

Differences in Pulmonary Function Test among the Athletic and Sedentary Population

ShobhaRani Vedala¹, Niranjana Paul², Abhay B Mane²

¹ Department of Physiology, Kurnool Medical College, Kurnool, Andhra Pradesh, India

² Department of Community Medicine, Navodaya Medical College, Raichur, Karnataka, India

Correspondence to:

ShobhaRani Vedala
(shobha_niranjana@rediffmail.com)

Received: 17.12.2012

Accepted: 18.12.2012

DOI: 10.5455/njppp.2013.3.109-114

ABSTRACT

Background: Pulmonary function assessment has achieved a lot of importance nowadays owing to a steep rise in air pollution. Lung function parameters tend to have a relationship with lifestyle such as regular exercise and non-exercise. Hence the present study was undertaken to assess the effects of exercise in athletes on respiratory system and compared with sedentary group.

Aims & Objective: To compare the differences in pulmonary function test among the athletes and sedentary group.

Materials and Methods: A total of 152 subjects comprising athletes and sedentary were assessed for pulmonary function test. The parameters used as determinants of lung function were FVC, FEV1, FEV3, PEFR and FVC/FEV1 ratio were recorded as per standard procedure using Medspiror.

Results: Pulmonary Function Profile was analyzed and compared between the study groups. In our study the athletic group were having higher mean of percentage value of FVC $88.0 \pm 12.8\%$, FEV1 of $86.8 \pm 22.0\%$, FEV3 of $86.5 \pm 13.7\%$, PEFR of $93.0 \pm 12.8\%$ and FEV1/ FVC ratio of $92.1 \pm 4.4\%$ as compared to sedentary group.

Conclusion: The FVC, FEV1, FEV3, PEFR and FEV1/FVC ratio were higher in athletes than in the normal sedentary control individuals. This study suggests that regular exercise has an important role in determining and improving lung functions.

KEY WORDS: Pulmonary Function Test; Athletes; Sedentary; Medspiror

INTRODUCTION

Pulmonary function tests (PFT) serve as a tool of health assessment and also to some extent as a predictor of survival rate. Spirometry is pivotal to the screening, diagnosis and monitoring of respiratory diseases and is increasingly advocated in primary care practice. Lung function parameters tend to have a relationship with lifestyle such as regular exercise and non-exercise.^[1,2] Due to regular exercise, athletes tend to have an increase in pulmonary capacity when compared to non-exercising individuals. Many researchers stated that the respiratory system can impact the strength and exercise performance in trained athletes.^[3,4] Hence pulmonary functions are generally determined by the strength of respiratory muscles, compliance of the thoracic cavity, airway resistance and elastic recoil of the lungs.^[5] Lung function tests provide qualitative and quantitative evaluation of pulmonary function in patients with obstructive and restrictive lung diseases. The parameters used to describe lung function are the lung volumes and lung capacities. It is well known that pulmonary functions may vary according to the physical characteristics including age, height, body weight and altitude. Regular exercise as in athletes produces a positive effect on the lung by increasing pulmonary capacity and thereby improving the lung functioning.

The Pulmonary Function Capacities of normal sedentary individuals have been studied extensively in India^[6-9] but less in the context of an athletic population. Such studies are scanty and have also been carried out by the researchers on a small sample.^[10-12]

Hence the present study was undertaken on a large randomly selected sample of athletes and compared with matched controls as sedentary group.

MATERIALS AND METHODS

The study population comprised of athletes and sedentary group selected randomly from urban

areas. Athlete group consisted of marathon runners running at least 2 km per day for at least 6 months. Sedentary group comprised subjects with leisure-time physical activity or activities done for less than 20 minutes or fewer than 3 times per week. The subjects were carefully selected at random from Urban Population aged between 18-40 years, non-obese and willing to participate in the study. All of them were nonsmokers and free from active respiratory diseases. Athletes were selected randomly from 3 Colleges for Physical Education, Kadapa. The sedentary subjects were students from Government Medical College, Kadapa. Smokers (Cigarettes, Beedies, Chutta, Tobacco chewing etc), active respiratory disorders and epileptic disorders were excluded.

The lung function tests were carried on all these subjects as per the standards mentioned by M.R Miller et al.^[13,14] The informed consent was obtained and procedure was explained to each subject during test. The tests were carried by a well-trained doctor familiar with Medspiror (Computerized spirometry) after reinforcing the method of test to each subject. Measurements were taken between 8 AM and 12 PM to avoid diurnal variations in lung functions. The study subjects undergoing the tests were well informed about the instrument and the technique of the test by demonstration of the procedure.

