Research Article

# A comparative study on effect of acute exercise on pulmonary function tests of first year MBBS students

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**Abstract** The work is done to study the pulmonary function tests in 1st M.B.B.S. students (M=30, F=30, mean age= 18.64 years) and also to compare the changes in PFTs before and after acute exercise of 6 minutes (Harward's step test) of those students. Parameters recorded were age, height, weight, PFTs. Parameters like FVC, $FEV_1$, $FEV_{1\%}$ and FEF $_{25\text{-}75\%}$ were recorded before and after exercise with computerized spirometer and for PEFR Wright's Mini peak flow meter was used. Results were analyzed using paired and unpaired t-test. The study concluded that the spirometric variables decreased after acute exercise and the values were higher in boys than in girls.
**Keywords:** Harward's, pulmonary function, step test, students.

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## INTRODUCTION

To enjoy a long and healthy life, everyone should make lifestyle choices that include a healthy diet, regular exercise, and maintaining normal weight. The combination of inactivity and eating the wrong foods is the second most common preventable cause of death in the United States (smoking is the first). Exercise for Persons with Chronic Obstructive Pulmonary Disease (COPD), such as emphysema, chronic bronchitis and asthma, is defined by the American Thoracic Society as a condition characterized by airflow obstruction that reduces the ability to sufficiently empty the lungs. Lack of exercise contributes to disability in COPD. Exercise training is a major component of pulmonary rehabilitation programs today and is an established safe and effective intervention for improving physical capacity and quality of life. Aerobic exercise (riding a stationary bike or walking) and resistance exercise (lifting a light weight with the arms or legs) can help restore and maintain functional independence in COPD.

## AIMS AND OBJECTIVES

The objectives were

- To study the effect of acute exercise on pulmonary function tests of first year MBBS students.
- To compare the changes in pulmonary function tests before and after acute exercise of those students.

## MATERIAL AND METHODS

Medical students (M=30, F=30) of first M.B.B.S. of L.T.M.M.C., Sion, Mumbai were selected as the subjects. An informed consent was obtained. A questionnaire was filled in by the subjects before testing to confirm that each subject was a non-smoker, with no personal history of allergy with special reference to respiratory allergy or previous history of any respiratory diseases like asthma, etc. Age was obtained from date of birth. Standing height

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in cms was taken in erect standing position without shoes with his back close to the calibrated stand on a Standiometer. Body weight was recorded in kgs correct to o.o5 kg on a Wegeberid weighing machine with a sensitive lever with subject in his normal clothing without shoes. The subjects were assessed during the same time of year and at the same time of day to avoid possible seasonal and diurnal variation. It was ensured that all subjects were normal at the time of testing and at least 6 weeks prior to it.

### Apparatus

Computerized Spirometer was used to record the forced expiratory spirograms. Before testing each subject, the spirometer was calibrated for accuracy using 3 liter syringe. Temperature, barometric pressures were adjusted to that of room temperature and pressure. Zero flow through the pneumotach was also ensured before testing. For recording of peak expiratory flow values Wright's Mini Peak Flow meter was used. Wright's Mini Peak Flowmeter and Pneumotach were sterilized with potassium permanganate and hydrogen peroxide respectively with every volunteer. Subjects were asked not to have heavy meals just before this test because a full stomach may prevent lungs from full expansion. They were also asked not to exercise strenuously for 6 hours before the test, asked to wear loose clothing so that it did not restrict breathing in any way. Lung function tests were done in a room of department that has all of the lung function measuring devices. Adjustment of frequency was done with electronic metronome at one beep with every two seconds adjusted as on the metronome calibration was from 40 to 60 per minute. For getting frequency of 30 times per minute adjustment was done with 60cycles/minute. The procedure was first demonstrated to all for basal readings of PFT. FVC was recorded by asking the subject to take a deep inspiration followed by forceful expiration which was again immediately followed by deep inspiration through pneumotach into machine with nose clip in position. The subjects were asked to make at least three satisfactory forced expiratory vital capacity manoeuvres. The computer system analysed the performance to give FVC, $FEV_1$, $FEV_1$% and FEF $_{25-75\%}$.. For the readings of PEFR the subject was being asked to take a maximum/deep inspiration and then to blow through flowmeter and basal reading was recorded. 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. Five readings were taken each time and the average of the highest three calculated.

