Peak Expiratory Flow Rate Among Rural and Urban Normal School Children in Chattogram, Bangladesh

Abstract

**Background:** Asthma remains the most common chronic inflammatory lung disease in childhood. Asthma management needs lung function assessment. Peak Expiratory Flow Rate (PEFR) is one of the lung function tests. PEFR has been used as a measure of ventilatory capacity for long mainly because of a simple, less tiring procedure than other lung function tests. It is easy to use, inexpensive, portable, reliable can be used by patients, parents, home & clinic. There is no national nomogram on PEFR in Bangladesh. We always use the nomogram of other countries for diagnosis, management of Asthma. This study was taken to establish what is the normal pattern of PEFR in Bangladeshi children of rural and urban areas and to construct nomogram of PEFR in healthy Bangladeshi children.

**Materials and methods:** It is a cross-sectional study conducted in different 6 schools (Urban & rural) in Chattogram District of both sexes (5-15 yrs old) in equal proportion of child. Study period was from April 2009 to November 2009 under supervision of Pediatrics Department of Chattogram Medical College. Sample was selected by non-probability technique. Data were collected by pre-tested questionnaire including exclusion criteria.

**Results:** A total of 1424 healthy school children (Age 5-15 yrs) of equal sexes of both rural and urban schools were included during study. The best of three PEFR of boys ranged from 90 to 750 L/min (Mean 291 L/min, SD 143) and in case of girls ranged from 80 to 540 L/min (mean 236 L/min, SD 94.38). The positive correlation of PEFR with various anthropometric parameters specially height and observed difference with boys and girls. The most significant correlation was observed PEFR with height and also found different value of PEFR between rural and urban children.

**Conclusion:** This study concluded that there is significant difference of PEFR between Bangladeshi boys and girls (5-15 yrs). Height is the best predictor of PEFR value than any other anthropometric parameters. PEFR value of Bangladeshi Girls is lower than that of Boys and significant difference between PEFR values among urban & rural Bangladeshi children.

**Key words:** Bronchial Asthma; PEFR; Children.

INTRODUCTION

There are many lung function tests used clinically and epidemiologically to measure status of lung function, which help to assess lung diseases. Most of the lung diseases effect ventilatory status of the organ. Ventilatory function Studies provide a better understanding of functional changes in the lungs and their significance from...
the view points of diagnosis. Ventilatory function can be assessed by Spirometry, Bronchial provocative tests, Peak Expiratory Flow Rate (PEFR) Gas dilution, Diffusion of gas (Gas exchange) Perfusion, Ventilation-perfusion etc. Though these tests do not provide a specific diagnosis, they help us to understand the physiology, course, the severity and prognosis of the respiratory diseases and thus help us the management of numbers of respiratory diseases. PEFR has been used as measure of ventilatory capacity for long mainly because of a simple and less tiring procedure than other lung function tests. PEFR is the maximum speed at which a person can exhale air from the lung in a single breath or PEFR is the greatest flow velocity that can be obtained during a forced expiration, standing with fully inflated lung or it is measurement how faster a person can blow out. Asthma remains the most common chronic inflammatory long disease in childhood. Childhood Asthma in Bangladesh appears to substantial health problem. About 5 million children in Bangladesh are victim of Asthma. Prevalence of Asthma in Children is increasing day by day and is a major global health problem which exert a substantial burden on the family and health care service and the society as a whole. The PEFR measurement can reveal diurnal variability of airway of patients suffering from reactive airway disease but not in normal children, that gives the early clue to have the diagnosis and management. Daily measurement of PEFR can be used as a guideline for Br. asthma management as like assessment of urinary sugar in diabetic patient by physician. As PEFR varies on age, sex, height, weight and ethnicity. In our country there is no nomogram on PEFR. We always use the nomogram of other countries for diagnosis and management of Bronchial astha, as we do not have our own. From this point of view this study was undertaken to determine a normal PEFR pattern in Bangladeshi urban & rural normal children and whether any difference exists among rural and urban children and also to construct a nomogram on PEFR of Bangladeshi normal children.

