Influence of controlled breathing technique on exertion in overweight college students

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Introduction: Overweight individuals showed higher oxygen uptake in relation to BMI and rating perceived exertion than the normal individuals.
Objective: To find out the influence of controlled breathing on exertion in overweight college students.
Method: Study design was Quasi-experimental design. Study type was Pre-test post-test, sample size was 50. Study setting was SRM College of Physiotherapy.
Procedure: According to inclusion and exclusion criteria, 50 Subject were selected and informed consent was obtained. The subjects was conveniently divided into Group A (n=25) and Group B (n=25). Controlled breathing technique was taught to the Group A subjects with relaxation of upper chest, shoulder and using the lower chest during stair climbing. Prior to climbing the stairs the Group B does not receive any intervention. Resting respiratory rate, heart rate were measured as pretest values for both groups. After climbing four flights of stairs, respiratory rate, heart rate and Borg rate of exertion was assessed as post-test values.
Results: The result shows that there is significant increase in the mean values of heart rate and respiratory rate with $p<0.05$ between the pretest and post-test values in the Group A and B. The mean post-test values of heart rate, respiratory rate and Borg scale of exertion between Group A and B shows that the increase is significantly lesser in the Group A when compared to Group B.
Conclusion: The study concludes that the overweight college students who underwent controlled breathing technique during stair climbing has significant reduction in the heart rate, respiratory rate and exertion when compared to subjects who did not undergo controlled breathing technique.
Key Words: *Overweight; Controlled breathing technique; Heart rate; Respiratory rate; Borg scale of exertion*

INTRODUCTION

Overweight is defined, when the body mass index (BMI) is 25-29.99 kg/m^2. Obesity is also associated with low level of physical activity and in return to become a greater risk of insulin resistance, and cardiovascular problem, musculoskeletal deconditioning [1,2].

According to statistics, about 10%-20% of children in India are obese [3]. The number increased to up to 30% among adolescents. About 2/3rd of children with obesity continue to become obese even during their adult life. So, obesity is becoming an evolving health problem. India is ranked as the third most obese country in the world. Consuming unhealthy food and alcohol, with life style of low level activity are the leading cause of self-destruction, making five in one Indian men or women susceptible to obesity or overweight [2].

According to WHO, globally there are more than 1 billion adults who are overweight and 300 million people were found to be obese. In developing country, the problem of obesity is increasing with more than 115 million people prone for developing problems related to obesity. Recent study indicated that in 97.1 million of USA adults in 55% of the total adult people are either Pre-obese [(BMI) 25.0-29.9 or obese (BMI>30.0 kg/m^2)] [4]. A lot of studies have provided evidence that high body weight, BMI, or adiposity are associated with lower levels of physical activity and less interest towards physical activity programs.

In obese people, the presence of adipose tissue around the rib cage, abdomen and in the visceral cavity loads the chest wall [5]. Overweight people showed higher oxygen uptake in relation to body weight and the rate of perceived exertion is increased than in normal individuals.

The adipose tissues have a lower metabolic rate than other tissues, and so the increase in body weight directly influences the rate of oxygen consumption (Vo2). As a consequence, if Vo2 is expressed in per kilogram body weight, lower than usual values are obtained in obese individuals [6].

Even at rest respiratory muscle work is greatly enhanced in obese people. The reduction in FRC (functional residual capacity), vital capacity and in total lung capacity is detectable, even at a modest increase in weight. Most studies have shown a reduction in lung compliance in obese individuals which appears to be exponentially related to BMI [2]. A large epidemiological survey shows that 80% of middle aged obese people reported difficulty in breathing after climbing of two stories compared with 16% non-obese of similar aged people [7].

Hence obesity has involved in effects on lung function and reduces the well-being of respiratory system, even in the specific absence of respiratory disease, and can also aggravate the existing airway disease [8].

Breathing control is known as a relaxed basal, diaphragmatic or else abdominal breathing as the sole intervention [9]. During controlled breathing technique, the person is predominantly encouraged to exert the abdominal muscle throughout the time of inhalation while at the same time decrease upper rib cage motion and accessory muscle use Gosselink [10]. In physiotherapy practice, Controlled breathing is used as a therapeutic technique commonly to , improve the breathing efficiency, prevent abnormal chest motion, reducing the work of breathing, varying the distribution of ventilation and dyspnoea sensation [10,11].

