Research Article

# Correlation of peak expiratory flow rate with age and anthropometric parameters in elderly (>65 years)

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## Abstract

**Background:** Peak expiratory flow rate (PEFR) is of value in the identification of chronic bronchitis and for the assessment and follow-up of asthma. For these purposes, evaluation of an observed reading of PEFR required knowledge for its range in normal subjects. **Aims and Objective:** To determine the normal PEFR values in elderly men to establish local reference standards. **Materials and Methods:** The PEFR was measured in 96 healthy men aged ⩾65 years of rural areas of Patiala district using the Mini-Wright peak flow meter in standing position. Best out of the three trials was recorded. Its correlation with age, anthropometric variables, body mass index (BMI), and body surface area (BSA) were calculated. **Result:** The mean PEFR in the age group of 65–74 years for males was 339.44 ± 35.51 L/min. The correlation of PEFR was negative and highly significant with age, positive and significant with height, and nonsignificant with weight, BMI, and BSA. **Conclusion:** It was concluded that with advancing age, the PEFR declines. The mean PEFR values of taller subjects were also higher.

**KEY WORDS:** PEFR; Elderly; Age; Height; Weight; BMI; BSA

## Introduction

Peak expiratory flow rate (PEFR) is the largest expiratory flow rate achieved with a maximally forced effort from a position of maximal inspiration.[1] The PEFR is one of the convenient methods of measuring lung functions,[2] and also used as a screening tool in surveys and can be measured by untrained individuals with an inexpensive Mini-Wright peak flow meter.[3] Assessment of lung function in middle aged and elderly persons is important for studying the effects of aging on the respiratory system and in clinical geriatric practice.[4] Pulmonary function is known to vary considerably between different regional and ethnic groups, residing within the same country.[5] Few studies have been conducted on PEFR in the elderly population in Asia.[6,7] There is a need to know the normal ranges of PEFRs in the elderly for clinical use.[8]

A study was, therefore, planned to evaluate the PEFR reference value in relation to age and anthropometric parameters for elderly men in the age group of 65 years and above from rural regions in the Patiala district of Punjab, India.

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## Materials and Methods

### Subject

The cross-sectional study was carried out in normal healthy ambulatory elderly men of age ⩾65 years residing in rural areas of Patiala district, Punjab, India. The study was conducted from January to April 2007. Informed consent was taken from the subjects prior to the study. A total of 96 men were included in this study. The subjects of this study were chosen at random irrespective of their socioeconomic status and religion so that it can reflect an overall picture of the PEFR status of the study region.

Following were the inclusion criteria for the study: (1) ambulatory subjects of Punjabi origin; (2) absence of any

**Table 1: Mean and standard deviation values of physical measurements and PEFR**

| Age group (years) | No. of subjects | Weight (kg), Mean ± SD | Height (m), Mean ± SD | BMI (kg/m$^2$), Mean ± SD | BSA (m$^2$), Mean ± SD | PEFR (L/min) |
|---|---|---|---|---|---|---|
| 65–74 | 72 | 69.47 ± 7.65 | 168.62 ± 5.10 | 24.38 ± 1.98 | 1.77 ± 0.11 | 339.44 ± 35.51 |
| 75–84 | 21 | 72.47 ± 9.19 | 169.40 ± 5.17 | 25.19 ± 2.40 | 1.80 ± 0.12 | 267.61 ± 54.94 |
| 85–94 | 3 | 82.66 ± 11.01 | 171.66 ± 8.03 | 27.94 ± 1.43 | 1.93 ± 0.17 | 220 ± 78.10 |

PEFR, peak expiratory flow rate; BMI, body mass index; BSA, body surface area; SD, standard deviation.

chronic lung disease; (3) no history of acute respiratory tract infection in the past 2 weeks; (4) no major respiratory tract disease; (5) no major systemic disease such as cardiac or renal problems; and (6) no bone deformity of chest or spine.

Following were the exclusion criteria for the study: (1) history of smoking; (2) history of neuromuscular disorders; and (3) subjects not performing properly.

### Methods

A detailed history of the subjects was taken to rule out cardiorespiratory illness. The study subjects were explained about the purpose and procedure of the study; and they were assured of keeping the study confidential.

Anthropometric measurements of the study subjects were done to calculate the body mass index (BMI) and body surface area (BSA).

Age was calculated in years to the nearest of 0.5 years. Their standing heights were measured in centimeters by making the subjects to stand barefoot on the floor against the wall, with their heels slightly separated and their buttocks in contact with the wall. Their weights were measured in kilograms with a subject standing on a portable weighing machine without wearing shoes. BMI was calculated using the formula BMI (kg/m$^2$) = weight (kg)/height (m$^2$).

BSA was calculated by Dubois formula.[9] BSA (m$^2$) = 0.0071 × weight (kg)/height (m$^2$).

