

PEAK EXPIRATORY FLOW RATE AND ITS PREDICTION FORMULAE IN HARYANVIS

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Summary : Peak expiratory flow rate (PEFR) was studied in 806 healthy 6 to 58 years old Haryanvi males. A steep rise in PEFR is seen with age upto 18 years, little variation occurs between 19 to 26 years and is followed by a gradual fall thereafter. The formulae for the prediction of PEFR from age and height in different age groups have been worked out. Haryanvi children are taller having PEFR and predicted values of PEFR higher than the children of other Indian states and are well comparable to Western children. On the other hand in Haryanvi adults observed and predicted values of PEFR are low. It is possible that economical uplift of this area due to industrialization and green revolution, has led to improved nutrition resulting into better physical and functional (PEFR) development of younger generation. It is suggested that in developing states the physical and functional norms should be periodically reviewed.

Key words : peak expiratory flow rate prediction formulae

INTRODUCTION

It is essential to detect and treat respiratory obstruction at an early and reversible stage for the prevention of permanent damage. For the demonstration of narrowing of the respiratory passages different expiratory flow rates are being employed. Peak expiratory flow rate (PEFR) is one such parameter which can be easily measured. Published data on PEFR by Indian authors are mostly in children (13, 14) or in adults (2,5,9,10,15). In the present study we are reporting PEFR in Haryanvi males in different age groups.

MATERIAL AND METHODS

This study was undertaken at Medical College Hospital, Rohtak and nearby schools. A total of 806 healthy non-smoker male subjects from 6 to 58 years were studied. The subjects were school boys, medical students, teachers and other staff members of medical college and attendants of patients. Children were studied in their schools while other subjects were studied in the medical college hospital. Peak expiratory flow rate was measured by using Wright's Peak Flow Meter. The test was performed in standing position.

After a group demonstration, the subject was asked to blow into the mouthpiece as forcibly as possible. The test was repeated 3 to 5 times and best of these readings was recorded for analysis as Lt/mt. Age of the subject was recorded in years to the nearest birthday and was confirmed from school register in case of children. The height was measured in centimeters without shoes, with the subject standing erect.

RESULTS

Mean values of PEFR at different age groups are shown graphically in Fig. 1. From this figure, three distinct phases in the curve can be observed. There is a steep rise in PEFR with age from 6 to 18 years, then there is only a little variation (Plateau) between 19 to 26 years which is followed by a gradual fall in PEFR from 27 to 58 years. Therefore, we have divided our subjects into 3 groups - children, young adults and adults.

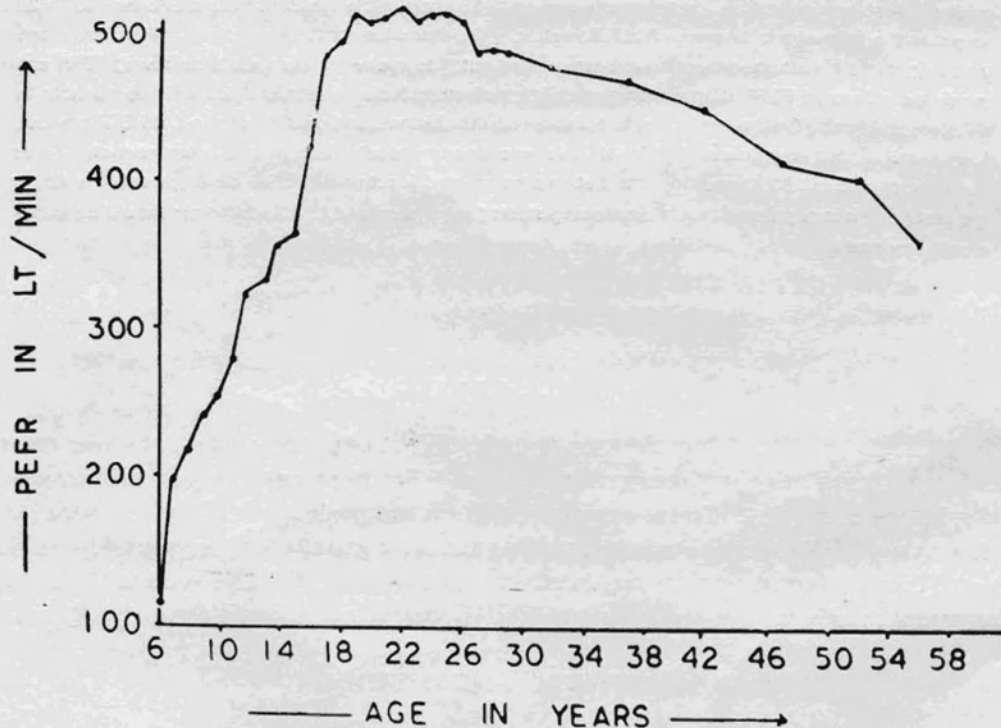


Fig. 1 : Graphic presentation of PEFR at different age groups in Haryanvi males.

