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ANTHROPOMETRIC PARAMETERS AS DETERMINANT OF PEAK EXPIRATORY FLOW RATE IN YOUNG INDIAN ADULTS MALE.

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ABSTRACT

Objective: The present study was undertaken to study the variations in the Peak Expiratory Flow Rate (PEFR) with various factors like age, height, weight, the Body Mass Index (BMI) in healthy nonsmoking adults .
Material and Methods: Five hundred fifty healthy nonsmoking male subjects who were aged 15-60 years were selected and their PEFRs were analysed retrospectively. The influences of age, height, weight, and BMI on the PEFR were studied. The PEFR test was performed by electronic spiromrter in the Dept. of physiology , R.G.Kar Medical College, Kolkata.
Results: The mean PEFR of the subjects was found to be 355.51± 2.041 L/min litres/minute. The PEFR increased with an increase in the height, weight , but it decreased with an increase in age and BMI.
Conclusion: This study generated the preliminary values of PEFR for the healthy nonsmoking male.

KEYWORDS :

Introduction:

Pulmonary function tests like Peak expiratory flow rate (PEFR) provide a better understanding of the changes in the lungs from a diagnostic viewpoint. Peak Expiratory Flow Rate (PEFR) as a measurement of ventilatory function was introduced by Adorn in 1942, and was accepted in 1949 as an index of spirometry[1]. The PEFR has been defined by the European Respiratory Society as the maximal flow which is achieved during the expiration which is delivered with maximal force, starting from the level of maximal lung inflation, following the maximal inspiration which was expressed in litres/min[2,3]. PEFR is considered as the simplest index of pulmonary function to assess the ventilatory capacity. It is effort dependent and reflects mainly the calibre of the bronchi and larger bronchioles, which are subjected to reflex bronchoconstriction[4]. It is relatively a simple procedure, and may be carried out in the field using portable instruments. The average PEFR of healthy young Indian males and females are around 500 and 350 litres/minute respectively[5]. The PEFR reaches a peak at about 18-20 years, maintains this level up to about 30 years in males, and about 40 years in females, and then declines with age. This lung function test is useful for screening and monitoring the severity of asthma in a community, especially when the prevalence of asthma and asthma related hospital admissions are rising[6].

Pulmonary functions are generally determined by respiratory muscle strength, compliance of the thoracic cavity, airway resistance and elastic recoil of the lungs[7]. Pulmonary functions may vary according to age, height, body weight [8], and altitude (hypoxia or low ambient pressure).[9]

PEFR is one such parameter that can be easily measured by a peak flow meter and is a convenient tool to measure lung functions in a field study.[10] The PEFR values are affected by various factors, such as sex, body surface area, obesity, physical activity, posture, environment and racial differences.[11-13]

The present study has been taken up to look into the relationship between PEFR and anthropometric parameters like height and weight in males and determining which factor has a stronger association with PEFR.

Aims and objectives:

1. To study the variations in the Peak Expiratory Flow Rate (PEFR) with various factors like age, height, weight in healthy adult male subjects.
2. To find out any correlation of Peak Expiratory Flow Rate (PEFR) with BMI in healthy adult male subjects.

Methods:

Spirometric data obtained from subjects tested in the Pulmonary Function Laboratory of the Physiology Department, R.G.Kar Medical College, Kolkata, over a period of one year from March 2012 to July 2014, were considered for inclusion in this retrospective study. Out of 3200 test results, 1563 were included in the present study following inclusion and exclusion criteria. Written informed consent from every subject was taken before performing the test.

Experimental Protocol: Subjects were selected from the participants, referred to the pulmonary function laboratory in the Physiology Department by a variety of medical specialties The treatment sheets of all the subjects were consulted for their relevant history so also for the pulmonary functions test results. The essential inclusion criteria were (i) the performance of acceptable spirometry manoeuvre as per the ATS and European Respiratory Society (ERS) recommendations[4], (ii) subjects were 15 to 50 years of age, (iii) apparently healthy (iv) spirometric values considered: FVC ≥ 80% of predicted, FEV1 ≥ 80% of predicted, FEV1/FVC ≥70% of predicted.