## OBSERVATION AND RESULTS

Age group of subjects was between 17 to 19 years obtained from the date of birth. Mean height of the male was 166.5 cms and female was 156.26 cms. Mean weight of women was 53.0kgs and of men was 62.1kgs. The height and weight were significantly greater in men ($P< 0.05$). There was no significant difference between the ages of men and women. Resting FVC, $FEV_1$, $FEF_{25-75\%}$ and PEFR were higher in men ($P<0.05$) but no significant difference of $FEV_{1\%}$ (Table 1, 2 and Figure 1). Even after exercise there was significant difference in decrease in FVC, $FEV_1$, $FEF_{25-75\%}$ but no significant difference in decrease in $FEV_{1\%}$ (Table 3, 4,5 and 6 and Figure 2,3,4,5,).

**Table 1:** Showing mean age, height, weight, and the pre-exercise pulmonary function tests

| Sr. No. | | Men | | Women | | p value | Significance |
|---|---|---|---|---|---|---|---|
| | | Mean | S.D. | Mean | S.D. | | |
| 1 | Age(years) | 18.76 | 0.59 | 18.53 | 0.69 | P< 0.05 | S |
| 2 | Height | 166.5 | 6.39 | 156.26 | 6.32 | P< 0.05 | S |
| 3 | Weight | 62.1 | 10.88 | 53.0 | 9.55 | P< 0.05 | S |
| 4 | FVC(lit.) | 3.43 | 0.65 | 2.59 | 0.49 | P< 0.05 | S |
| 5 | $FEV_1$(lit.) | 3.17 | 0.56 | 2.33 | 0.47 | P< 0.05 | S |
| 6 | $FEV_{1\%}$ | 89.4 | 4.47 | 91.03 | 5.23 | p> 0.05 | Ns |
| 7 | $FEF_{25-75\%}$ | 3.97 | 0.97 | 3.47 | 1.51 | P< 0.05 | S |
| 8 | PEF(lit/min) | 484 | 92.01 | 367 | 48.4 | P< 0.05 | S |

**Table 2:** Showing basal FVC, FEV1, $FEF_{25-75\%}$ readings in men and women

| Sr. No. | | Men | Women |
|---|---|---|---|
| 1 | FVC(lit.) | 3.43 | 2.59 |
| 2 | $FEV_1$(lit.) | 3.17 | 2.33 |
| 3 | $FEF_{25-75\%}$ | 3.97 | 3.47 |

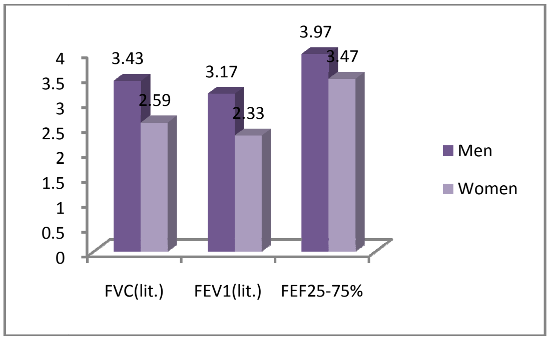


**Figure 1:**

**Table 3:** Showing pre and post-exercise FVC, FEV1, $FEF_{25-75\%}$ readings in women

| Sr. No. | | Women | |
|---|---|---|---|
| | | pre | post |
| 1 | FVC(lit.) | 2.59 | 2.38 |
| 2 | FEV1(lit.) | 2.33 | 2.08 |
| 4 | $FEF_{25-75\%}$ | 3.47 | 3.14 |

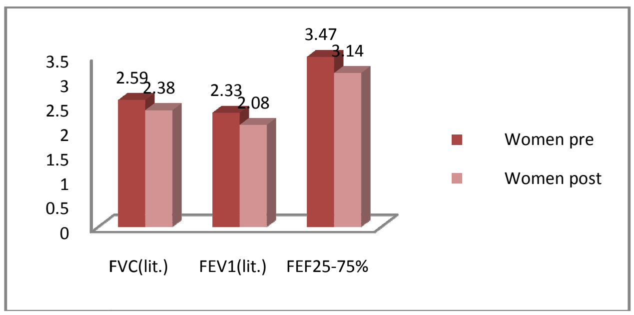


**Figure 2**

**Table 4:** Showing pre and post-exercise FVC, FEV1, $FEF_{25-75\%}$ readings in men

| Sr. No. | | Men | |
|---|---|---|---|
| | | pre | post |
| 1 | FVC(lit.) | 3.43 | 3.47 |
| 2 | $FEV_1$(lit.) | 3.17 | 2.94 |
| 3 | $FEF_{25-75\%}$ | 3.97 | 3.72 |

