Comparative Study of Pulmonary and Anthropometric Parameters in Females of Garhwal

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ABSTRACT

Introduction: Ventilatory pulmonary function tests are particularly useful in evaluation of patients with respiratory complaints, screening for presence of obstructive and restrictive lung diseases Spirometers and peak flow meters are useful and versatile devices to assess airway disorders This study establishes the relationship of peak expiratory flow rate (PEFR) and anthropomorphic parameters like age, sex, height (Ht), weight (Wt), body surface area (BSA)and arm span a with respiratory parameters like maximal expiratory pressure (MEP), respiratory endurance time (RET) and breath holding time (BHT).

Material and Methods: 100 apparently healthy women of Garhwal in, 18 – 40 years were selected and underwent peak flow testing along with other respiratory and anthropomorphic parameters recording. All tests were conducted using standard methods. Correlation of all parameters was observed with PEFR using Karl pearson 's coefficient of correlation denoted by "r".

Result: Mean PEFR value obtained in Garhwali women was 425.1/min ± 35.18. It varied between 300 – 480 liters / min in different subjects. PEFR recorded was highest in the younger age group women but declined gradually with increasing age. MEP, BHT, RET also showed a similar trend. Further correlation of PEFR with respiratory and anthropomorphic parameters was statistically significant. Regression equations for PEFR for a given value of height in different age groups were derived and estimated flow rates using the prediction formulas were calculated.

Conclusion: The study indicated that PEFR in Garhwali women is higher than that of women of other states of India, which may be attributed to their better respiratory muscle strength and general muscle powerThis work has been done in anticipation of the usefulness of the prediction values for clinical purposes whenever required.

Keywords: PEFR, Garhwal, women

INTRODUCTION

Pulmonary function tests (PFT's) provide objective quantifiable measures of lung functions. Ventilatory pulmonary function tests are particularly useful in evaluation of patients with respiratory complaints, screening for presence of obstructive and restrictive lung diseases. Important ventilator function tests are Tidal Volume (TV), Inspiratory Reserve Volume (IRV), Inspiratory Capacity (IC), Expiratory Reserve Volume (ERV), Forced Vital Capacity (FVC), Forced Expiratory Volume in 1st second, Peak Expiratory Flow Rate (PEFR) and Maximum Voluntary Ventilation (MVV).It is essential to detect and treat respiratory obstruction at an early and reversible stage for prevention of permanent damage.[1-4] Spirometers and peak flow meters are useful and versatile devices to assess airway disorders.[5,6] At the end of 1994, guidelines were issued regarding the use of peak flow meter in outpatient treatment of bronchial obstruction by American Thoracic society.[7]

The primary aim of this study therefore was to report the findings of PEFR and establish relationship between PEFR and anthropomorphic indices like Age, Ht, Wt, BSA, Arm span and respiratory parameters like MEP, BHT, RET. PEFR is defined as, "the largest expiratory flow rate achieved with a maximally forced effort from a position of maximal inspiration expressed in litres per minute". It is an effort dependent parameter emerging from the large airways, within about 100 – 120 ms of the start of forced expiration. It remains at its peak for about 10 ms.[8,2]

The Wright's peak flow meter has been used to test ventilator capacity in many epidemiological surveys and in recent years it has been used increasingly by clinicians in outpatient departments. It is preferred because of its relative cheapness, size, independence of electrical power and the speed with which the test is performed. Measurement of peak expiratory flow (PEF) is of value for identification of chronic obstructive bronchitis and for the assessment and follow up of patients with asthma. For these purposes evaluation of an observed reading of PEF requires knowledge of its range in normal subjects of the same sex, age and body size.[1,5,9]

Regression equations with height in different age groups have been calculated and predication formulae of PEFR in women of Garhwal, Uttarakhand have been derived. Studies on PFT are available on people of most of the states of India, however the present study is first of its kind where PEFR has been reported on women of Uttarakhand, comparatively a new state.

Aim of the study was to study PEFR in adult females of Garhwal, Uttarakhand and to study the correlation of PEFR with the anthropomorphic and respiratory parameters and to derive the prediction equations.

MATERIAL AND METHODS

Subjects and Study Area: 100 apparently healthy women of Garhwal in age group 18 – 40 years were selected and underwent peak flow testing along with other respiratory and anthropomorphic parameters recording. All tests were conducted using standard methods.

Selection of Subjects: The following criteria were required for acceptance as a 'normal' subject – She should be a resident of Uttarakhand for more than ten years. Physically and mentally fit with no history of cardiopulmonary disease, should have capacity to co operate adequately during the test. A detailed personal history related to life style (regular exercise or

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sedentary), socioeconomic status, menstrual cycle, alcohol addiction, smoking, tobacco chewing and family history regarding hypertension, diabetes mellitus and tuberculosis was recorded.

