Peak expiratory flow rate in Saudi school boys at Al-Khobar City, Saudi Arabia

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ABSTRACT

Objective: To determine the normal peak expiratory flow rate for Saudi school boys living at Al-Khobar City.

Methods: A self administered questionnaire was completed by the parents of 1312 school boys who satisfied the selection criteria of the study. Peak expiratory flow rate was measured for them, using Wright peak flow meter. The multiple linear regression equation for peak expiratory flow rate was generated where height, age, weight, socio-economic class, presence of smoker, pets or both at home were the independent variables.

Results: Height, age and weight were found to correlate significantly with peak expiratory flow rate. However, only height and age were included in the final regression model which had a reasonably high coefficient of multiple determination value (R2 =0.72).

Conclusion: Peak expiratory flow rate values in this study were lower than those reported from Riyadh, other Arab countries, Europe and North America. However, they are close to those reported from Yanbu (Saudi Arabia). Normal values of peak expiratory flow rate for Saudi children should be developed.

Keywords: Peak expiratory flow rate, school children, bronchial asthma.

Bronchial asthma during childhood is a common chronic lung disease.[1-3] Wheezing among children was estimated to be up to 11.5% in Saudi Arabia which is higher than the range reported from Western countries.[1,4] There is enough evidence to suggest that prevalence of this disease is increasing.[5] Consequently, morbidity and mortality of bronchial asthma continues to increase.[1,6] Peak expiratory flow rate (PEFR) recording is an essential measure in the evaluation, monitoring, management and follow up of patients with bronchial asthma.[7] Peak expiratory flow rate can be measured by a simple instrument; Peak Expiratory Flow meter. It is widely used by patients at home and at the clinic to reflect the severity of airflow obstruction and was shown to anticipate early any deterioration of the patients condition before it actually happens.[8,9] Wright and mini-Wright Peak Flow meters are the most commonly used instruments. Many factors are known to affect the reading of this pulmonary function test. These include age, sex, height, ethnic group, diurnal variations and environmental factors.[10-14] Few studies were conducted in Saudi Arabia to study certain aspects related to PEFR measurement.[15-19] Most of these studies were limited in size, age group while others suffered certain shortcomings. There is evidence that children from Eastern Saudi Arabia had lower PEFR than children living in Jordan.[18] Environmental factors such as passive smoking and having pets at home were found to be related to wheezing among school children in Saudi Arabia.[1] However, to the best of the investigator's knowledge, the impact of these factors on PEFR among school children was not subjected to research. The objective of this study was to determine the peak expiratory flow rate among

normal school boys in Al-Khobar city and factors influencing it.

Methods. The Saudi boys in elementary and preparatory schools at Al-Khobar City were the subjects of this cross-sectional study. Al-Khobar City is located on the Arabian Gulf coast in the Eastern province of the Kingdom of Saudi Arabia. A total of 22077 school boys were identified at elementary (15829 (72%)) and preparatory (6248 (28%)) schools in Al-Khobar City. Seven percent of the total number of pupils were selected to be our sample. This was based on the prevalence rate of bronchial asthma among school children reported earlier in the area.[1] A total sample of 1550 school boys (elementary = 1110 (72%) and preparatory = 440 (28%) was drawn from 7% of schools selected by simple random sampling (4 elementary + 2 preparatory schools). The total number of sample students in each school was in accordance with the ratio they represent in relation to the total number of students in all schools (in each level of education). In each school the sample was drawn evenly from different classes. This was important as height is known to be an important influencing factor on the pulmonary function development. The methods used included measurement of PEFR and a self administered pre-tested and pre-coded questionnaire directed to parents. This questionnaire was previously standardized and validated for the Saudi community.[19] The definition of asthma used in this study was modified from the Medical Research Council (MRC) definition.[20] The criteria selected to identify asthmatic children was as follows: Any school boy whose parents responded to all of the following questions with 'Yes' was considered to be 'Questionnaire Diagnosed Asthmatic' (QDA): 1) Has your child ever had an attack of wheezing? (whistling noise that comes from chest). 2) Did your child get attacks of shortness of breath with wheezing? 3) Does the breathing of your child become normal in between attacks? The boys and their parents were requested to give details of personal data such as age, area of residence, father's education, occupation and income. Data included the subjects' current or history of bronchial asthma including (dyspnea, dyspnea after exercise, wheeze or whistle), cough, cardiopulmonary disease and past diagnoses. Histories of smoking by the subject or any family member and presence of pets at home (cats, birds, etc) were noted. Each family was classified into upper, middle and lower socio-economic class based on an aggregate score of education, occupation and income of the father.[21] School boys whose parents confirmed their diagnosis by a physician (based on history, physical examination and formal tests when needed) were considered Physician Diagnosed Asthmatic (PDA).

