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Relationship between Pulmonary Function Measurements and Height in Normal Subjects of Manipur

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Abstract:
Background: *Pulmonary function tests provide objective information about the status of an individual's respiratory system. Pulmonary function variables are known to vary with age, sex, height, weight, race and geographic location. So, the present study was conducted to determine pulmonary function among male and female healthy subjects of Manipur and to evaluate the relationships between height with FVC and FEV_1.*
Materials and Methods*: This cross-sectional study conducted on 100 normal subjects between 18 and 65 years of age at the Department of Physiology, Regional Institute of Medical Sciences, Imphal from September 2018 to August 2019.The variables studied were FVC, FEV_1 and FEV_1/FVC using computerized spirometry (Helios 401). Statistical analysis was done using SPSS version 21. $p<0.05$ was taken as significant.*
Results*: Mean values of FVC, FEV1 and FEV1/FVC were 3.98±0.56, 3.42±0.46 and 85.98±3.97 respectively for males and 2.90±0.36, 2.47±0.33 and 85.21±5.10 respectively for females. Statistically significant positive correlation between height and FVC and between height and FEV_1 were present in males ($r = 0.493$, $p = 0.000$; $r = 0.492$, $p = 0.000$) and also in females ($r = 0.415$, $p = 0.004$; $r = 0.426$, $p = 0.003$) respectively.*
Conclusion*: This study establishes preliminary results of FVC, FEV_1 and FEV_1/FVC and showed positive correlation between height and FVC and between height and FEV_1 for both normal male and female subjects of Manipur.*
Key Words*: FEV_1, FVC, Height, Pulmonary function, Spirometry*

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I. Introduction:

Spirometry is an old procedure still in use that is simple and inexpensive but highly significant in health care. Regarding tests of pulmonary function, spirometry is the most common and useful tool in clinical practice and research studies. Pulmonary function tests provide objective information about the status of an individual's respiratory system. It is one of the basic and essential tests for diagnosis and assessment of pulmonary diseases such as pulmonary dysfunction, chronic obstructive pulmonary disease (COPD) and asthma.[1, 2] The pulmonary function tests are considered as an essential part for evaluation of lung functions. Pulmonary function tests are influenced by various factors like anthropometric, geographic, genetic, socioeconomic and life style. The development of pulmonary functions and growth of physical parameters i.e. height and weight are coexistent. These physical parameters are further affected by nutrition and physical activities of children.[3] Since those factors are significantly associated with pulmonary functions, they are used for equation of regression calculating predicted normal values of pulmonary functions test.[4] There is no doubt that gender and height are the most important predictors of lung function. Height linearly correlates with lung size.[5]

Since, there is paucity of data regarding the relationship between pulmonary function parameters and height in the northeastern region of India, especially Manipur, the current study was conducted to evaluate the normal pulmonary function parameters and the relationship between pulmonary function parameters and height in normal subjects of Manipur using computerised spirometry.

II. Material and methods:

This cross-sectional study was conducted in the Department of Physiology, Regional Institute of Medical Sciences, Manipur from September 2018 to August 2019 among 100 normal adults living in Manipur within the age range of 18-65 years irrespective of their sex, ethnicity or socioeconomic status.

Inclusion criteria:

1. Normal adults living in Manipur irrespective of sex
2. Age range between 18 and 65 years
3. Giving consent

Exclusion criteria:

1. Subjects having h/o smoking
2. Pulmonary diseases like bronchial asthma, COPD
3. Any physical disabilities like khyphoscoliosis, pectus excavatum, pectus carinatum

Procedure methodology:

Informed written consent was taken from all the subjects after having explaining them the study protocol. Study was approved by the Research Ethics Board, RIMS, Imphal. A proforma of all the participants was maintained wherein brief clinical information, family history, personal and dietary history was included. Proper general and systemic examination was done and recorded. Using Computerised spirometer-Model Helios 401, Recorders and Medicare Systems, ISO 9001:2008, Chandigarh, the tests were performed in a suitable environment with room temperature ranging from 18-28˚C. The subjects were advised to wear loose fitting clothes and resting time between each test was 5-10 minutes. The subjects were asked to breathe out only through the mouth by keeping their nostrils closed with a nose clip in sitting position holding the transducer hand unit into the mouth throughout the procedure. Then the pulmonary function parameters - Forced vital capacity (FVC), forced expiratory volume in 1st second (FEV_1), Maximum voluntary ventilation (MVV) were recorded. Three consecutive tests were recorded with a rest of 5 to 10 minutes between two spirometry sessions.