Anthropometric measurements like height and weight of each subject was measured before the test procedure. Information was gathered regarding the personal history, about smoking, recent respiratory illness, medications used etc., and also elicited about the family history of any bronchial asthma.

Data Analysis

Data were entered in Microsoft Excel and analyzed using SPSS version 17.0 statistical software. Mean, standard deviation and standard error of mean were calculated for quantitative data. Mean values were compared between the two groups, using unpaired t test for the difference in the mean scores. All statistical tests

were two-tailed, and results were considered significant at $p < 0.05$.

RESULTS

The study population consisted of total 152 members included in two different categories namely sedentary group (76 members) and Athletes (76 members). The mean age and mean anthropometric measurements of both groups have been depicted in table 1. These findings suggest that both the groups did not differ significantly and were comparable. The sex-wise distribution of subjects is shown graphically that showed equal representation of both sexes in each group as shown in fig 1.

Table-1: Baseline Characteristics of Participants (N=76)

Variables	Groups		t value	p value
	Athletes	Sedentary		
Age (years)	26.0 (5.0)	25.8 (4.5)	0.99	>0.05 NS
Weight (kg)	54.3 (8.5)	56.2 (8.6)	1.32	>0.05 NS
Height (cm)	163.4 (7.0)	162.5 (8.3)	1.18	>0.05 NS
BMI	24.02 (1.6)	25.82 (2.2)	1.08	>0.05 NS

Values in parenthesis are standard deviation; NS: Not Significant

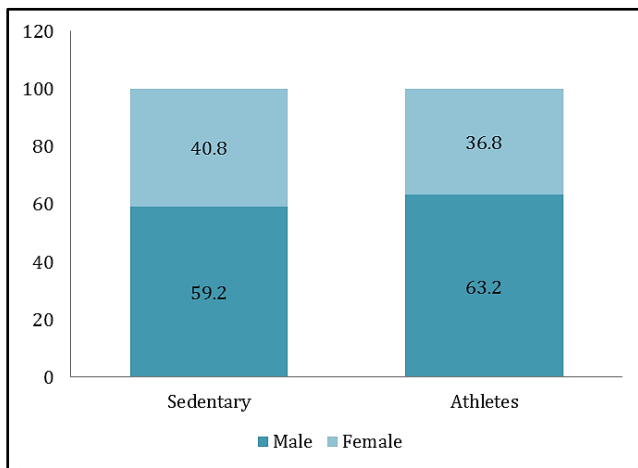


Figure-1: Sex-wise Distribution of Participants in Both Groups

The following five parameters were taken into consideration and the values obtained were recorded. The best value from three measurements were used and recorded by a spirometer. Predicted values were calculated by the standard formulae originally programmed in the spirometer. The parameters chosen were-

1. Percentage of Forced vital capacity (% FVC)

2. Percentage of Forced expiratory volume in 1st second (% FEV1)
3. Percentage of Forced expiratory volume in three seconds (% FEV3)
4. Percentage of peak of expiratory flow rate (% PEFR)
5. Percentage of FEV1/FVC ratio

Percent of predicted FVC (%FVC), FEV1 (%FEV1), FEV3 (%FEV3), percent of predicted PEFR (%PEFR), and FEV1/ FVC ratio were analyzed for both athletic and sedentary group. Values for all measurements are expressed as mean (%) \pm SD. The results are shown in table 2. Mean percent of predicted FVC of athletes was higher compared to sedentary subjects and the difference was found statistically significant. The result is shown in figure 2. Similarly it was found that mean of % FEV1 of athletes (86.8 ± 22.0) was significantly higher than that of sedentary group (72.0 ± 27.8) as shown in figure 3. Statistically significant difference was observed in the mean percent of predicted FEV1 values of both athletes and sedentary group.

Table-2: Pulmonary Function Test Parameters between the Two Groups

Variables	Groups		t value	p value
	Athletes	Sedentary		
FVC	88.0 (12.8)	79.8 (21.5)	2.84	< 0.01**
FEV1	86.8 (22.0)	72.0 (27.8)	3.63	< 0.01**
FEV3	86.5 (13.7)	75.3 (17.9)	4.33	< 0.01**
PEFR	93.0 (12.8)	86.4 (15.2)	2.88	< 0.01**
FEV1/FVC	92.1 (4.4)	81.1 (7.3)	11.10	< 0.01**

