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Effect Of 4 weeks Of Inspiratory Muscle Training As An Adjunct To Anaerobic Exercises On Aerobic Fitness Amongst Overweight Children Aged 13 to 18. A Randomized Control Trial.

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INTRODUCTION

The prevalence of overweight children in the age group of 13 to 18 years was 17.8% for boys and 15.8% for girls in India. The prevalence of diabetes mellitus (DM) and cardiovascular disease (CVD) is increasing in urban India. Overweight in adolescence is a marker of overweight in adult age, and it shows an association with the above diseases. Life style factors influenced BMI in adolescent age. (1)
Prevention could be the key strategy for controlling the current epidemic of obesity.
Prevention may include primary prevention of overweight or obesity, secondary prevention or prevention of weight regains following weight loss, and avoidance of more weight increase in obese persons unable to lose weight. Prevention may be achieved through a variety of interventions targeting built environment, physical activity, and diet. Some of these potential strategies for intervention in children can be implemented by targeting preschool institutions, schools or after-school care services as natural setting for influencing the diet and physical activity. All in all, there is an urgent need to initiate prevention and treatment of obesity in children. (2)
Obesity causes multiple systemic complications, some of which result in severe impairment of organs and tissues. Obesity affects the respiratory system by several mechanisms, including direct mechanical changes due to fat deposition on the chest wall and abdomen which causes mechanical disadvantage to the inspiratory muscles.hence there is a decrease in respiratory system compliance and functional capacity. (3)

NEED OF STUDY

In normal respiration, the diaphragm contracts, pushing the abdominal contents down and forward. At the same time, the contraction of the external intercostal muscles pulls the ribs upward and forward. Due to the deposition of adipose tissue, this mechanism is impaired because the excess body fat that lines the chest and occupies the abdomen limits the action of the respiratory muscles. These structural changes in the thoracic-abdominal area restrict diaphragmatic mobility and rib movement, which promotes changes in the dynamics of the respiratory system and reduces its compliance, leading to mechanical impairment of the respiratory muscles which reduces the functional capacity and hence endurance is reduced.
Aerobic capacity is the capacity of large skeletal muscle groups to adapt to work by using energy obtained as a result of aerobic metabolism. VO2max is a good indicator of aerobic capacity and is considered to be an indicator of the physiological integration of pulmonary,

cardiovascular and neuromuscular functions. It was found that anaerobic training caused a high level of difference in terms of aerobic capacity values, and thus increased aerobic capacity. (4)

Inspiratory muscle training (IMT) is currently used in pulmonary rehabilitation to increase the strength and endurance of the inspiratory muscles. It is proven that IMT has improved respiratory muscle function and exercise tolerance in COPD patients. (5)

AIM

To study the effect of inspiratory muscle training on aerobic fitness among overweight children from age 13 to 18 at the end of 4 weeks.

OBJECTIVE

To see the effect of inspiratory muscle training on aerobic fitness amongst overweight children aged 13 to 18.

HYPOTHESIS

Null hypothesis (H0) - Inspiratory muscle training will have no effect on aerobic fitness amongst overweight children aged 13 to 18 at the end of 4 weeks.

Alternate hypothesis (H1) - Inspiratory muscle training will have effect on aerobic fitness amongst overweight children aged 13 to 18 at the end of 4 weeks.

METHODOLOGY

- Study design - Randomized control trial
- Sample size - 52
- Sample method - Random sampling
- Allocation: chit method
- Study population - males and females of age 13 to 18
- Study setting - schools and playgrounds in and around the city
- Study duration - 6 months
- Duration of intervention- 4 weeks

PROCEDURE

The project was started with the presentation of synopsis and ethical clearance from the ethical committee of PES modern college of physiotherapy was taken. Samples were selected according to the inclusion and exclusion criteria. The nature of study was explained and written consent was obtained from the patients prior to the study. Participants were divided in 2 groups randomly by the chit method. Pre-intervention cooper run test was done. Participants in group 1(control group) followed the aerobic exercise protocol and group 2 (interventional group) followed both aerobic exercises and inspiratory muscle Training.

Inclusion criteria

Age group between 13 - 18

Both males and females

Bmi between 85-95 percentile (overweight category) according to the CDC guidelines.

Exclusion criteria

Patients with cognitive impairments

Individuals who are contraindicated to maximal exercise tolerance testing.

MATERIALS
Marker cones
Stopwatch
Measuring tape
The inspiratory muscle training device
Recording sheets
Pen
Assent form
Consent form

OUTCOME MEASURE
The cooper 12-minute run test
Developed in the 1960s by Dr Cooper, the 12-minute run test measures how far a person can cover (run, walk, jog) in 12 minutes. The purpose of this test is to measure aerobic fitness (6)

EXERCISE PROTOCOL
An appropriate Warm up and cool down before and after the exercise session.
GROUP 1
Aerobic exercise protocol
12 key aerobic and strengthening exercises of all the major muscle groups (3days/ week)

GROUP 2
Aerobic exercise protocol
12 key aerobic and strengthening exercises of all the major muscle groups (3days/ week)

Inspiratory muscle training (5)
Duration - 15 mins. Frequency - twice in a day, 5 - 7 days per week. Intensity - 30 to 50% with incremental load.

