity exercise on weight, BMI and waist circumference as shown in Table 1.

The systolic blood pressure changed from 121.7 before the MIT to 115.8 after MIT and the diastolic blood pressure went from 79.7 before the MIT to 70.8 after MIT, the mean heart rate of all the participants shows a reduction from 77 beat/min before the MIT compared to 72 beat/min after MIT, there is significant effect on blood pressure and heart rate as shown in Table 2.

The mean total cholesterol decreased from 170.34 before the MIT to 167.32 after MIT, while triglycerides level changed from 68.81 before the MIT compared to 63.23 after MIT, after the group went under the training the mean of their HDL levels increased from 65.60 compared to 68.62 before MIT, while the LDL decreased from 93.96 down to 89.87, the mean of Lipid accumulation product changed from of 13.7240 before MIT to 11.9392 after MIT, and the mean of VAI changed from 0.5582 before MIT to .4861 after the MIT, there is a significant effect of moderate-intensity exercise on LAP and VAI as shown in Table 3.

By assessing cardiovascular risk using a scoring system based on Framingham, ASSIGN, and BNF equations, there is a significant effect of moderate-intensity exercise on MI and the risk for development of CVD according to BNF criteria, as shown in Table 4.

Table 1: Comparison of the anthropometric measurements before and after the MIT expressed as mean±SD.

Anthropometric measures	Pre-exercise group, mean±SD	Post-exercise group, mean±SD	P value
Weight (kg)	64.9± 5.1	61±5.0	0.389
BMI (kg/m^2)	25.8±2.7	25.1±2.8	0.529
Waist circumference (cm)	82 ±3	81 ± 3	0.090

Table 2: Comparison of the effect of moderate-intensity exercise on the blood pressure and heart rate before and after the MIT, (n=47).

Variables	Pre-exercise group, mean± SD	Post-exercise group, mean±SD	P value
Systolic BP	121.7±1.3	115.8±1.4	0.004
Diastolic BP	79.7±1.4	70.8±1.3	0.002
Heart rate	77±2	72±1	≥0.001

Table 3: Comparison of the effect of moderate-intensity exercise on the lipid profile, VAI and LAP before and after MIT expressed as mean±SD.

Variables	Pre-exercise group, mean±SD	Post-exercise group, mean±SD	P value
TC	170.3±21.8	167.3±21.3	0.500
TG	68.8±14.6	63.2±14.3	0.065
HDL	65.6±12.3	68.6±11.6	0.225
LDL	93.9±21.9	89.8±22.6	0.377
LAP	13.72±3.57	11.93±3.17	0.010
VAI	0.55±0.14	0.48±0.12	0.012

Table 4: Comparison of the effect of moderate-intensity exercise on risk of CVD before and after MIT, (n=47).

Variables	Pre-exercise group, mean±SD	Post-exercise group, mean±SD	P value
CHD	0.0109±0.08	0.0080±0.005	0.055
MI	0.02±.002	0.01±0.009	0.042
Stroke	0.0154±0.002	0.0149±0.002	0.330
CVD	0.0058±0.035	0.0046±0.002	0.054
CVD death	0.7071±0.29	0.6136±0.25	0.105
BNF	0.0263±0.01	0.0230±0.006	0.048
ASSIGN	0.7088±0.144	0.6602±0.126	0.086

DISCUSSION

The study showed a significant reduction in LAP and VAI after moderate intensity exercise this reduction indicated that moderate intensity exercise training significantly decreasing the risk of type 2 diabetes, CVD and metabolic syndrome this is true because these adiposity indices regarded as better predictors for cardio-metabolic disorders.[11,12]

In this study moderate-intensity exercise significantly decreased the blood pressure and heart rate, indicating protective value of this type of the exercise against the hypertension and for the future prevention of CVD by practicing moderate intensity exercise training. This finding agrees with the study that conducted by Balas-Nakash.[13]

Some researcher attributes the reduction in the blood pressure after the practice of physical exercises in hypertensive individuals to humoral alterations related to the production of vasoactive substances such as the atrial natriuretic peptide or the ouabaina-like, centrally modulated. A significant improvement on the insulin

sensibility also occurs, besides the reduction of the plasma noradrenalin level, suggesting reduction of the sympathetic nerve activity associated to the increase in the serum taurine and prostaglandin E, which inhibit the release of noradrenalin into the sympathetic nerve terminations and the reduction on the ouabaina-like factor, what would cause a noradrenalin recapture in the synaptic clefts. This hypothesis is refused, once a reduction on the blood pressure can be demonstrated even before a reduction on the plasma noradrenalin levels is verified. Other researcher reported that the noradrenalin levels decrease with training only for hyper adrenergic individuals. A reduction on the plasma renin levels was also observed as well as an increase in the production of nitric acid.[14,15]

In this study moderate-intensity exercise also significantly decreased the risk for MI and the risk for development of different CVD according to BNF criteria. This result gives evidence of easy way to prevent MI and to reduce the high mortality rate of CVD by using moderate intensity exercise training, these findings in accord with the results of the study that conducted by Bala.[16]

The American Heart Association estimates that 1.1 million new cases of myocardial infarctions occur in the United States alone and that 40% of these patients will die. Approximately half of the deaths occur prior to the patient receiving medical attention. Taken together with corresponding figures for myocardial infarction in the UK, these data suggested that the incidence of acute myocardial infarction is in the range of 1 per 250 to 1 per 500 of the population per year.[17] So, that moderate intensity exercise training is of a great value in life's saving. On the other hand, our study showed that there is no significant relationship between moderate intensity exercise and weight, BMI and waist circumference, which doesn't match the result of the study that conducted by Bala.[16] This difference in the results can be explained by the short period of our study in comparison with Bala study. In this study also there is no effect on lipid profile which inconsistent with the result of the study that conducted by Bala.[16] In addition, there is no significant effect of moderate-intensity exercise on the risk of CHD, stroke, CVD, and death from CHD-or CVD and there is no effect on CVD according to ASSIGN criteria. These insignificance effects might be due to the short period of intervention beside the younger age of the study population.

Limitations

Our study sample size was less it will be better if large sample size is considered in the future, study was conducted on male if both genders were used will be valuable.

CONCLUSION

Moderate-intensity exercise associated with significant reduction in LAP, VAI, blood pressure, heart rate, the risk for development of CVD according to BNF criteria and the risk for MI.

Recommendations

Our recommendations are to carry out more researches in this vital issue "the effect of moderate-intensity exercise on cardiovascular risk factors" with more numbers of participants and more duration of time to provide more strong findings.

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