# Peak expiratory flow rate (PEFR) of Malaysian children

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## Summary

Prediction equations for peak expiratory flow rate (PEFR) of Malay, Chinese and Indian children were obtained by analysing 1020 PEFR recordings of children free of respiratory symptoms and illnesses. Boys had significantly higher PEFR than girls. For both sexes the highest levels of PEFR were observed in Malays and the lowest in Indians. The differences between Malay and Chinese boys were not statistically significant but the levels of PEFR for Malay and Chinese boys were significantly higher than those for Indian boys. In girls the differences among the ethnic groups were not statistically significant. Although ethnic differences were observed in boys these differences might not be clinically important. A common prediction equation for each sex should be both practical and accurate.

When compared with predicted levels for white American and Australian children the predicted levels of PEFR of Malaysian children were found to be lower; these differences could be clinically important and the use of standards for Western children when assessing Malaysian children might not be appropriate.

*Key words:* Peak expiratory flow rate, normal children, Malay, Chinese, Indian

## Introduction

Ethnic differences in normal values of peak expiratory flow rate (PEFR) of children have been reported.[1,2] As such, the use of Western standards in the management of non-Caucasian children may not be appropriate. Also, ethnic differences in PEFR within the population of a country is a possibility that needs to be examined.[1] We performed this study to establish normal standards for Malaysian children of Malay, Chinese and Indian origins and to compare these standards with those of western children.

## Methods

This study was part of a bigger study of respiratory illness in 7–12 year old urban Malaysian children performed in the months of July to October 1987. Details of the methodology have been described elsewhere.[3,4,5] Four primary schools in the Kuala Lumpur city areas were selected at random. A sample of 2109 children were selected. A modified version of the American

Thoracic Society's ATS-DLD-78C respiratory questionnaire,[6] which had been translated into Bahasa Malaysia, Mandarin and Tamil were distributed to parents through class teachers. The questionnaire contained questions pertaining to personal and demographic data, environmental exposures and respiratory symptoms and illnesses. Parents were asked to complete the questionnaire in the language of their choice and completed questionnaires were collected a week later.

Children who returned questionnaires which had been satisfactorily completed were asked to participate in lung function tests which were performed at the respective schools. PEFR was measured while standing using a Wright's peak flow meter. After a practice blow the best of three blows were recorded. Spirometry was also performed using a Vitalograph model R spirometer. Standing height was measured in centimetres in stockinged feet and weight was measured fully clothed after removing heavy objects from pockets.

For the purpose of obtaining prediction equations for normal children, those who admitted to active smoking and those with respiratory symptoms or illnesses were excluded. The respiratory symptoms and illnesses that were considered important were:
a)  chronic cough: defined as a positive reply to "Does he/she cough on most days (four or more days per week) for as much as three months a year?"
b)  chronic phlegm: defined as a positive reply to "Does this child seem congested and bring up phlegm, sputum or mucous from his/her chest on most days (four or more days per week) for as much as three months a year?"
c)  persistent wheeze: defined as positive responses to A and B and/or C in the series of questions: "Does this child's chest ever sound wheezy or whistling:
    a)  when he/she has a cold?
    b)  occasionally apart from colds?
    c)  most days and nights?"
d)  doctor diagnosed asthma: defined as a positive reply to "Has a doctor ever said that this child has asthma?" and
e)  chest illness: defined as a positive reply to "During the past one year has this child had any chest illness that has kept him/her from his/her usual activities as much as three days?"

Statistical analysis was performed using the SAS Version 5 statistical package.[7] Linear regression analysis was performed on log-transformed PEFR data. Prediction equations were obtained in the form of $PEFR = a.H^b$ (where a is the exponential of the constant of the regression equation, and b the regression coefficient for log-height, H) by regressing log-PEFR on log-height as performed by previous workers.[1,2,8] Analysis of normal spirometric lung function will be presented elsewhere.

## Results

One thousand six hundred and twenty one children returned their questionnaires. After exclusion of poorly completed questionnaires and 26 children of minority ethnic groups, 1512 children were invited for lung function studies. PEFR was successfully performed by 1414 children. During analysis of the PEFR data children with at least one positive response to questions on respiratory symptoms and those who admitted to active smoking were excluded. The remaining 1020 children were considered to be normal with regard to respiratory illness and their PEFR were analysed for the purpose of obtaining normal lung function data.

On regressing log PEFR on height, weight and age in turn, it was found that height, weight and

age were highly significant predictors of log-PEFR ($p < 0.001$). Height was the most significant predictor with the highest F value. The correlation coefficient between PEFR and height was 0.99.

Prediction equations obtained by regressing log-PEFR on log-height are presented in Table 1. The prediction curves obtained from the equations are shown in Figures 1–3.