Statistical analysis:

Data was entered and analysed using IBM SPSS version 21 for windows. Data was summarized using descriptive statistics like percentages for categorical data, means (standard deviation). Pearson's correlation test was done. A p value of < 0.05 was taken as significant.

III. Results:

The study was conducted on 100 subjects consisting of healthy adults of Manipur in the age group 18-65 years. The demographic characteristics of study population are shown in Table I.

Table I: Demography of study population:

Sl. No.	Variables	Mean±SD	No. of participants
1.	Age	24.67±9.06	100
2.	Weight	60.77±9.84	100
3.	Height	163.22±7.75	100

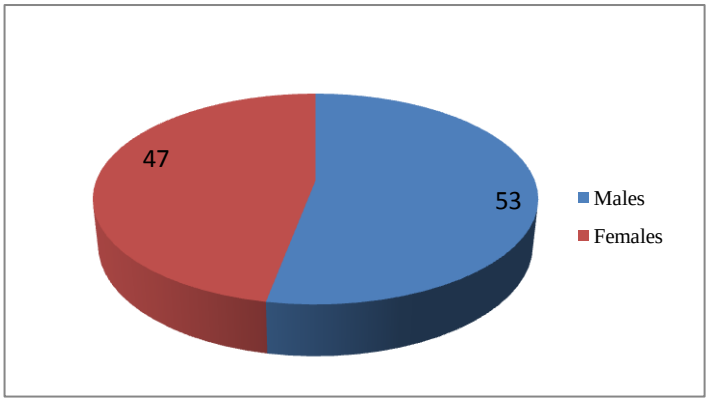

Figure 1: Gender-wise distribution of study subjects

Table II: Mean values of pulmonary function variables of study population:

Sl. No.	Variables	Male (53) Mean±SD	Female (47) Mean±SD	Total (100) Mean±SD
1.	FVC	3.98±0.56	2.90±0.36	3.47±0.72
2.	FEV_1	3.42±0.46	2.47±0.33	2.97±0.62
3.	FEV_1/FVC	85.98±3.97	85.21±5.10	85.62±4.53

Table III: Pearson's correlation between height and FEV_1 and FVC in males:

		FEV_1	FVC
Height	r	0.492**	0.493**
	p	0.000	0.000

**significant, $p<0.05$

Above table III shows statistically significant positive correlation between height and FEV_1 and FVC in males i.e. the values of FEV_1 and FVC increase as height increases.

Table IV: Pearson's correlation between height and FEV_1 and FVC in females:

		FEV_1	FVC
Height	r	0.426**	0.415**
	p	0.003	0.004

**significant, $p<0.05$

Above table IV also shows statistically significant positive correlation between height and FEV_1 and FVC in females.

IV. Discussion

From our study, it is seen that with increasing height the values of FEV_1 and FVC increase significantly, more significant among males, which is similar to the studies done by Dockery et al[6] and Schwartz et al[7]. Reason for this variation given by them is that, with increasing height, chest girth and thoracic area is increased and hence total surface area of lungs is increased. In taller people, more area for exchange of air is available than in shorter ones, and therefore greater amount of air can exchange in and out and this causes an increase in vital capacity of taller people. A tall individual may have a higher VC, FRC and TLC. A study from Nigeria showed that vital capacity increases with height.[8] In his historic study, John Hutchinson (the inventor of the spirometer) found that age and height are the most important determinants of lung function.[9] Height is considered as better index of body size and body size is proportional to lung size. This might be reason for its best correlation with pulmonary function tests.[10] Height is consistent in its association with ventilatory function indices among cigarette smokers and non-cigarette smokers.[11] Several studies suggest that height is the best single standard of reference, but to be more accurate, the prediction of correlation is gained by references of age and weight in addition to height with preference to index of build or chest girth.[12]

V. Conclusion

Our study determined the normative values for pulmonary function parameters for normal healthy adults of Manipur, where these values are positively correlated with height. Height is the robust factor which affects the lung volumes and capacities among all other physical factors, e.g., gender, age, and ethnicity. Moreover, the established normal values of spirometry will be useful for finding the obstructive and restrictive lung diseases.

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