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Study of pulmonary function tests and muscle strength in sportsmen of tribal region of Gujarat

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***Abstract*---**Introduction -Regular exercise has a direct association with pulmonary function measures. When compared to non-exercising persons, athletes have greater lung capacity as a result of frequent exercise. Muscle strength is defined as the maximum force created during a maximal voluntary contraction under a certain set of circumstances. The researchers wanted to see if there was a difference in pulmonary function tests [Vital Capacity (VC), Forced Expiratory Volume in One Second (FEV1), and Maximum Voluntary Ventilation (MVV)] and handgrip muscular strength between athletes and sedentary controls. Material and Methods – The study included 100 volunteers between the ages of 18 and 25, 50 of whom were athletes who had participated in sports such as cricket, badminton, football, volleyball, and others for at least 3-5 years, and 50 of whom were sedentary control subjects. Pulmonary function tests (VC, FEV1, and MVV) and handgrip muscle strength were performed on both groups. Results - Sportsmen and control group comparison was analyzed by applying an unpaired "t" test. Significant P-value was less than 0.05 ($P < 0.05$). In our study, it was observed that pulmonary function tests (VC, FEV1, and MVV) and handgrip muscle strength were significantly higher in sportsmen as compared to the control group.Conclusion - In terms of pulmonary functioning, training and physical exercise have a definite favourable effect. The findings of this study strongly suggest that sedentary medical students engage in frequent physical activity.

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Keywords---sportsmen, vital capacity (VC), FEV1, maximum voluntary ventilation (MVV), pulmonary function tests, muscle strength.

Introduction

Genetic factors, ethnic features, environmental pollution, physical activity, altitude, and to a lesser extent nutritional and socioeconomic factors all influence pulmonary function test (PFT) parameters. [1] The pulmonary function tests are crucial for determining an individual's physiological fitness. The relationship between pulmonary function and athletic performance has long been a source of debate among exercise scientists. Many researches believe that the respiratory system has an impact on trained athletes' strength and exercise performance. [2,3] Regular exercise has a direct association with lung function measures. [4,5] When compared to non-exercising people, tribal athletes and athletes had a higher pulmonary capacity as a result of frequent exercise. As a result, the strength of respiratory muscles, the compliance of the thoracic cavity, airway resistance, and elastic recoil of the lungs are all factors that influence pulmonary function. [6]. It's possible that sedentary lifestyles are linked to less efficient lung function. Intensity and seriousness Handgrip Muscle strength is defined as the maximum force created during a maximal voluntary contraction under a certain set of circumstances. (1) Strength athletes use the term "hand grip power" to refer to the muscular strength and force they can generate with their hands. The forceful flexion of all finger joints, thumbs, and wrists with the maximal voluntary force that the person is able to exert under normal biokinetic conditions results in the strength of a hand grip (2). For numerous years, handgrip muscle strength tests have been a common way to assess muscle function in sports and exercise. It is frequently employed as a measure of overall physical strength. In a variety of scenarios, determining handgrip strength is critical. Finally, one of the most common uses of muscle strength testing in athletic, ergonomics, and medical investigations has been to evaluate functional movement performance. The link between active muscle group strength and selected movement performance has frequently been characterised as muscular strength test external validity. Strength, speed, endurance, mobility, and talents, as well as technical-tactical competence, personal abilities, physical attributes, and health issues, all play a role in sporting performance(9). The most essential determinant is hand grip strength (grasping strength). Hand grip strength is a physical characteristic that contributes to effectiveness and efficiency in everyday job and sports activities. Furthermore, in many sports, hand grip is a significant predictor of performance. Muscle strength and power are critical for successful performance in both individual and team sports. (10) Grip strength has been shown to improve sports performance when a sporting implement is held in the hand(11). Strength, speed, endurance, mobility, and talents, as well as technical-tactical competence, personal abilities, physical attributes, and health issues, all play a role in sporting performance. 12. As a result, the current study was carried out with the goal of determining the pulmonary functional capacities and muscle strength of various groups of athletes and comparing them to those of sedentary people.

Material and Methods

The study population consists of tribal sportsmen and sedentary group selected from medical college. Sportsmen group consisted of players involved in various sports like badminton, hockey, cricketers, basketball, cyclist, kabbadi. The subjects were carefully selected at random from medical college-aged between 18-25 years, non-obese who were willing to participate in the study Sedentary group consist of subjects who are not doing any exercise. All of them were non-smokers, non-alcoholic, and free from any cardiorespiratory, endocrine diseases. Sportsmen were selected from local sports institute, playing the sport for 4-5 years. The informed consent was obtained and the procedure was explained to each subject during the test. The pulmonary function tests were carried out using an RMS Helios spirometer. Anthropometric measurements like the height and weight of each subject were measured before the test procedure. Information was gathered about the personal history, smoking, recent respiratory illness, medications used, etc. and we also ask about the family history of any respiratory disease. Evaluation of Vital capacity (VC), Forced Expiratory Volume in 1 second (FEV1) and maximum voluntary ventilation (MVV) was done.

