EFFECTIVE INTENSITY OF EXERCISE FOR IMPROVING THE MODIFIABLE RISK FACTORS OF CVD IN OVERWEIGHT ADULT MALES

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Abstract

Background:
The leading cause of death is CVD worldwide. Physical activity has been labeled as the single most important modifiable risk factor that alters majority of the other risk factors. However, the existing literature about the effective intensity of exercise to influence other modifiable risk factors is obscure and contradictory. Therefore, this study is aimed to find out the effective exercise intensity beneficial enough to influence the other modifiable risk factors. Methodology: After ethical approval and written informed consent 20 male overweight and apparently healthy participants, (age = 31 ± 6.1 years) were recruited. Participants attended the lab for 4 days one week apart. On day 1, height, weight, blood pressure, heart rate, waist and hip circumference, and body composition was measured using Tinnita body analyzer was measured. Based on submaximal exercise testing the intensity for 50%, 60% and 70% of the predicted maximum heart rates were calculated. On subsequent visits, blood samples for fasting sugar, fasting lipid and insulin were taken. The participants performed exercise test on the treadmill as per calculated intensity for 30mins. Exercise induced thermogenesis and substrate metabolism was calculated using breath by breath analyzer. Post exercise blood sampling for lipid, blood sugar and insulin were taken immediately after intervention. Results: A dose response relationship of exercise with majority of the parameters was found. Exercise intensity of 60% and above were found to be significantly influencing the other modifiable risk factors including

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cholesterol (0.04 & <0.001), HDL (0.03), Triglyceride (0.023 & <0.01), insulin (0.12 & 0.05) and blood sugar level (0.02 & 0.001). ***Conclusion:*** *Exercise intensity need to be in the influential range for affecting the other modifiable risk factors. If well planned even a single bout of exercise can be proved beneficial and add towards prevention of CVDs.*

Keywords: CVDs, Exercise, Modifiable risk factors, Physical activity

Introduction

One of the leading causes of mortality around the world is the cardiovascular disease (CVD) with 17.1 million reported annual deaths. It was previously thought that the cardiovascular events occurs during adulthood but according to latest studies the risk factors for CVD have its origins in childhood leading to the appearance in later life (1). Continues exposure to the causative risk factors increases the mortality rate in such patients (2). The early identification of these patients with an abnormal risk profile is the main goal in developing and the enactment of suitable health strategies (3).

Many risk factors are associated with CVD. Poor dietary habits, reduced physical activity, low aerobic fitness, being overweight, persistent hypertension and deranged lipid profiles are to name a few (4). The etiology of the disease is multiplex, with many interdependent risk factors. The increasing prevalence of obesity in young generation is ascribed to decrease of routine physical activity (2).

Studies have proven that physical activity at regular intervals will protect against future risk of CVD. Studies also estimates that amount of physical activity in our youth is not sufficient to meet the guided recommendations (5). Developing period of CVD is critical stage and favorable activities including lifestyle interventions might contribute to reduce the future risk for CVD (6). Present findings on the beneficial effects of different exercise programs to enhance the physical activity levels in young individuals is arguable (7, 8). There are few

interventional studies focused on obese adults, susceptible to the changes in metabolic profile that can potentially alter the other modifiable risk factors.

A poor cardio metabolic profile has been substantially correlated with physical inactivity. In addition, clinical evidence is lacking in providing a proper guideline referring to the quality and quantity of physical activity needed to decrease the risk of CVD (9). The most effective means of improving the cardio metabolic profile of obese and overweight adults is via interval training (10, 11). Different studies have reported metabolic adaptations in adolescents with low volume sprint interval and traditional endurance training (12). Physical activity does affect the modifiable risk factors for CVD. However, the exact intensity of exercise which affects the other modifiable factors is unknown. There is an immense need of considering the effectiveness of exercise interventions in term of effective intensity, as mean of improving the health status and wellbeing of obese adolescents.

Therefore, the aim of the current study is to determine the effects of different intensities of exercise on the other modifiable factors including lipid profile, insulin and blood sugar level.

Methodology
Study Design and Population
A noncommercial experimental trial, including a cohort of 20 overweight adult males volunteered in the study based on convenience sampling. The trial was carried out in the physiology lab of Insititute of Basic Medical Sciences, Khyber Medical University, Peshawar.

Ethical Approval and Consent
The study was carried out according to Helsinki Declaration 1964. Ethical permission for the study was obtained from the Ethical Review Committee of the Khyber Medical University, Peshawar. Concerned investigators visited the participants and discussed their involvement in

the study. Information sheets and consent forms were filled.