MATERIALS AND METHODS

It is a cross sectional study conducted in different 6 schools (Both urban & rural) in Chattogram District of both sexes in equal proportion of child (5-15yrs). Study period was from April 2009 to November 2009 under supervision of Pediatrics Department of Chattogram Medical College. Sample was selected by non-probability (Purposively sampling) technique. Data were collected by pre-tested questionnaire with exclusion criteria. All the primarily selected students were interviewed for inclusion in the study. The student having asthma, atopy, wheeze, eczema, chest deformity, acquired heart disease TB and malnutrition were also excluded from the study. Information were taken from parents (KG to class III) & directly from students (Class IV to Class X). The schools are situated in various areas of the Chattogram district including metropolitan and rural area. Schools were selected by purposive sampling technique. Considering the age (5-15) years with equal gender and socioeconomic status. Written consent was taken from headmaster / principle of the institution. Height was measured by stadiometer in standing position with Frankfurt line, weight was recorded by bathroom scale without shoes and minimum clothes. Five well functioning mini Wright peak flow meter (m WFEM) (2 ranging from 50-350 L/min and 3 ranging from 60-800 L/min). Students were demonstrated how to use m WFPM correctly and repeatedly most of them were given trials 3-4 times before performing the work. Then serial 3 blows for PEFR was registered in the individual sheet after the child has become familiar with the technique. Highest reading was taken as representative value. All the collected data were checked consistancy and verified for its compiled. The data were compiled, analyzed and then tabulated according to key variables. The Statistical programs SPSS V.12 for Windows was used to calculate correlation coefficients and mean age, heights, weight and body surface area. The study protocol was reviewed earlier and approved by Ethical Review Committee (ERC) of Chattogram Medical College.

RESULTS

The study population included 1424 (712 from urban and 712 from rural) with equal distribution of sex and equal ratio from rural and urban inhabitance, of six different school of Chattogram. The positive correlation of PEFR with height, age, weight and body surface area was observed in both the boys and girls which means that the value of PEFR increased with increase in those anthropometric parameters. The most significant correlation was observed PEFR with height (T-I, p<.001). Age was found second variable had positive correlation with PEFR, among boys and girls (p<.001) and body surface area (p<.001). In this study also found PEFR of girls in relation to height were always lower than that of boys (Table II). The age range of boys was between 60 to 190 months (mean age 127 months, SD 37.94) and girls was 60 to 190 months (Mean age 126 months, SD 37.01). The height range of boys was 88 to 188cm. (Mean 140cm, SD 17.60). Girls’ was 90-168cm (Mean 139cm, SD 14.86). The best of three PEFR of boys ranged from 90 to 750 L/min (Mean 291 L/min, SD 143) and in case of girls ranged from 80 to 540 L/min (Mean 236 L/min, SD 94.38). High significant correlation of PEFR was found with heigh (T-II), body weight, body surface area and age (Table-II). This study also found difference value of PEFR in rural and urban children ie PEFR were lower in rural children than urban (p<.05). (Table III). Prediction equation of PEFR for boys PEFR [L/min]= 6.84I height (cm)- 658.32 and for girls PEFR [L/min]= 4.64 I height (cm)- 390.99 derived from regression analysis where PEFR of individual person was considered dependent variable and height as an independent variable. From These prediction equation we enabled to construct the nomogram of normal PEFR for Bangladeshi children and girls (Figure 1 & 2). PEFR of Bangladeshi children were comparable with that of different regions of the world (Table-IV). The PEFR value of Bangladeshi normal children is a bit lower than other countries in the world.
Table I: Pearson correlation coefficient (r) and level of significance between mean PEFR in L/min and anthropometric parameters

| Parameters       | Correlation Coefficient | p Value | Sig. |
|------------------|--------------------------|---------|------|
| Height of the Children in Cm | Mean 0.824 0.000 p < 0.001 |         |      |
| Weight of the Children in Kg | Mean 0.790 0.000 p < 0.001 |         |      |
| Body Surface Area | Mean 0.792 0.000 p < 0.001 |         |      |
| Age of the Children | Mean 0.812 0.000 p < 0.001 |         |      |

Table II: Mean PEFR in L/min of Bangladesh normal children in relation to height interval (n= 1424)

| Height interval CM | BOYS (n=714) Mean PEFR (±SD) | GIRLS (n=710) Mean PEFR (±SD) | p Value |
|-------------------|-------------------------------|-------------------------------|---------|
| 80.5-90 | 1 | 86.67 | 0 | - |
| 90.5-100 | 0 | - | 3 | 85.56±(6.94) |
| 100.5-110 | 39 | 93.93(+19.70) | 36 | 87.96(±12.43) |
| 110.5-120 | 57 | 109.28(+34.21) | 63 | 114.18(±35.65) |
| 120.5-130 | 143 | 149.11(+47.52) | 111 | 144.56(±45.88) |
| 130.5-140 | 144 | 200.76(+59.09) | 139 | 180.24(±60.32) |
| 140.5-150 | 87 | 259.08(+62.33) | 175 | 246.99(±65.52) |
| 150.5-160 | 133 | 369.32(+76.09) | 170 | 294.42(±63.86) |
| 160.5-170 | 100 | 452.17(+90.55) | 13 | 304.87(±63.28) |
| 170.5-180 | 9 | 551.11(+95.14) | 0 | - |
| 180.5-190 | 1 | 316.67 | 0 | - |