Procedure: Subjects were given proper instructions about the use of the Helios spirometer and the Forced Vital Capacity (FVC) manoeuvre was conducted in the following order:

1. The subject was asked to sit comfortably and take a rest for 5 minutes.
2. The mouthpiece was sterilized in an antiseptic solution.
3. The subject was instructed to the hold mouthpiece firmly between teeth and lips.
4. Nose was closed with nose clips.
5. The subject was asked to take deep inspiration and breathe out as forcefully as possible for recording FVC and FEV1.

The Maximum Voluntary Ventilation (MVV) manoeuvre was conducted in the following order

Subjects were instructed to breathe in and out as rapidly and deeply as they could for a period of 15 seconds through the mouthpiece. All the recorded manoeuvre results were analyzed for acceptability and repeatability. Three acceptable readings were taken and their mean values were calculated and analyzed.

Muscle strength

The handgrip strength was measured by using handgrip dynamometer (INCO INDIA LTD.AMBALA).

Procedure

The handgrip dynamometer was held in the dominant hand, in a sitting position, with the forearm extended in front of a table and elbow flexed at 90˚. The subject was instructed to hold the dynamometer in such a way that the second phalanx

was against the inner stirrup. The subject was then asked to grip the dynamometer handle with as much force as possible. If necessary, the examiner stabilized the dynamometer and encouraged the subject to give their best performance. The reading was taken in kilograms as indicated by the pointer on the dynamometer. Three readings were taken with a gap of two minutes between two readings and the maximum value was recorded and analyzed [13,14]

Statistical analysis: The detailed data was entered into the Microsoft excel sheet and subsequently analyzed by using SPSS (Statistical package for social science) software. Values were reported as Mean ± SD. Sportsmen and control group comparison was analysed by applying unpaired "t" test. Significant P-value was set at less than 0.05 ($P < 0.05$).

Results

Table I: Mean values of physical characteristics in sportsmen and control Group

Sr. no.	Parameters	Sportsmen Mean ±SD	Control group Mean ±SD
1	Age (years)	20.16± 2.18	20.14±2.22
2	Height (cm)	172.3±6.38	176.7±6.06
3	Weight (kg)	65.74±8.55	62.84±8.72
4	Pulse rate (beats/min)	66.84± 4.71	82.72±7.81

Graph-I

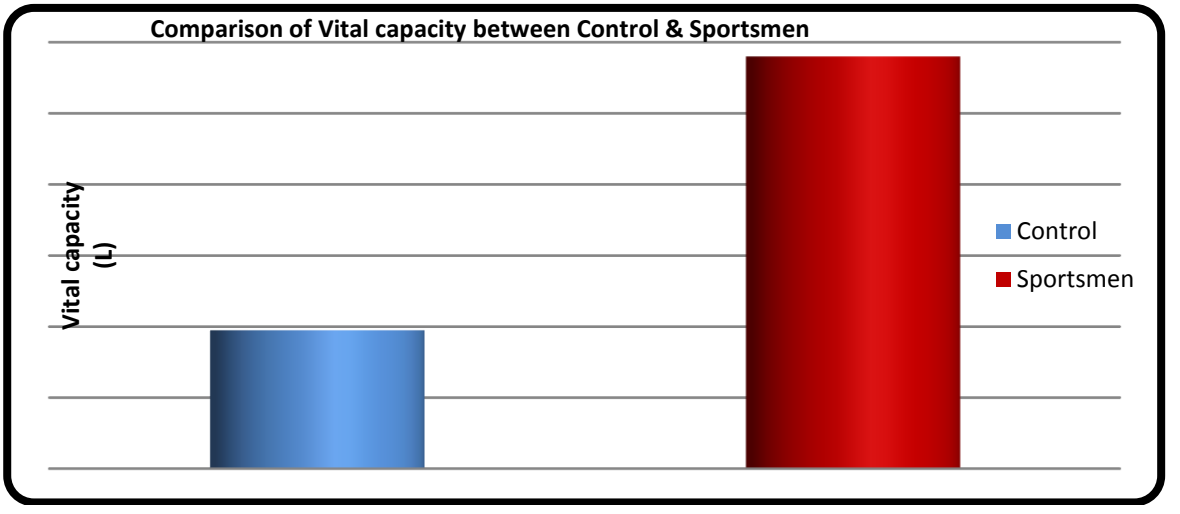

Table II - Comparison of Vital capacity between Control & Sportsmen

	Vital capacity (Liters)	
	Control	Sportsmen
Mean	3.495	3.880
SD	±0.41	± 0.43
P	P<0.001 (Significant)	