Sample Size Calculation

The sample size was calculated using the OpenEpi calculator, considering 95% confidence interval and power was 80%, a total of 20 participants were calculated as sample size for this study.

Inclusion Criteria

Male participant who were overweight but healthy with the age range of age 25-40 years were included in the study.

Exclusion Criteria

Underweight men, females, males with co-morbidities were excluded from the study.

Demographic Parameters

The study included both demographic and biological measures through blood sampling. On day 1, height, weight, BMI, blood pressure and heart rate were measured.

Metabolic Measurements

Participants were asked to attend the lab for 4 days, one week apart. Measurement of all the parameters and Serial blood samples were before and after exercise. On subsequent visits one week apart, blood samples were analyzed for cholesterol, LDL, VLDL, triglycerides, fasting blood sugar and insulin levels.

Exercise Protocol

After recruitment participants were asked to attend the lab for 4 days one week apart. Based on sub-maximal exercise testing the intensity for 50%, 60% and 70% of the predicted maximum heart rates were calculated. The participants performed exercise on the treadmill as per calculated intensity for 30mins. Breath by breath analyzer was used for calculation exercise induced thermogenesis and substrate metabolism.

Statistical Analysis

SPSS version 20 was used for all statistical analysis. Data was presented as Mean ± SD. Mean difference before and after each exercise protocol

was carried out through paired sample T test. ANOVA was used for thermogenesis and exercise parameters. Data was presented in tabulated and graphical form. P value less than 0.05 was considered significant.

Results

Data for all the participants were analyzed after checking the normality. Demographics of the participants are outlined in table 1. As there were no females, a gender based comparison was not done. The exercise parameters during each session are outlined in table 2, analyzed through ANOVA, which shows a significant difference in majority of the parameters across all three exercises formats pointing towards the fact that increasing challenge/stress, was posed on the body with the increasing intensity of the exercise. Table 3 shows the difference noticed in the parameters of interest at all 3 sessions before and after exercise compared through paired sample T-test. A dose response relationship between the exercise intensity and parameters can be appreciated, in the column titled as "Mean difference" which shows the difference of the mean for the group at pre and post interventional interval at all sessions.

Error! No text of specified style in document.**-1: Demographics of Participants**

	Values
Number (n)	20
Age (Yrs)	29.4 ± 7.2
Height (m)	1.69 ± 0.10
Weight (kg)	78.7 ± 14.2
BMI	27.2 ± 3.33
SBP	121 ± 0
DBP	83 ± 7
HR (bpm)	80 ± 5

Table- 2: Exercise parameters of the participants at different exercise intensities. P value shows the difference in parameters at all the 3 protocols

n=20	50% PMHR	60%PMHR	70%PMHR	P value (ANNONA)
HR (bpm)	112 ± 5	123 ± 7	153 ± 6	<0.001
ΔHR (bpm)	26 ± 7	45 ± 8	75 ± 8	<0.001
Speed (Km/hr)	5.01 ± 0.1	5.8 ± 1.2	6.2 ± 1.9	<0.02
Distance (km)	2.6 ± 0.8	3.1 ± 0.4	3.4 ± 0.4	0.04
BVo$_2$ (ml/kg/min)	4 ± 0.4	3.7 ± 0.3	3.7 ± 0.4	0.23
VO$_2$ (ml/kg/min)	16 ± 4	22 ± 5	28 ± 6	<0.001
VCO$_2$ (ml/kg/min)	14 ± 4	20 ± 5	23 ± 4	0.01
RER	0.86 ± 0.04	0.91 ± 0.04	0.92 ± 0.04	0.03
EE (kcal/min)	5.4 ± 2.1	7.6 ± 2.7	9.8 ± 3.3	0.01
RCHO (gm/min)	$0.82 \pm .5$	1.4 ± 0.6	1.98 ± 0.8	0.03
RFO (gm/min)	$0.25 \pm .1$	$0.27 \pm .1$	$0.27 \pm .1$	0.23

Table: **3 Parameters under consideration at pre and post exercise at all the 3 different protocols**

Parameter	50% PMHR				60% PMHR				70% PMHR			
	Pre level	Post level	Mean diff	P value	Pre level	Post level	Mean diff	P value	Pre level	Post level	Mean diff	P value
Cholesterol	205	195	-10	0.09	219	199	-20	**0.04**	215	180	-35	**<0.01**
Triglyceride	235	220	-15	0.08	229	201	-28	**0.023**	240	185	-55	**<0.01**
HDL	40	45	+5	0.23	41	52	+11	**0.045**	45	60	+15	**0.02**
LDL	153	148	-5	0.3	155	143	+12	**0.04**	151	131	-20	**0.032**
VLDL	22	20	-2	0.53	25	18	+7	**0.037**	24	12	+12	**0.022**
FBS	118	110	-8	0.08	122	105	-17	**0.02**	121	98	-23	**0.001**