Children with cardiopulmonary diseases, smokers or diagnosed as PDA or QDA were excluded from the study. The beam balance was used for measuring weights and heights of children. The weighing scale was adjusted to the nearest 100 grams. The weight was recorded to the nearest 500 grams. The height was measured with uncovered head and bare foot and was recorded to the nearest 0.5 cm. One medical intern was pre-trained and assigned to this work. The portable Wright peak flow meter (product of Ferraris Medical Ltd) was used throughout the study. The investigator was trained on the use of the instrument. The investigator carried all the PEFR measurements by himself. The instrument was calibrated automatically using continuous flow methods. The children were gathered in groups in the school during the afternoons to avoid the effect of the diurnal variation of peak expiratory flow. The test was explained to the children. The investigator performed a clinical examination to exclude acute infection. The test was then performed while the subject was standing with a nose clip. The subject then takes a full inspiration, and blows maximally and as fast as possible. At least three trials were carried out for each subject. Only the highest was recorded as the PEFR value. Data was analyzed using an IBM compatible personal computer. The Statistical Program SPSS/PC was used to calculate correlation coefficients and mean age, heights and weights. Multiple linear regression was used to analyze the data using the stepwise method. Peak expiratory flow rate was the dependant variable while age, weight, height, socio-economic class, presence of a smoker at home and presence of pets at home were the independent variables. A test was considered statistically significant at P-value < 0.05.

Results. A total of 1550 school boys were requested to participate in this study. Twenty one boys were excluded from the study because they did not live in Al-Khobar City. Forty seven students declined to participate for other reasons not related to the study subject. A total of 159 asthmatics were also excluded from the study (QDA=141 and PDA=18). Eleven boys were excluded as they suffered from cardiopulmonary disease or were smokers or both. Therefore, a total of 1312 school boys satisfied the inclusion criteria and they were evaluated. The ages of these school boys ranged from 6-15 years. The mean age of the school boys in the sample was 10.5 $\pm$ 3.0 years, height 135.2 $\pm$ 15.2cm, and weight 33.5 $\pm$ 15.7kg. One hundred and eighty four (14%) school boys were found to belong to the upper socio-economic class families compared with 643 (49%) and 485 (37%) in the middle and lower socio-economic classes. The correlation coefficients between PEFR and age, height, weight were 0.92, 0.95 and 0.87 (p < 0.0001). Table 1

Table 1 - Multiple linear regression coefficients and equation for PEFR in Al-Khobar School Boys 6-15 years.

Independent variable		Coefficient value	P-value
Constant	(b0)	-350.2	
Height	(b1)	4.1	<0.0001
Weight	(b2)	4.9	<0.05

