International Journal of Recent Trends in Science And Technology, ISSN 2277-2812 E-ISSN 2249-8109, Volume 3, Issue 3, July to September, 2013 pp 01-03

A Comparative Study of Pulmonary Function Tests in Children and Adolescents, in a Rural Area of Guntur District, Andhra Pradesh, India

Venkata Venu Gopala Raju S.[1*], Madhu Babu K.[2], Chaitanya G.[3]

{[1]Associate Professor, [2]Assistant Professor, Department of Physiology}

{[3]Assistant Professor, Department of Community Medicine}

Katuri Medical College, Guntur, Andhra Pradesh, INDIA.

[*]Corresponding Address:

jampanas@sify.com

Research Article

Abstract: **Introduction**: Pulmonary Function Tests are used to measure baseline status of respiratory function, to monitor treatment and to estimate prognosis. The present study was aimed to determine pulmonary function tests values and to compare the different parameters like FVC, FEV_1, ERV, $FEF_{25-75\%}$, PEFR in children and adolescents. **Materials and Methods:** A cross sectional study was conducted to determine the pulmonary function tests in selected children and adolescents, belonging to rural area of Guntur district. Fifty male subjects were considered for the study and divided them into two groups basing on the age, who are in good health and without any signs and symptoms of disease. Pulmonary function tests were done with the help of Computerized Spirometer. Different parameters like FVC, FEV_1, ERV, $FEF_{25-75\%}$ and PEFR were recorded. **Results and Discussion:** Increase of FEV_1 of 93.58%, FVC of 105%, ERVof 67.39%, $FEF_{25-75\%}$ of 52.03%, PEFR of 46.19% was observed in adolescents, when compared to children. Statistical significance was obtained by using t test ($P<0.001$). Among the parameters studied, FVC showed a greater increase (i.e. 105%) in adolescents than the remaining parameters when compared with children. **Conclusion:** In the current study, Pulmonary function test values of children and adolescents, a marked increase was observed in all the five parameters, from childhood to adolescence as per the body needs of oxygen. It is important to understand the improvement of Pulmonary function test values with age among adolescents, in interpretation of PFT variations in different clinical settings.

Keywords: Adolescents, Children, Pulmonary Function Tests, Spirometry.

Introduction

Several studies on lung functions were carried out in children of different age groups in different parts of India.[1-6] The present study was aimed to determine Pulmonary Function Tests values in children (8-12 yrs) and adolescents (14-18 yrs), belonging to rural area of Guntur district and to compare the different parameters like FVC, FEV_1, ERV, $FEF_{25-75\%}$ and PEFR.[7] Individual values vary with subject's age, sex, height and race.[8] These tests are used to measure baseline status, to monitor treatment and to estimate prognosis.[9] Spirometry is a simple bedside test that can provide great insight into significant respiratory impairment.[10]

Materials and Methods

A cross sectional study was conducted to determine the pulmonary function tests in selected children and adolescents, belonging to rural area of Guntur district. Fifty male subjects were considered for the study and divided them into two groups (children with age 8 to 12 years and adolescents with age 14 to 18 years) who are in good health and without any signs and symptoms of disease. The purpose and objectives of the study were explained to the subjects and parents and their consent was obtained. The ethical committee of the Institute approved the design and study protocol. Age was taken as completed years as per the school records. The height and weight were measured by using height and weight scale. The heights were measured to nearest mm. Weight was measured with minimal clothing to the nearest 100 g. Body surface area (BSA) was calculated from height and weight. Pulmonary function tests were done with the help of Computerized Spirometer P.K.MORGAN Model no. SPIRO-TM-232.[11,12] Each boy was explained and demonstrated the technique of the lung function test and was given three trials prior to the actual measurement. Different parameters like FVC, FEV_1, ERV, $FEF_{25-75\%}$, and PEFR were recorded. Considerable physical effort and attentiveness are required for accurate results. Reproducibility of several test attempts (at least three and the best value was recorded as the test result) is important and is a criterion for valid interpretation of test results.[11,12] Subjects with medical problems like pulmonary congestion, coughing, thyroid dysfunction, neurologic illness, poor nutrition and corticosteroid-associated muscle weakness were excluded from the study, as they can confuse spirometric testing.[9]