The levels of PEFR adjusted for standing height were generally higher in Malay children than in the other races. However, the differences between Malay and Chinese boys were small and not statistically significant. Significant differences were observed between the PEFR of Malay and Indian boys ($p = 0.001$), and between those of Chinese and Indian boys ($p < 0.009$). The differences of PEFR were not statistically significant among the ethnic group in girls.

### Table 1
### Prediction equations for Peak Expiratory Flow Rate (PEFR) of Malaysian children

|  | N | Boys PEFR (L/min) | N | Girls PEFR (L/min) |
|---|---|---|---|---|
| All races | 584 | $7.33 \times 10^{-3} \ H^{2.15}$ | 436 | $3.49 \times 10^{-3} \ H^{2.29}$ |
| Malay | 263 | $8.82 \times 10^{-3} \ H^{2.12}$ | 237 | $3.87 \times 10^{-3} \ H^{2.28}$ |
| Chinese | 178 | $7.74 \times 10^{-3} \ H^{2.14}$ | 115 | $2.23 \times 10^{-3} \ H^{2.38}$ |
| Indian | 143 | $2.86 \times 10^{-3} \ H^{2.34}$ | 84 | $3.55 \times 10^{-3} \ H^{2.29}$ |

H = height in cm.
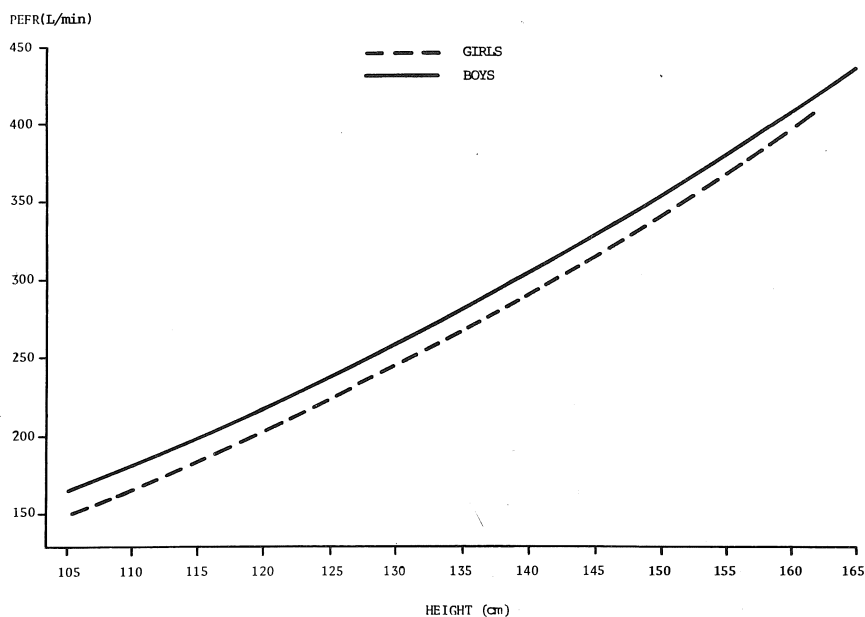


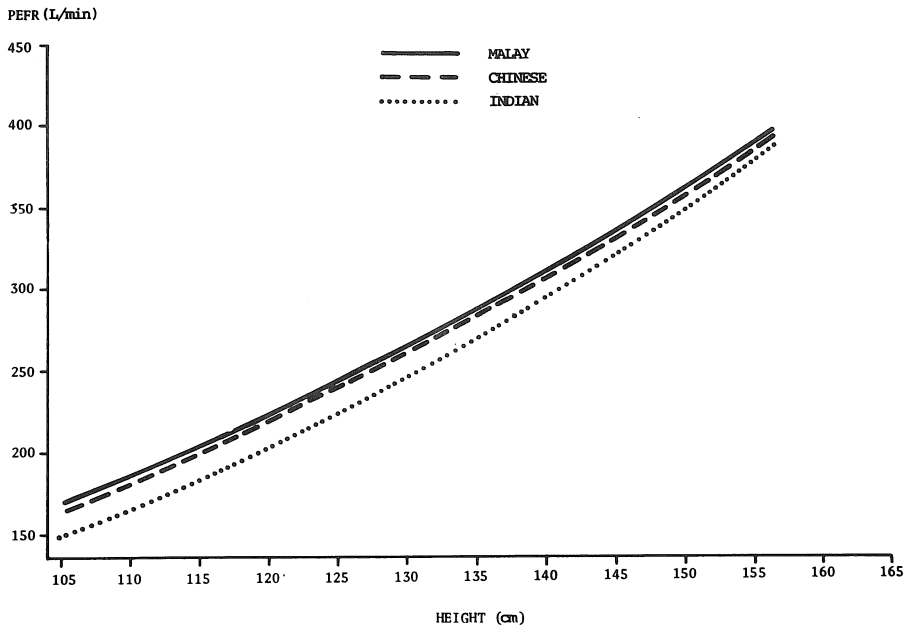Figure 1
PEFR prediction curves for Malaysian children

