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# ORIGINAL ARTICLE

## CORRELATION OF PEAK EXPIRATORY FLOW RATE WITH ANTHROPOMETRIC DETERMINANTS IN HEALTHY ADULT MALE POPULATION OF HARYANA

Seema[1], Krishan Bihari Verma[2], Shelesh K. Goel[3], Subarna Ghosh[4], Chandana Bera[5]

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**ABSTRACT: INTRODUCTION:** Ventilatory function tests provide a better understanding of functional changes in the lungs and they are significant from the viewpoint of diagnosis, so factors contributing to their variation within the population need to be identified, assessed and the appropriate allowances made. There have been reports on the variations of PEFR with anthropometric determinants, however, data regarding study of PEFR with various anthropometric factors in different age groups is lacking. **AIMS:** The present study was therefore done to observe the "Correlation of peak expiratory flow rate with anthropometric determinants in healthy adult male population of Haryana". **MATERIAL AND METHOD:** Peak expiratory flow rate was measured using mini Wright peak flow meter in 150 healthy subjects of same socioeconomic status. The correlations of PEFR with Age, height, weight and chest circumference were calculated in healthy younger (20-34yrs) and older (35-49yrs) adult males. **STATISTICAL ANALYSIS:** The obtained data were analyzed statistically with the help of IBM SPSS VERSION.20. **RESULT:** In this study the mean PEFR was found to have statistically significant ($p \leq 0.05$) positive correlation with the height, weight and chest circumference in younger males whereas noticeable fluctuations were observed in their older counterparts. Maximum values of PEFR were attained in the age group of 25-29yrs after which it showed a declining trend with advancing age. **CONCLUSION**: PEFR correlates more with height, weight and chest circumference in young adult males than in older males. Respiratory function indices collected from healthy young adult males may be more reliable and predictable than those from older ones.

**KEYWORDS:** Peak Expiratory flow rate, Height, Weight, Chest Circumference, Haryanvi Healthy adult male.

**INTRODUCTION:** During the last few decades lung function tests evolved from tools for physiological study to clinical investigations in assessing respiratory status. These tests have also become a part of routine health examination in respiratory, occupational, sports medicine and in public health screening. Tests have been designated to indicate the extent of narrowing of airways. A simple but important test is to measure how quickly air can be forced out from the lungs.This is called Peak expiratory flow rate (PEFR).[1] Estimation of PEFR using the Wright Peak flow meter is a rapid and reliable test of ventilator function. The instrument is inexpensive, portable and easy to operate; the observation of PEFR is practical for both hospital and general practice and as a screening test in epidemiological studies.[2]

There are many biological sources of variation in pulmonary function. Intra individual variation may be attributed to body position, head position, effort dependency of maximum flow and

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circadian rhythm. Intra individual variability may also be due to host factors including size (height, weight), age, past and present health.

Geographic factors, exposure to environmental and occupational pollution and socio-economic status also may influence inter individual variation.[3] Therefore it would be more appropriate for each region to have its own value.[4] It is difficult to establish national norms in India for healthy men as the lung function varies with socio-economic, geographical, climatic, environmental and nutritional condition.[5]

It has been observed that age, height and chest circumferences are amongst the factors affecting Peak expiratory flow rate. It is also noticed that PEFR not only increases with anthropometric determinants, but that the increase correlates significantly in healthy young adult males, especially adults below the age of thirty years.

The age of the individual plays an important role in determining the final response even amongst apparently healthy.[6]As advancing age is associated with increasing disability and functional impairments which may be contributed by functional decline in cardiovascular, pulmonary, musculoskeletal and other systems.[7]

PEFR shows a positive correlation with the vital capacity and forced expiratory volume in 1 second (FEV1).[8] It may therefore be used as a test to assess the reversibility of airways obstruction and the response of an asthmatic patient to bronchodilator therapy.[9] When lung function test is used as an aid in diagnosis, the signal is usually the patient's results compared with the expected result for subjects without disease but similar in the personal characteristics that determine lung function such as age, height, ethnic or race of an individual.[10]

**MATERIAL AND METHODS:** The present study was conducted on 150 healthy and socioeconomically compatible male Haryanvi subjects, chosen from the relatives and attendants of the patients attending the outpatient department and indoor wards.