Equation: PEFR (L/min) = -350.2 + 3 (height) + 11.5 (age)
$R^2 = 0.72$. P-value < 0.001
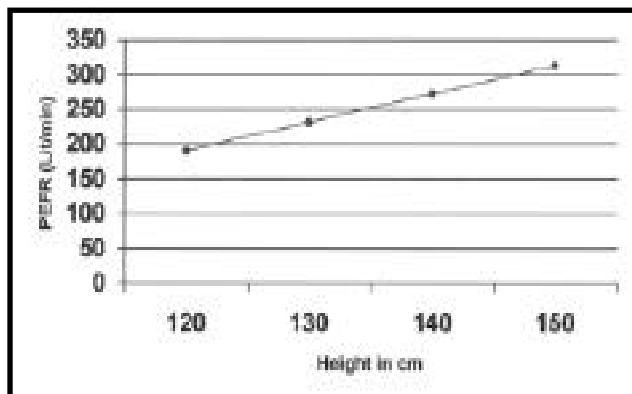
Figure 1 - PEFR in relation to age for 4 heights.
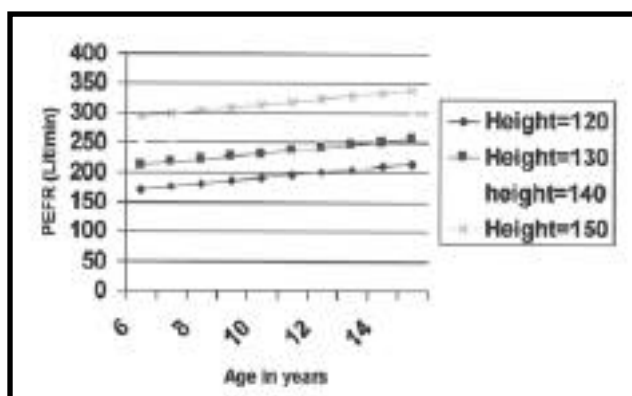
Figure 2 - PEFR in relation to height at age 10 years.

shows the multiple linear regression coefficients and equation for PEFR of the sample. Height and age were the only variables included in the final model using the step-wise method. The variability of these two variables can explain up to 0.72% of the variation of PEFR in this model. When the data was plotted it was clear that the relationship between the variables was linear. Peak expiratory flow rate increased as age and height were increasing. Figure 1 shows the plot of peak expiratory flow rate in relation to age for 4 heights. Figure 2 shows the plot of peak expiratory flow rate in relation to height at age 10 years.

Discussion. The sample size in this study was large enough to give a very high power of estimate in the range of 0.012 ± 1 SE (Standard Error). The study enjoyed the advantage of including environmental and socio-economic class variables that were not tested in previous studies. Peak expiratory flow rate as a pulmonary function test was found to correlate best with height and age was the second best which supports earlier reports.[16,18,19] Peak expiratory flow rate was shown to begin declining at age 25 years in Saudi populations and 35 years in British populations.[17] In this study the coefficient of multiple determination (R^2) was moderately high. This means that a high percentage of the variation in PEFR can be explained by the variation in the independent variables. Consequently, this equation is reasonably reliable in predicting PEFR. Meanwhile, presence of a smoker at home and the level of socio-economic class were not found to influence PEFR. Although socio-economic class was not included in their study, Graff-Lonneving et al thought that this factor might have influenced their results.[16] For a given age and height the PEFR in this study was less than the same reported in the study from Riyadh.[16] However, the sample size in that study was much smaller and highly selected from central Riyadh. The equation described in this study is very close to the one reported from Yanbu where the same methodology was adopted.[19] Peak expiratory flow rate in this study was found to be much lower than the same for Arab, Europe and North America for the same age and sex.[10,11,16,22] This may be explained by differences in height between Saudi children and children from these populations.[16,23] This is supported by the finding that Saudi male and female adults were found to have significantly lower PEFR than Americans and Europeans.[15] Other factors such as ethnicity and altitude should be taken into consideration when comparing different studies.[12,13,18] Moreover, differences between rates in the same environment were also reported.[16] The non-inclusion of school girls in this study was due to difficulties in gaining access due to cultural reasons, a limitation that was

faced previously by some investigators researching this subject.[17-19]

This study recommends that normal values of PEFR for children in Saudi Arabia should be established. This work can be considered as a step forward in attaining this objective. This study may be considered as a base line for further and larger studies in the same area in the future including wider age group and female children.

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