Values in parenthesis are standard deviation; ** Highly Significant

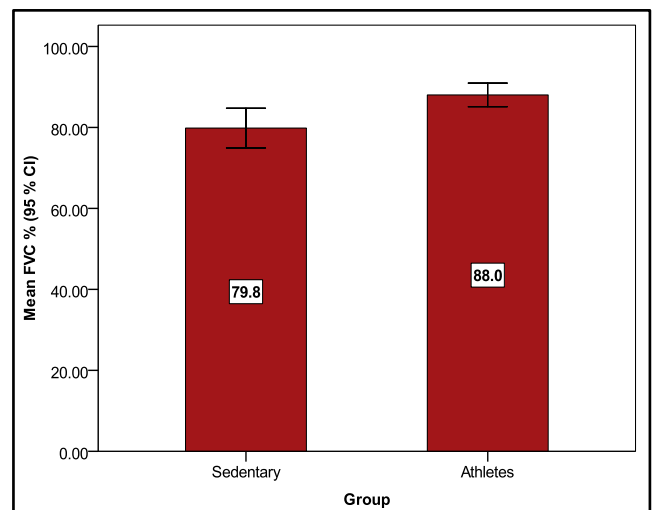


Figure-2: Mean % FVC among Both Groups

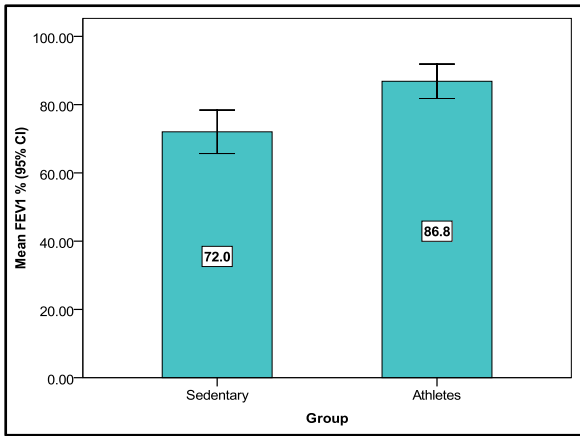


Figure-3: Mean % FEV1 among Both Groups

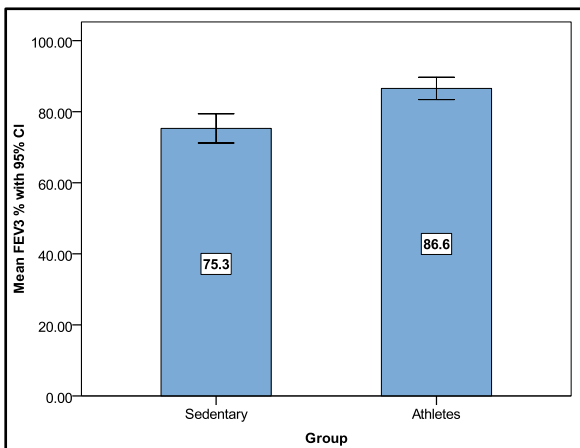


Figure-4: Mean % FEV3 among Both Groups

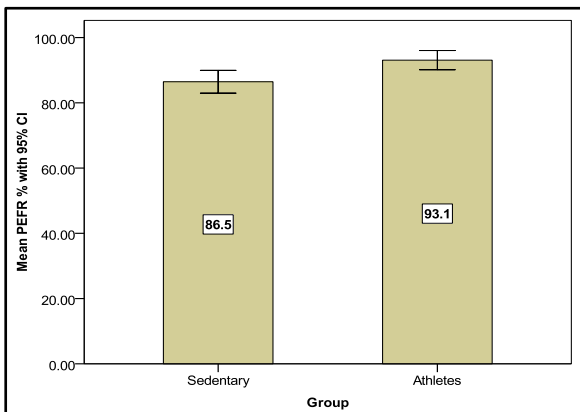


Figure-5: Mean % PEFR among Both Groups

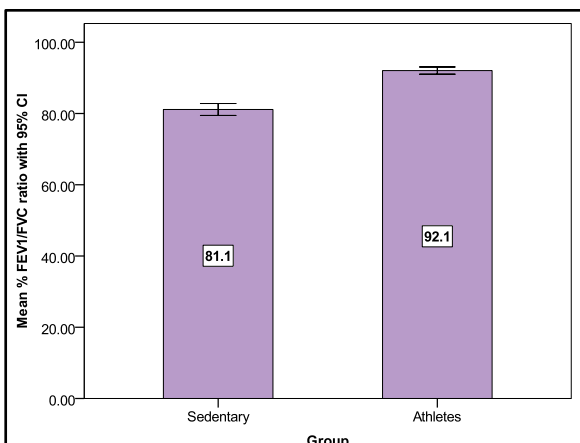


Figure-6: Mean % FEV1/FVC ratio among Both Groups

Mean % FEV3 was also higher in athletes than sedentary group and the difference in the mean values between them was statistically significant (figure 4). The mean percent of predicted PEFR was 93.0 ± 12.8 among athletes and 86.4 ± 15.2 among sedentary group. The higher mean of % PEFR observed among athletes compared to sedentary group was statistically significant which is also shown graphically in figure 5. The mean percent of FEV1/ FVC ratio also showed a significant difference with higher value in athletes than sedentary group. These findings are shown by a bar diagram in figure 6. Lung function results from the present study showed significant difference between athletes and sedentary subjects.

DISCUSSION

It has been observed that the mean of percentage of predicted value of FVC for Sedentary study subjects was 79.8 and for Athletes was 88.0, clearly showing that the subjects who were athletes had better FVC values than the Sedentary. Similar observations were made by Shivesh Prakash et al.^[15] with reference to FVC. A study by Douglass G and et al.^[16] also reported higher mean FVC scores in athletes as compared to non-athletes.

With reference to FEV1 the second parameter studied, the mean of the percentage of the predicted value of FEV1, for sedentary subjects was 72.0 and for Athletes it was 86.8. The values reflect that the FEV1 values of athletes were much better when compared to Sedentary subjects. When Sedentary and Athlete groups are compared, results showed higher FEV1 in Athletes as reported by other studies^[15,17] while Ayesha AK and et al.^[18] did not observe any significant change in FEV1.

Many authors emphasized on the importance of PEFR as one of the important indicators of pulmonary function. In the present study, the mean of the percentage of predicted value of PEFR for Sedentary subjects was 86.4 compared to Athletes which was 93.0. The above observations revealed PEFR values in athletes