**SELECTION OF SUBJECTS:**

**INCLUSION CRITERIA**:

1. 150 subjects from healthy adult population of age group 20-49yrs were considered for this study.
2. They were all non- smokers.
3. The non-athletes those who were involved in similar kind of daily activities were taken.
4. All the subjects were explained the purpose of the study and need for complete co-operation and strict adherence to protocol.
5. All the subject satisfied the criteria of being free from any cardio-respiratory diseases, injuries, infections and other systemic diseases.

**EXCLUSION CRITERIA:**

1. History of cardiopulmonary disease as was evidenced by questionnaire filled by the subjects prior to the study. Such Information was confirmed by oral interview and observations during the course of study for symptoms and signs of respiratory disease such as-dyspnoea, wheezing and coughing.
2. Those who were doing regular exercises.

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3. Those who were having any metabolic disorders related to obesity such as DM, Hypothyroidism or Hypertension.
4. Subjects with history of long term drug intake in preceding 6months.
5. Those with any thoracic or spinal deformity
6. Those who are having any kind of neurological disorder.
7. Smokers and those who are exposed to any kind of occupational hazard.

To carry out this study the following parameters were taken in all the subjects:

1. **Age:** was recorded from birthday by calendar to the nearest of year (<6months and >6 months).
2. **Anthropometry:** Height, weight and chest circumference.

   **Standing height** was recorded in centimeter without shoes and with light cloths on a wall mounted measuring scale to the nearest of centimeters (<5 mm and >5 mm). The range of scale was 140-190cm in standing posture (Fig.1).

   **Body weight** was recorded in kilograms (with shoes off in minimal clothing and empty bladder) before lunch by weighing machine (Fig.3).

   **Chest circumference** was taken in centimeter with measuring tape placed at the level of nipples (Fig. 2)
3. **PEFR:** It was measured by using mini Wright peak flow meter (Fig.4.). It is a light plastic Cylinder measuring 15x5cms weighing 72gms (without mouth piece). It consists of a spring piston that slides freely on a rod within the body of the instrument. The piston drives an independent sliding indicator along a slot marked with a scale graduated, low range from 50-350L/min and high range from 60-800L/min. The indicator records the maximum movement of the piston, remaining in that position until return to zero by the operator. In use the machine must be held horizontally with air vents uncovered. The instrument may be cleaned easily in running water or in a detergent solution. Performance of accuracy of the mini-Wright peak flow meter meets national asthma education program (NAEP) guideline variation <± 5% with standard Wright peak flow meter.[11]

**STEPS:**

1. The device read zero at the beginning.
2. The subject was seated comfortably and neck was not allowed to be flexed.
3. The subject held the meter lightly and did not interfere with the movement of the marker (arrow) or cover the slot (Fig.5.).
4. The subject took a deep breath and placed the mouth piece end into his mouth made an airtight seal with the lips around the mouth piece (Fig.5.).
5. He blew into the Wright's peak flow meter as hard as he could (Fig.5.).
6. It was made sure that the subject did not cough, spit or let his tongue block the mouth piece.
7. The values were read at the pointer and were written down on PEFR recording form.
8. The pointer was returned to its ''zero'' position.
9. The process was repeated twice more so that at the end, series of three readings were achieved. Highest amongst the three readings was taken as subject's PEFR value.
10. Same Peak flow meter was used for the measurement every time.

**GROUPS:** The present study was conducted on 150 subjects. The subjects were grouped according to their age into two groups:

A-80 young healthy adult males aged 20-34yrs.

B-70 Older healthy adult males aged 35-49yrs.

Subjects in each group were distributed according to ranges in age, height and weight and chest circumference. Correlation of PEFR with age, height, weight and chest circumference for each group was calculated separately.

**RESULTS:** Total 150 healthy adult males including 80 younger (20-34 Years) and 70 older adults (35-49 years) were used in this study.

