

Effectiveness of High Intensity Exercise Program on Cardiovascular Endurance in Overweight Children

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Overweight is defined as excessive or abnormal accumulation of fat that produces risk to health. The childhood overweight is epidemic, accelerating throughout the world and the fundamental cause of overweight is an energy imbalance between calories consumed and expended. The main objective of the study was to find the effect of high intensity exercise program on cardiovascular endurance in overweight children. Quasi experimental study, pre and post test type, Study duration is 4 weeks at Sree Sankara balavidhyalaya school pallikarani. Thirty overweight children were divided into two groups Group A=15, Group B= 15. Both Group A and Group B performed six minute walk test and distance walked in 6- minute was measured and recorded. Group A: high intensity exercises were taught to them along with that diet chart was given. Group B: The diet chart was given to them. After 4 weeks the post test was conducted and the data were analyzed. The outcome measure VO_2 max was calculated by 6 -minute walk test. The post test mean value of Group A is 20.3 and Group B is 17.58, statistical result shows that there was significant change in mean values between pre and post test. Thus both Group A and Group B mean values show statistical significance $p < 0.05$. The study concluded that the high intensity circuit training program with diet was effective when compared to diet protocol among overweight children.

Keywords: BMI Percentile; Diet Chart; High Intensity Exercise; Overweight children; Six Minute Walk Test.

The overweight is defined as “excessive or abnormal fat accumulation that presents a risk to health” (WHO) ¹. The childhood overweight is epidemic, accelerating throughout the world and it is also due to change in dietary habits, environment and genetics and lack of physical activity. The children who are overweight will face certain increased risk of compromised physical health like juvenile diabetes, hormonal imbalance, hypothyroidism, hypertension, cardiovascular disease, shortness of breath, high cholesterol

levels, fatty liver disease and mental health like teasing, poor self-esteem, depression. Identifying childhood overweight in early stage during their schooling helps in preventing disease progression in adulthood². There should be combination of physical activity with healthy eating is most effective way to lose weight in overweight as well as in obese children. The overweight or obese children should perform physical activities for at least 30 minutes per day.

The obesity and overweight prevalence rate among preschool children in south India 4.5% and 1.4%³, overweight prevalence in Delhi schools overall prevalence 1.0% and 24%⁴. Obesity and overweight prevalence in south Karnataka among school children prevalence 9.9%, boys 9.3% and girls 10.5%⁵, overweight and obesity prevalence in age group of 5 to 15 years rural school children in Coimbatore prevalence 3.03%, boys 50.7%, girls 49.3%⁶. Globally there are least 300 million of obese adults and almost more than 1 billion adults were seems to be overweight⁷. The overweight girls are attaining early puberty, menarche in there adulthood. The children above 85th to 95th percentile are considered as overweight which is calculated in BMI percentile⁸. The objective evaluation of functional exercise capacity can be assessed by six minute walk test which is easy and quick to administer, reproducible and more reflective activities of daily living⁹. The 6 minute walk test is used to evaluate one's individual functional exercise capacity and is reliable and valid test. Six minute walk test is used as an assessing tool in weight reduction program which is used before and after the exercise program to identify possible predictors of 6-minute walk test in overweight adolescent and children¹⁰.

The high intensity circuit exercise can burn calories and fat in short duration, improving cardio respiratory fitness and it is safe and well tolerated and can improve oxygen consumption. Some studies show High intensity Circuit Training burns more calories that is 25 to 30 % than cycling, resistance training and treadmill running¹¹. The high intensity intermittent exercise (High intensity circuit training) has been shown effective as a result of greater amount of fat loss¹². The evidence shows us that high-intensity intermittent exercise (High intensity circuit training) has the greater potential to be an economical, effective and beneficial exercise protocol for reducing weight of overweight individuals¹³.

METHODOLOGY

The study design was Quasi – Experimental and study type was pre and post test type. 30 subjects were selected according to their convenience. The study setting was school children in Sree Sankara balavidhyalaya school pallikaranai.