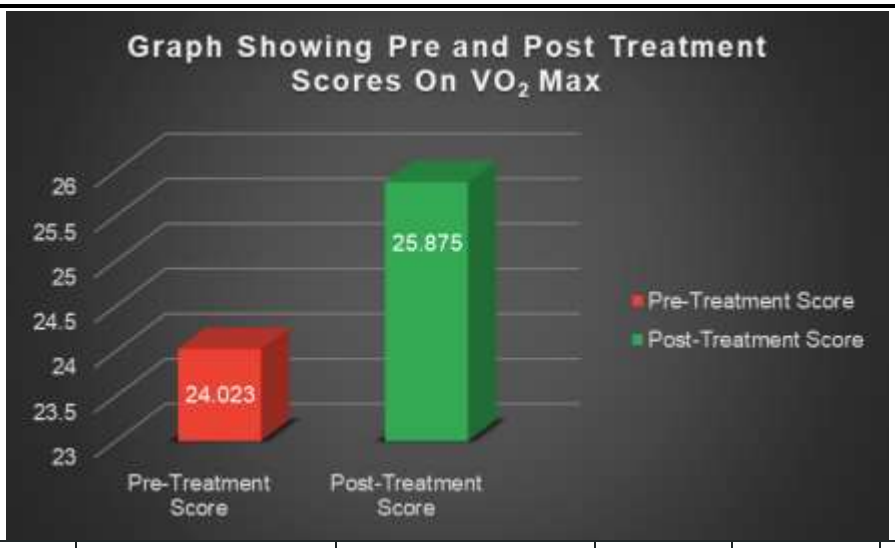
Aerobic exercise protocol
1. Jumping jacks
2. Wall sits
3. Push up
4. Abdominal crunch
5. Step up
6. Squat
7. Triceps dip
8. Plank
9. High knees
10. Lunge
11. Push up and rotation
12. Side plank

After 4 weeks post-intervention cooper run test was done.

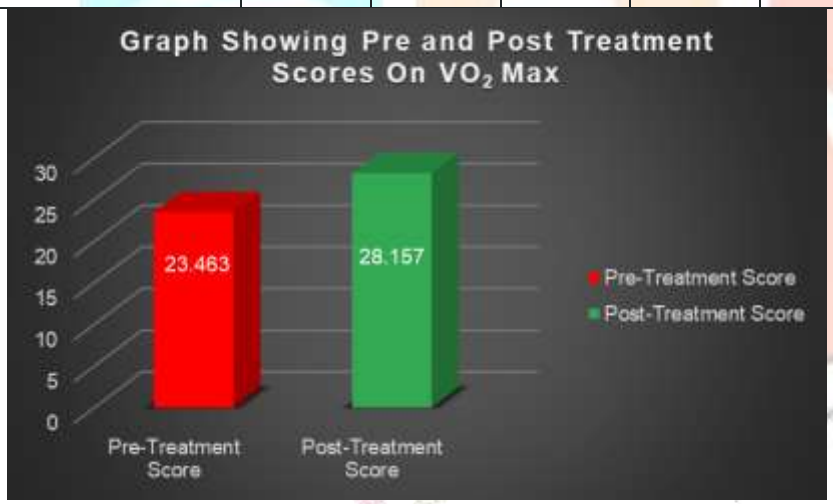
Statistical Analysis and Result

The data was statistically analysed using microsoft excel sheet and GraphPad.com. Unpaired t-test was used to obtain the difference between post intervention values in Group A and group B. Various statistical majors such as Mean , Standard Deviation and test of significance were used to analyse the data. The data is represented in graphical format.

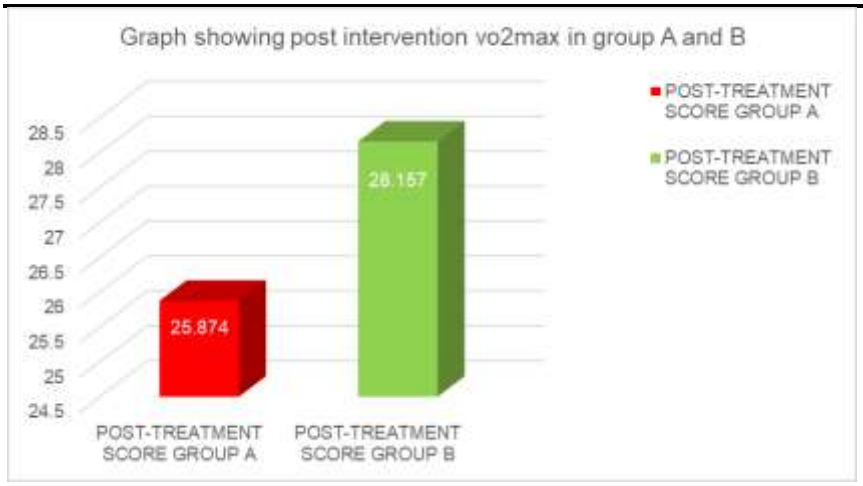
PARAMETERS	PRE TEST		POST TEST		T VALUE	P VALUE	RESULT
Cooper 12 Min Run Test	MEAN	SD	MEAN	SD	22.035	<0.0001	EXTREMELY SIGNIFICANT
	24.023	±2.810	25.875	±2.915			



