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A Study on Effect of Acute Exercise on Pulmonary Function Tests of First Year M.B.B.S. Students

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Abstract

Background: One of the most common stress on human body is exercise. It places a major demand on the cardiopulmonary system. The most practical test of assessing the respiratory function is spirometry. The present study was carried out to know the effect of acute excercises on pulmonary function test in 90 1st year M. B. B. S. students (M=46, F=44). The changes in PFTs before and after acute exercise of 6 minutes (Harward's step test) of those students were recorded. Results were analyzed using paired and unpaired t-test

Results: No significant changes were observed in all the four groups before and after exercise in males. However the post exercise values of FVC and VC were reduced than the baseline values in overweight and obese females ($p < 0.01$).

Conclusion: Acute exercise did not significantly affect the respiratory parameters. However the BMI of the individual may significantly influence the ventilatory response to acute exercise in otherwise healthy individuals.

Keywords: *Pulmonary function, Harward's step test, Acute exercise.*

Introduction

Exercise is a stressful condition which produces a marked change in body functions and lungs are no exception. [1]The cardiovascular and respiratory mechanisms operate in an integrated fashion to meet the oxygen demands of the tissues during exercise. Exercise testing is a non-invasive tool to evaluate the cardiopulmonary response to stress under carefully controlled conditions. The ventilatory capacity of a healthy individual often exceeds the demands even during strenuous exercises. [2] Despite this enormous reserve, the ventilatory response to exercise may become constrained in obese individuals with normal lungs. Extensive research has been done on various aspects of pulmonary function tests, but surprisingly very few studies had explored the effect of acute exercise on pulmonary function tests in normal individuals and they had revealed controversial results. Though the association of gender and anthropometric indices on lung functions have been well established[3, 4], their influence on the exercise induced changes on pulmonary function tests in young healthy individuals have received less attention. Hence the present study was undertaken to study the effect of acute exercise on pulmonary function test of first year M. B. B. S. students.

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Materials and Method

A total of 90 students comprising of 46 males and 44 females in the age group of 18-20 years were recruited for this cross sectional study by simple random sampling, from the first year medical students of SKIMS medical college.

Exclusion criteria:

- Smokers
- Students with recent respiratory tract infections
- History of allergy, bronchial asthma

Informed consent was obtained from all the study participants after clearly stating the purpose of study to them. A detailed medical history was taken, followed by general and systemic examination. The participants were instructed to wear light clothing during their exercise sessions. Weight (in kilograms) and Height (in centimetres) were measured. Body Mass Index (BMI) was calculated as the ratio of weight and square of Height in meters, using Quetelet Index. The study participants were divided into four subgroups based on their body mass index (BMI) in both the genders as:

Group 1–BMI < 18.5 (Underweight)

Group 2–BMI-18.5-24.9 (Normal)

Group 3–BMI-25.0-29.9 (Overweight)

Group 4–BMI ≥ 30 (Obese)

Pulmonary function tests were measured using a computerised spirometer. Subjects were asked not to have heavy meals just before this test because a full stomach may prevent lungs from full expansion and were asked to wear loose clothing to prevent any restriction of movements.

The procedure was explained and demonstrated to them at the outset and subjects were asked to make at least three acceptable manoeuvres and the best of the three trials was selected for reporting. The following variables were measured–Vital capacity (VC), Forced vital capacity (FVC), Forced Expiratory volume in 1st second (FEV1), FEV1/FVC ratio (FEV1%) and Peak expiratory flow (PEF) at rest and the basal readings were noted. After basal recordings, subject was allowed to do exercise i.e. Harvard's step test for 6 minutes. The post-exercise readings of forced expiratory spirograms and PEFR were recorded immediately after exercise. Three readings were taken each time and the average was calculated. Mean and standard deviation were calculated.

