Original Article

Assessment of peak expiratory flow rate in preadolescent children of sub-tribal communities in Odisha

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Abstract

Background and Aim: Peak expiratory flow rate (PEFR) is considered to be a reliable index to assess the ventilatory functions of lungs. Gender is one of the important independent variable that influences PEFR value. Though there are studies on PEFR in tribal children, there is paucity of data regarding the gender differences in PEFR among tribal children. Therefore, the present study was undertaken to assess the effect of gender on PEFR in age-matched, preadolescent tribal children in an urban area of Odisha and also to compare the same between the sub-tribal groups.

Methods: It is a cross-sectional study conducted at a residential school in Bhubaneswar during the period from September 2011 to March 2012. Total of 1000 tribal children were selected from standard 4 and 5, of which 868 participants were included in the study. PEFR and anthropometric measurements were recorded in these subjects. Students '*t*' test and one-way analysis of variance were used to test the difference in various parameters among the gender and sub-tribal groups, respectively. Association between anthropometric parameters and PEFR was determined using correlation analysis.

Results: The mean ± SD age in years of the boys and girls were 9.87 ± 1.5 and 9.75 ± 1.2, respectively. The mean ± SD of PEFR in L/min was significantly ($P < 0.001$) more in boys (255.34 ± 65.60) than in girls (210.59 ± 55.70). The boys showed a better correlation of PEFR with weight, height and chest circumference than the girls. PEFR values significantly differed between the subtribal groups ($P < 0.001$). The anthropometric variables showed a positive correlation with PEFR in all the subtribes. While Santala and Munda subtribes showed maximum correlation of PEFR with weight and height, the chest circumference was well correlated with PEFR in Soura and Bonda subtribes.

Conclusion: The mean PEFR of the tribal boys is higher than those of the tribal girls of Odisha. Height, weight and chest circumference were observed to be better correlated with PEFR in boys when compared to girls, among the sub-tribal groups of Odisha.

Key words: Odisha, peak expiratory flow rate, preadolescent, sub-tribe, tribe

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INTRODUCTION

Peak expiratory flow rate (PEFR) is considered to be a simple and reliable index of pulmonary function test to assess the ventilatory functions of lungs.[1] The former reflects the caliber of the bronchi and larger bronchioles, which are influenced by reflex broncho-constrictions.

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Bronchial asthma, one of the common respiratory problems in childhood, is associated with frequent fluctuations in airway calibers. PEFR can thus be one of the simplest and cheapest ways to assess the airways in children.[2] PEFR usually varies according to many independent variables including gender, age, weight, height and chest circumference; its variability due to age generally establishes different reference values for children. Gender is one of the important independent variable which influences PEFR value; many important studies from North India,[3-5] South India[2,6,7] and Western India[8-11] have demonstrated the effect of gender and anthropometric variables on PEFR in healthy children. However, there are only few reports available from Eastern India,[12,13] especially from Odisha.[14] Though there are studies on PEFR in tribal children,[4,15,16] scarce and very

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old reports are available regarding the gender differences in PEFR among tribal children.[14] Therefore, the present study was designed to assess the effect of gender on the association between PEFR and anthropometric parameters of age-matched preadolescent tribal children of Odisha and also to compare such association among the different subtribal communities.

MATERIALS AND METHODS

The present cross-sectional study was conducted in healthy tribal school children, aged between 8 and 11, residing at Kalinga Institute of Social Sciences (KISS), Bhubaneswar, during the period from September 2011 to March 2012. After obtaining ethical clearance from the Institutional ethical committee, permission was procured from the Head of the KISS. The purpose and objective of the study was explained to the institutional head, the caretakers of the children and teachers. KISS is a residential institute providing free education to students studying from standard I to standard XII, each standard containing 10 sections with approximate 50 students in each section.

Exclusion criteria

Participants having history of (h/o) any febrile illness in the last 3 weeks, upper respiratory tract infections (URTI)-like symptoms in the past 3 weeks, acute or chronic respiratory diseases, any major systemic disease like cardiac or renal problems, h/o any drug intake which can affect PEFR, h/o any allergy; children with bone deformity of chest or spine and any muscular weakness were also excluded from the study.

All the above sets of information were obtained from a questionnaire filled up by the caretaker of the children as also from the available information list given by the parents to the school at the time of admission of the student. Such information was further confirmed by oral interview and clinical examination of each child. Clinical examinations of all the children were done by the same assigned Paediatricians of KISS.