were much higher than the control group. Nagarathna R and Nagendra HR^[19] in their study found improvement in the peak flow rate after Yoga training for 2 weeks.

The FEV1/FVC ratio when coupled with other parameters could be used as a predictor of obstructive and restrictive patterns of lung disorders. In the present study, the mean of the percentage of predicted value of FEV1/FVC for Sedentary subjects was lower (81.1) than Athletes (92.1). Some previous studies^[20-22] have observed no significant differences in vital capacity in athletes when compared with non-athletes. The conflicting findings may be due to genetic and ethnic factors.

Vital capacity is determined by the lung dimensions, compliance and respiratory muscle power whereas PEF is determined mainly by airway caliber, alveolar elastic recoil and respiratory muscle effort. The period of exercise to bring improvement in PFT varied from 1 month to 8 months reported by various researchers in India.^[23,24] The possible explanation is that regular forceful inspiration and expiration during exercise leads to strengthening of the respiratory muscles which in turn help the lungs to inflate and deflate maximally. This maximum inflation and deflation is an important physiological stimulus for the release of surfactant as stated by Hildebrand and et al.^[25] The findings of the present study can also be explained on the basis of better functions of respiratory muscle strength, improved thoracic mobility and the balance between lung and chest elasticity which the athletes may have gained from regular exercise. Hence regular physical activity causes many desirable physiological, psychological and physical changes in the individual.

CONCLUSION

The study revealed that the sedentary subject's performance on PFT was poorer when compared with Athletes. This emphasizes the need to change their life style and adopt measures like exercises to improve their wellbeing. Regular

exercise produces a positive effect on the lung by increasing the pulmonary capacities. The present study suggests that regular exercise training has an important role to play in determining and improving lung volumes. It also has thrown some light on the need for pulmonary function tests as a screening method to identify subjects who may be prone for respiratory disorders. The knowledge so gained of the respiratory functions through spirometry can be utilized for the betterment of the population by bringing in a modification in their life styles.