Table III: Mean PEFR by Inhabitance & Sex (Rural & Urban)

| Inhabitance & sex of study group | n | Mean | Std. Deviation | Std. Error | p Value |
|----------------------------------|---|------|----------------|------------|---------|
| Mean PEFR in L/min | Urban | 712 | 238.8530 | 118.45689 | 4.43861 0.050 |
| Mean PEFR | Rural | 712 | 226.5272 | 118.10908 | 4.42632 |
| Mean PEFR | Boy | 714 | 255.4575 | 137.97773 | 5.16369 0.000 |
| Mean PEFR | Girl | 710 | 209.7944 | 89.10685 | 3.34412 |

Table IV: Comparison of PEFR value of the present study with other studies else where in the world

| Studies | 120 cm (Height) Boys | 140cm (Height) Boys | 160 cm (Height) Boys |
|---------|----------------------|---------------------|----------------------|
| Present Study, 2009 | 165 | 160 | 299 |
| S. Rajesh Anil Jain et al, 2003 | 199 | 186 | 286 |
| Swaminathan et al, 1993, Madras | 205 | 193 | 266 |
| Mridha MA Amin R. 2002, Dhaka Bangladesh | 220 | 205 | 340 |
| Malik et al, 1981/82, Punjab, India | 222 | 216 | 320 |
| Bejaponpitak et al, 1999, Thailand | 256 | 214 | 306 |
| Host et al, 1994, Denmark | 256 | 219 | 321 |
| Udugihale et al, 1994, Sri Lanka | 271 | 254 | 360 |
| Kashyap et al, 1992, Tribal, India | 202 | 170 | 304 |
| Sanz et al, 1990, Australia | 252 | 237 | 352 |
| Carson et al, 1989, Dublin | 222 | 213 | 342 |
| Wall et al, 1982, North America | 240 | 228 | 327 |
| Parmar et al, 1977, India | 198 | 229 | 300 |
| Godfrey et al, 1970, UK | 212 | 211 | 317 |

Table IV: Comparison of values of PEFR (l/min) Predicted from regression equation in relation to height in studies of different places of the world. It revealed that excepting a few studies PEFR value obtained in present study was more or less similar with other studies.

Figure 1: Nomogram of normal mean PEFR of Bangladeshi Boys in Relation to Height
DISCUSSION
Peak Expiratory Flow Rate (PEFR) recording is an essential measure in the evaluation, monitoring, management and follow-up of patients with bronchial asthma. Peak Expiratory Flow Rate (PEFR) is a lung function test which is easily measurable and reproducible but base line value of PEFR has not been studied in large scale among Bangladeshi children. This study found strong correlation between PEFR with height, age, sex and body surface area. The regression equations for PEFR were determined for boys and girls considering height and age weight, body surface area, separately as independent variable. Correlation of height with PEFR was the highest in comparison to other anthropometric parameters (Age, body weight and body surface area). This study found boys had significantly higher values of PEFR than that of girls at any height. The difference of PEFR in boys and girls were also observed by other investigations. The difference of PEFR in boys and girls were also observed by other investigations. But some study observed equal value of PEFR in both sexes. PEFR values of Bangladeshi children were slightly lower to British and nearly, similar to Indian children but lower than that of Sri lankan children. Studies in neighboring countries (Srilanka, India, Thailand) observed that PEFR in boys was significantly higher than the girls which strongly support the findings of the present study. Our study was found that PEFR values of rural children was lower in that of urban children, which was significant (p < .05) which also support our hypothesis. When mean PEFR (L/min) values calculated from prediction formula of different studies with different height to compare our result was revealed that mean predicted PEFR values of present study is lower. The previous Bangladesh study (In Dhaka city) found abit higher value than present study (It is possibly due to inclusion of both rural and urban children in present study). Nomogram were constructed in relation to height and in relation to age separately for boys and girls as applying the principle of other study else where in the world. Findings of this study suggested to prefer height based nomogram to age based nomogram because height correlated best with PEFR as height should have the first preference for prediction of PEFR because of more accuracy, easily measurable at any place and its highly significant relationship with PEFR. Our present study results appear to be reliable as we include both rural and urban children and large sample size in present study.

CONCLUSION
This study concluded that there is significant different of PEFR between Bangladeshi boys and girls (5-15 yrs). Height is the best predictor of PEFR value than any other anthropometric parameters age, body weight and body surface area also correlates with PEFR but less predictive in comparison to height. PEFR value of Bangladeshi girls is lower than that of boys. There is a significant difference between PEFR values among urban & rural Bangladeshi children. The PEFR value of Bangladeshi children is slightly lower than other countries (It is possibly due to inclusion of both rural an urban children in present study). The result of this study may be use as PEFR of Bangladeshi normal boys and girls.

RECOMMENDATION
Further study is needed to include more variable to find out the affects of variables (If any) on PEFR values and also include more areas of Bangladesh and large sample size among normal Bangladeshi children.

DISCLOSURE
All the authors declared no competing interest.
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