PEFR (L/min)

Figure 2
PEFR prediction curves for Malaysian boys according to race
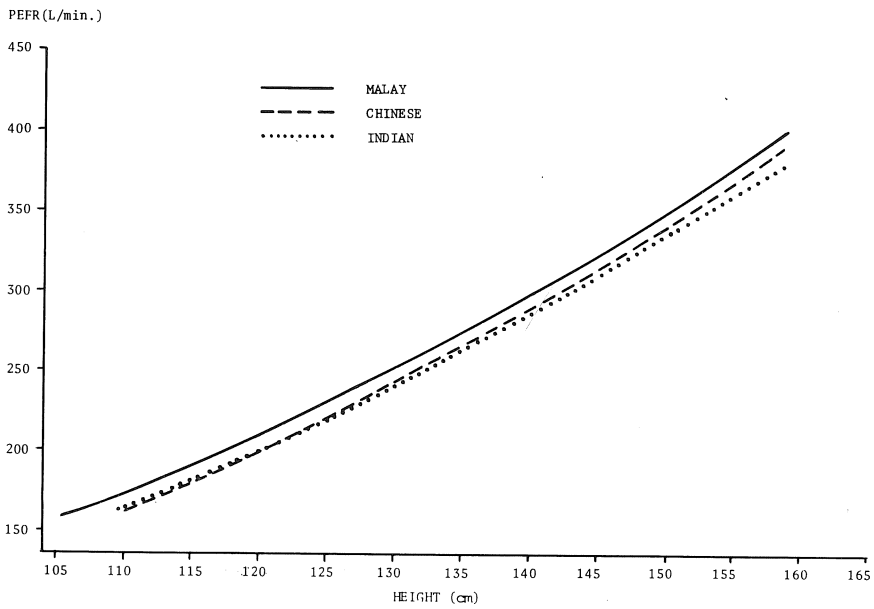
PEFR(L/min.)

Figure 3
PEFR prediction curves for Malaysian girls according to race

For comparison, PEFR values obtained from prediction equations for white American children[1] and those of Australian children[9] were tabulated together with those of Malaysian children (Table 2). Marked differences were observed between the values for girls obtained from the American and Australian standards and those of Malaysian girls obtained in the study. In contrast, for boys with heights of less than 130 cm the PEFR values for Malaysian and white children were almost similar. At greater heights American and Australian boys had higher PEFR. In particular, the differences between Malaysian and American boys became increasingly prominent as height increased.

**Table 2**
**Prediction mean PEFR of Malaysian (Mal),**
**white American (W/A)* and Australian (Aus)** children**

| Height (cm) | PEFR for boys | | | PEFR for girls | | |
|---|---|---|---|---|---|---|
| | Mal | W/A | Aus | Mal | W/A | Aus |
| 105 | 162 | 161 | – | 148 | 180 | – |
| 110 | 180 | 180 | – | 165 | 197 | – |
| 115 | 198 | 199 | – | 183 | 216 | – |
| 120 | 216 | 220 | 250 | 201 | 235 | 221 |
| 125 | 236 | 242 | 264 | 221 | 255 | 244 |
| 130 | 257 | 265 | 279 | 242 | 276 | 266 |
| 135 | 279 | 290 | 296 | 264 | 297 | 290 |
| 140 | 302 | 316 | 315 | 287 | 320 | 314 |
| 145 | 325 | 342 | 336 | 311 | 343 | 338 |
| 150 | 350 | 370 | 358 | 336 | 367 | 361 |
| 155 | 375 | 400 | 389 | 362 | 392 | 385 |
| 160 | 402 | 430 | 409 | 389 | 417 | 411 |
| 165 | 429 | 462 | 438 | 418 | 444 | 428 |

\* Reference 1
\*\* Reference 9
– Not available

## Discussion

In this study we measured the PEFR of a large number of healthy primary school children in Kuala Lumpur and have produced normal standards that should be useful in the management of asthma and other respiratory disorders in Malaysian children. It is hoped that with the availability of these standards more local doctors will routinely use the peak flow meter in the assessment of children's respiratory function.

The establishment of local standards for PEFR is justified by the fact that ethnic differences in the levels of PEFR of normal children have been well documented.[1,2] Both environmental

and genetic factors may be responsible for these differences. The differences may be of such magnitude that the use of inappropriate standards may render interpretation of PEFR measurements invalid. It is often recommended that different centres should have their own standards for reference.[9] As we have demonstrated, the use of Western standards is probably inappropriate in the Malaysian setting.

We demonstrated some ethnic differences in the levels of PEFR in normal Malaysian boys but not in girls. Indian boys had lower levels than Malay and Chinese boys. The reasons for these were not immediately clear. However, these differences were sufficiently small in real values that common prediction equations formulated for all the three ethnic groups should be both valid and practical.

## Acknowledgements

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