This technique is practiced by breathing in through the nose and expiration through the mouth in a steady slow rhythm. While doing this technique, the mouth should be kept closed when breathing in through the nose and purse the lips when breathing out. The breathing out should be twice as long as breathing in. This helps to empty the lungs completely, and to make as much room in the lungs for fresh, oxygen- rich air. To do this count ‘one, two’ during breathing in, and ‘one, two, three, during breathing out [12]. Breathlessness is increased if the accessory muscles are used rather than the diaphragm. To use the diaphragm place the hands just below the sternum and breathe in to expand the upper abdomen. This technique can be used during breathlessness and during all functional activities which will provoke breathlessness, like stair climbing.

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Sedentary lifestyle is adopted even by normal individuals. Increasing physical activity in day to day life like walking, stair climbing will help improve quality of life and fitness levels. To ease dyspnea with controlled breathing techniques during stair climbing can facilitate more physical activity. There are very few studies done to prevent dyspnea among pre obese population, hence the study has been taken. Thus the aim of this study is to find out the influence of controlled breathing on exertion in overweight college students.

METHOD

This study compares heart and respiratory rate along with perceived exertion (Borg scale) in a cohort of 50 students, aged between 18 to 30 years, with a BMI between 25 and 30, who have been split opportunistically into two experimental groups. Half of the participants (the intervention group) were asked to climb stairs while controlling their pulmonary ventilation *via* a controlled breathing technique. The other half of participants (the control group) climbing the stairs with no instruction to breathe in a controlled manner.

The subjects for the study were selected depending upon the inclusion and exclusion criteria. Prior to the commencement of the study, informed consent was obtained. The subjects were conveniently divided into Group A (n=25) and Group B (n=25). Controlled breathing technique was taught to the Group A subjects with relaxation of upper chest, shoulder and using the lower chest during stair climbing. During Controlled breathing technique, the person was predominately encouraged to move the abdominal muscle while doing inhalation while similarly decreasing the motion of rib cage. Resting respiratory rate and heart rate were measured as pretest values. The subjects are explained about breathing control prior to climbing the stairs by doing inspiration deeply for one step through nose and expiration for one/two steps through mouth. This procedure was then followed by the subjects. Subjects were encouraged to climb at their own pace and use the handrail for support and one hand can be placed in abdomen for feedback. After climbing four flights of stairs, respiratory rate, heart rate and Borg rate of perceived exertion was assessed as post-test values.

Group B did not receive any intervention. The subjects' respiratory rate and heart rate are measured as pretest values and the subjects were made to climb up four flights of stairs at their own pace, without any breath control. After the completion, respiratory rate, heart rate and rate of perceived exertion are assessed immediately in the first minute as posttest values. The results of Group B is compared with the Group A to check the difference in heart rate, respiratory rate, and Borg scale of exertion.

The collected data were tabulated and analyzed using descriptive and inferential statistics. Standard deviation and mean were used to assess all the parameters of the data using statistical package for social science IBM (SPSS) VERSION 20. As the test of normality shows lower bound of significance we had used non parametric test.

RESULTS

The below Table 1 shows that there was a significance difference between Pretest and post-test of Group A and Group B in Heart rate,Respiratory rate ($p<0.05$)

TABLE 1 Comparison of pre-test and post-test mean values of heart rate and respiratory rate of the group A and group B

Variables	PRE-TEST		POST-TEST		t-test	Significance
	Mean	SD	Mean	SD		
Heart Rate (Group A)			77.68	7.744		0
Respiratory Rate (Group A)	19.52	3.368	23.4	2.799	8.445	0
Heart Rate (Group B)	72.4	10.2	91.8	11.8	16.25	0
Respiratory Rate (Group B)	19.04	3.28	30.8	4.62	26.83	0

The Table 2 shows that there was a significance difference between Group A and Group B in Heart rate, Respiratory rate and Perceived Exertion ($p<0.05$).

TABLE 2 Comparison of post-test mean values of heart rate, respiratory rate and rate of perceived exertion between group A and B

	POST HR GA *vs* GB	POST RR GA *vs*	GA BORG *vs* gb
Mann-Whitney U	110.5	55	32
Wilcoxon W	435.5	380	357
Z	-3.927	-5.016	-5.583
Asymp. Sig. (2-tailed)	0	0	0

DISCUSSION

The purpose of this study was to determine the effectiveness of controlled breathing technique during exertion in overweight college students. Swinburn et al. suggested that exercise performance worsens in activities against gravity such as stair climbing. This occurs with even a small amount of increase in BMI. In patients with respiratory disorders a small amount of increase in BMI can increase their level of dyspnea [13].

