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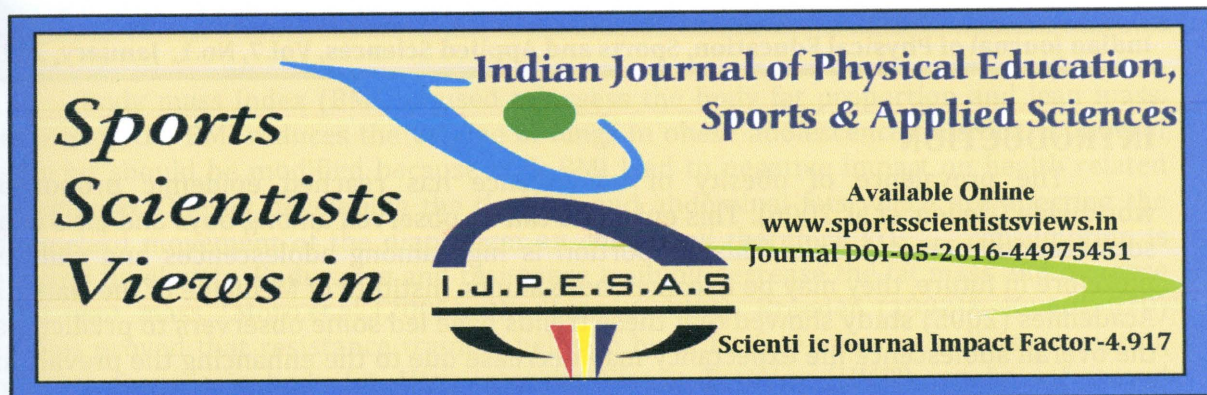
EFFECT OF CIRCUIT TRAINING AND ENDURANCE TRAINING ON SELECTED VARIABLES OF SCHOOL OBESE BOYS

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ABSTRACT

The purpose of the study was to examine the effect of circuit and endurance training on selected variables of school obese boys. To achieve this study, the investigator has randomly assigned ninety (N=90) obese school students, age range of the students were between 16 and18. They were equally divided into three groups such as Endurance Training (ET), Circuit Training (CT) &Control Group (CG) and recruited subjects have undergone 12 weeks of ET & CT. Cycling was considered as Endurance Training and Circuit Training consisted resistance and aerobic training. Control group does not engage any kind of physical activity during this study. Pre test and post test data's were collected from following variables such as Resting Heart Rate (RHR), Body Mass Index (BMI), High Density Lipoprotein (HDL), and VO2max. T test was administered to find out the significant differences between pre test and post test. ET group had significant differences on all the variables and CT group also had significant differences excepted HDL but Control group does not have any significant level so further ANOVA was used to find out the significant on each variables among groups. There, each variable had significant level of differences among groups. It revealed that ET group had significant level of improvement on RHR, HDL and VO_2max compared to CT and CG but BMI level showed significant level of improvement in ET and CT compare to CG therefore they can consider the endurance training an appropriate and non medication training package to prevent the cardiovascular disease and obesity related disease.

Keywords- Circuit Training, Endurance Training, RHR, BMI, HDL, VO_2max

INTRODUCTION

The prevalence of obesity of adolescence has reached epidemic proportion worldwide (Ogden, et.al.,2006). This epidemic can be observed among boys and girls of all socioeconomic class people. This proportion is high among adolescences and children therefore in future, they may be become obese adults. Institute of Medicine of the National Academies (2005) study showed that these trends have led some observers to predict that the overall adolescence life expectancy may decrease due to the enhancing the prevalence of obesity related disease such as type 2 diabetic, cardiovascular diseases and cancer. Wagner,et.al.,(2005) recent study found that gradually changes have occurred in the health status of adolescence due to wrong lifestyle and food habits. Moreover Matton et.al., (2007) recent study found that physical fitness and involving in physical activity have declined worldwide in the last decades among adolescence therefore obesity proportion has been increasing worldwide.