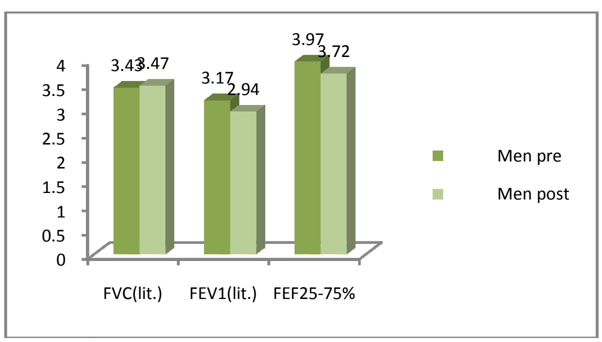


**Figure 3**

**Table 5:** Showing pre and post-exercise PEFR readings in men and women

| Sr. No | PEFR(L/min) | Men | Women |
|---|---|---|---|
| 1 | Basal | 484.4 | 367 |
| 2 | Post exercise | 472 | 382.8 |

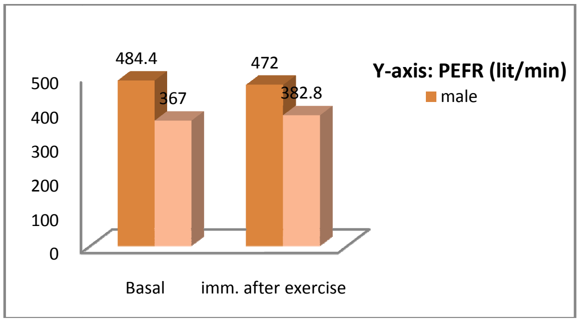


**Figure 4**

**Table 6:** Showing pre and post-exercise $FEV_{1\%}$ readings in men and women

| Sr. No. | $FEV_{1\%}$ | Men | Women |
|---|---|---|---|
| 1 | Basal | 89.4 | 91.03 |
| 2 | Post exercise | 85.1 | 88.4 |