PEFR was recorded by Mini-Wright peak flow meter (Clement and Clarke),[3] an instrument to record PEFR from 60–800 L/min. Before testing, the procedure was explained and demonstrated to each subject until full familiarity was achieved. Each subject was asked to take deep breath and then blow into peak flow meter as hard and fast as he could with nose clipped. Three trials were given and best of the three was chosen for analysis. The same peak flow meter was used throughout this study. Recordings were taken in the standing position.

The study design was approved by the ethics and research committee of the institute.

### Statistical Analysis

Data obtained from the study were given as mean ± standard deviation (SD). After recording the data, the parameter stated above was analyzed statistically by applying the Student's *t*-test and *p*-values $<0.05$ and $<0.001$ were considered statistically significant and highly significant (HS), respectively.

## Result

A total of 96 ambulatory healthy male subjects of rural areas of Patiala district were studied. The age of the subjects ranged from 65–94 years. Table 1 shows the mean and standard deviation values of the physical measurements and PEFR. Mean PEFR in the age group of 65–74 years was 339.44 ±35.51 and it declined with the increase in age. The correlation of PEFR with different parameters under study is shown in Table 2. It was negative, HS with age, while it was positive and significant with height. The correlation of PEFR with weight, BMI, and BSA was found to be negative and statistically nonsignificant (NS). The regression equations of PEFR with different parameters under study are shown in Table 3. The table shows that the best-suited regression equation for the PEFR is with age.

## Discussion

The study was conducted in 96 healthy elderly male subjects in the age group of ⩾65 years recruited from rural regions of Patiala in Punjab. Influences of age, height, weight, BMI, and BSA on the PEFR of these men were studied

### PEFR and Age

This study showed that the PEFR decreased with the increase in age. The correlation was found to be negative and HS ($p < 0.001$). Similar findings were observed by other investigators.[10–13] Decrease in the PEFR with age is probably due to degenerative

**Table 2: Correlation of PEFR with age, weight, height, BMI, and BSA among men**

| Parameter | Coefficient of correlation (r) | *p*-value |
|---|---|---|
| PEFR | - | - |
| Age (years) | -0.68 | $<0.001^{**}$ |
| Weight (kg) | -0.09 | $>0.05^{NS}$ |
| Height (cm) | +0.25 | $<0.05^{*}$ |
| BMI (kg/m$^2$) | -0.21 | $>0.05^{NS}$ |
| BSA (m$^2$) | -0.04 | $>0.05^{NS}$ |

PEFR, peak expiratory flow rate; BMI, body mass index; BSA, body surface area.
*, significant;
**, highly significant; NS, not significant.

**Table 3: Regression equation of PEFR in relation to age, weight, height, BMI, and BSA**

| Independent variable | equation (y) | *R* (Multiple correlation coefficient) | SEE (Standard error of estimate) | *p*-value |
|---|---|---|---|---|
| Age (years) | -6.22 (age) + 763.62 | 0.68 | 39.46 | $<0.05^{S}$ |
| Weight (kg) | -0.64 (Wt) + 365.28 | 0.09 | 54.01 | $>0.05^{NS}$ |
| Height (cm) | 0.34 (Ht) + 260.97 | 0.03 | 54.25 | $>0.05^{NS}$ |
| BMI ($kg/m^2$) | -3.68 (BMI) + 410.97 | 0.14 | 53.68 | $>0.05^{NS}$ |
| BSA ($m^2$) | -26.18 (BSA) ± 366.71 | 0.05 | 54.19 | $<0.05^{S}$ |

PEFR, peak expiratory flow rate; BMI, body mass index; BSA, body surface area; Ht, height; Wt, weight.
S, significant, NS, not significant.

changes in the musculoskeletal system of thoracoabdominal compartment leading to decrease in respiratory muscle strength with associated decrease in joint mobility and lung elasticity.

### PEFR and Height

There was a positive correlation of height with the PEFR, which was significant ($<0.05$). This revealed that the mean PEFR values of taller subjects were more than the shorter subjects. Similar observations were made by other authors.[2,14–17] This is probably owing to more chest volume and greater muscular effort seen in the taller subjects.

### PEFR and Weight

There was an NS correlation of the PEFR with weight, *p*-value $> 0.05$. This observation was consistent with the report of other authors.[18–20]

### PEFR and BMI

Correlation between the PEFR and BMI was found to be negative in the study subjects. The PEFR decreased with the increase in BMI. However, correlation between the two parameters was found to be statistically NS ($p > 0.05$). Similar observations were made by other authors.[21,22]

### PEFR and BSA

Correlation between the PEFR and BSA was found to be NS ($p > 0.05$). Similar observations were made by authors.[19]

The normal ranges and simple regression equation of the PEFR with age constructed as a result of this study for normal males of age $\geqslant 65$ years can be put to use in clinical work and public health.

## Conclusion

The findings of this study show the effect of age and anthropometric parameters on the PEFR. It was found that with the increase in age, PEFR declines. The PEFR of taller subjects was more. There was an NS relationship of PEFR with weight, BMI, and BSA.

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