Table II and graph I show comparison of vital capacity between control & sportsmen. Mean value of vital capacity in sportsmen was higher than control group. The difference between mean value of vital capacity of sportsmen and control group was statistically significant (p<0.001).

Table III - Comparison of FEV1 between Control & Sportsmen

	FEV1(liters)	
	Control	Sportsman
Mean	3.294	3.574
SD	± 0.41	± 0.36
P	P<0.001 (Significant)	

Table III and graph II show comparison of FEV 1 between control & sportsmen. Mean value of FEV 1 in sportsmen was higher than control group. The difference between mean value of FEV 1 of sportsmen and control group was statistically significant (p<0.001).

Graph II

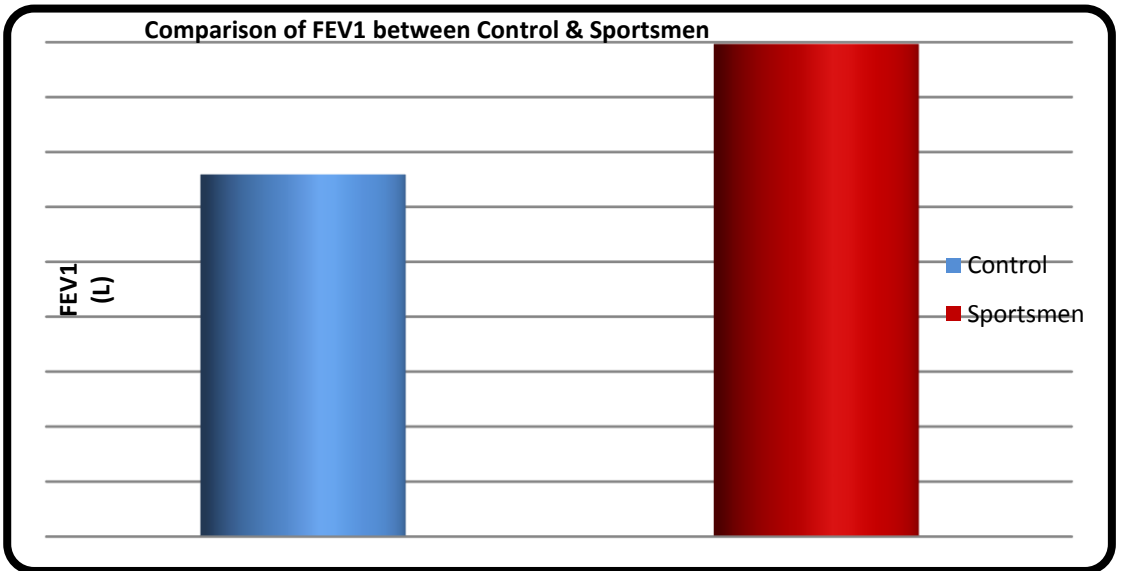

Table IV - Comparison of MVV between Control & Sportsmen

	Maximum Voluntary Ventilation (MVV) (Lit/min).	
	Control	Sportsman
Mean	113.3	139.9
SD	±17.95	±13.68
SEM	2.53	3.19
P	P<0.001 (Significant)	