Of the 1000 children examined, 868 (boys-464, girls-404) were included in the study and the rest 132 were excluded as they had one or more of the above-mentioned exclusion criteria. Standing height was measured (without shoes) in centimetres with a standard height measuring rod and weight was measured in kilograms, without shoes and with light clothing, using a calibrated weighing scale.[17] Body mass index (BMI) was calculated using equation 'body mass in kilograms/(height in meter)^{2}'. The chest circumference was measured at the level of the nipples at the end of inspiration using a measuring tape.[17]

PEFR of all children was measured using Mini Wright digital peak flow meter (Clement-Clarke International Ltd., Edinburgh Way Harlow Essex CM202TT); recordings were taken in all the subjects seated straight during the same time of the day (i.e., between 4 pm-5 pm) to avoid diurnal variations. Instruction and method of carrying out the test were demonstrated to all the subjects individually. After proper rest, the subjects were asked to inspire deeply, and then blow into the instrument's mouthpiece with nostrils closed as hard and quickly as possible. The machine was returned to zero after every measurement. It was ensured that a tight seal was maintained between lips and mouthpiece of the peak flow meter. Mouthpiece was washed and sterilized for each participant.[18] Each subject made at least three attempts and the best of the three values was considered for analysis.

From the questionnaire, the subtribe of each of the tribal children was obtained, such as: Kandha, Santala, Soura, Munda, Bonda, Pho, Desia, Ho, Phorja, Mahali, Gamanja, Jodia, Bhuyan, Sadri, Kolha, Kisan, Juanga, Urab, Sabara, Chosai. For convenience, they were re-classified into seven sub groups according to their subtribes namely, Santala, Soura, Munda, Kandha, Bonda, Pho and Others. As the children were very less in many of these subtribe groups, they were taken in the "others" sub group.

Statistical analysis of the data

Statistical analyses were done using statistical package for social sciences (SPSS) software version 16 (SPSS Software Inc, Chicago, IL, USA). Data were expressed as mean ± standard deviation (SD). Independent *t*-test was performed to see the differences of mean of all variables between boys and girls. One way analysis of variance (ANOVA) was done to assess any differences in mean values of the variables among the subtribe groups. Correlation coefficient (r) was determined between anthropometric parameters and PEFR. The $P < 0.05$ was considered to be statistically significant. As there are group of 7 subtribes, expression of the level of significance of the data across the group was considered for determining the statistical significance for the parameters.

RESULTS

Of the 868 tribal children included in the study, 464 were males and 404 were females with mean age in years 9.87 ± 1.5 and 9.75 ± 1.2, respectively. The choice of the age matching of the children was to avoid differences in the measured values due to age dependence. Table 1 depicts the comparison of PEFR and anthropometric parameters between boys and girls. The mean weight was not significantly different between the two groups. The height and PEFR were observed to be significantly higher

in boys than the girls, while mean values of BMI and chest circumference were significantly higher in the girls.

Coefficients of correlation between various anthropometric variables and PEFR in boys and girls were found to be positively correlated with all parameters [Table 2]. The PEFR of both boys and girls showed significant correlation with height, BMI and chest circumference.

The anthropometric parameters and the PEFR differed significantly ($P < 0.001$) among different subtribe groups. Post-hoc LSD (Least Significant Difference) test was done to see the difference in the PEFR among all the subtribe groups [Table 3]. Mean PEFR of Soura subtribe was significantly ($P < 0.01$) lower than mean PEFR of all other subtribe groups except Kandha. Mean PEFR of Pho subtribe was significantly ($P < 0.05$) higher than mean PEFR of Santala, Soura, Kandha and other subtribe groups. Kandha subtribe showed significantly lower mean PEFR than Bonda and Pho subtribe groups.

The correlation coefficients between each of the anthropometric variables and PEFR among the subtribes are depicted in Table 4. The mean height, weight and chest circumference were found to be highest in the Bonda subtribe followed by Pho, but the mean PEFR was slightly higher in the Pho than for the Bonda subtribe. The anthropometric variables showed a positive correlation with PEFR in all the subtribes. While Santala and Munda subtribes showed maximum correlation of PEFR with weight and height, the chest circumference was well correlated with PEFR in Soura and Bonda subtribes. Kandha subtribe was observed to exhibit a significant but weak positive correlation between PEFR and other independent variables.

Table 1: Comparison of PEFR and anthropometric parameters between boys and girls

Parameters	Mean±SD		*P* value
	Boys	Girls	
Age (years)	9.87±1.5	9.75±1.2	1.98
Height (cm)	139.28±9.4	137. 87±9.3	0.03*
Weight (Kg)	30.07±6.1	30.28±5.9	0.61
Body mass index (kg/m^2)	15.38±1.9	15.76±1.6	0.002**
Chest circumference (cm)	65.45±4.8	67.33±6.8	0.0001**
PEFR (L/min)	255.34±65.6	210.59±55.7	0.0001**

PEFR: Peak expiratory flow rate. Statistical significance. *P<0.05, **P<0.001

Table 2: Correlation coefficient between various anthropometric variables and PEFR

Variables	Boys (*r*)	Girls (*r*)	Total (*r*)	*P* value
Weight (Kg)	0.67	0.56	0.58	0.342
Height (cm)	0.63	0.51	0.57	0.001*
BMI	0.35	0.36	0.30	0.000*
Chest circumference (cm)	0.66	0.52	0.48	0.001*

PEFR: Peak expiratory flow rate, BMI: Body mass index. *Statistically significant P<0.05

DISCUSSION

Many parameters like ethnic variations, physical activities, environmental conditions, nutrition, socioeconomic status and anthropometric determinants can affect normal values of PEFR. India is a country with a large multi-ethnic population; hence, regional differences in PEFR among healthy Indian children are expected.[16] The present study makes a preliminary effort to assess the difference in PEFR among the age-matched urban tribal boys and girls of Odisha.