Insulin	28	24	-4	0.12	30	22	-8	**0.05**	26	16	-10	**0.03**
IR	3.2	3	-0.2	0.3	3.3	3	-0.3	**0.12**	3.4	2.9	-0.5	**0.05**

Figure 1: Outlines the effects of different protocols on Cholesterol (chol), Triglyceride (TGs), High density lipoprotein (HDL) and Low density lipoprotein (LDL), 1 represent pre exercise samples and 2 represent post exercise samples
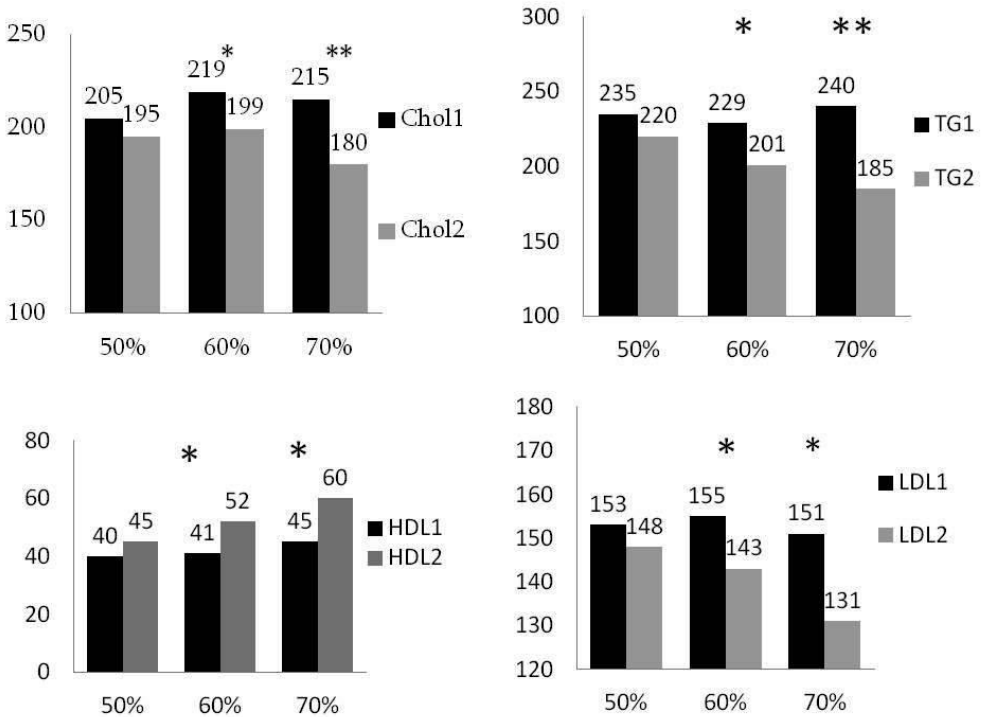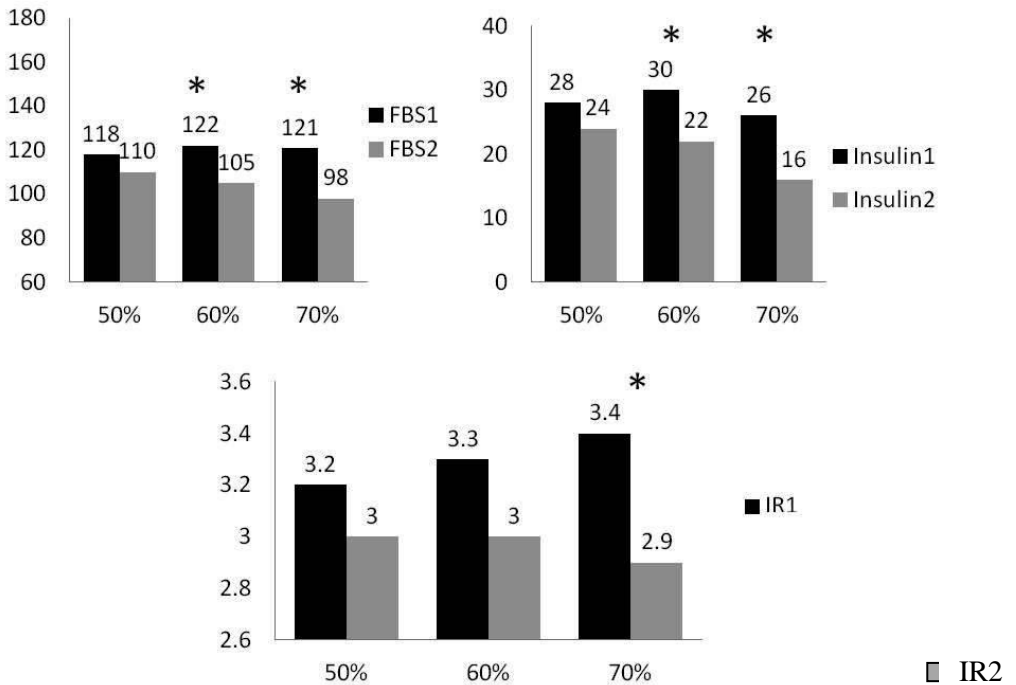
Figure-2: Outlines the effects of different protocols on Fasting blood sugar (FBS), Insulin, and Insulin resistance (IR), 1 represent pre exercise samples and 2 represent post exercise samples