The study was to identify the effectiveness of high intensity exercise program on cardiovascular endurance in overweight children..

In this current study 30 Participants were chosen according to inclusion and exclusion criteria. The Procedures was clearly explained to the children and their parents. Prior to the study the participants and the parents were asked to fill the concern form to participate in the study. They were assessed with 6 minute walk test after that high intensity exercise was taught to the overweight children. The exercises were clearly demonstrated to the children with the help of videos.

Then the children was included in the study according to some criteria with age group of 8 – 10 years both boys and girls with BMI of overweight children of 85th -95th percentile were included in the study and exclusion criteria like Cardiovascular diseases, Hypertension, Congenital heart diseases, Dyspnea, Metabolic disorder like Juvenile diabetes, Any Orthopedic problems like upper limb fracture and lower limb fracture, slipped capital epiphysis and the children who refuses to do the 6 minute walk test.

The high intensity exercise was prescribed by 7- minutes circuit training intervention was done for 4 weeks and in pre and post - test six minute walk test was done to estimate sub maximal exercise tolerance in overweight children as an outcome measure. Before starting high intensity exercise program the overweight children were asked to perform warm up for 5 minutes like brisk walking, and running and cool down exercises for 5 minutes like arm cross over, hamstring stretch, quadriceps to reduce stress to the heart and other muscles. After warm up first one week familiar high intensity circuit training exercises was taught to the overweight children then gradually all the 12 sets of exercises were done

30 samples were divided into two groups where GROUP A=15 (experimental group) 6 minute walk test was performed and the distance walked in six minute was measured and recorded then the high intensity exercise was taught to them along with that diet chart was given to the Group A children. GROUP B=15 (control group) 6 minute walk test was performed and distance walked in six minute was measured and recorded and diet chart was given to the Group B children. After 4 weeks post test was conducted.

6 minute walk test equation $v_{O_2 \max} \text{ (ml.kg}^{-1}.\text{min}^{-1}) = 0.03 \times \text{distance (m)} + 3.9$

Table 1: shows that Group A- the high intensity circuit training exercise protocol was performed for approximately for 7 minutes and time period of 4 weeks. First one week familiar exercises was done. All the 12 sets of exercises like jumping jacks, wall sit, abdominal crunches, squat, step up onto chair, high knees, Triceps dip on chair, lunge, plank, push up, push up and rotation, side plank these exercises can be repeated as a circuit for 2 to 3 times and 30 seconds of rest or less than that can be given between exercises and the total duration was 20 minutes to 30 minutes.

GROUP-B : DIET PROTOCOL

Group B overweight children were treated with diet protocol for 4 weeks. The overweight children were asked to consume healthy foods like vegetables, fruits, whole grains etc., protein rich foods like meat, fish, and eggs, beans, peas, soy products etc. The fat free and low fat milk products was given to the children such as soy beverages with calcium and Vitamin-D. The green leafy vegetables was given every day such as carrot, cucumber etc. Fruits like 1 – medium size banana, 1- medium size apple, 1 – cup grapes was taken regularly in the morning. The children were strictly informed not to take fast food items and they were informed not to eat food while watching , TV.

Table 1. High Intensity Circuit Training Exercise Protocol (Group A)

Time Period	Total Duration	Rest Between Exercise	Main Exercise Phase
4 Weeks	Duration at least 20 minutes to 30 minutes.	30 seconds of rest or less than that.	Exercises are performed for 30 seconds of rest time between bouts. Total time for the entire circuit workout is approximately 7 min. The circuit can be repeated for 2 to 3 times, progressively 1. Jumping jacks 2. Wall sit 3. Abdominal crunch 4. Step- up onto chair 5. Squat 6. High knees / running in place 7. Triceps dip on chair 8. Lunge 9. Push up 10. Plank 11. Push up and rotation 12. Side plank

Table 2. Dietary Protein Intake to Balance the Energy for Vegetarian and Non Vegetarian Subjects

Food Group	Food	Portion
Milk products	Milk	1 cup
Protein	Cheese	30 Grams
	Yogurt	1 cup
Veggies	Dry beans,	1 cup cooked,
	Peanut butter	1 – 2 table spoons
Fresh fruits	All vegetables	½ cup
Grains	Juice	½ – 1 cup
	Cooked	½ – ¼ cup

The above table 2: shows that the Dietary protein was taken in portion and it was followed regularly to balance the energy and protocol was followed by both vegetarian and non - vegetarian children.