Sri Lanka is a middle income country used to utilize human physical energy by most population and people are middle income family although obesity proportion is increasing. Deurenberg.et.al. (2002) study stated that South Asian adolescents are having high proportion of body fat and abdominal obesity. It was ensured in global health observatory (Gho, 2012) study showed that Sri Lankan adults overweight and obesity proportion were 25.2% and 9.2% respectively. There is no more research studies conducted in Jaffna district among obese. Jaffna district health department make alarm among adolescence to engage any kind of physical activity to control the non communicable diseases of obese adults. Physical activity is a major modifiable determinant of chronic disease (Physical Activity Guidelines Advisory Committee, 2008). The Australian National Physical Activity Guideline(1999) recommended that at least 30 minutes of moderate intensity of physical activity is good for healthy life.

Obesity is characterized by excess fat storage in adipose tissue which is a major cause for cardiovascular disease. Cardiovascular disease is associated with high blood lipids profile such total cholesterol, low density lipoprotein and triglycerides. Those are major risk factors for coronary heart diseases (Wooten, et.al., 2008). Previous research studies have ensured that high level of blood cholesterol can lead to secondary heart disease (Durrington,et.al.,2003) on other hand high level of high density lipoprotein(HDL) prevent from arthrosclerosis and coronary heart disease(Chapman,2006). Previous studies found that an increased percentage of body fat can predict an increased low density lipoprotein (LDL)(Mosca L,1997). Elevated concentration of LDL is associated with coronary heart disease. Regular exercise is remedy to control the LDL. Regular endurance exercise has raised the plasma HDL cholesterol level (Hardman ,el.al., & Tambalis et al., 1999). Kang and Jung, et.al.,(2003) studies reported that 12 weeks of aerobic exercise significantly increased HDL cholesterol in contrast resistance training showed no significant changes after 8 weeks on lipids profiles (Elliott,et.al.,2002). Benz et.al.(2003) study compared the advantages of resistance and endurance training concluded that aerobic exercise lead to enhance performance and had useful impact on individual susceptible to cardiovascular disease. Endurance exercise with proper intensity and duration are more effective than resistance training in increasing the HDL cholesterol. Sallinen et al.,(2007) showed that chronic resistance training schedules by 21 weeks(80% of 1-RM) don't improve blood lipid profile but muscles strength was improved.

Body mass index (BMI) is used to assess the body fat proportion and lean mass. Increasing the BMI reduces the volume of lungs in obese adolescence thus distribution of body fat should be modified because high BMI lead to negative impact on health related parameters. Obesity developing the thoracic and abdominal fats which are affecting the downward movement of the diaphragm on chest wall therefore $VO_{2\ max}$ consumption is affected by obesity. Endurance and resistance training decrease the fat mass and increase total lean mass (Moro,et.al.,(2005): Nindl.et.al.,(2000)). Broeder (1992)& Kwon(2010) studies proved that resistance training helps to build fat-free mass as well as promoting positive changes in body fat. High intensity Circuit Training (HICT) can be a fast and efficient way to lose excess body weight and body fat (Gibala, 2006; Murphy, 1992). Aerobic training is also the most recommended type of exercise in the treatment of obesity (Paoli, 2010). Previous studies found that significant decreases in body weight, body mass index, abdominal fat in aerobic and resistance groups compared to control group (Sigal et.al., 2007).

An increasing in RHR can be harmful to the heart because it can shorten the diastolic period in the cardiac cycle, decreases coronary flow increasing cardiac workload and promote build up of atherosclerotic plaque (Perski A,1988). Always emphasized to reduction of RHR. Reduction of RHR ensured the improvements of physical fitness especially in cardiovascular system. Cardiovascular fitness is good indicator on RHR range. Moreover endurance exercise decrease activation of the sympathetic nervous system, while rising the activity of the parasympathetic nervous system resulting in dropped RHR (Gielen .et.al.,2001). Low RHR is associated with physical fitness, and the RHR can be declined through improving physical fitness (Plasqui,2005). Dashti (2011) recent study found that selected 8 weeks of endurance training significantly changes on RHR.

American college of sports medicine study (2009) found that endurance training had a greater effect on maximum oxygen uptake (VO_2max) and associated cardio-pulmonary parameters, which effectively modifies cardiovascular disease risk factor associated with the development of coronary artery disease on other hand that combined exercise may not effect on VO_2max improvements due to simultaneously resistance and endurance training. Santos, (2011) study found that VO_2max increased significantly only in the endurance training group after 8 weeks.