PARAMETERS	PRE TEST		POST TEST		T VALUE	P VALUE	RESULT
Cooper 12Min Run Test	MEAN	SD	MEAN	SD	39.8	<0.0001	EXTREMELY SIGNIFICANT
	23.463	±2.312	28.157	±2.264			



PARAMETERS	GROUP A		GROUP B		T VALUE	P VALUE	RESULT
Cooper 12Min Run Test	MEAN	SD	MEAN	SD	3.153	<0.0027	VERY SIGNIFICANT
	25.874	±2.915	28.157	±2.264			



Unpaired t test was used to assess the difference between post intervention aerobic fitness of group A and B. The results are extremely significant.

DISCUSSION

The present study was designed to observe the additive effect of inspiratory muscle training along with Anaerobic exercises in overweight children from 13 to 18 years. Both males and females were included in this study. Participants were divided into 2 groups. Group A received exercises and group B received exercises and IMT for 4 weeks.The outcome measure namely the cooper 12 min run test was used.

The advantages of physical exercise include bringing about an increase in the cardiac output and an enhancement of the innate ability of muscles to extract and to utilise oxygen from the blood. This benefit is further compounded by the benefit physical exercise has on high-density lipoprotein cholesterol (HDL-C), adipose tissue distribution,increased insulin sensitivity, improved cognitive function, enhanced response to psychosocial stressors. (7)

Additionally Anaerobic exercises show the following effects - Increased resting levels of anaerobic substrates (ATP-PC), Increased quantity and activity of key anaerobic enzymes controlling glucose

breakdown in fast-twitch fibres, Increased blood lactic-acid capacity during maximal exercise, Increased skeletal muscle cross-sectional area and altered neural activation of skeletal muscle. (8)

The studies demonstrate that acute exercise stimulates the increase of a variety of neurochemicals: lactate; cortisol; neurotrophins, including BDNF, IGF-1, and VEGF; neurotransmitters, including dopamine, norepinephrine, serotonin, acetylcholine, GABA, and glutamate; and neuromodulators, including endogenous opioids and endocannabinoids. Hence it can be used as a powerful tool to enhance brain functioning in healthy individuals. The most commonly reported area to undergo improvement is the prefrontal cortex, with exercise-induced enhancements observed in attention and other executive functions . As well as for improving cognition in children and healthy adults,these long-term effects of exercise are of particular interest for their possible role in improving cognitive function. (9)

The IMT was specifically developed to increase inspiratory strength, and was found to increase diaphragm thickness and aerobic performance , as well as relieving the sensationof dyspnea. (10)

Fatiguing work of the inspiratory muscles is associated with significant neural andcardiovascular consequences which impairs exercise performance. There is induction ofinspiratory muscle fatigue on heavy endurance activity and accumulation of metabolites.These metabolites are sensed by the receptors present within the inspiratory muscles, which relay this information to the dorsal horn of the spinal cord. The informationreaches to the nucleus tractus solitarius and other cardiovascular controlling areas in the brain stem. Followed by this several haemodynamic adjustments occur and there is sympathetic vasoconstrictor activity. As a result, leg blood flow during high-intensity exercise has been shown to be inversely related to the work of breathing which further results in peripheral muscle fatigue, known as inspiratory muscle metaboreflex. Inspiratory muscle metaboreflex limits exercise performance and reduces endurance. IMT induces the delay in activating this mechanism, decreasing the onset of peripheral muscle fatigue and the sensation of dyspnea and improving the whole body exercise performance. (11) (12)

The associations between established risk factors, adverse health behaviours, and accelerated atherosclerotic and hypertensive processes in childhood and adolescence. Patterns of major lifestyle behaviours associated with cardiovascular disease are established early in childhood and influence risk factors for cardiovascular disease in childhood and adolescence as well as in adulthood. The available literature summarises the evidence for ‘starting young’ and targets for health-promoting lifestyle interventions.(13)

CONCLUSION

Inspiratory muscle training along with Anaerobic exercises has proven to be more effective to improve aerobic fitness in overweight children aged 13 to 18.

CLINICAL IMPLICATIONS

In order to improve the aerobic fitness levels and exercise performance in overweight children inspiratory muscle strength is crucial.The study proves that inspiratory muscle training has additive benefits in order to improve the aerobic capacity. Therefore IMT should be added in the protocol to prevent or delay inspiratory muscle fatigue, so that children would benefit from it while they exercise at high intensity.

LIMITATIONS

1. The study was done on a small population.
2. Lack of long term follow up.

FUTURE SCOPE

1. The study can be done for different population
2. A comparative study can be done between males and females

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