Definitions

1. Forced vital capacity (FVC): Maximum volume of air exhaled from the lungs after a maximum inspiration.

2. Forced expiratory volume in one second (FEV_1): Volume exhaled during the first second of an FVC manoeuvre.[13]
3. Forced expiratory flow ($FEF_{25–75}$): Mean rate of airflow over the middle half of the FVC between 25% and 75% of FVC. (Figure 1)
4. Expiratory reserve volume (ERV): The volume of air that can be expired with a maximum expiratory effort after passive expiration.[14]
5. Peak expiratory flow rate (PEFR): Maximum velocity with which air is forced out of the lungs.[15]

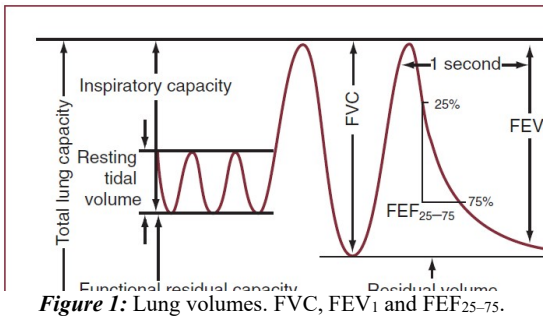

Figure 1: Lung volumes. FVC, FEV_1 and $FEF_{25–75}$.

Results and Discussion

Mean age, weight, height & body surface area in children and adolescents were depicted in figure 2.

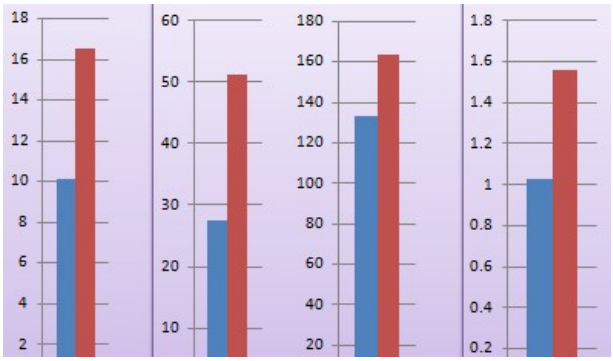

Figure 2: Age, Weight, Height & Body surface area comparison between children (8-12 yrs) and adolescents (14-18 yrs)

The mean forced vital capacity (FVC) in the children was 1.72 litres when compared with the mean forced vital capacity of adolescents, which was 3.52 litres, shown an increase in forced vital capacity of 105% in male adolescents. The mean forced expiratory volume (FEV_1) in the children was 1.56 litres when compared with the mean forced expiratory volume of adolescents which was 3.02 litres, shown an increase of forced expiratory volume of 93.58% in adolescents. The mean forced expiratory flow ($FEF_{25-75\%}$) was 2.21 litres/sec in children when compared with the mean forced expiratory flow in adolescents which was 3.36 litres/sec. These results shown an increase in mean forced expiratory flow ($FEF_{25-75\%}$) of adolescents by 52.03%. The mean expiratory reserve volume (ERV) in the children was 0.92 litres when compared with the mean expiratory reserve volume of male adolescents which was 1.54 litres .These results shown an increase in expiratory reserve volume by 67.39% in adolescents. The mean peak expiratory flow rate (PEFR) in the children was 281.92 L/min when compared with the mean peak expiratory flow rate in the adolescents which was 412.16 L/min, showed an increase of 46.19%. Various national and international studies have shown the variability of PEFR with age, sex, height and BMI. [15] Pande et al conducted a comparative study in 783 children (aged 6-17 years) from a school in urban Delhi and 523 children (aged 6-15 years) from another school in Nellore, Andhra Pradesh.[16] Age, sex, height and weight were independent predictors of PEFR in children from Nellore. Age, sex and height, were independent predictors of PEFR in boys from Delhi while height alone was an independent predictor of PEFR in Delhi girls. Common prediction equations for predicting PEFR in boys and girls have been developed for both regions based on age and height. For the same height and age, boys had higher PEFR than girls. The PEFRs of children from both parts of the country were similar, but were lower than those reported for American white children. Chowgule et al did a study on children between age range 6 years to 15 years.[1] The pulmonary function data was separated by sex, and classified on the basis of height and age. The mean and standard deviation was calculated for every such variable. The lung function test variables show a linear positive correlation with height and age. Height explained the maximum variance in lung function parameters. For clinical evaluation of child's lung function, height is the most significant independent parameter in comparison to age and weight. Lung function first increases with weight (muscularity effect) and decreases with further increase in weight (obesity effect).[17] This study was conducted with an idea to compare the Pulmonary Function Tests in children and adolescents of Guntur rural area. Among the parameters recorded in our study (FVC, FEV_1, $FEF_{25-75\%}$, ERV and PEFR), FVC showed a greater increase (i.e. 105%) in adolescents than the remaining parameters when compared with children. (Table 1)