Graph III

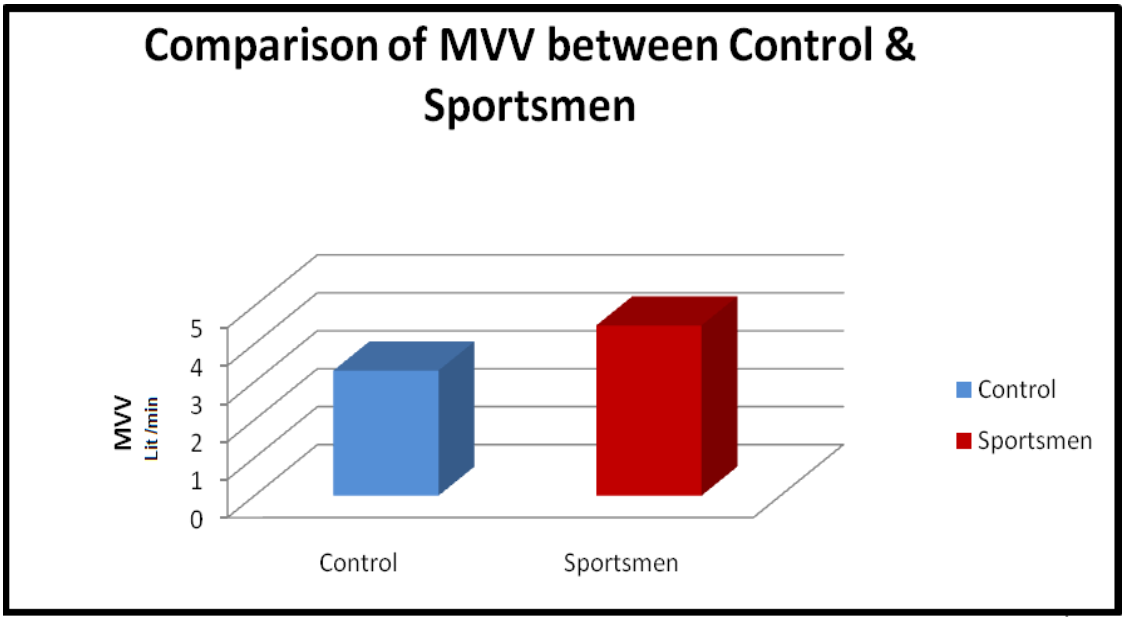

Table IV and graph III show comparison of MVV between control & sportsmen. Mean value of MVV in sportsmen was higher than control group. The difference between mean value of MVV of sportsmen and control group was statistically significant (p<0.001)

Table VII - Comparison of muscle strength between control & sportsmen

	Muscle strength (kg)	
	Control	Sportsmen
Mean	41.66	48.74
SD	±4.65	±4.57
P	P<0.001 (Significant)	

Graph-IV

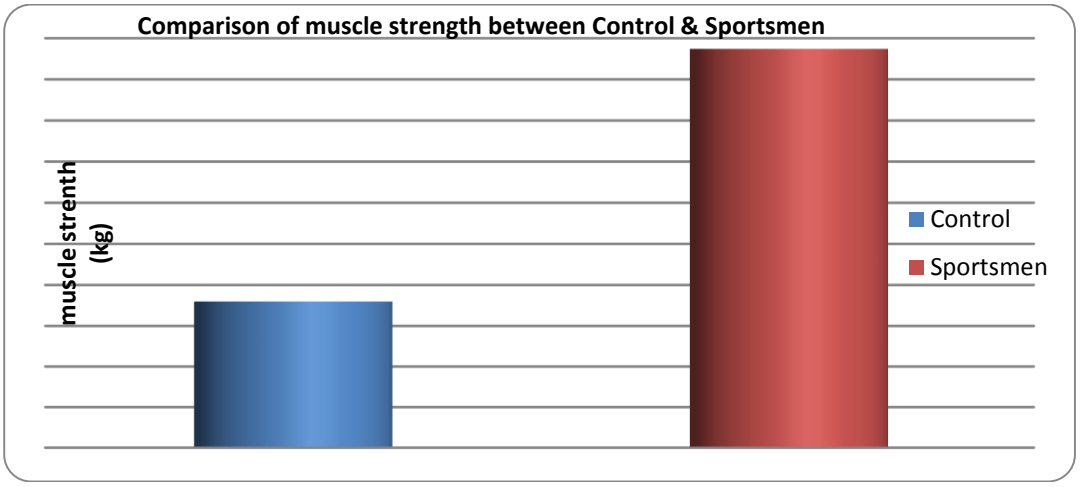

Table VII and graph VI show comparison of muscle strength between control & sportsmen. Mean value of muscle strength in sportsmen was higher than control group. The difference between mean value of muscle strength of sportsmen and control group was statistically significant ($p<0.001$).

Discussion

In the present study, we recorded various pulmonary function parameters (VC, FEV1, and MVV), and muscle strength in tribal sportsmen and in sedentary control group. We found statistically significant increase in all parameters in sportsmen as compared to control group. Table no. I shows mean values of physical characteristics in sportsmen which were age in years (20.18 ± 2.19), height in cm (170.3±6.39), weight in kg (64.96±8.55) and pulse rate/min (64.94± 4.61).The mean values of physical characteristics in control group were age in years (20.12 ± 2.22), height in cm (179.7±6.08), weight in kg (63.82 ± 8.72), and pulse rate/min (80.72 ± 7.71).There was no significant difference in age, height and weight while the pulse rate was significantly higher for control group as compared to sportsmen. ($p<0.0001$)FEV1 means values of forced expiratory volume at the end of first second.