In the present study, the mean PEFR of tribal boys (mean height: 140 cm) and girls (mean height: 138 cm) are 255 L/min and 210 L/min, respectively. A reported study on tribal boys in Tripura[16] showed a higher PEFR value,

Table 3: Comparison of means of anthropometric parameters and PEFR in subtribes

Variables	Santala (180)	Soura (76)	Munda (72)	Kandha (260)	Bonda (64)	Pho (68)	Others (148)	*P* value
Weight (Kg)	30.5±7.0	27.4±3.4	31.2±6.1	29.6±4.5	35.1±8.9	32.6±5.6	29.8±6.6	0.000
Height (cm)	140.0±10.0	134.5±8.5	141.0±8.8	138.1±8.0	145.0±11.0	142.0±9.9	137.8±10.6	0.000
BMI	15.5±1.8	15.1±0.9	15.5±1.6	15.5±1.5	16.5±2.1	16.1±1.4	15.6±2.5	0.000
CC (cm)	67.6±6.9	63.7±4.3	66.5±6.0	66.0±4.5	70.8±7.1	66.6±4.4	65.2±6.6	0.000
PEFR L/min	239.52±65.67	192.00±38.40	238.67±71.10	223.55±62.28	285.0±44.08	290.0±71.76	241.35±63.65	0.000

BMI: Body mass index, CC: Chest circumference, PEFR: Peak expiratory flow rate. Data expressed in Mean±SD (standard deviation). P<0.05 is considered statistically significant

Table 4: Correlation coefficients between anthropometric variables and PEFR among the sub tribes

Variables	Santala (*r*)	Soura (*r*)	Munda (*r*)	Kandha (*r*)	Bonda (*r*)	Pho (*r*)	Others (*r*)
Weight	0.60†	0.50*	0.72†	0.46†	0.62	0.60	0.58†
Height	0.61†	0.37	0.82†	0.42†	0.59	0.49	0.63†
BMI	0.40*	0.21	0.41	0.20	0.58	0.41	0.18
CC	0.50†	0.62*	0.59*	0.39†	0.71*	0.50	0.47†

BMI: Body mass index, CC: Chest circumference. Statistical significance *P<0.05, $^\dagger P$<0.005

while the mean PEFR value of boys and girls of tribes of Himachal[4] was closer to values of our study. Various studies from Western India[8,10,11] and Southern India[2] show higher value of PEFR compared to our study. The mean PEFR of school going boys and girls of the same age group in Kolkota[12,19] was higher when compared to this study. Few studies[3,7] also reported lower PEFR in boys and girls compared to our study.

Many studies[2-4,10] have reported PEFR of boys to be significantly higher than the girls, as observed in the present study, whereas Parmesh *et al*. showed no difference in PEFR between both the genders.[20] In this study, the boys showed a better correlation of PEFR with weight, height and chest circumference than the girls, which is similar to the reports from western India.[10]

Weight, height, BMI, chest circumference and PEFR values significantly differed in between the subtribal groups. Mean PEFR of Soura subtribe was significantly ($P < 0.01$) lower than mean PEFR of all other subtribe groups except Kandha. Similarly, mean PEFR of Pho subtribe was significantly ($P < 0.05$) higher than mean PEFR of Santala, Soura, Kandha and other subtribe groups. Kandha subtribe showed significantly lower mean PEFR than Bonda and Pho subtribe groups [Table 4].

The significant positive correlation of weight on PEFR was best seen in Munda, Bonda and Santala subtribes when compared to others. Similarly, height was best correlated with PEFR in the Munda, Santala and others subtribes. In Bonda and Soura subtribes, chest circumference was significantly and best correlated to PEFR.

Further probes involving larger sample size of each subtribe and measurements of other anthropometric variables such as chest length, waist circumference, body surface area and other such parameters influencing PEFR is essential for generating reference values in this group of population.

Limitations of this study

PEFR of tribal children has not been compared with non-tribal children. Also, gender difference among the sub-tribal groups has not been studied, because of less sample size in the individual sub-groups.

CONCLUSION

The mean PEFR of the tribal boys is higher than those of the tribal girls of Odisha and it also correlates better with anthropometric parameters in the boys than those in girls. The anthropometric variables show a positive correlation with PEFR in all the subtribes. While Santala and Munda subtribes show maximum correlation of PEFR with weight and height; the chest circumference correlated well with PEFR in Soura and Bonda subtribes. Future studies with a larger population should be carried out for detailed gender-based assessment of PEFR in the sub-tribal communities of Odisha and to compare the pulmonary functions of these subjects with their non-tribal counterparts.

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