Spirometric Values of Healthy School Children in Three Rural Schools of Bangladesh

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Abstract

Background: The prevalence of asthma in Bangladesh is about 7%. The spirometric values in healthy children were obtained in a single urban school more than a decade ago. No rural data is available till date. **Objective**: To determine the spirometric values of healthy school going children in three rural schools of Bangladesh. **Materials and Methods**: This cross-sectional study was carried out from July 2019 to June 2020 among 300 healthy children among both boys and girls aged 11 to 15 years in three rural schools. Among 350 approached students 332 students responded to the study, 18 students did not meet inclusion criteria and 14 students could not follow spirometry procedure. Informed written consent was taken from guardians. History regarding socio-demographic profile, passive smoking, concurrent or past respiratory illness and medication were taken and weight, height and BMI were measured of the children. Spirometry was done with spirometer machine and reports were generated by software installed in a laptop. **Results**: Boys showed higher FVC, FEV1 and PEFR but lower FEV1/FVC ratio than those of girls. Regression equations for lung function values were determined for boys and girls considering height as independent variable. **Conclusions:** Spirometric indices were higher in boys than those of girls and they tended to increase with height, except FEV1/FVC ratio that was higher in girls with a negative correlation with height.

Introduction

Atopic diseases are a set of conditions including atopic dermatitis, asthma and allergic rhinitis that are estimated to affect approximately 20 % of the world's population[1]. Among them asthma is the most common chronic inflammatory disease in children and is a major global health problem. Asthma is estimated to affect nearly 340 million people globally[1]. Prevalence of asthma in children is 7%[2] in Bangladesh. A recent study showed the overall prevalence of atopic dermatitis, asthma and rhinitis in rural Bangladesh to be 7.6 % (UK criteria), 7.0% (ISAAC criteria) and 4.2% (ISAAC criteria) respectively[1].

The diagnosis of asthma depends on clinical history, physical examination and investigations. A child with a family history of asthma presenting with episodic and recurring chest tightness, cough, difficulty in breathing, or wheeze in response to common triggers who also demonstrates improvement with a SABA likely has asthma[3]. It is often associated with other allergic conditions like atopic dermatitis, rhinitis and allergic conjunctivitis. Vesicular breath sound with prolonged expiration along with rhonchi is the characteristic clinical finding of asthma.

The diagnostic tools used in diagnosing childhood asthma include chest x-ray, allergy test, spirometry, methacholine challenge test and fractional excretion of nitric oxide (FeNO) test[3]. Spirometry is the most commonly used method to assess lung function[4]. It is used to identify the underlying cause of respiratory symptoms both in children and adolescents and to monitor the status of lung diseases. As spirometry testing is not an invasive procedure, it is safe and quick for most people[5].

In spirometry, lung function indices commonly used for the estimation of lung function are - forced vital capacity (FVC), forced expiratory volume in the first second (FEV_1), FVC/FEV_1 ratio and peak expiratory flow rate (PEFR)[6]. Predictive values of these indices are essential for meaningful clinical interpretation to narrow down respiratory diseases.

Spirometry's usefulness for assessing childhood respiratory diseases has emerged due to the development of methods and techniques of spirometry and the convenience of the instruments[7]. However, Predictive normal values are essential for meaningful clinical interpretation of these tests.

Extensive studies have been done to find the cut off value for interpretation in the western population, but it varies widely across geographical boundaries. Regional values may differ as well. In Bangladesh very little work has been done on this aspect. Only one study was done on healthy children in a single school more than a decade ago. No data on spirometric values of healthy children of rural setting in Bangladesh is available till date.

Therefore, this study was conducted on apparently healthy school-going children in two districts of Bangladesh to see the spirometric values.

Materials and methods

This cross-sectional study was carried out at department of pediatric pulmonology, ICMH, Matuail from July 2019 to June 2020. Site of sample collection were Galimpur Rahmania High School, Nobabganj, Dhaka; Bakultola H A K High School, Munshiganj Sadar, Munshiganj and Al-haj M A Khaleq High school, Munshiganj Sadar, Munshiganj. Three hundred apparently healthy school going children among boys and girls aged 11-15 years with prior consent taken from respective guardian were enrolled into the study. Students having any known chronic respiratory disease, congenital heart disease, taking any regular medication, concurrent fever, cough and runny nose were excluded.

To determine the sample size, the following formula was followed

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Where,

n= Sample size, p=7%=0.07, q=1-p=0.93 z= Standard normal deviation, usually assumed at 1.96 which corresponds to 95% confidence limit, d= 5% error =0.05.

Thus, n = 100

This study took 100 school going children from each school. So, total sample was 300.

All the children were divided into two groups according to gender.

Spirometric variables were Forced Vital Capacity (FVC), Forced Expiratory Volume in One Second (FEV_1), FEV_1/FVC and Peak Expiratory Flow Rate (PEFR). Other variables were age, gender, socio-demography and family related factors, parent's education, parent's occupation, socio economic status and residence.

Respective school authorities were addressed initially for permission to conduct the study. Details procedure, merits and ethical issues were explained thoroughly to the school authority, teachers and students. Consent papers were delivered to 350 students, among them 332 students responded to participate with prior consents taken from their guardians. Again 18 students were excluded from the study and 314 students took part in the procedure. Spirometry reports were rejected in 14 patients due to technical error. Eventually spirometry reports of 300 students were selected for analysis.