The following subjects were excluded from the study: (i) history of chest trauma; tobacco smoking; exposure to substances known to cause lung injury i.e., asbestos, silica, cotton dust, coal, etc.; (ii) professions, such as, stone crushers, wood workers, cotton dust workers, pigeon breeders etc.; (iii) known to have other diseases such as bronchial asthma, chronic obstructive pulmonary disease, pulmonary tuberculosis, pneumonia, chronic bronchitis, emphysema, hypertension, heart failure, diabetes mellitus or any other abnormality (iv) abnormal chest radiograph and electrocardiogram (ECG); and (v) use of diuretics, cardiac glycosides or beta-adrenergic blocking drugs.

Spirometry: Pulmonary functions were measured by the electronic spirometer, model-RMS Helios-702 in accordance with the standards of lung function testing of the American Thoracic Society/European Respiratory Society (ATS/ERS) [4]. The test was explained and demonstrated to the subjects. After a rest for 5–10 minutes, the test was carried out. The best of the three acceptable results was selected. Post bronchodilator (reversibility test) testing was performed 10 minutes after administration of the bronchodilator. Pulmonary function report included patient's gender, height, weight, age and smoking status. Standard spirometric measurements included were forced vital capacity (FVC), forced expiratory volume in one second FEV1, the ratio of forced expiratory volume in one second to forced vital capacity (FEV1/FVC), Forced Expiratory Flow in 25% (FEF25%), Forced Expiratory Flow in 50% (FEF50%), Forced Expiratory Flow in 75% (FEF75%), and Forced Expiratory Flow in 25-75% (FEF25%-75%), peak expiratory flow rate (PEFR). Spirometric parameters were recorded as a percentage of the normal value predicted on reported height and age.

Measurement of Anthropometric Parameters: Weight was measured nearest to 0.1 kg using a standardized electronic weighing machine, with the subjects standing without footwear, with light clothes. The height of the subjects was measured with the stadiometer, to the nearest centimetre.

Statistical analysis

The data were expressed in mean ± SD and they were analyzed by SPSS (Statistical Package for Social Sciences) statistical software version 17 using proper statistical test. Differences were considered statistically different when $p < 0.05$

Result: Table-1 demonstrates the baseline characteristics of the subjects. Mean age of the male subjects was 35.78 ±13.67 years. Mean Height, weight, BMI of the subjects were 163.09±7.93 cm, 58.15 ± 11.56 kg and 24.7±1.3 kg/m^2 respectively. Mean PEFR of the subjects was 355.51± 2.041 L/min. Table 2 shows that the male subjects grouped according to their age and the mean PEFR recorded in each group. With age we see a proportionate increasing trend of PEFR value up to the age of 39 years. PEFR was maximum among the subjects of 35-39 years of age.Table-3 shows the male subjects grouped according to their height and the mean PEFR value recorded in each group. We observe a gradual trend of increasing PEFR with respect to increasing height. Table 4 shows that the male subjects grouped according to their weight and the mean PEFR recorded in each group. With weight also we see a proportionate increasing trend of PEFR values. Table 5 shows that Pearson correlation analysis of PEFR which showed an negative correlation of PEFR with the adiposity marker and age but significant positive association was seen with height and weight.

Discussion:

A number of factors influence PEFR in normal subjects. The primary factors that affect PEFR are the strength of the expiratory muscles generating the force of contraction, the elastic recoil pressure of the lungs and the airway size[14]. Abdominal adiposity may influence pulmonary functions by restricting the descent of the diaphragm and limiting lung expansion as compared to overall adiposity which may compress the chest wall.

The PEFR and age:

This study showed that the PEFR decreased with an increase in age, as shown in [Table5]. This correlation was found to be negative and the results were found to be statistically highly significant ($p< 0.001$), as shown in [Table-5]. This was in agreement with the reports of other investigators [15-18]. The decrease in the PEFR with an increase in age was probably because this variable was dependent on the expiratory effort and the elastic recoil of the lungs and the airway size, factors which are known to reduce with advancing age.

The PEFR and height:

In our study we observe a gradual trend of increasing PEFR with respect to increasing height (Table-3). There was a positive correlation of the PEFR with height in the study subjects, as shown in [Table-5]. The results were found to be statistically highly significant ($p<0.001$), as shown in [Table-5]. This showed that there was an increase in the PEFRs of the study subjects with an increase in their heights. This observation was consistent with the findings of the studies which were conducted by other authors [18-20]. This was probably because of the greater chest volume in the taller subjects. The growth of the airway passages and the expiratory muscle effort also increase with an increase in the height.