Obese adolescence need to select appropriate type of training package which must be possible to obese adolescences therefore cycling is a possible method of training and subjects may involve with enthusiasm further improve better cardio respiratory fitness than other type of exercise and has high compliance for obese boys to prevent from non communicable disease. Circuit exercise is taxing less nature of aerobic to working muscles. So circuit type of exercise may be appropriate to obese subjects to do efficient work moreover circuit type of training improve the muscular efficiency and decrease the fat mass therefore aim of the present study was to examine the effect of endurance and circuit training on health variables among obese school boys. This study hypothesize that endurance training may have positive impact on VO_2max and HDL on other hand the circuit exercise may have optimistic effect on muscular strength and BMI.

METHODOLOGY
Subjects
The school obese boys, who's followed their studies in Jaffna zonal schools. They were recruited for this study by school advertisement. The random obese subjects were answered a questionnaire, which possesses information about personal data, sports participation, and medical history. Recruited subjects have completed a preliminary medical history, exercise questionnaire and written informed consent from participants and parents. According to questionnaire reports, 17 subjects were excluded from study due to recently surgery, unwillingness, arthritis, physical abnormalities. After the medical screening, each potential subjects were examined by physician specializing in family practice and sports medicine, who excluded 12 subjects from this study due to abnormal heart rate, hypertension and chest pain. Finally ninety one (90) healthy obese school boys were assigned for this study. Assigned subjects were healthy and untrained. They were randomly divided into three groups such as Endurance Training (ET=30), Circuit Training(CT=30)&Control group(CG=30). Subjects age ranges were between 16 and 18 years.

Endurance Training Protocol
Endurance training session started with 5-10 minutes warm up. Participants performed cycling training 3 days (Monday, Wednesday, Friday) per week consecutive for 12weeks under the guidance of qualified trainee in sports science and supervised by researcher. Subjects used Lumula products gents bicycle. Cycling training performed in free pathway road which don't have traffic jam or rush in certain place. Intensity of cycling training was 50% to 60% until 30 minutes duration. Exercise duration has been increased by 5 minutes in every couple weeks until 12 weeks. Subjects worse Polar Finland monitor (Polar USA, Inc, Woodbury,(NY) to measure the heart rates during training. 6 polar Finland tools used in one time for 6 subjects, their heart rate was recorded then replaced other 6 subjects this system followed for entire subjects. To design intensity of aerobic exercise that investigator has used the maximum heart rate secured during maximal graded test. During the test, during the training to assess exercise intensity investigator used Karvonen formula to establish the heart rate reserve (HRR).

Circuit Training Protocol
Circuit training was preceded by 5 to 10 minutes warm up performed 3 alternative days (Tuesday, Thursday, Friday) of a week. Circuit training consisted aerobic and resistance type of exercise. Subjects were taught appropriate circuit training technique. All exercises were fully demonstrated by trainee to subjects of CT group. They attempted some trails before starting the first session of intervention. Ten stations were engaged in one session of circuit, subjects performed 30 second exercise in a station followed 30 second recovery. During exercise the subjects have to complete as many repetitions as possible in 30 second. 5minutes rest was allotted to subjects after successfully completed one circuit of ten stations. One circuit session started from 25 minutes to lasted 55 minutes.

Statistical Analysis
All the value of selected parameters was expressed as mean and standard deviation. T test was used to find out significant differences between pre test and post of all the variables further Analysis of Variance (ANOVA) test was administered among group to find

out the significant differences. In each case the significant level was chosen at 0.05 levels. All the data was interpreted by using Minitab-14 version of statistical software.

RESULTS

RHR, BMI, HDL&VO2max were recorded in pre and post test of training, which test means(M), standard deviation(S.D), P values and F values are shown in table I.