Table I and II show the number of subjects, their height and PEFR in children (Table I), young adults and adults (Table II). The comparison of PEFR values of present series with those reported by other Indian workers has been shown in Table I and III. The correlation coefficient of PEFR with age and height, alone and combined is shown in

TABLE I : Comparison of PEFR values of Haryanvi boys with those of South Indian boys (Singh and Peri; 14) :

| Age in years | Present series | | | Singh and Peri (14) | | |
|--------------|-----------------|----------------------------|------------------------------|---------------------|----------------------------|----------------------------|
| | No. of subjects | Height (cms) mean \pm SD | PEFR (Lt/mt) mean \pm S.D. | No. of subjects | Height (cms) mean \pm SD | PEFR (Lt/mt) mean \pm SD |
| 6 | 26 | 114.3 \pm 3.2 | 116.1 \pm 35.4 | 25 | 110.2 \pm 4.1 | 121.6 \pm 31.6 |
| 7 | 26 | 116.4 \pm 4.1 | 196.3 \pm 36.6 | 33 | 115.7 \pm 6.0 | 147.4 \pm 39.6 |
| 8 | 26 | 120.8 \pm 4.6 | 216.2 \pm 27.1 | 17 | 123.7 \pm 5.6 | 184.1 \pm 34.6 |
| 9 | 29 | 125.8 \pm 4.7 | 230.3 \pm 30.8 | 21 | 126.0 \pm 5.1 | 197.4 \pm 42.8 |
| 10 | 28 | 129.6 \pm 3.4 | 253.8 \pm 44.0 | 26 | 132.5 \pm 6.9 | 227.5 \pm 45.7 |
| 11 | 25 | 134.5 \pm 6.2 | 272.0 \pm 48.7 | 33 | 130.7 \pm 5.6 | 231.4 \pm 47.8 |
| 12 | 43 | 141.7 \pm 3.9 | 321.0 \pm 63.1 | 24 | 138.1 \pm 8.1 | 267.9 \pm 38.9 |
| 13 | 35 | 148.6 \pm 6.7 | 330.1 \pm 48.5 | 31 | 140.1 \pm 7.0 | 270.0 \pm 43.8 |
| 14 | 29 | 153.5 \pm 8.2 | 354.8 \pm 42.8 | 20 | 147.7 \pm 7.9 | 318.8 \pm 68.2 |
| 15 | 33 | 161.3 \pm 6.9 | 357.3 \pm 47.9 | 21 | 151.1 \pm 9.9 | 363.3 \pm 67.6 |
| 16 | 30 | 165.8 \pm 5.2 | 427.8 \pm 62.8 | 21 | 159.4 \pm 7.0 | 400.5 \pm 70.0 |
| 17 | 28 | 167.6 \pm 6.6 | 489.01 \pm 46.4 | — | — | — |
| 18 | 38 | 168.4 \pm 5.8 | 487.2 \pm 52.9 | — | — | — |

TABLE II : Height and PEFR in Haryanvi adults.