The PEFR and weight:

Our study shows a proportionate increasing trend of PEFR values with weight. The PEFR was found to be positively correlated with the weight, as shown in [Table-5]. This observation was consistent with the reports of other authors[21]. This was found to be statistically highly significant ($p<0.001$).

The PEFR and BMI

We found that PEFR is negatively associated with BMI (Table-5), after the effects of variation in age and height were removed. In another study, Chen *et al* [22] showed a positive correlation between maximum mean expiratory flow (MMEF) and increasing BMI that was significant in the middle age group of 40 to 69 years. The MMEF is generally regarded as "effort independent" and it may be that higher levels of BMI are associated with increased chest wall elastic recoil, and thus, with a change in the balance of elastic recoil. The study by Chinn *et al*[23] on young adults found evidence of linearity in relation of slope to BMI. The "Slope" declined with increasing BMI in males, that is, bronchial hyperresponsiveness increased. The statistical significance of the results was similar to our study. In the study conducted by Carey *et al*[24] on obese healthy subjects suggests that both total respiratory resistance and airway resistance increased significantly with the level of obesity, disclosing a significant linear relationship between airway conduction and functional residual capacity. The lower values of PEFR could be linked to obesity through several mechanisms, such as mechanical effects on the diaphragm (impeding descent into the abdominal cavity) and also because of the fat deposition between the muscles and the ribs that can lead to increase in the metabolic demands and work-load of breathing.

Conclusion: Hence, it was concluded that the PEFR increases with an increase in age, height, weight, but that decreases with an increase in the BMI.

Table 1. Mean anthropometric data, body mass index (BMI), in different age groups males

Parameters	(n)	Range	Mean	SD
Age(years)	550	15-60	35.78	13.666
Height (cm)	550	131-206	163.09	7.937
Weight(kg)	550	32-99	58.15	11.566
BMI (Kg/m^2)	550	22.5-26.4	24.7	1.3
PEFR(L/min)	550	188.8	355.51	2.041

Table 2: Mean (SD) peak expiratory flow (PEFR) of 550 subjects according to age

Age (years)	(n)	PEFR(l/min)	SD	SE
15-19	71	304.2	1.799	0.213
20-24	77	358.2	1.971	0.224
25-29	72	387	1.677	0.197
30-34	52	408	2.350	0.325
35-39	53	411.6	2.125	0.292
40-44	54	376.8	2.209	0.300
45-49	44	343.8	2.143	0.323
50-54	58	338.4	1.796	0.235
55-59	69	282	1.571	0.189

TABLE 3: Variations of PEFR with height in normal young adult males Height (cm)

Height (cm)	(n)	PEFR (Mean ±S.D) L/min	SD	SE
131-145	71	282.6	1.799	0.213
146-150	77	304.2	1.971	0.224
151-155	72	338.4	1.677	0.197
156 – 160	52	343.2	2.350	0.325
161 – 165	53	358.2	2.125	0.292
166 – 170	54	376.8	2.209	0.300
171 – 175	44	387	2.143	0.323
176 – 180	58	387.6	1.796	0.235
181 – 185	69	407.4	1.571	0.189

TABLE 4: Variations of PEFR with weight in normal young adult males Weight (kg)

Weight (kg)	(n)	PEFR (Mean ±S.D) L/min	SD	SE
28- 35	8	268.8	1.259	0.445
36-40	19	249.6	1.882	0.431
41-46	61	258.2	1.814	0.232
46 – 50	63	331.8	1.681	0.211
51 – 55	83	353.4	1.86	0.204
56 – 60	90	358.8	2.096	0.220
61 – 65	85	387	2.264	0.245
66 – 70	60	372	1.993	0.257
71 – 75	41	373.8	1.506	0.235
76 – 80	23	424.2	2.234	0.465
81-85	11	487.2	1.718	0.518
86-90	5	316.2	2.415	1.08
91-100	1	325.8	0	0

Table 5. Partial correlation coefficient of PEFR with age, height, weight, BMI in males

Correlation with PEFR	Pearson correlation coefficient (r)	p-values
Age (years)	-0.248	0.0001
Height (m)	0.345	0.0001
Weight (Kg)	0.268	0.0001
BMI (Kg/m2)	-0.229	0.0001

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