Results were expressed as mean PEFR ± standard deviation (mean ± S.D), while the students' t-test was used to determine the differences between the means. P-values less than or equal to 0.05 ($P \leq 0.05$) were taken as statistically significant.

In both age groups the PEFR is significantly ($p<0.05$) and negatively correlated with age i.e. in both the age groups the PEFR decreases with the increase in age. The correlation coefficient in younger and older age groups are respectively -0.293 and -0.233 [Table: A1, B1].

In younger adults the PEFR shows a significant ($p<0.05$) positive and linear correlation with height, weight and chest circumference with correlation coefficient respectively 0.78, 0.716, 0.716. Therefore, the PEFR increases with the increase of height, weight and chest circumference in younger adults [Table: A2, A3, A4].

In older adults the PEFR shows a significant ($p<0.05$) positive but non-linear correlation with height and weight with the correlation coefficient respectively 0.662, 0.528 [Table: B2, B3]. On the contrary the PEFR of the older adults does not vary significantly ($p>0.05$) with the chest circumference [Table: B4].

**DISCUSSION:**The present study was done to observe the "Effect of Age, height, weight and chest circumference on PEFR in 150 healthy adult Haryanvi males". It is study on unbiased mixed homogenous population of Haryana. This is in order to set the normal standard values and to collect reference data that would enable the physiologists and physicians to have a framework on which they can base their future findings.

In our study values of PEFR in younger males (aged 20-34yrs) ranged from 430-570 liter/minute (Table A1).

Singh and Peri[12] tabulated PEFRs obtained from a number of Indian studies. They observed that young Indian males have a PEFR of about 450-550 liter/minute. The minor difference in our range could be explained by the fact that it is difficult to establish national norms in India even for healthy subjects as the lung function varies with socio-economic, geographical, climatic, environmental and nutritional condition.[5] Therefore it becomes appropriate for each region to have its own values.[4]

Mean values of PEFR were highest in the age group of 25-29yrs (TableA1) after which it showed a declining trend with advancing age. This is in accordance to Udwadia FE et al [13] and also study done by Malik SK et al[14] They observed that the highest values for mean peak expiratory flow rate in North Indian males were noted at the age of 25 to 29 years whereas lower values were found

in older age groups. Ray et al[15] and Dugdale AE et al[16] also observed that PEFR declined with advancing age which is in agreement with the present study.

In the present study the peak expiratory flow rate in younger adults had a tendency to increase with increasing height. It also tended to rise with increasing weight, but the extent wasnot as remarkable as in the case of height. (Table A2andA3) The similar trends were noticed by Mohammad et al.[4]

Ebomoyi MI and Iyawe VI[6] observed a linear increase in PEFR with respect to three anthropometric variables (height, weight, and chest-circumference) only in young adult males and also noticed that, the PEFR correlates more with height, weight and chest-circumference in younger adults. In older adult males, values of Peak Expiratory flow rate fluctuated considerably with above mentioned variables. Results of our subjects, younger and older (Table A1, A2, A3, A4 and B1, B2, B3, B4) also showed similar trends.

Further the fluctuations of PEFR in older age might be due to the fact that young adults are more likely to be healthier than the older adults and after the age of 30 years, several other factors may come into play to preclude what the real responses should have been such as prolonged exposure of the airways and lung tissues to insults, environmental hazards and stresses and so forth, resulting in loss of muscle elasticity, increase in body fat content in relation to protein, increase in reaction time to stimuli and so on.[6]

Different workers have carried out correlation studies of Peak Expiratory Flow Rate with different anthropometric parameters[18,19] but no such report is available for adult males of Haryana. So this study will establish the normal standards in adult (younger and Older) Haryanvi males.

Peak expiratory flow rate is one of the pulmonary function tests that provide a quantifiable measure of lung function.[20] So it will be used to evaluate and monitor diseases that affect lung function, monitor the effects of environment, occupational exposures, to assess risks of surgery and to assist in evaluations performed before employment or for insurance purposes.[17]

**CONCLUSIONS:**Correlating Peak Expiratory Rate with Age, Height, Weight and Chest Circumference using data from 150 male adults of Haryana(aged 20-49 years), was the aim successfully achieved in this study.