FEV1 in sportsmen (3.574±0.36) liters was significantly higher than in control group (3.294±0.41) liters. MVV in sportsmen (139.9±13.6)Lit/min was higher than in control group (113.3±17.95)Lit/min.The difference between mean value of MVV of sportsmen and control group was statistically significant ($p<0.001$) Muscle strength in sportsmen (47.74±4.67) kg was higher than in control group (41.60±4.67) kg. The difference between muscle strength values of sportsmen and control was statistically significant. ($P<0.001$) Regular exercise has proven to be beneficial for human body especially for the heart and lungs. Cardiovascular system and respiratory system are benefited due to improved vascularity and more efficient circulation to them. The present study was attempted to study the effects of physical training on lungs function. Ghosh AK et al found more values of vital capacity, MVV in sportsmen as compared to sedentary control group [15].

Richa Thaman et al studied pulmonary function tests in border security force trainees of India. They found that vital capacity,FEV1 and MVV were more in trainees as compared control group[16]. The higher value of MVV was advantageous for physical work capacity of trainees. Similar study was conducted by Olufeyi Adegoke on Nigerian athletes. They found increased vital capacity, and MVV in Nigerian athletes as compared to non-athletes [17] Doherty M. and L. Dimitriou found higher FEV1 and MVV values in swimmers as compared to athletes and sedentary control group[18]. When Sedentary and Athlete groups are compared, results showed higher FEV1 in Athletes as reported by other studies [19,20] while Ayesha AK and et al. [18] did not observe any significant change in FEV1. 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 Hildebrean and et al. [21] MVV has been used to assess endurance performance of respiratory muscles. Values of MVV depend on factors like maximum achievable respiratory rate during voluntary hyperventilation, patency of airways and tone of the respiratory musculature.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. De AK conducted a study on kabbadi players in comparison with football goalkeepers. He found more muscle strength in kabbadi players as compared to football goalkeepers [22] Shymal Koley and M.kumar Yadav found more hand grip strength in cricketers as compared to control group. The difference may be due to the effect of regular physical activities and training programme in cricketers (11)B randon K Doan et al noted significant increase in grip strength, power and flexibility test from pre to post training in intercollegiate golf players [23]. In cricketers, right and left hand grip strength have significantly positive correlations with height, weight and BMI, (11) there was an excellent strong positive correlation when age, body height and body weight were compared with handgrip strength [24, 25]. The grip strength is measured in several sports disciplines and its importance to success is clearly identified. The estimation of hand grip strength is of immense importance in sports like wrestling, tennis, badminton, cricket, handball, basketball, hockey, baseball and softball, where sufficient degree of grip strength is necessary to be successful. Dopsaj, Koropanovski confirmed that men showed significantly greater maximal hand grip force in both dominant and non-dominant hands than women.[26] Observed that hand grip strength correlated with throwing speed in experienced pitchers. Hand grip strength plays an important role to predict the performance in various sports activities especially in baseball [27], tennis [28] and in cricket (11). Thus finding of the present study can be attributed to better achievable respiratory rate and depth which may be due to better respiratory muscle endurance and increased tone and strength of respiratory muscles in tribal sportsmen. It was observed that intense inspiratory muscle training results in increased lung volume. In the present study hand grip strength might have increased due to regular physical exercise and endurance. Strength training induces increase in muscle strength. Hand grip strength is a physiological variable that is affected by many factors like age, gender and body size. There is a strong correlation between grip strength and

various anthropometric factors. Hand grip strength is a significant predictor of performance in various sports discipline.

Conclusion

In our study it was observed that pulmonary function tests (VC, FEV_1, and MVV), aerobic power, anaerobic power and muscle strength were significantly higher in sportsmen as compared to control group. Our study was mainly aimed to show the effect of training on pulmonary functions and muscle strength. It revealed that the physical activity has a definite effect as far as the respiratory functions are concerned. The parameters like VC, MVV, and FEV1 can be taken as indices for cardio-respiratory fitness. 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.The result of this study strongly recommends regular physical exercise for the medical students. Medical students are always under tremendous stress which affects their work output and this is precipitated by sedentary life style. Regular physical exercise will definitely improve their cardio-respiratory fitness and will help them to lead a better quality of life. Secondly, evaluation of these results will also help sportsmen to decide the type of sport for which they are best suited.

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