

The Athletes versus Lung Volume Responses of Non-Athlete Children to Intense Exercise

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ABSTRACT

Background: Results from spirometry can be impacted by factors such as age, gender, weight, height, ethnicity, physical fitness, smoking habits, workout, and environmental factors.

Aim: To compare the spirometry lung volumes of children who were athletes to those of children who were not.

Methodology: This descriptive, cross-sectional study was conducted at Department of Physiology, Gomal Medical College, Dera Ismail Khan from 1st March 2022 to 30th November 2022. Spirometry was done on a total of 1,500 subjects, and 1100 recordings that satisfied the 2005 ATS/ERS task force acceptance criteria were chosen. Children and teenagers between the ages of 8 and 18 participated. An altered version of the International Study of Asthma and Allergies in Childhood (ISAAC) Questionnaire 17 was utilized prior to the test. A record of physical measurements, height, and weight was made. On all subjects, a thorough physical and systemic examination was done.

Results: Variables related to pulmonary function, such as FVC, FEV₁, FEV₁/FVC ratio, PEFR, and FEF_{25-75%} were 1.13±0.64, 1.05±0.62, 82.01±3.51, 212.1±58.8 and 1.61±0.1 respectively.

Conclusion: When interpreting spirometry data, age and physical activity should be taken into account as they have a significant impact on spirometry reference values. Young children should be encouraged to engage in physical activity since it increases lung volumes, especially during intense exercise in athletes.

Key words: Spirometry, Athletes, Physical activity, Pulmonary function testing, Reference values

INTRODUCTION

Respiratory disorders are a major source of morbidity and death globally¹. Asthma affects 235 million people worldwide, and COPD is responsible for more than 3 million fatalities. Over 90% of such fatalities take place in low- to middle-income nations. Spirometry is a quick, non-invasive technique used to evaluate a person's lung function². It is used to test for, identify, and track respiratory conditions including COPD and asthma. Results from spirometry can be affected by a number of factors, including age, sex, height, weight, ethnicity, smoking habits, physical fitness, and environmental factors³. Results from spirometry are useless unless they are contrasted with reference values. Therefore, obtaining predictive values for certain groups is crucial.

Professional athletes have special training to enable them to reach high minute ventilation⁴. The cardiac outputs and stroke volumes of athletes are often higher, and their overall cardiovascular health is noticeably better. When Greek athletes' spirometry results were compared to those anticipated by the European Community of Steel and Coal, they showed under estimated lung capacities and FEV₁/FVC ratios⁵. Another research evaluated the pulmonary function of athletes, yogis, and non-athletes; as compared to people who led sedentary lifestyles, athletes had the greatest mean FEV₁ and Peak Expiratory Flow Rate (PEFR), followed by yogis¹. On the basis of this, we may assume that they would have greater spirometric values than the overall population⁶. However, relatively few researches have been conducted to determine how exercise affects pulmonary function testing. As far as we are aware, none of these studies have been conducted on population of KP. Spirometry's effectiveness is lowered as a result, and respiratory illnesses are under diagnosed, especially in younger athletes.

The purpose of the current study is to determine the spirometry lung volumes of young athletes and compare them to non-athlete children in general.

MATERIALS AND METHODS

Children and teenagers between the ages of 8 and 18 participated in this descriptive, cross-sectional study from March to November

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2022. The study was authorized by the Peshawar Medical College Ethics Review Committee. The sample size was calculated using OpenEpi. Using a multistage sampling approach, schools and subjects were chosen. First and foremost, eight schools from various socioeconomic tiers in Peshawar were chosen at random. The next step was to choose pupils for data collection who were the appropriate age; fortunately, complete sections were picked. Parents' and the school's administration's consent was obtained. Children and adolescents who were either not within the 8 to 18 year age range, or who had a history of respiratory system-related trauma, or who had been diagnosed with wheezing, allergic rhinitis, asthma, any significant respiratory tract disease, congenital heart diseases, or muscular disorders like Duchene muscular dystrophy, as well as smokers, were excluded from the study.

An altered version of the International Study of Asthma and Allergies in Childhood (ISAAC) Questionnaire 17 was utilized prior to the test. A record of physical measurements, height, and weight was made. On all subjects, a thorough physical and systemic examination was done. A Vitalograph-alpha TM that had been calibrated before the test was used for spirometry. Lung volumes were measured using the American Thoracic Society/European Respiratory Society (ATS/ERS) Task Force 2005 standardization guidelines¹⁸. Peak expiratory flow rate (PEFR), forced expiratory flow between 25% and 75% expired volume (FEF_{25-75%}), forced vital capacity (FVC), forced expiratory volume in the first second (FEV₁), FEV₁/FVC, and forced expiratory flow were all recorded.