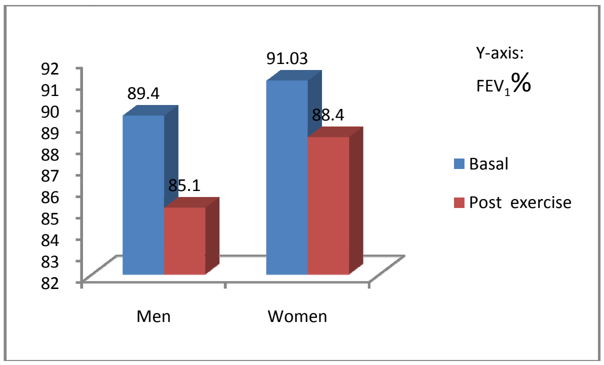


**Figure 5:**

## DISCUSSION

The present study was conducted to find out the effects of acute exercise on students of first year M.B.B.S., L.T.M.M.C., Sion, Mumbai. This study shows that the lung volumes and flow rates in men are significantly higher than in women. FVC, $FEV_1$, and PEFR have been shown to be higher in men even after adjusting for height and weight but $FEV_1$ % is greater in women. The published reports in the literature support this finding. As lung growth keeps pace with body growth, age, height and weight are the three important variables which influence the pulmonary functions. Hence there may be variation in resting values between men and women[1]. *Mc* Ilroy *et al* found a decreased non-elastic resistance with exercise. There is biphasic response with an initial bronchodilation followed by a bronchoconstriction with exercise[2]. So the exercise while it lasts has a protective effect on airways against bronchoconstriction. The bronchodilation could be due to a combination of factors. A decrease in vagal tone and increased beta-adrenergic stimulation are known to occur during exercise[3]. Inhibitory mediators such as some prostaglandin ($PGE_2$) may also play a role in causing the bronchodilation. Prostaglandin $E_2$ is not a directly acting relaxant, it may inhibit histamine-induced muscle contraction. This response is transient and followed by bronchoconstriction, which is believed to be caused by mediator release resulting from airway cooling or osmolality changes. The dry , cold air inspired during exercise can stimulate thermally active receptors with resultant bronchoconstriction. Bronchoconstriction may also be caused by mediators like prostaglandins ($PGI_2$) and leukotrienes released from locally resident cells (such as mast cells) or cells brought to the airways by the circulation (such as basophils, eosinophils and neutrophils)[4,5]. Regular physical activity of adequate intensity and duration involving large muscle groups has been proved to have a number of potential beneficial effects on general health, including improvement in aerobic capacity, body composition, flexibility, muscular strength, and psychosocial measures[6]. This improvement might be particularly true for patients who suffer from chronic diseases such as congestive heart failure, chronic obstructive pulmonary disease (COPD), and bronchial asthma. However, patients with chronic respiratory diseases tend to show less tolerance to exercise due to pulmonary limitation, self-restriction of activities, or lack of physical activity secondary to medical advice or family influence[7]. The exercise effect is due to increased patency and possibly increased number of conducting airways. The maximum inflation and deflation, which occurs during exercise, is an important physiological stimulus for the release of lung surfactant and prostaglandin ($PGE_2$) into the alveolar spaces thereby increasing the lung compliance and decreasing bronchial smooth muscle tone respectively[8]. Airway resistance greatly increases after cigarette smoking. This increases the cost of breathing, which could be detrimental to performance during prolonged exercise but this bronchoconstrictior effect, caused by inhalation of cigarette smoke, was rapidly reversed by brief exercise. Administration of propranolol does not block the exercise effect observed, because the predominant mechanism is more likely due to lessened parasympathetic activity than to beta adrenergic stimulation. Smooth muscle tone, mediated through cholinergic vagal pathways, is probably increased through the bronchoconstricing effect of cigarette smoke. Pulmonary rehabilitation is a program of exercise, disease management and counseling, coordinated to benefit the individual[9]. In those who have had a recent exacerbation, pulmonary rehabilitation appears to improve the overall quality of life and the ability to exercise, and reduce mortality[10]. It has also been shown to improve the sense of control a person has over their disease, as well as their emotions[11]. Breathing exercises in and of themselves appear to have a limited role[12]. Being either underweight or overweight can affect the symptoms, degree of disability and prognosis of COPD. People with COPD who are underweight can improve their breathing muscle strength by increasing their calorie intake[13]. When combined with regular exercise or a pulmonary rehabilitation program, this can lead to improvements in COPD symptoms. Supplemental nutrition may be useful in those who are malnourished[14]. Exercises in the form of sports, aerobics or workouts, if performed regularly have a beneficial effect on the various systems of the body. These systems are benefited by such exercises as the blood flow is increased to various organs thereby delivering more nutrients, thus improving their functioning. Special attention is being given to the vital organs of the body like heart, brain and lungs to know the effect of exercise on these organs. The evidence shows that regular physical activity slows the rate of decline of most of the physiological parameters that we associate with health and fitness-viz muscle strength, aerobic capacity, reaction time and joint flexibility[15]. The study suggests better airway function in women. Epidemiological studies also have demonstrated greater small airway dysfunction in men than in women[16]. The influence of female sex hormones on the airways may account for these differences. Progesterone has been shown to have a smooth muscle relaxant effect[17] and therefore may have a bronchodilator action. Moreover it is also known that female sex hormone levels can affect a number of biological factors that can modify airway caliber such as prostaglandin metabolism[18], lung adrenoceptor density[19]. and leukocyte dysfunction[20]. Hence it is possible that in females, a better functional status of the airways is maintainted by an interplay of all these functions. Apart from the differences between men and women attributed to greater muscular strength of men and their airways diameter, which may be larger in men as much as 17%, the female sex hormones are likely to influence airway behavior. During pregnancy, the airways may also be affected by the fetal sex hormones. The mother's airways are less reactive if the fetus is male[21]. Several published reports indicate that exercise may have a beneficial effect on airway function. The exercise of short duration while it lasts, has a protective effect on airways against broncho constriction and broncho constriction caused by cigarette smoking can be rapidly reversed by exercise. Propranolol does not block this exercise bronchodilation, but atripin does, suggesting inhibition of vagally mediated reflexes rather than beta adrenergic mechanism. Similarly, repeated short sprints are protective in exercise induced asthma, by inducing bronchodilation[22] and methacholine airway responsiveness decreases during exercise in asthmatic subjects[23].

## CONCLUSION

The study concludes that

1. The values of pulmonary function tests decrease immediately after a bout of acute exercise.
2. Respiratory response patterns of men and women after exercise are significantly different.