RESULTS

According to Table 3 , the Group A mean values of High intensity circuit training exercise program and diet protocol pre and post values are 14.47 and 20.3 mean values respectively. As p value <0.05, statistical result shows that there is statistical difference in mean values of High intensity circuit training program and diet

According to Table 4 , the Group B mean values of Diet. The pre and post test values are 15.64 and 17.58 mean values respectively. As p value <0.05, statistical result shows that there is statistical difference in mean values of Diet protocol.

According to Table 5 and Bar diagram 1, the Post test mean values for the Group A of high intensity circuit training exercise program along with diet and control Group B diet protocol is 20.3 and 17.58 .By comparing the post test mean values of Group A and Group B shows that the high intensity circuit training exercise program with diet was effective when compared to diet alone. Statistical result shows that there is a significant difference in mean values of High intensity circuit training exercise with diet and diet protocol.

DISCUSSION

The study is aimed to find the effectiveness of high intensity exercise program on cardiovascular endurance in overweight children. Statistical analysis of this study showed that there is significant difference between mean values of high intensity circuit training exercise along with diet and diet protocol which is 20.3

Table 3. Pre and Post Test Mean Values of Vo_2 Max of Group- A

Six Minute walk test	Mean	n	Standard deviation	Standard error Mean	t –value	Significant (2-tailed) P value
PRE TEST	14.47	15	1.969	.50862	-12.552	.000
POST TEST	20.30	15	1.068	.27589		

Table 4. Pre Test and Post Test Mean Values of Vo_2 Max of Group –B

Six Minute walk test	Mean	n	Standard Deviation	Standard Error Mean	t–value	Significant (2-tailed) P value
PRE TEST	15.64	15	1.910	.49327	-3.360	.005
POST TEST	17.58	15	2.083	.53799		

Table 5. Post Test Comparison Between Group A and Group B Mean Values of Vo_2 Max

Six Minute walk test	Mean	n	Standard deviation	Standard error mean	t -value	Significant (2 tailed) P value
POST GROUP A Experimental	20.30	15	1.06	.2758882	4.4	.000
POST GROUP B Control	17.58	15	2.08	.5379857		

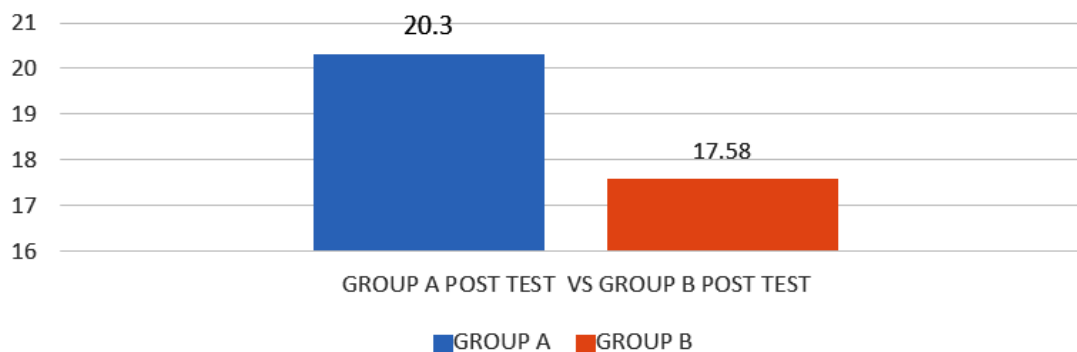


Fig. 1. Post Test Comparison Between Group A and Group B Mean Values of Vo2 Max

and 17.58 respectively. As p value <0.05 . The study showed there is significant difference in high intensity circuit training exercise and diet protocol in overweight children. When compared to Group B, the Group A showed more improvement within 4 weeks.