| Young adults (19-26 years) | | | | Adults (27-58 years) | | | |
|----------------------------|-----------------|----------------------------|----------------------------|----------------------|-----------------|----------------------------|----------------------------|
| Age (years) | No. of subjects | Height (cms) mean \pm SD | PEFR (Lt/mt) mean \pm SD | Age (years) | No. of subjects | Height (cms) mean \pm SD | PEFR (Lt/mt) mean \pm SD |
| 19 | 37 | 168.8 \pm 5.9 | 507.5 \pm 48.9 | 27-29 | 43 | 168.5 \pm 8.2 | 483.8 \pm 50.5 |
| 20 | 52 | 169.4 \pm 6.8 | 504.7 \pm 49.5 | 30-34 | 32 | 166.0 \pm 10.4 | 471.2 \pm 55.6 |
| 21 | 39 | 168.8 \pm 7.2 | 505.3 \pm 37.7 | 35-39 | 28 | 167.4 \pm 11.2 | 464.6 \pm 32.9 |
| 22 | 25 | 169.3 \pm 6.9 | 511.7 \pm 53.6 | 40-44 | 22 | 165.9 \pm 6.9 | 439.5 \pm 70.5 |
| 23 | 20 | 168.7 \pm 10.2 | 504.3 \pm 56.2 | 45-49 | 25 | 167.2 \pm 7.2 | 405.3 \pm 59.4 |
| 24 | 17 | 168.9 \pm 9.2 | 507.7 \pm 50.4 | 50-54 | 20 | 167.9 \pm 9.2 | 394.7 \pm 36.2 |
| 25 | 18 | 169.3 \pm 7.8 | 508.7 \pm 49.5 | 55-58 | 20 | 168.0 \pm 12.4 | 348.3 \pm 30.2 |
| 26 | 16 | 169.0 \pm 4.2 | 501.5 \pm 42.9 | | | | |

TABLE III : Comparison of PEFR values at different age groups with other Indian authors.

| Age groups | Kamat <i>et al.</i> (7) | | Malik <i>et al.</i> (9) | | Singh and Peri (15) | | Present | |
|------------|----------------------------|------|----------------------------|------|------------------------|------|---------|-------|
| | Ht. | PEFR | Ht | PEFR | Ht. | PEFR | Ht. | PEFR |
| 15-19 | 163.1 | 487 | 164 | 442 | 162.2 | | 166.4 | 453.8 |
| 20-24 | 164.0 | 502 | 167 | 482 | 165.2 | 493 | 169.1 | 506.3 |
| 25-29 | 165.8 | 506 | 167.1 | 486 | 165.2 | | 168.8 | 493.3 |
| 30-34 | 162.4 | 505 | 167.4 | 475 | 163.4 | | 166.0 | 471.2 |
| 35-39 | 165.9 | 497 | 165.9 | 450 | 163.4 | 467 | 167.4 | 464.6 |
| 40-44 | 165.9 | | 165.9 | 417 | 163.9 | 459 | 165.9 | 439.6 |
| 45-49 | 161.4 | 391 | — | 415 | 163.9 | | 167.2 | 405.3 |
| 50-54 | 161.4 | | | 418 | 163.7 | 458 | 167.8 | 394.7 |
| 55-58 | 161.2 | 356 | — | 396 | 163.7 | | 168.8 | 348.3 |

Ht : Height

TABLE IV : Prediction formulae for PEFR in different groups.

| Physical parameter | Children (6-18 yrs) | | | Young adults (19-26 yrs) | | | Adults (27-58 yrs) | | |
|--------------------------------------------|-------------------------|---------------|---------|-----------------------------|---------------|---------|------------------------|---------------|---------|
| | Pred. Form. | r or R | P value | Pred. Form. | r or R | P value | Pred. Form. | r or R | P value |
| Age (yrs) | 27.0 A-12.0 | 0.9395 | <.001 | 516.3-0.54A | 0.0581 | -NS | 629.5-4.78A | 0.5602 | <.001 |
| Height (cms) | 5.0HT-403.3 | 0.9424 | <.001 | 2.14HT+144.4 | 0.2903 | <.01 | 1.43HT+202.7 | 0.2081 | <.05 |
| Combined Height and Age | 2.83HT+14.94A -273.1 | 0.9999 (R) | <.001 | 2.36HT-1.21A +133.6 | 0.3048 (R) | <.01 | 1.71HT-4.93A +349.3 | 0.6123 (R) | <.001 |
| <i>Predictability of combined formulae</i> | | | | | | | | | |
| Increased over age | | | <.001 | | | <.001 | | | <.001 |
| Increased over height | | | <.001 | | | <.05 | | | <.001 |

A : Age Ht : Height R : Multiple correlation coefficient r : Correlation Coefficient

Statistical analysis using simple linear regression for Age and Height alone and Multiple Regression plane for plan Age and Height combined.