TABLE- I
RHR, BMI, HDL&VO₂ MAX DESCRIPTIVE STATIC, F & P VALUES ARE SHOWN

Variables	Type of Group	Pre-test M±SD	Post-test M±SD	T-test P Value	F-Value	P-Value
Resting Heart Rate(RHR)	ETG	80.23±3.99	69.93±3.24	0.000		
	CTG	80.03±4.98	73.83±4.96	0.000		
	CG	78.70±3.95	79.00±3.57	0.455	38.84	0.000
Body Mass Index(BMI)	ETG	36.30±4.25	27.73±3.61	0.000		
	CTG	38.30±3.33	28.03±4.19	0.000		
	CG	36.90±5.10	37.30±5.61	0.206	42.82	0.000
High Density Lipoprotein (HDL)	ETG	23.83±3.51	31.46±5.15	0.000		
	CTG	26.03±3.59	24.70±6.82	0.374		
	CG	25.16±3.86	25.33±3.49	0.646	14.74	0.000
VO₂Max	ETG	35.90±3.85	56.13±5.82	0.000		
	CTG	37.06±3.29	43.40±5.31	0.000		
	CG	37.16±4.77	37.43±4.43	0.368	100.5	0.000

TABLE II
RESTING HEART RATE OF INDIVIDUAL 95% CIS MEAN FOR BASED ON POOLED STANDARD DEVIATION

	N	Mean	St.Dev	Individual 95% CIs Mean for Based on Pooled St Dev
				+ + + + 69.0 72.0 75.0 78.0
ET	30	69.933	3.248	(-------*----------)
CT	30	73.833	4.963	(--------*-----)
CG	30	79.000	3.572	(-------*--------)

TABLE III
BODY MASS INDEX OF INDIVIDUAL 95% CIS MEAN FOR BASED ON POOLED STANDARD DEVIATION

	N	Mean	St.Dev	Individual 95% CIs Mean for Based on Pooled St Dev
				+ + + + 28.0 31.5 35.0 38.5
ET	30	27.733	3.610	(-------*-----)
CT	30	28.033	4.198	(--------*-----)
CG	30	37.300	5.615	(-------*--------)

TABLE IV
HIGH DENSITY LIPOPROTEIN OF INDIVIDUAL 95% CIS MEAN FOR BASED ON POOLED STANDARD DEVIATION

	N	Mean	St.Dev	Individual 95% CIs Mean for Based on Pooled St Dev
				+24.0 +27.0 +30.0 +33.0
ET	30	31.467	5.151	(-------*-----------)
CT	30	24.700	6.819	(--------*-----)
CG	30	25.333	3.497	(-------*--------)

TABLE V
VO2 MAX OF INDIVIDUAL 95% CIS MEAN FOR BASED ON POOLED STANDARD DEVIATION

	N	Mean	St.Dev	Individual 95% CIs Mean for Based on Pooled St Dev
				+36.0 +42.0 +48.0 +54.0
ET	30	56.133	5.818	(---*------)
CT	30	43.400	5.315	(--------*-----)
CG	30	37.433	4.431	(-------*--------)

According to this table, significance (P<0.05) differences observed between pre test and post test of ET and CT group, excepted HDL of CT. There were no significant differences between pre and post test of CG. ET (80.23) and CT(80.03) baseline mean of RHR were similar but ET(69.93) and CT(73.83) intervention results were significant difference, which is shown in Table II. Significant level of differences could be observed in BMI parameter between pre and post test of ET and CT. After intervention BMI mean value decreased among ET and CT but there were no significant differences between ET and CT but both(ET&CT) had significant difference compared to CG. HDL of CT does not have significant differences between pre and post test but ET had significant level of differences between pre test and post test, ET had significant level of difference compared to CT and CG.VO2 max was significant differences between pre and post test of ET and CT. both group had significant differences compared to CG, further significant difference observed between ET and CT in VO2.max.

DISCUSSION

Resting Heart Rate (RHR) is an important indicator of cardiovascular disease and a powerful marker of cardiovascular health (Palatini, 1997). A low RHR indicates the good health condition. Whereas higher values are apparently related to a higher mortality risk (Greenland, 1999). Exercise and weight reduction are ways to reduce the RHR as well as ET also has reduced heart rate (Iaia,2009; Ricci, 1982; Swank,2010).It was ensured in present study that ET and CT groups BMI level also significantly reduced which significantly decreased the RHR and increased VO2max capacity. However Table II is showing, there were significant differences between ET &CT.