Discussion

This study confirmed the beneficial effects of all the different intensities of exercise on most of the parameters under consideration. Majority of the overweight population of our study under investigation showed a dyslipidaemic picture which is alarming and needs special consideration. The dyslipidaemia exhibited a dose response relationship with increasing intensity of exercise. This was a novel study in local population with calculation of real time exercise induced thermogenesis. Our study reports an improvement in basal oxygen consumption (BVO_2) outlined in table 2, after the exercise protocol. Our findings are in state with the recent studies by Myers et al., suggesting that aerobic fitness might be

an important marker of the health status and it might predict early mortality in adults (13). They also observed a significant improvement in the aerobic fitness after 7 weeks of moderate to high intensity exercise.

Huang et al., in 2007 reported that low physical activity increases the prevalence of a poor metabolic profile in young adults (14). So, it is very important to implement health amplifying strategies in early adulthood. However, there is limited information on the effective physical of activity strategies/programs on reducing the risk factors for CVD in youth (10).

A study by Blomqvist et al., reported improved aerobic fitness of young adults by 26.8 and 8.3%, respectively, in moderate and high intensity exercise groups. It can be counseled that the moderate intensity exercise intervention caused improvements in maximal cardiac output of the participants by increasing the stroke volume (15). A recent study was conducted by Daussin et al., in young adults suggesting that different intensities of exercise might have specific effects on central and peripheral mechanisms affecting VO_2max (16). They reported that continuous endurance exercise increases maximal cardiac output (central adaptation) while, there was no significant effect observed in the VO_2 difference (peripheral adaptations) (16). Similar findings have also been observed elsewhere in studies by Wisloff et al., which stated that different activity programs with various intensities might result in the area specific physiological adaptations of the body (17).

The current study reported abnormal lipid profile and insulin level along with Insulin resistance in obese adults before the exercise intervention. Abnormal lipid profile and an increase serum plasma Triglycerides (TG) are interlinked with the development of CVD in adulthood (18). Different exercise interventions which reduces elevated serum TG concentrations in the adult youth is important for reducing the risk of CVD (18). The reviews by Kelly et al.,2007; Strong et al.,2005 has documented the beneficial effects of exercise interventions on serum triglycerides (18, 19). Studies by Kelly et al., have observed the positive

effects of different exercise interventions on the serum TG levels in overweight participants ([18]). Zimmet et al., proposed a cut off point for TG to be of > 1.7 mmol/L, this may serve as the means of detecting elevated serum TGs in adult youth ([20]). They suggested that the individuals with an abnormal TG profile shows significant improvement after intervention ([18]). Our study reports a significant improvement in the lipid profile, Insulin concentration and Insulin resistance of the participants. Our findings are consistent with the findings by Lefevre et al., who reported positive changes in lipid profile and blood pressure in the individuals with exercise, favoring a reduction in CVD risk ([21]).

Conclusion

The study in conclusion suggests that being overweight is highly correlated with deranged cardiometabolic profile in local community which needs special consideration. In addition, exercise intensities under consideration were found to be easy to incorporate into life style evident by the fact that no drop out was reported. In addition, exercise of all the intensities under consideration proved its beneficial effects by improving the lipid and diabetic profiles of participants. However, intensities at 60% of predicted maximum heart rate and above showed a more substantial impact on reducing the parameters of interest. Moreover, a structured exercise along with diet modification is an excellent strategy for improving modifiable risk factors of CVDs.

References

1.   Andersen LB, Wedderkopp N, Hansen HS, Cooper A, Froberg K. Biological cardiovascular risk factors cluster in Danish children and adolescents: the European Youth Heart Study. Preventive medicine. 2003;37(4):363-7.
2.   Kipping RR, Jago R, Lawlor DA. Obesity in children. Part 1: Epidemiology, measurement, risk factors, and screening. Bmj. 2008;337.