A nasal clip was placed on each subject's nose as they underwent spirometry while seated. The best value was selected for statistical analysis out of a minimum of 3 moves that were recorded. Data analysis was performed using SPSS-24. The reference values were created, the quantitative data were given as Mean±SD, and the normal distribution curve was used to determine the significance of Mean±S 2 SD. The Mann-Whitney U-test was used to determine how the data were distributed across the subjects. With a 95% confidence interval, the independent t-test was used to assess pulmonary function characteristics between athletes and non-athletes, with p0.05 being regarded as statistically significant.

RESULTS

The mean and standard deviation of demographic data for study participants, including age, height, weight, and BMI, as well as

variances between athletes and non-athletes. Variables related to pulmonary function, such as FVC, FEV₁, FEV₁/FVC ratio, PEFR, and FEF_{25-75%}, were 1.13±0.64, 1.05±0.62, 82.01±3.51, 212.1±58.8 and 1.61±0.1 respectively (Table 1).

Mann-Whitney U test revealed that both athletes and non-athletes had normal distributions of all pulmonary function measures, including FVC, FEV₁, PEFR, and FEF_{25-75%}. The independent t-test was used, and results showed that there were significant differences in all pulmonary function variables between athletes and non-athletes, with a 95% confidence range (Table 2)

Table 1: Descriptive statistics of the patients

Variables	Total	Athletes	Non-Athletes
Age	12.01±1.8	11.01±1.7	12.01±1.9
Height	161.1±14.8	162.1±14.7	160.1±14.8
Weight	42.4±14.5	43.4±14.3	42.4±15.5
BMI	18.6±3.3	19.5±3.5	18.6±3.2
FVC	1.13±0.64	1.15±0.53	1.03±0.61
FEV ₁	1.05±0.62	1.07±0.71	1.02±0.60
FEV ₁ /FVC	82.01±3.51	83.01±3.76	82.01±3.49
PEFR	212.1±58.8	222.1±59.7	212.1±58.5
FEF _{25-75%}	1.61±1.0	1.61±1.3	1.61±1.0

Table 2: Variables related to pulmonary function in athletes and non-athletes are compared.

Variables	t	95% CI		P-value
		Lower	Upper	
FVC	70.73	1.16	1.25	0.00
FEV ₁	66.56	1.02	1.03	0.00
PEFR	78.76	212.1	225.3	0.00
FEF _{25-75%}	60.29	1.54	1.66	0.00

DISCUSSION

Spirometry is a crucial diagnostic technique for assessing a variety of respiratory disorders, including chronic bronchitis, emphysema, and asthma, among others. Due to the frequent use of this test to assess lung function in outpatient settings, we require population-specific reference values for comparison. Age, height, gender, ethnicity, weight, and socioeconomic level all have an impact on the spirometry-measured factors. It has been challenging to choose which of the many variables that impact the reference values should be preserved as an independent variable while developing the prediction equation. In this study, we examined how age and physical activity affected the spirometry reference values. Numerous researches have confirmed that there is a linear link in the case of children and adolescents when age is preserved as the independent variable⁶⁻¹⁰. A favorable correlation between age and spirometry metrics including FVC, FEV₁, PEFR, and FEF_{25-75%} has also been shown in recent studies. The logical reason for this association might be because as people age, their muscles become larger and their thoracic diameter rises, increasing the lung's capacity to extend. However, due to a reduction in lung elasticity and narrowing of the airways, there is a negative association between lung function and age in adults^{11,12}. Although other studies have shown that lung volumes decline from 4 to 10 years of age and subsequently grow till age 20, the current study reveals that there is a gradual increase in lung volumes from 8 to 18 years¹³.

Exercise has several advantages, and one of them is enhanced pulmonary function parameters. Exercise and spirometry measurements like FVC, FEV₁, PEFR, and FEF_{25-75%} have a favourable connection. Inspiratory muscle training is frequently offered to athletes, and it improves lung function and diaphragm thickness in addition to increasing muscle strength and endurance. These findings were in line with another study in which Cystic Fibrosis patients' lung function, diaphragm thickness, and

stamina improved following IMT.¹³ According to a study done in Thailand, yoga is also one of the workouts that enhance lung function and chest wall expansion. Yoga enhances lung volumes, particularly in youngsters, claims Bhavanani.¹⁴ Another study conducted in India¹⁵ found that those who played Sports, especially swimming, have higher lung volumes than the general population. Increased thoracic cavity width and an increase in the number of alveoli might be one explanation for why exercisers have superior lung volumes. This process is crucial for the growth of larger lung sizes in youngsters.

CONCLUSION

When interpreting spirometry data, age and physical activity should be taken into account as they have a significant impact on spirometry reference values. Young children should be encouraged to engage in physical activity since it increases lung volumes, especially during intense exercise in athletes.

Conflict of interest: Nil

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