One way analysis of variance was used for the comparison of the respiratory parameters within various groups of BMI in both the genders at rest. Student unpaired 't' test was carried out to test the significance of mean between males and females at rest. Student paired' test was carried out to test the significance of mean before and after acute exercise in both the genders. Statistical software SPSS 16 version was used for the analysis of the data. $p < 0.05$ was considered to be statistically significant.

Results

A total of 100 students were recruited for this cross sectional study, comprising of 50 males and 50 females. Ten students were excluded from the study as they refused to as they did not meet the study criteria. Table 1 shows the baseline characteristic of the study participants before exercise. All the respiratory parameters other than FEV1% were significantly higher in males compared to the females ($p < 0.001$). Table 2 shows the respiratory parameters before and after acute exercise within the groups in males. Intergroup comparison of the resting values, revealed that VC, FEV1, FVC and PEF were significantly lower in groups 1 (underweight), 3 (overweight) and 4 (obese) compared to group 2 (normal) ($p< 0.001$). No significant changes were observed in the respiratory parameters after exercise in all the four groups. Table 3 shows the respiratory parameters before and after acute exercise within the groups in females. Intergroup comparison of the resting values, revealed that VC, FEV1, FVC and PEF were significantly lower in groups 1 (underweight), 3 (overweight) and 4 (obese) compared to group 2 (normal) ($p< 0.001$). However intragroup comparison of the pre and post exercise values revealed that FVC was significantly reduced in 3 (overweight) group after exercise and VC was reduced in 4 (obese) group after exercise ($p < 0.01$).

Table 1: Baseline characteristics of the study participants

Gender	n	BMI	VC	FEV1	FVC	FEV1%	PEFR
Male	46	22.48±3.55	3.22±0.84*	3.30±0.70*	3.47±0.80*	97.52±3.47	6.72±1.72*
Female	44	24.02±3.25	3.14±0.80	3.03±0.77	3.14±0.79	96.22±3.58	6.24±1.67

Values are expressed as mean ± S. D, *$p < 0.001$–Between males and females

Table 2: Comparison of respiratory parameters before and after acute exercise within groups in males

Parameters	Exercise	Group 1 Underweight	Group 2 Normal	Group 3 Overweight	Group 4 Obese
VC	Before	2.51 ± 0.39*	4.12 ± 0.49	3.03 ± 0.52*	2.03 ± 0.08*
	After	2.51 ± 0.38	4.15 ± 0.52	3.03 ± 0.52	1.95 ± 0.09
FEV1	Before	2.52 ± 0.39*	3.95 ± 0.50	2.94 ± 0.50*	2.01 ± 0.07*
	After	2.57 ± 0.48	3.97 ± 0.48	2.93 ± 0.50	1.85 ± 0.16
FVC	Before	2.57 ± 0.35*	4.05 ± 0.48	3.09 ± 0.52*	2.04 ± 0.07*
	After	2.66 ± 0.51	4.09 ± 0.49	3.03 ± 0.52	1.97 ± 0.15
FEV1%	Before	97.40 ± 2.88	97.48 ± 2.69	94.84 ± 3.98	98.67 ± 2.31
	After	94.60 ± 4.28	96.65 ± 1.66	96.84 ± 3.37	94.00 ± 1.00
PEFR	Before	5.41 ± 0.48*	8.27 ± 1.08	6.16 ± 1.23*	3.89 ± 0.15*
	After	5.48 ± 0.42	8.33 ± 1.03	5.84 ± 1.49	3.95 ± 0.15

Values expressed as mean ± S. D, * p < 0.001 (Intergroup comparison at rest)

Table 3: Comparison of respiratory parameters before and after acute exercise within groups in females