Table 1: Comparison of Pulmonary Function Test values between children and adolescents

Pulmonary Function Tests	Children (8-12 yrs)	Adolescents (14-18 yrs)	P-value
	MEAN ±SD	MEAN± SD	
FVC (Lit)	1.72±0.28	3.52±0.26	0.001
FEV_1 (Lit)	1.56±0.23	3.02±0.22	0.001
$FEF_{25-75\%}$ (Lit/sec)	2.21±0.32	3.36±0.22	0.001
ERV (Lit)	0.92±0.10	1.54±0.07	0.001
PEFR (Lit/min)	281.92±42.23	412.16±20.74	0.001

Limitations of the study

1. Only male subjects were included, 2. Spirometric measurements are effort dependent and cannot be done reliably by children.[13]

Conclusion

In the current study, Pulmonary function test values of children and adolescents, a marked increase was observed in all the five parameters (FVC, FEV1,ERV, FEF $_{25\text{-}75\%,}$ and PEFR), from childhood to adolescence as per the body needs of oxygen. It is important to understand the improvement of Pulmonary function test values with age among adolescents, in interpretation of PFT variations in different clinical settings.

Acknowledgements

The authors would like to thank all the subjects for their cooperation in the study.

References

1. Chowgule RV, Shetye VM, Parmar JR. Lung function tests in normal Indian children. Indian Pediatr 1995; 32: 185-191.
2. Mallik SK, Jindal SK. Pulmonary function tests in healthy children. Indian Pediatr 1985; 22: 677-681.
3. Bhattacharya AK, Banerjee S. Vital capacity in children and young adults of India. Indian J Med Res 1966; 54: 62-71.
4. Sharma PP, Gupta P, Renu D, Gupta P. Lung function values in healthy children (10-15 years). Indian J Pediatr 1997; 64: 85-91.
5. Harikumaran NR, Kesavachandran C, Sanil R, Srikumar R, Shashidhar S. Prediction equation for lung functions in south Indian children. Indian J Physiol Pharmacol 1997; 41: 390- 396.
6. Jain SK, Ramaiah T J. Lung volumes and mechanics of breathing in healthy 7-14 years old. Indian J Chest Dis 1968; 10: 63-68.
7. Park J. Park's Text book of Preventive and Social Medicine. 21st ed. M/s Banarsidas Bhanot, India; 2011. Chapter10, Preventive Medicine in Obstetrics, Paediatrics and Geriatrics; P.546.
8. Piccini, Nilsson. The Osler Medical Handbook. 2nd ed. Johns Hopkins University; 2006. Chapter 80, Pulmonary Function Tests; p 858-864.
9. Goldman, Goldman's Cecil Medicine. 24th ed. Saunders; 2011. Chapter 85, Respiratory structure and function; p e14-20.
10. Walsh. Palliative Medicine, 1st ed. Saunders, 2008. Chapter 73, Pulmonary Function; p 385-390.
11. American Thoracic Society. Lung function testing: Selection of reference values and interpretative strategies. Am Rev Respir Dis 1991;144:1202-1218.
12. Guidelines for the measurement of respiratory function. Recommendations of the British Thoracic Society and the Association of Respiratory Technicians and Physiologists. Respir Med 1994;88:165-194.
13. Johns H. The Harriet Lane Handbook, 19th ed. Mosby, 2011. Chapter 24, Pulmonology; p 584-605.
14. Pal GK, Pal P. Text book of Practical Physiology, 1st ed. Orient Longman, 2001. Chapter 26, Pulmonary Function Tests; p 178-190.
15. Agarwal AN. Measurement of interpretation of peak expiratory flow. Ind J Physio Pharma 1998; 42:567-8.
16. Pande IN, Mohan A, Khilnani S, Khilnani GC. Peak expiratory flow rate in school-going children. Indian J Chest Dis Allied Sci 1997; 39: 87-95.
17. Schoenberg JB, Beck GJ, Bouhuys A. Growth and decay of pulmonary function in healthy blacks and whites. Respir Physiol. 1978 Jun; 33(3):367–393.

Corresponding Author:
Dr. Venkata Venu Gopala Raju. Srijampana
Associate Professor, Department of Physiology,
Katuri Medical College,Guntur
(A.P) INDIA 522019.
E mail: jampanas@sify.com