3. Raitakari OT, Juonala M, Kähönen M, Taittonen L, Laitinen T, Mäki-Torkko N, et al. Cardiovascular risk factors in childhood and carotid artery intima-media thickness in adulthood: the Cardiovascular Risk in Young Finns Study. Jama. 2003;290(17):2277-83.

4. Ruiz JR, Castro-Piñero J, Artero EG, Ortega FB, Sjöström M, Suni J, et al. Predictive validity of health-related fitness in youth: a systematic review. Br J Sports Med. 2009;43(12):909-23.

5. McLure S, Summerbell C, Reilly JJ. Objectively measured habitual physical activity in a highly obesogenic environment. Child Care Health Dev. 2009;35(3):369-75.

6. Pan Y, Pratt CA. Metabolic syndrome and its association with diet and physical activity in US adolescents. J Am Diet Assoc. 2008;108(2):276-86.

7. Durant N, Harris SK, Doyle S, Person S, Saelens BE, Kerr J, et al. Relation of school environment and policy to adolescent physical activity. J Sch Health. 2009;79(4):153-9.

8. Van Sluijs EM, McMinn AM, Griffin SJ. Effectiveness of interventions to promote physical activity in children and adolescents: systematic review of controlled trials. Bmj. 2007;335(7622):703.

9. Steele RM, Brage S, Corder K, Wareham NJ, Ekelund U. Physical activity, cardiorespiratory fitness, and the metabolic syndrome in youth. J Appl Physiol. 2008;105(1):342-51.

10. Tjønna AE, Stølen TO, Bye A, Volden M, Slørdahl SA, Ødegård R, et al. Aerobic interval training reduces cardiovascular risk factors more than a multitreatment approach in overweight adolescents. Clinical science. 2009;116(4):317-26.

11. Buchan DS, Ollis S, Young JD, Thomas NE, Cooper SM, Tong TK, et al. The effects of time and intensity of exercise on novel and established markers of CVD in adolescent youth. Am J Hum Biol. 2011;23(4):517-26.

12. Burgomaster KA, Howarth KR, Phillips SM, Rakobowchuk M, MacDonald MJ, McGee SL, et al. Similar metabolic adaptations during exercise after low volume sprint interval and traditional endurance training in humans. The Journal of physiology. 2008;586(1):151-60.

13. Myers J, Prakash M, Froelicher V, Do D, Partington S, Atwood JE. Exercise capacity and mortality among men referred for exercise testing. New Engl J Med. 2002;346(11):793-801.

14. Huang TT-K, Ball GD, Franks PW. Metabolic syndrome in youth: current issues and challenges. Appl Physiol Nutr Metab. 2007;32(1):13-22.

15. Bassett DR, Howley ET. Limiting factors for maximum oxygen uptake and determinants of endurance performance. Medicine and science in sports and exercise. 2000;32(1):70-84.

16. Daussin FN, Zoll J, Dufour SP, Ponsot E, Lonsdorfer-Wolf E, Doutreleau S, et al. Effect of interval versus continuous training on cardiorespiratory and mitochondrial functions: relationship to aerobic performance improvements in sedentary subjects. American Journal of Physiology-Regulatory, Integrative and Comparative Physiology. 2008;295(1):R264-R72.

17. Wisløff U, Støylen A, Loennechen JP, Bruvold M, Rognmo Ø, Haram PM, et al. Superior cardiovascular effect of aerobic interval training versus moderate continuous training in heart failure patients: a randomized study. Circulation. 2007;115(24):3086-94.

18. Kelly AS, Steinberger J, Olson TP, Dengel DR. In the absence of weight loss, exercise training does not improve adipokines or oxidative stress in overweight children. Metabolism. 2007;56(7):1005-9.

19. Strong WB, Malina RM, Blimkie CJ, Daniels SR, Dishman RK, Gutin B, et al. Evidence based physical activity for school-age youth. The Journal of pediatrics. 2005;146(6):732-7.

20. Zimmet P, Alberti KGM, Kaufman F, Tajima N, Silink M, Arslanian S, et al. The metabolic syndrome in children and adolescents–an IDF consensus report. Pediatric diabetes. 2007;8(5):299-306.

21. Lefevre M, Redman LM, Heilbronn LK, Smith JV, Martin CK, Rood JC, et al. Caloric restriction alone and with exercise improves CVD risk in healthy non-obese individuals. Atherosclerosis. 2009;203(1):206-13.