Present study showed that PEFR reached to its highest values in the age group of 25-29 yrs, after which it showed a declining trend with advancing age. Mean values of PEFR were found to have Statistically significant positive correlation ($p<0.05$) with height, weight and chest circumference in younger adults. In older adults PEFR showed noticeable fluctuations with above mentioned anthropometric determinants.

It can be concluded that, PEFR values not only increase with anthropometric determinants like height, weight and chest circumference but this increase correlates significantly in healthy younger adults only. So, the age of the individual plays an important role in determining the final responses of lung functions even amongst apparently healthy.

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| GROUPS | A | B |
|---|---|---|
| No. of Subjects | 80 | 70 |
| Age (years) | 20-34 | 35-49 |
| Height (cm) | 151-185 | 151-185 |
| Weight (kg) | 46-80 | 46-80 |
| Chest circumference (cm) | 71-105 | 71-105 |

TABLE 1: SUMMARY OF SUBJECT CHARACTERISTIC AND THEIR ANTHROPOMETRIC MEASUREMENTS

CORRELATION OF PEFR WITH AGE, HEIGHT, WEIGHT and CHEST CIRCUMFERENCE FOR GROUP A-80 YOUNG HEALTHY ADULT MALES AGED 20-34YRS.

| Age(Years) | No.ofPersons | PEFR(Mean ± S.D) L/min |
|---|---|---|
| 20-24 | 24 | 524.09±22.39 |
| 25-29 | 30 | 532.93±44.12 |
| 30-34 | 26 | 493.46±34.75 |

TABLE A1: CORRELATION OF PEFR WITH AGE IN YOUNGER MALES

Correlation Coefficient= -0.293

$p<0.05$*

| Height (cm) | No. of persons | PEFR(Mean ± S.D) L/min |
|---|---|---|
| 151-155 | 3 | 453.33±5.77 |
| 156-160 | 6 | 478.33±29.26 |
| 161-165 | 11 | 488.18±33.71 |
| 166-170 | 11 | 501.64±33.72 |
| 171-175 | 23 | 530.57±29.61 |
| 176-180 | 18 | 539.72±27.85 |
| 181-185 | 8 | 556.33±26.45 |

TABLE A2: CORRELATION OF PEFR WITH HEIGHT IN YOUNGER MALES

Correlation Coefficient=0.78

$p<0.05$**

| Weight(Kg) | No. of persons | PEFR(Mean ± S.D) L/min |
|---|---|---|
| 46-50 | 2 | 455.00±7.66 |
| 51-55 | 5 | 484.00±28. 81 |
| 56-60 | 10 | 485.00±30.64 |
| 61-65 | 14 | 501.86±37.65 |
| 66-70 | 22 | 525.00±34.74 |
| 71-75 | 18 | 537.93±26.34 |
| 76-80 | 9 | 555.00±23.60 |

TABLE A3: CORRELATION OF PEFR WITH WEIGHT IN YOUNGER MALES

Correlation Coefficient =0.716

$p< 0.05$**

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| Chest circumference(cm) | No. of persons | PEFR(Mean ± S.D) L/min |
|---|---|---|
| 71-75 | 6 | 473.33±29.43 |
| 76-80 | 8 | 482.50±29.64 |
| 81-85 | 21 | 500.29±36.65 |
| 86-90 | 17 | 528.82±30.72 |
| 91-95 | 8 | 533.53±24.52 |
| 96-100 | 10 | 540.50±29.62 |
| 101-105 | 10 | 558.00±21.79 |

TABLE A4: CORRELATION OF PEFR WITH CHEST CIRCUMFERENCE IN YOUNGER MALES

Correlation Coefficient =0.716
p< 0.05**

CORRELATION OF PEFR WITH AGE, HEIGHT, WEIGHT and CHEST CIRCUMFERENCE FOR GROUP B-70 OLDER HEALTHY ADULT MALES AGED 34-49YRS

| Age(Years) | No.of Persons | PEFR(Mean ± S.D) L/min |
|---|---|---|
| 35-39 | 23 | 486.40±73.28 |
| 40-44 | 25 | 481.18±82.23 |
| 45-49 | 22 | 454.56±57.71 |