According to Suzanne Steinbaum (2014) an untrained healthy person average RHR is 50 to 70, in this study that ET had good positive impact on RHR (69.93) after 12 weeks as well as CT group also had significant level of improvement on RHR (73.83) but which is beyond the normal range. According to Harvard Health Publication (2009) heart rate higher than 76 beats per minutes at resting, which may be linked to a higher risk of heart disease and indicate the degree of aerobic condition. Peterson (1988) showed that heart

rate was directly related to the percentage of body fat. There is evidence that elevated resting heart rate (>80-85 beats/min) is directly associated with risk of developing atherosclerosis, hypertension, and plaque disruption leading to various cardiovascular events (Palatini, 2009). Objective of this study is to identify the suitable training package for reducing the heart rate because positive reduction of heart rate, which is highly correlated with VO$_2$ max improvement if the VO$_2$ max had significant improvement definitely there should be weight reduction on subjects, it was ensured in present study, the study revealed that weight reduction led to low RHR. On other hand high proportion of body fat is a big barrier to promote the RHR and VO$_2$ max. Vanderburgh, (1996) & Nevill (1992) studies revealed that negative correlation between body weight and VO$_2$ per unit of body weight. Welsman (1996) highlighted this relationship ensured that heavier person has lower oxygen uptake and hence, low aerobic condition which increase RHR. Further Table IV is showing that RHR had significant differences among group particularly ET group which had good improvement than CT group, it indicates that low RHR is associated with good cardiovascular fitness and low or lack of cardiovascular fitness is associated with heart disease so obese person or overweight person may have low cardiovascular fitness so this study make alarm that they have to involve endurance activity. Dashti (2011) reported that 8 weeks of selective endurance exercise decreased the RHR.

High BMI value (more than 25) and obesity are highly associated with heart diseases and reduced the life expectancy. Most of the obese adolescences were not born with obese. When they fall into adolescence then BMI proportion dramatically increased. Colditz (1990) study makes alarm that weight is gained after 18 years of age, which increases cardio- vascular risk. BMI is a numerical representation of the weight to height and helps determine the lean tissue to fat ratio in your body. High BMI may affect the heart and respiratory system through its influence on known risk factor like dyslipidemia, hypertension, glucose intolerance, inflammatory marks, obstructive, sleep apnea, hypoventilation and prothrombotic.

Obesity has negative effects on respiratory well being too because which decrease the lung volume. Besides the obesity ensure high fat in abdominal and thoracic fat that affect downward movement of the diaphragm and on chest wall properties. In present study BMI level significantly controlled by ET and CT but range was more than (>25) which stage is not a healthy stage however during 12 weeks significant level was reduced. Based on BMI we can predict recovery rates of exercise. Recovery rate is associated with heart rate and heart rate determines the fitness level. Reduced aerobic fitness and exercise capacity are closely related with the level of cardiopulmonary fitness and commonly observed finding in patients with high body mass index (BMI)(Rowland, 1991;Reybrouck et al., 1997). Despres et al. (1990) & Young et al. (1995) studies ensured that adolescence proved the aerobic fitness is associated with reduction in risk related to later cardiovascular system. Cardiovascular disorder due to obesity result in increased morality from complication such as coronary artery disease, heart failure, arrhythmias and sudden death. Thyagarajan et al. (2008) confirmed that individual with a BMI $\geq$ 26.4kg/m^2 had reduction in force expiratory volume (FEV).There is negative relationship between the overweight and force vital capacity. Thyagarajan (2008) confirmed that who gain more weight they drop in force vital capacity(FVC) and decreased the total lungs capacity too(Saliman(2008);Zerah (1993); Jones (2006) but who is normal weight had significant increment in total lungs capacity compared to those moderate or morbid obesity.

Endurance exercise is mostly proposed for obese to have good effect on physical characters it was confirmed in this study and Choi, Kang (2000) ;Sung et al. (2001) studies which have shown that continuous aerobic exercise can help obese people to lose weight and body fat but obese subjects naturally have poor aerobic condition compared to normal range of BMI (>25). Previous studies recommend that resistance training may offer a more accepted form of training to children and adolescence. This study author agreed with his study because CT had good impact on BMI parameter in this study and no significant differences were observed between CT and ET on BMI parameter.