TABLE V : Comparison of predicted values of PEFR in children at different heights by different prediction formulae.

| Sr. No. | Series | Type of subjects | Prediction | Predicted PEFR (Lt/mt) at height of | | |
|---------|---------------------------|----------------------|-----------------|-------------------------------------|--------|--------|
| | | | | 120 cm | 135 cm | 150 cm |
| 1. | Nairn <i>et al.</i> (12) | Western | 5.59Ht-476 | 195 | 279 | 363 |
| 2. | Murray and Cock (11) | Western | 5.7Ht-480 | 204 | 290 | 375 |
| 3. | Lunn (8) | Western | 3.92Ht-271.15 | 199 | 258 | 317 |
| 4. | Parmar <i>et al.</i> (15) | N. Indian Chandigarh | 5.058Ht-408.664 | 198 | 274 | 350 |
| 5. | Singh and Peri (14) | S. Indian | 5.0Ht-420.4 | 180 | 255 | 330 |
| 6. | Present | N. Indian (Haryana) | 5.0Ht-403.3 | 204 | 278 | 351 |

Ht = Height in centimeters.

TABLE VI : Comparison of predicted values of PEFR in young adults and adults at different age and height by different prediction formulae.

| Sr. No. | Series | Type of subject | Prediction formulae | Predicted PEFR (Lt/mt) at | | |
|---------|-----------------------------|-----------------|-----------------------------------------------------------------------|---------------------------|----------------|----------------|
| | | | | 20 yrs. 169 cm | 35 yrs. 167 cm | 50 yrs. 168 cm |
| 1. | Ferris <i>et al.</i> (3) | Western | 4.73 Ht-2.46 A-200.32 | 550 | 502 | 471 |
| 2. | Johannsen and Erasmus (5) | Bantu (African) | 2.92 Ht-4.19 A+37.89 | 448 | 379 | 319 |
| 3. | Woolcock <i>et al.</i> (16) | New Guinea | 3.85 Ht-2.64 A-42.5 | 555 | 508 | 472 |
| 4. | Gragg and Nunn. (4) | Western | 30.63 A-723 A ² +0.00521 A ³ +1.46 Ht-30.15 | 582 | 623 | 590 |
| 5. | Basavaraju and Parvathi (1) | S. Indian | 13-22 A : 30.2A-177.7 23-48A : 571.8-3.3A PEFR=5.2Ht-414.2 | 427 | 456 | 407 |
| 6. | Singh and Peri (15) | S. Indian | Age 17-29 : 2.74 Ht+53.4 30 and more : 567-2A | 516 | 497 | 467 |
| 7. | Malik <i>et al.</i> (9) | N. Indian | 10.91 A-2686 A ² +0.001681A ³ +5.0808 Ht-502.99 | 480 | 470 | 435 |
| 8. | Present | N. Indian | 19-26A : 2.36Ht-1.21A+133.6 27-58A : 1.71Ht-4.93A+349.3 | 508 | 462 | 390 |

A = age in years

Ht = Height in centimeters

Table IV, from which it is clear that predicted value is significantly increased at all age groups when both age and height are taken into consideration than either of these alone. The predicted value of PEFR by our formulae at given age and height are compared in Table V and VI with those derived at by using formulae of other authors.

DISCUSSION

Measurement of PEFR is a simple procedure. In children PEFR increase with age and height, the correlation is highly significant (Table I and IV). Haryanvi boys are generally taller than South Indian boys and have higher PEFR (table I). The predicted values from height alone in Haryanvi boys are higher than South Indian boys (1.4) and are well comparable to Chandigarh (13) and Western boys (8, 11, 12). Basavraj and Parvathi (1) observed an increase in PEFR with age upto 22 years and thereafter a gradual decrease.

In the present study, there is insignificant variation in PEFR in young adults (19-26 years) while a gradual decrease occurs with the advancement of age in older individuals. Younger Haryanvi adults are taller than old ones and have well comparable or slightly higher PEFR than other Indians but at higher age they have definitely lower PEFR (Table III). There is significant increase in correlation when both age and height are used than either of these alone for the prediction of PEFR value in all the three groups (Table IV). The predicted PEFR by our formulae at 50 years of age and 168 centimeters of height is quite low as compared to the predicted values derived for other Indian (1, 9, 15) and Western subjects (3, 4, 16) but higher than that for Bantu subjects (6). However, at 20 years of age and 169 centimeters of height our predicted PEFR is comparable or higher than other Indians (1, 9, 15) but lower than Western subjects (3, 4, 16).

It is possible that economical uplift of this area due to industrialization and green revolution has led to better nutrition of the population. This in turn has resulted in increased height and higher PEFR in younger generation. Malik *et al.* (10) have found higher PEFR in good socio-economic status teachers than their earlier observation in general population (9) of the same area.

It is suggested that in developing states, the physical and functional norms should be periodically reviewed in view of a likely improvement in socio-economical status and health.

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