The present study shows that there are significantly increased values in the heart rate, respiratory rate with $p<0.05$ in both Group A and Group B which is a usual exercise response.

This present study shows that the increase in post-test mean values of heart rate, rate of perceived exertion and respiratory rate is lesser in Group A, who underwent controlled breathing technique when compared to Group B who did not undergo controlled breathing technique, of which only the heart rate did not shows statistically significant reduction.

Controlled breathing technique has shown significant results in a number of studies that are related to physiological outcomes (arterial oxygen saturation, respiratory rate, tidal volume) and the mechanism of intervention. However there was no effect found on oxygen consumption or ventilation.

Breathing control technique has shown significant outcomes on diaphragm and abdominal movement, heart rate, respiratory rate and exertion. However, control breathing was shown to have a beneficial effect on the work of breathing and breathlessness (Lucy K Lewis) [14].

Marie Carmen Valenza et al. concluded that significant progress in psychological and functional variables in the experimental group with controlled breathing program for COPD patients.

In some cases which need assessment of exercise performance, there is a limitation in the exercise performance before it has reached to physiological maxima due to exertion symptoms [15-18]. In obese population there is a loading of both the peripheral skeletal muscles and respiratory muscles which requires contractile muscle effort and increased motor output to enhance the two groups of muscles into succession. The dyspnea with increased intensity likely reflects the increased chemo stimulation and central neural respiratory drive to the respiratory muscles (and increased central corollary discharge to the somatosensory cortex) secondary to the relatively increased VCO2 for a given power output in obesity. Babb et al. have shown that during exercise there is an increased dyspnea which was related to oxygen cost of breathing with an increased rate. It was measured at rest during eucapnic voluntary hyperpnoea in women with moderate obesity of about 37% [15].

The aim of controlled breathing technique is to restore the diaphragm to a more function and normal position, to reduce the respiratory rate, to diminish the breathing work, to minimize breathing discomfort and to progress exercise performance (Faling, 1993; Gosselink and Houtmeyers, 2000). A more experiment have been listed as the means by which controlled breathing attain these aims . They concluded that enhanced in tidal volume result in a reduction in respiratory rate.

Controlled breathing is an awareness exercise while, walking, pacing, coping, stair climbing strategies, modification in functional activity being useful in exertion of physiotherapy management [19]. This technique is used as a life style modification to decrease exertion in obese people during climbing. The controlled breathing is home-based, self-monitored program is better than outpatient hospital-based practice. The function of the autonomic nervous system is affected, thus in turn influence the cardiac output. It is well proved that the cardiac cycle is affected by act of breathing. The heart rate is slowed down due to this effect which arises from the respiratory sinus arrhythmia (RSA) during expiration [20]. The product of vagal nerve activity is due to heart rate reduction, with greater slowing of the heart associated with an increasing activity of the vagus nerve. This explains the significant reduction of heart rate in the experimental group compared to the control group.

Clinically, a supervised breathing control changes the respiratory mechanics and surrounding physiology, thus resulting on effect of symptoms. More number of studies, that controlled breathing techniques investigating the effect of treatment showed specific outcomes in this sequence.

Vora explained that non-pharmacological measures such as relaxation techniques, posture, breathing control, stress management and lifestyle modification are useful tool for control of breathlessness [19].

The controlled breathing improves the heart rate variability and vagal output. Thus, variability of heart rate changes during a breathing control program can be measured and recorded ultimately, given that an mindfulness indirectly.

Blaney and Sawyer (1997) suggested controlled breathing technique is thought to improve diaphragmatic excursion and thus changes the distribution of ventilation and improves the lung volumes following abdominal surgery [21].

Many authors suggested that breathing control improves tidal volume and respiratory rate [10,16,17]. There are few limitation of the study - Small sample size,Short duration study,18 to 30 age group , only overweight people were included in study. Future studies can be done on other population like COPD patients, Post-surgical patients.

Thus this study supports the use of controlled breathing technique during functional activities like stair climbing to reduce exertion in overweight college students.

CONCLUSION

The study concludes that the overweight college students who underwent controlled breathing technique during stair climbing has significant reduction in the heart rate, respiratory rate and exertion when compared to subjects who did not undergo controlled breathing during stair climbing.

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