Informed Consent was sort voluntarily from each prospective participant by way of a request-for-consent/ questionnaire form, explaining the nature of the investigation. Approval was attained from the college Ethical Committee.

Following anthropomorphic and respiratory parameters ware recorded and pulmonary functions assessed:

Anthropomorphic Parameters

Age: It was calculated in years to the nearest birthday.

Height: It was measured using stadiometer. Calibration of stadiometer was done using a standardized measuring rod. Stadiometer was checked once in two weeks for any error. Subject was instructed to stand straight on a flat surface with feet flat, heels almost together, arms at side and looking straight ahead. Heels, hips, shoulder blades and occiput pressing against the vertical bar then the slider was brought down to rest on the top of the head pressing the hair. The arrow accurately measured the height.

Arm span: It was taken as the distance in centimeters, between the tips of middle fingers of both outstretched hands in standing position.

Weight (Wt): It was measured using digital weighing machine. Subject was instructed to wear light clothing with no footwear and stand stand straight on the foot bar.

Body surface area (BSA): it is calculated by using Dubois formula BSA (m2) = W0.425. H0.725. 71.84 where W = body weight in kg, H = height in cm.

Peak Expiratory Flow Rate (PEFR): To record PEFR, Wright's peak flow meter was used. The subject was asked to stand in an upright position with the peak flow meter held horizontally in front of her mouth and allowed to take a deep breath. Further she was asked to close her lips firmly around the mouthpiece, making sure that no air leaks around the lips. The subject was asked to breathe out as hard and as fast possible and the reading indicated by the cursor on the peak flow meter scale was noted and the sequence was repeated twice more, thus obtaining three readings. The highest or best reading of all three measurements was taken as the peak flow rate and expressed in liters/min.

Maximal Expiratory pressure (MEP): MEP was recorded by asking the subject to take a maximal deep inspiration and put the tube of aneroid blood pressure apparatus in the mouth, clipped her nose and adjusted the tube so that no air escaped from the lips, and blow against the mercury column so as to push the pointer as high as possible. MEP that could be maintained for about 3 seconds was noted. It was ensured that the subjects did not use oral muscles to develop pressure or use their tongue to block the tubing.

Respiratory Endurance Time (RET): Following a deepest possible inspiration, subject was asked t apply a nose clip and to blow into the tube of aneroid blood pressure gauge to rise pressure up 40-mmHg mark and maintain the pointer at that level for as long as possible. Time was noted in seconds with the help of a stopwatch.

Breath holding Time (BHT): The subject was asked to pinch her nostrils with thumb and forefinger and made to hold her breath after a quiet expiration. Time for which breath could be held was noted in seconds.

STATISTICAL ANALYSIS

Data collected was subjected to standard statistical analysis using Microsoft excel. Data collected was expressed as mean ± sd. Correlation of all parameters was observed by Karl pearson's coefficient of correlation denoted by 'r'. Probability (P) values were derived to see the significance. P<0.001-highly significant, P<0.01-significant, P>0.05-not significant.

RESULTS

All the participants (n=100) were divided into 4 groups according to their age- group I (18-25), group II (26-30) group III (31-35) group IV (36-40) years. Mean values with standard deviations (SD) of PFT'S ie (PEFR, MEP, RET, BHT) were highest in group I, in younger women (18-25) years (Table-1). Further a gradual decline in respiratory parameter's values is observed from group I to IV in all the PFT'S. Mean values with SD's of anthropomorphic parameters in different groups showed that height, weight and arm span of women in groups I to III is relatively similar but slightly on the higher side in group IV women (Table-1).

Correlation coefficient (r) and P values of PEFR with anthropomorphic parameters was analysed (Table-2 and Table-3). The anthropomorphic parameters height, arm span and body surface area showed a stastistically significant positive correlation with PEFR in all subjects as well as in group study (Table-2 and Table-3). The correlation of weight with PEFR in total subjects is not statistically significant, (p>0.05), though group studies show a significant positive correlation (Table-3). Age shows a highly significant negative correlation with PEFR in total subjects, (r=-0.83, p <0.001) whereas in group studies correlation of age with PEFR in groups I, II and III is not significant while in group IV, women showed a negative correlation with age (r= -0.29) (Table-3). PEFR with respiratory parameters also showed a significant positive correlation with respect to total subjects and in groups (Table-3).