TABLE B1: CORRELATION OF PEFR WITH AGE IN OLDER MALES

Correlation Coefficient = -0.233
p< 0.05*

| Height (cm) | No. of persons | PEFR(Mean ± S.D) L/min |
|---|---|---|
| 151-155 | 5 | 408.80±53.14 |
| 156-160 | 11 | 428.82±45.03 |
| 161-165 | 16 | 443.50±57.28 |
| 166-170 | 16 | 479.25±84.82 |
| 171-175 | 13 | 530.79±40.51 |
| 176-180 | 7 | 524.24±63.12 |
| 181-185 | 2 | 526.00±2.83 |

TABLE B2: CORRELATION OF PEFR WITH HEIGHT IN OLDER MALES

Correlation Coefficient = 0.662
p< 0.05**

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| Weight(Kg) | No. of persons | PEFR(Mean ± S.D) L/min |
|---|---|---|
| 46-50 | 2 | 420.00±28.28 |
| 51-55 | 12 | 415.83±43.68 |
| 56-60 | 15 | 462.20±93.25 |
| 61-65 | 25 | 518.42±56.06 |
| 66-70 | 9 | 457.23±58.42 |
| 71-75 | 5 | 468.00±72.23 |
| 76-80 | 2 | 526.00±2.83 |

TABLE B3: CORRELATION OF PEFR WITH WEIGHT IN OLDER MALES

Correlation Coefficient = 0.528p < 0.05**

| Chest circumference(cm) | No. of persons | PEFR(Mean ± S.D) L/min |
|---|---|---|
| 71-75 | 4 | 407.50±59.03 |
| 76-80 | 10 | 432.30±41.41 |
| 81-85 | 11 | 465.55±64.78 |
| 86-90 | 26 | 491.04±76.18 |
| 91-95 | 16 | 516.76±60.66 |
| 96-100 | 1 | 480.00±00 |
| 101-105 | 2 | 382.75±4.86 |

TABLE B4: CORRELATION OF PEFR WITH CHEST CIRCUMFERENCE IN OLDER MALES

Correlation Coefficient = 0.440
p> 0.05**

**Fig. 1: Measurementof Height**

**Fig. 2: Measurement of Chest Circumference**

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**Fig. 3: Measurement of Weight**

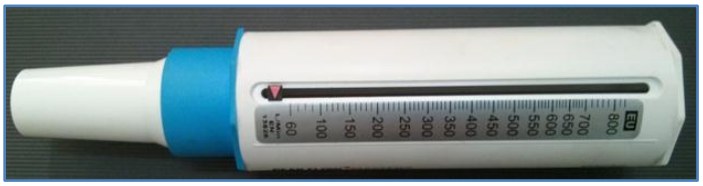

**Fig. 4: Wright's Peak Flow Meter**

**Fig. 5: Measurement of Peak Expiratory**

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**AUTHORS:**

1. Seema
2. Krishan Bihari Verma
3. Shelesh K. Goel
4. Subarna Ghosh
5. Chandana Bera

**PARTICULARS OF CONTRIBUTORS:**

1. Assistant Professor, Department of Physiology, Gold Field Institute of Medical Sciences & Research.
2. Assistant Professor, Department of Physiology, Gold Field Institute of Medical Sciences & Research.
3. Professor and HOD, Department of Community Medicine, Gold Field Institute of Medical Sciences & Research.
4. Tutor (Demonstrator), Department of Physiology, Gold Field Institute of Medical Sciences & Research.
5. Tutor (Demonstrator), Department of Physiology, Gold Field Institute of Medical Sciences & Research.

**NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:**

Dr. Seema,
H. No. 131,
Mirzajan Dasna Gate,
Ghazibad-201001,
Uttar Pradesh.
Email: gbubai@rocketmail.com

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