Parameters	Exercise	Group 1	Group 2	Group 3	Group 3
VC	Before	2.32 ± 0.23*	3.40 ± 0.31	2.49 ± 0.47*	1.96 ± 0.24*
	After	2.44 ± 0.19	3.44 ± 0.34	2.47 ± 0.48	1.81 ± 0.21#
FEV1	Before	2.10 ± 0.27*	3.28 ± 0.33	2.49 ± 0.47*	1.75 ± 0.11*
	After	2.11 ± 0.23	3.35 ± 0.32	2.40 ± 0.49	1.68 ± 0.19
FVC	Before	2.15 ± 0.25*	3.41 ± 0.35	2.52 ± 0.49*	1.79 ± 0.80*
	After	2.18 ± 0.24	3.42 ± 0.33	2.45 ± 0.51#	1.72 ± 0.22
FEV1%	Before	97.00 ± 3.06	95.66 ± 3.49	97.53 ± 4.23	97.33 ± 2.30
	After	96.44 ± 2.58	96.92 ± 2.50	98.06 ± 2.53	97.33 ± 2.08
PEFR	Before	4.71 ± 0.97*	5.57 ± 1.01	4.95 ± 0.92*	3.89 ± 1.45*
	After	4.76 ± 1.33	5.61 ± 0.98	4.67 ± 0.84	3.97 ± 1.85

Values expressed as mean ± S. D, * p < 0.001–Intergroup comparison of resting values
# p < 0.01–Intra group comparison of pre and post exercise value

Discussion

The present cross sectional study aimed to study the influence of exercise on pulmonary function tests in young healthy individuals. The baseline values of the respiratory parameters between the genders showed a significant statistical difference, with males showing the higher values. These results are supported by other studies and could be explained with the greater muscular strength in males. A comparison of the respiratory parameters before exercise between the various groups of males and females, revealed a statistically significant influence of body mass index on the pulmonary function. Individuals with a normal body mass index had a significantly higher values compared to the underweight, overweight and the obese individuals. However there was no change in FEV1 %. These results are consistent with the results of Wannametheeet al. [5]These results specify a restrictive mode of impairment in overweight and obese individuals. Further the increased body fat percentage, mechanical restraint to the movement of abdomen and thorax and increased airway resistance in overweight and obese individuals, could explain these results. Poor respiratory muscle strength could contribute to lower values of the respiratory parameters in the underweight individuals as suggested by Muralidhara DV[6]. Considering the effect of acute exercise, overall no significant change was observed in the respiratory parameters after exercise in males and the underweight and normal females. These results are consistent with the results of Chen Y et al who did not observe any significant changes in the post exercise values[7]. However this was in contrast to the findings of Ikram MH, who showed that release of catecholamines during exercise, cause a significant rise in FEV1 after exercise in both the sexes[8]. Lakshmi PVV studied the cardiopulmonary changes

with exercise in adolescents and observed an increase in FEV1, but without any changes in FVC. It has also been reported that mild and moderate exercise do not produce a significant alteration in the pulmonary function tests in young individuals[9]. In females, a significant reduction was observed in FVC and VC after acute exercise in individuals with a higher body mass index. However Faria AG et al studied the effect of exercise test on pulmonary function of obese adolescents and reported that body fat distribution influence the resting values more than the changes after exercise[10]. A decrease in lung volumes in persons with higher body mass index appears to increase respiratory resistance, contributing to exercise induced reduction in FVC in these subjects as observed by Kaplan et al[11]. This reduction being significant only in the females could be explained by the fact that they have lesser respiratory muscle strength and therefore prone for a greater reduction of lung volumes and flow rates. This again coincides with the results of Soundariya K et al. [12]

Conclusion

The results of the present study indicates that pulmonary function tests are not altered with acute exercise in normal individuals, however exercise induced changes may be significantly influenced by higher body mass index and respiratory muscle strength. This shows that enormous ventilatory reserve in an individual with normal lungs could be compromised due to many factors like obesity. Although the beneficial effects of continuous physical training has proven effects, more research has to be done to explore the beneficial effects of acute exercise and its effectiveness as a screening tool in assessing the functional capacity of the lungs.

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