Regression equations of PEFR(y) for a given value of height (x) for different groups were calculated. Estimated and observed values of PEFR in healthy women subjects of Garhwal were observed. The predicted values were very close to the observed values (Table-4)

DISCUSSION

The lung function studies in population of Uttarakhand are sparse and very little information is available on PFT`s like PEFR in the woman population. PFT`s have evolved from tools for physiological study to those of clinical investigations in assessment 0f respiratory status. Further PEFR has been accepted as a simple and reliable way of monitoring bronchial asthma and chronic obstructive bronchitis. Age and height dependence of PEFR of subjects in different groups and at various ages was studied. It is well documented that PEFR correlates positively with height, weight and body surface area.[1,3,6,8,9,17,21–25,27] Mahajan et al have reported that pulmonary

Parameters	Mean± standard deviation	I (18-25years)	II (26-30years)	III (31-35 years)	IV (36-40years)
Age in years	Mean ±sd	20.55±2.16	27.35±1.46	32.85±1.46	37.95±1.70
Weight (kg)	Mean ±sd	56.7±5.42	56.65±5.75	56.4±2.83	60.2±4.08
Height (cms)	Mean ±sd	157.1625±5.07	154.75±5.12	154.4±2.83	156.75±4.03
Arm Span (cms)	Mean ±sd	158.8±4.95	156.7±5.10	156.25±2.59	158.6±3.99
BSA (m^2)	Mean ±sd	1.6±0.10	1.6±0.07	1.6±0.06	1.6±0.07
PEFR (L/Min)	Mean ±sd	457.50±13.54	430.00±13.54	395.00±15.00	385.50±29.10
MEP (mm of Hg)	Mean ±sd	70.50±12.03	66.75±9.97	64.90±19.66	47.15±15.05
RET (Sec)	Mean ±sd	37.10±3.53	34.50±4.81	34.25±6.13	26.60±3.73
BHT (Sec)	Mean ±sd	38.20±4.16	35.30±4.51	32.50±6.34	26.50±3.5

Table-1: Mean values of PFT's and anthropomorphic parameters in different age groups

Parameters	Total subjects	*P*value	I	II	III	IV
PEFR-Age	- 0.83***	<0.001	0.24^{NS}	0.24^{NS}	0.06^{NS}	-0.29
PEFR-Height	0.09^{NS}	>0.05	0.62***	0.64***	0.68***	0.7***
PEFR WT	0.41***	<0.001	0.62***	0.57**	0.64**	0.73***
PEFR-Armspan	0.38***	<0.001	0.59***	0.6**	0.67***	0.69***
PEFR-BSA	0.21**	<0.01	0.62***	0.6**	0.73***	0.72***

P value <0.001is highly significant (***), <0.01 is significant (**), >0.05 is not significant (NS)

Table-2: Correlation coefficient and 'p' values of PEFR with Anthropomorphic parameters in Total subjects and indifferent groups

Parameters	Total subjects	I	II	III	IV
PEFR-MEP	o.61***	0.53***	0.53***	0.67***	0.72***
PEFR-RET	0.62***	0.45**	0.52***	0.24^{NS}	0.53**
PEFR-BHT	0.73***	0.55***	0.54***	0.25^{NS}	0.82***

*** highly significant, **significant, NS (not significant)

Table-3: Correlation of PEFR with respiratory parameters In total subjects and different groups

Group	Height (x)	PEFR (y)	Prediction Formula	Predicted PEFR Values	Observed PEFR Mean values
	Mean ±sd	Mean ±sd		(L/Min)	(L/min)
I	157.2±5.07	457.50±13.54	y = 1.66x+197.21	458.00	457.50
II	154.8±5.12	430.00±12.14	y = 1.52x+195.09	429.00	430.00
III	154.4±2.83	395.00±15.04	y = 3.6x-162.98	392.00	359.00
IV	156.8±4.03	385.50±29.1	y = 5.05x – 407.05	384.00	385.50

Table-4: Regression Equations and estimated and observed values for Peak Flow Rate in Garhwali women based on Height

functions correlate better with height, arm span and upper segment than with age.[3] In the present study, the probable reason of higher PEFR value in females of group I (18-25 years) could be their mean height (157.16 cm) which was more than females of group II (154.75 cm) group III (154.4 cm) and group IV (156.75 cm), though their mean weight was similar (Table-1). Moreover mean armspan value in group I females was 158.8 cm which was also higher than the other groups significant in relation to armspan (table-1). In absence of reliable values for height as in kyphoscoliosis, arm span measurements may very well with height.[11]

Another noticeable observation is that women of group IV (36-40) years of age are anthropometrically similar to women of group I (18-25) years of age (Table-1). Their mean weight (60.2 kg) is even higher than that of group I females (56.7 kg) (Table-1). Mean PEFR in group IV females was 385 I/min which was much lower than that of group I women (457 I/min) (Table-1). Much of this variation may be attributed to the effect of increase in age, difference in thoracic volumes and musculature since these women were anthropomorphically similar. Thus the higher PEFR values in these subjects may be attributed to better respiratory muscle strength which is reflected by the significant higher values of respiratory parameters (MEP, RET and BHT) (Table.1).