Before spirometry procedure a detailed history was taken regarding demographic features, past illness, and current illness. Proper clinical examinations were done. Age was calculated from the date of birth given

by parents. Height was measured by stadiometer, and weight was recorded by bathroom scale in children with school uniform and putting off shoes. A computerized spirometer (MicroQuark Pony FC spirometer, Cosmed, Italy) was used in this study. Before testing, the procedure was explained and demonstrated to each child. Each subject was allowed to practice at least three times, and after being satisfied with the subject's ability to perform the test, three recordings were obtained, and the best one was chosen for analysis. All measurements were made in a standing posture. FVC, FEV_1, FEV_1 /FVC%, PEF were measured while the subject performed a forced vital capacity maneuver. A semi structured questionnaire was used to collect data.

Statistical analysis of the result was obtained by using window-based computer software devised with Statistical Packages for Social Sciences (SPSS-21). Independent sample t-test was done to compare quantitative variables. Chi-square test was done to compare qualitative variables. Pearson correlation test was done to determine the linear relationship between two variables. The probability of <0.05 was considered as statistically significant.

The protocol was submitted to the Institutional Review Board of ICMH for approval. Permission from Ethical Committee of ICMH was taken before starting the study. Informed written consent was taken before starting the interview.

Results

The present study was conducted on 300 apparently healthy school going children in three rural schools with the aim of determining their spirometric values. Initially 350 students were approached, among them 332 students responded to participate. Response rate was 94.85%. From these students 18 children were excluded and again 14 children could not follow spirometry procedure. Eventually 300 children were enrolled into the study. They were categorized into two groups, boys and girls.

Among the participants, majority aged 14 years (30.7%), 22.7% were 15 years of age and 21.0% were 13 years of age. Mean age was 13.29±1.40 years. Boys (54%) were slightly predominant than the girls (46%). Different factors associated with pulmonary functions were taken into consideration. Boys (15.4%) were more exposed to passive smoking than girls (5.8%) that were significant statistically. The difference between family history of atopy among boys (9.3%) and girls (10.1%) was not significant statistically.

The mean weight of boys (45.85±12.67 kg) was more than girls (42.76±9.09 kg) and mean height of boys (147.85±11.96 cm) was also more than girls (144.93±10.23 cm). Both of the values were significant statistically.

Spirometric values taken into account were FVC, FEV_1, $FEV_{1/}$FVC ratio and PEFR. The values of FVC, FEV_1 and PEFR were more in boys (2.20±0.69 L, 2.12±0.65 L and 4.50±1.07 L/s respectively) than girls (1.90±0.48 L, 1.86±0.46 L and 3.79±1.10 L/s respectively). The $FEV_{1/}$FVC ratio was higher in girls (98.07±0.85%) than boys (96.70±1.42%). All the differences were significant statistically.

Regression equations were obtained for prediction of lung function values using 'height; as an independent variables, in both groups.

Discussion

Spirometric values of healthy school children were performed in a single urban school in 2005 in Bangladesh[2]. The current study involved three different schools. It was carried out in rural schools of two districts of Bangladesh.

The former study included children of 6-15 years and took FVC, FEV_1, $FEV_{1/}$FVC ratio, PEFR and $FEF_{25\text{-}75\%}$ into account. This study included students of 11-15 years and also lacked in accounting FEF $_{25\text{-}75\%}$values. The previous study also compared the findings with regional and global values while the current study also lacked such comparison.

Budhiraja et al. in a similar study to see pulmonary function in normal school going child found mean age of

10.52±2.96 year[8]. Boys were slightly predominant (54.0%) than girls (46.0%) in the study which was in line with Budhiraja et al. and Doctor et al. in India[8,9]. About 46% study population belonged to middle-middle socio-economic group and 40.3% were from lower-middle group. All students (100%) hailed from rural area. In the study,9.67% participants had family history of atopy and about 11% had history of passive smoking. Globally the rate of second-hand smoking or passive smoking among school children was 40% which is more than this finding[10].

Anthropometric measurement of study showed that mean values of weight and height were significantly higher among boys than girls. While BMI was also higher in boys but it was not significant statistically. Sharma et al. in Western Rajasthan in India studied among 7-14 years old school children and found significant difference between male and female children regarding anthropometry[11]. Mean FVC, FEV_1 and PEFR were significantly higher among boys than girls while FEV_1/FVC ratio was significantly higher among girls in this study which was in line with Doctor et al. who have found significant difference between boys and girls regarding FVC, FEV_1 and PEFR[9]. Budhiraja et al. also found similar result in 6-15 years old school child regarding lung function test[8]. Previous studies on Bangladeshi teenagers showed that girls have a lower FVC and FEV_1compared to those of boys of similar age, weight, height[12]. Comparable correlation for FVC in male and female children was observed by Kumar et al.[13]. The mean FVC values for all the ages and both the sexes were found higher in the present study in comparison to the results of Rahman et al. and Deshpande et al.[12,14]. Lower mean values observed in these studies could be due to geographic and ethnic variations.

Different regression equations for lungfunction values were determined for boys and girls considering height as independent variable. The equations were somehow comparable while height was an independent variable to previous study in Bangladesh[2].

Conclusion

The mean FVC, FEV_1, PEFR values were higher among boys than those of girls but mean FEV_1/FVC was lower among boys than that of girls. Regression equations were obtained for prediction of lung function values using 'height; as an independent variables. Positive correlations were observed between height and FVC,FEV_1 and PEFR and a negative correlation was found between height and FEV_1/FVC ratio in both boys and girls respectively.

Limitations

There were a number of limitations of the study. Sample size was smaller in comparison to previous study of Bangladesh. Spirometric findings were not compared to regional and global values.

Recommendations

Further Population based study is necessary to infer the findings over the general population.

Conflict of interest

There is no conflict of interest

Authors contributions

MAA and MDH performed and interpreted spirometry. RBH, TI helped in data analysis and discussion writing along with MAA and MDH. WK contributed in literature review and writing discussion.

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