.   Lipid profile is one of the signals for cardiovascular disease. It can be maintained by healthy food and exercise, there are five types of lipids available in human body. It is classified as high density of lipoprotein (HDL), low density lipoprotein (LDL), very low density lipoprotein (VLDL), triglyceride (TG) and total cholesterol (TC). Among this cholesterol, the LDL is one of the dangerous substances for cardiovascular disease. There is relationship between LDL and HDL because increasing the HDL decreased the LDL and other cholesterol effect. High levels of HDL cholesterol are an indicator of a healthy cardiovascular system (Carroll 2012). Balas-Nakash et al. (2010) research studies showed that endurance exercise improve the lipid profile than other type of exercise it was confirmed in present study that there were significant differences between ET& CT, CG but there were not any significant level differences between CT and CG. Sallinen, (2007)showed that resistance training does not improve lipids profile due to limited improvements in VO2max, which was confirmed in present study that highlighted high VO_2 max has positive correlation with HDL level. Several studies confirmed similar result on endurance exercise which reduced total cholesterol triglyceride, and LDL and increased HDL but resistance training were negative effect on lipids profile (Kelley,2008). Elliott, Sale, & Cable (2002) conducted an 8 week of resistance exercise that showed no significant improvement on lipid profile.

Després (1991) confirmed that regular endurance exercise is a widely recognized modality to raise HDL cholesterol level. Low HDL is independent risk factor for cardiovascular disease. It was proved in Franceschini, (2001)& Boden (2000) studies which expressed the low blood levels of High Density Lipoprotein cholesterol (HDL-C) are independent risk factor for CVD. Some studies proved that reducing the abdominal fat which improves the HDL cholesterol. Kokkinos (1991) study ensured that strength type of exercise result were no beneficial changes in lipids profile. According to several research studies that lipids profile changes are depend on length of exercise it was confirmed in kikkinos (1995)study which proved the significant level of HDL improvement could be observed whose average run 7 to 10 miles per week further he reported that better HDL improvement could be observed on weekly mileage than exercise intensity further it proves that VO_2 max and HDL have significant level of correlation. Increased exercise practice, particularly endurance exercise, has been considered one of the best non-pharmacological strategies in preventing and treating cardiovascular disease. In present study the HDL level had significant level of differences between ET and CT due to cardiovascular capacity. It is now fairly well recognized that endurance exercise training can increase plasma HDL cholesterol (Durstine, 1994). Another finding proved that trained endurance athletes have higher HDL_C values compared to sedentary population (Haskell, 1984).

VO2max is one of the important indices to assess the obese cardio vascular fitness because low cardiovascular fitness may lead to cardiovascular disease. Low cardiovascular fitness may be linked with high proportion of body fat or BMI. Chatterjee,et.al.,(2005) studies also proved that high proportion of fat deposit decreased the VO2 max improvement and withdrawal of fat proportion increased the VO2 max (Bandyopadhyay, et.al., 2003) it could be observed in present study that BMI proportion was reduced by ET & CT and those group significantly improved VO2max. Heyward, V (1998)&Jump up Guyton, (2011) recommend that untrained healthy male will have VO2max approximately 40mL/(kg·min). According to appendix- D ET &CT group of VO2max is under healthy stage but significant differences can be observed between ET and CT group. It is unclear because BMI level does not have significant differences between ET and CT but VO2max level contrast further research is necessary. Some investigators found that type of training may be influenced on VO2max. Hill et. al., (2007) &Tomassoni et al., (1985) studies found that improving body composition, BMI and muscles mass by training which proved improvement on VO2max.

CONCLUSION

Obesity leads to many non communicable disease therefore appropriate of exercise may prevent from the diseases. Endurance and circuit training are one of effective packages on health variables. Endurance training has been greater impact on all the variables compare to CT and CG. However CT had improved significant level in BMI but it has not showed better improvement than ET on VO2max, HDL and RHR therefore present study revealed that endurance training showed better improvement on selected variables which detect from heart disease.

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