REFERENCES

1. Wasserman K, Gitt A, Weyde I, Eckel HE. Lung function changes and exercise-induced ventilatory responses to external restive loads in normal subjects. *Respiration* 1995;62(4):177-84.
2. Twick IW, Staal BJ, Brinknian MN, Kemper HC, Van Mechelen W. Tracking of lung function parameters and the longitudinal relationship with lifestyle. *Eur Resp J* 1998;12(3):627-34.
3. Boutellier U, Büchel R, Kundert A, Spengler C. The respiratory system as an exercise limiting factor in normal trained subjects. *European Journal of Applied Physiology and Occupational Physiology* 1992;65(4):347-353.
4. Harms CA, Wetter TJ, St Croix CM, Pegelow DF, Dempsey JA. Effects of respiratory muscle work on exercise performance. *Journal of Applied Physiology* 2000;89(1):131-138.
5. Cotes JE. *Lung Function, assessment and application in medicine*, 4th Ed. Oxford: Blackwell Scientific publications; 1979.
6. Singh HD. Ventilatory Function tests, Normal Standards in Male Adults. *Ind J Med Prof* 1959;5:2483-2486.
7. Jain SK, Ramaiah TJ. Normal Standard of Pulmonary Function Tests for healthy Indians 15-40 years old, comparison of different prediction equations. *Ind J Med Res* 1969;57:1433-1466.
8. Aggarwal AN, Gupta D, Chaganti S, Jindal SK. Diurnal variation in peak expiratory flow in healthy young adults. *The Indian J Chest Dis & Allied Sci* 2000;42:15 - 19.
9. Gupta P, Gupta L, Ajmer RL. Lung Functions in Rajasthan Subjects. *Ind J. Physiol. Pharmacol* 1979;23(1):9-14.
10. De AK, Dasgupta PK, Panda BK, Bhattacharya AK. Physical efficiency test on Indian male Kabbadi Inter University Players. *Brit J Sports Med* 1982;16(1):33-36.
11. Malhotra MS, Ramaswamy SS, Joseph NT, Sen Gupta J. Functional capacities and body compositions of Indian Athletes. *Ind. J. Physiol Pharmacol* 1972; 6: 55-62.

12. Ghosh AK, Ahuja A, Khanna GL. Pulmonary capacities of different groups of sportsmen in India. *Brit J Sports Med* 1985;19(4):232-234.
13. Miller MR, Hankinson J, Brusasco V, Burgos F, Casaburi R, Coates A et al. Standardization of spirometry series "ATS/ERS Task Force": Standardization of Lung Function Testing. *European Respiratory Journal*; 26 (2): 321.
14. Miller MR, Hankinson J, Brusasco V, Burgos F, Casaburi R, Coates A, et al. Standardization of spirometry Series "ATS/ERS Task Force": Standardization of Lung Function Testing; *European Respiratory Journal*; 26 (2): 326.
15. Prakash S, Meshram S, Ramlekkar U. Athletes, Yogis and individuals with sedentary life styles, Do their lung functions differ? *Indian J. Physiol Pharmacol* 2007; 51 (1): 76-80.
16. Stuart D, Collings WD. Comparison of vital capacity and maximum breathing capacity of athletes and non athletes. *Journal of Applied Physiology* 1959; 14 (4): 507-509.
17. Makwana K, Khirwadkar N, Gupta HC. Effect of short term Yoga Practice on ventilatory function tests; *Indian J Physiol. Pharmacol* 1988;32(3): 202-8.
18. Khanam AA, Sachideva U, Gulesia R, Deepak KK. Study of Pulmonary and Autonomic functions of Asthma Patients after Yoga Training. *Indian J. Physiol Pharmacol* 1996; 40 (4) 318-324.
19. Nagarathna R, Nagendra HR. Yoga for Bronchial Asthma: a controlled study. *British Medical Journal* 1985; 291:1077.
20. Lakhera SC, Kain TC. Comparison of pulmonary function amongst Ladakhi, Delhi, Vanvasi and Siddi boy athletes. *Indian J. Physiol. Pharmacol* 1996;39(3):255-258.
21. Adegoke OA, Arogundade O. The effect of chronic exercise on lung function and basal metabolic rate in some Nigerian athletes. *African Journal of Biomedical. Research* 2002; 5: 9- 11.
22. Hagberg JM. Pulmonary function in young and older athletes and untrained men. *J. Appl. Physiol* 1988;65:101-104.
23. Pansare MS, Pradhan SG, Kher JR, Aundhkar UG, Joshi AR. Study of effect of exercise on physical fitness tests and pulmonary function tests in tribal girls of Maharashtra. *Netaji Subhas National Institute of Sports Edition* 1994;3(4):39-43.
24. Shashikala L, Ravipathi S. Effects of exercise on pulmonary function test. *Indian Journal of Fundamental and Applied Life Sciences* 2011;1(3):230-231.
25. Hildebrean JN, Georice I, Clements JA. Surfactant release in exercised rat lung stimulated by air inflation. *Journal of Applied Physiology* 1981;51:905-910.

Cite this article as: Vedala S, Paul N, Mane AB. Differences in pulmonary function test among the athletic and sedentary population. *Natl J Physiol Pharm Pharmacol* 2013; 3:118-123.
Source of Support: Nil
Conflict of interest: None declared