## REFERENCES


1. Kagawa J, Kerr HD. Effects of brief graded exercise on specific airway conductance in normal subjects. Journal of Applied Physiology 1970; 28: 138-144.
2. Silverman M, Anderson SD. Standardization of exercise tests in asthmatic children. Archives disease of Children 1972; 47: 882-889.
3. Chryssanthopoulos C, Barboriak JJ, Fink JN et al. Adrenergic responses of asthmatic and normal subjects to submaximal and maximal work levels.Journal of All Clinical Immunology 1978; 61: 17-22.
4. Gelb AF, Tashkin DP, Epstein JD et al. Exercise induced broncho-dilation in asthma. Chest 1985; 87: 196-201.
5. Knight DA, Stewart GA,Thompson PJ. Prostaglandin E2, but not the prostacyclin inhibits histamine- induced contraction of human bronchial smooth muscle. European Journal of Pharmacology 1995; 272(1): 13-19.
6. American College of Sports Medicine (1991). Guidelines for graded exercise testing and training. (Lea and Febiger, Philadelphia), 4th edn. .

7. McFadden ER. (1984) Exercise performance in the asthmatic. Am Rev Respir Dis129:584–587.
8. Hildebran JN, Georke J, Clements JA. Sufactant release in exercised rat lung stimulated by air inflation. Journal of Applied Physiology 1981; 51: 905-910.
9. "COPD — Treatment". U.S. National Heart Lung and Blood Institute. Retrieved 2013-07-23.
10. Jump up^ Puhan MA, Gimeno-Santos E, Scharplatz M, Troosters T, Walters EH, Steurer J (2011). "Pulmonary rehabilitation following exacerbations of chronic obstructive pulmonary disease". In Puhan, Milo A. Cochrane Database Syst Rev (10): CD005305.doi:10.1002/14651858.CD005305.pub3. PMID 21975749.
11. Lacasse Y, Goldstein R, Lasserson TJ, Martin S (2006). "Pulmonary rehabilitation for chronic obstructive pulmonary disease". In Lacasse, Yves. Cochrane Database Syst Rev(4): CD003793. doi:10.1002/14651858.CD003793.pub2. PMID 17054186.
12. Holland AE, Hill CJ, Jones AY, McDonald CF (2012). "Breathing exercises for chronic obstructive pulmonary disease". In Holland, Anne E. Cochrane Database Syst Rev 10: CD008250. doi:10.1002/14651858.CD008250.pub2. PMID 23076942.
13. Rabe KF, Hurd S, Anzueto A, Barnes PJ, Buist SA, Calverley P, Fukuchi Y, Jenkins C, Rodriguez- Roisin R, van Weel C, Zielinski J (September 2007). "Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary". Am. J. Respir. Crit. Care Med. 176(6): 532–55. doi:10.1164/rccm.200703-456SO. PMID 17507545.
14. Ferreira IM, Brooks D, White J, Goldstein R (2012). "Nutritional supplementation for stable chronic obstructive pulmonary disease". In Ferreira, Ivone M. Cochrane Database Syst Rev 12: CD000998. doi:10.1002/14651858.CD000998.pub3. PMID 23235577.
15. Ward J. Exercise and the older person. Aust fam Physician 1994 Apr;23(4): 642-5 648-9.
16. Enjeti S, Hazelwood B, Permutt S, Menkes H, Terry P. Pulmonary function in young smokers: male-female differences. Am Retors in chsk facv Respir Dis 1978; 118: 667-676.
17. Diagnault PG, Fazekas AG, Rosenthall L, Fried GM. Relationship between gallbladder contraction and progesterone receptors in patients with gall stones. Am J Surg 1988; 155: 147-151.
18. Bedwani JR, Marley PB. Enhanced inactivation of prostaglandin E2 by the rabbit lung during pregnancy or progesterone treatment. Br J Pharmacol 1975; 33: 547-554.
19. Padbury JF, Hobel CJ, Lam RW, Fisher DA. Sex difference in lung and adrenal neurosympathetic development in rabbits. Am J Obstet Gynecol 1981;141: 199-204.
20. Bodel P, Dillard GM, Kaplan SS, Malawista SE. Anti-inflammatory effects of estradiolon human blood leukocytes. J Lab Clin Med 1972; 80: 373-384.
21. Becklake M, Kauffmann F. Gender differences in airway behavior over the human life span. Thorax 1999; 54: 1119-1138
22. Schnall RP, Landau LI. Protective effects of repeated short sprints in exercise-induced asthma. Thorax 1980; 35: 828-832.
23. Inman MD, Watson RM, Killian KJ, Obyrne PM. Methacholine airway responsiveness decreases during exercise in asthmatic subjects. Am Rev Respir Dis 1990; 141: 1414-1417.

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