The significant negative correlation of PEFR with age in total subject (r value -0.85, p<. 001) confirms to the values obtained by other investigators from India and from western countries.[1,4,9,10] When compared with the observation of Singh and Peri who worked on women of Andhra Pradesh,[9] the Uttarakhand women subject present with higher PEFR. In the values obtained by Jepegnum on Coimbatore women,[10] the difference is further heightened, since Coimbatore women possessed PEFR as low as 280 litres/min.

The values of PEFR in women from Rajasthan and Gujarat presented by Gupta et al and Rao et al[14] and Das and Dhundasi[5] were lower as compared to Uttarakhand women. Values obtained by Dixit et al[15] from Maharashtra were also low as compared to the present subjects. The lower values may be attributed to ethnic differences. Also environmental exposure to air pollution leads to low PEFR values and Coimbatore is an industrial town with significant air pollution.[10,23]

It is therefore obvious that in general, women folk from Uttarakhand in age group of 18-40 years present with higher PEFR as compared to the women subject of other states of India. Many of the women subjects were from the high altitude. The high altitude factor could be responsible for high PEFR values for these women. Studies by Cotes et al show clearly that people living at higher altitude possess greater values for pulmonary functions.[26] It has been stated by Udwadia et al that altitude may act by reducing oxygen tension in the blood increasing ventilation and thereby causing the work hypertrophy of lungs.[19] Further high altitude may also modify the lungs of the individual so expiratory muscle effort, lung elastic recoil pressure and airway size. The muscle effort in turn depends upon the physical activity and physical strength.[12,15,16] Hence, physical activity is also a factor that influences pulmonary functions. Since physical activity is likely to be more in cold and as the areas from where the Uttarakhand subjects came are comparatively cooler than other parts of India, the subjects might achieve higher PFT values because of this physical activity.

It has been reported that peak expiratory flow rate values in Indians are lower than the reported western figures.[18] In comparison to west, the values for European subjects are known to be higher than the age and sex matched Indian subjects and this has been attributed to racial background and nutritional status.[20]

PEFR values in Indian have been reported to be lower than observed in British and American subjects and the formula given by Greg and Nunn and Leiner et al give high estimates of PEFR. Higher values is western subjects appear to be due to their bigger physical built.[9]

Malik et al have compared the predicated values of PEFR from different studies globally.[13] In thirty five years old women with an average height of one hundred fifty seven centimeters, Leiner (1963) gave a prediction value of 422l/min, Ferris and associates (1965) predicted a value of 365 l/min while Gregg and Nunn in (1973) and Woolcock and associates (1972) had predicted a value of 470 l/min and 377 l/min respectively. The present study has predicted a value of 402 l/min in the Uttarakhand women of 35 years of age and similar height.

Further Greg and Nunn (1973) in a study in London have reported that relation of PEFR and age is curvilinear in both males and females (14-65 years of age). Their findings suggested that PEFR does not begin to decline until about the age of 35 years.[1] Dixit et al (2005) in a study from Maharashtra have reported that females appear to achieve maximum flow a little before 20 years and appear to maintain that level for almost two decades.[8] Mahajan et al (1984) in a study in people form Haryana have reported very similar results to the present study. They reported a steep rise in PEFR with increase in age from 6-18 years, with little variation years.[4] Japegnenum et al (1996) have also reported similar finding in healthy south Indian subjects. Peak PEFR values in their study were obtained at age between 21-25 years in females and 26-30 years in males.[10] The decline in PEFR with increase in age has been prominently shown in present study, it shows a curvilinear relationship between PEFR and age 18 to 40 years. This confirms to the values obtained by other investigators from India and from western countries.

The present study is the first of its kind where PEFR has been reported on women of Uttarakhand. The fact necessitates the prediction values for the women of Uttarkhand. There are substantial differences between the equations used to predict the normal lung function, because of difference among the population studied as well as technical and procedural differences.

Thus prediction formulas have been derived for these women for the calculation of PEFR, using simple anthropomorphic indices – height and age in view of significantly high correlation of these parameters with PEFR. This work has been done in anticipation of the usefulness of these prediction values for clinical purposes whenever required.

CONCLUSION

It can be concluded that simple test like PEFR substantiated with anthropomorphic and respiratory parameters can ascertain the level of physical fitness of given population and make a baseline for their pulmonary function in health. The values of these lung function test can be interpreted by comparing values measured in patients with reference values from this study. This work has been done in anticipation of the usefulness of these predictions values for clinical purposes whenever required.

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