The aerobic exercise improves oxygen transport and increase in trained muscles capacity to mobilize and oxidize fat¹⁴. It also produces metabolic adaptation in the different types of muscle fibers. Cardiovascular and respiratory systems were interlinked with both functional and dimensional systems such as heart rate, stroke volume, cardiac output and blood flow and distribution. It also enhances the respiratory functions which alters performance and body composition changes. During exercise the cardiac output is diverted to the working muscle. There is increase in blood flow during exercise and also increase in cardiac output.

Risk factors associated with high intensity circuit training are initial fitness level, intensity, duration, frequency and type of exercise. Brief bouts of interval and continuous training enhances aerobic capacity and fitness. The main goal of aerobic exercise was to improve overall cardio respiratory health and boosts heart health. Aerobic exercises not only help to reduces cholesterol and reduces the risk of type 2 diabetes mellitus, lowers blood pressure and improves immune function. The aerobic training increases the activity of mitochondria, capillarization of trained muscle and also enhances oxidization of fat and carbohydrate¹⁵.

The reduced calorie intake contribute to effectiveness of weight loss. Compared to

starvation as it only gains reduced weight as new body mass of total percentage of body fat. The high protein diet is potentially lethal as it suppresses appetite altering body's fat mobilization and forms ketone bodies. Regular aerobic exercise even without dietary restriction brings conventional changes in body mass and composition. Many recreational activities such as sports and games where effective in reducing body mass and increase in number of burned calories. So there will be weight loss through dieting and it is dramatic and sustained reduction in metabolic rate.

The ideal combination is diet plus exercise which offers more flexibility in fat loss than either exercise or diet alone and also achieving negative caloric balance. Children normally need certain number of calories each day that they use as energy for their daily activities such as walking, breathing and it ranges from 2000 calories for 7-10 years children. If a child consumes excess food and calories than those excess calories are converted into fat in overweight and obese children. The high intensity circuit training exercise burns the fat in less time. In terms of reducing the body fat, however when combining diet and exercise was most effective approach to weight loss.

The results of this study go in hand with results of Tremblay A et al., concluded that High-intensity circuit training exercise usually used to reduce body weight. The circuit training exercise results in muscle building along with fat reduction and increased calorie burn¹⁶. Brett Kilka et al., stated that high-intensity circuit training was said to be effective and also helps reduce body fat, improves insulin sensitivity, muscular fitness and improves sub maximal exercise tolerance¹⁷.

Figueroa-Colon Ret al., reported that the diet has shown weight loss but was not much effective in long term weight loss in children¹⁸. Leonard H. Epestein et al., concluded that diet alone was given to the one group of obese children and there was slight decrease in the body weight where as diet plus exercise was given to the children that showed significant difference and was more effective¹⁹. Epstein LH et al., concluded that following balanced diet regularly along with exercise which shows change in the health status and morphology²⁰.

So this study also concluded that there was significant difference between Group A (high intensity circuit training exercise and Diet) and Group B (Diet). Therefore High intensity circuit training was more effective when compared to diet, in overweight children.

CONCLUSION

The study concludes that the effectiveness of high intensity circuit training program with diet modification was effective in reduction of weight in overweight children. Childhood obesity has attained epidemic levels. Which we use the terms overweight and obese here in to convey the magnitude of risk factors associated with excess weight gain in children. Limitations of the study were sample size was small, Only high intensity exercises and diet were given, Study duration was less, More concentrated on aerobic exercises, The study has concentrated on age group of 8 -10 years. Recommendations for the study are further study can be done with larger sample size, Same study can be repeated in adult population, Apart from six minute walk test we can assess the child's joint position of ankle and knee and movement pattern etc, Mobile applications can be used to do exercises.

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Ethical Clearance

Departmental Ethical clearance was obtained.

Conflict of Interest

Nil

Source of Funding

Self

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