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Pulmonary Function Parameters in Healthy Nepalese Population

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Abstract

Background: The variables of pulmonary function tests are interpreted in relation to normal reference values but they can be affected by various factors like socio-economic, geographical, climatic, nutritional conditions and many more. **Objective:** To establish and introduce our own Nepalese population specific reference range of Lung Function Test parameters for the clinical interpretation rather than using the reference range and prediction equations provided in commercial equipment done in different races which does not match up with Nepalese population. **Materials and Methods:** The study population consisted of 300 healthy volunteers aged 18 to 60 years belonging to different ethnic groups of Nepal. The subjects were instructed to perform three acceptable and reproducible maneuvers so as to get highest possible peak flows. The pulmonary function parameters like VC, FVC, FEV_1, PEF, PEF_{25}andPEF_{75} which are frequently used by clinicians to differentiate restrictive and obstructive airways diseases and overall respiratory health were taken for analysis. **Result:** In present study, comparison of pulmonary function parameters between actual measured values of Nepalese population with that of predicted value provided in commercial equipment shows significant difference i.e. the pulmonary function parameters like VC, FVC, FEV_1, PEF, PEF_{25} shows significant decrease in actual measured value ($p<0.05$) while significant increase in FEV_1 % in Nepalese population as compared to that of predicted values. Also, the study revealed that all the pulmonary function parameters like TV, VC, FVC, FEV_1, PEF, PEF_{25} and PEF_{75} is significantly greater in non-mongoloid than compared to mongoloid ethnic group of Nepal. Likewise, the correlation analysis of age was significantly negatively ($P<0.001$) correlated with VC, FVC, FEV_1, PEF, PEF_{25} and PEF_{75} while significantly positively correlated ($P<0.001$) with height. Likewise, weight and body surface area were significantly positively correlated with TV, VC, FVC, FEV_1, PEF and PEF_{25}. **Conclusion:** In conclusion, from our study, we can say that there cannot be any single universal equation that can be predictor for all groups of people. The use of reference range of pulmonary function parameters from a country as near as India and china is also not relevant and can give a misleading picture.

Keywords: Pulmonary Function Test, Reference range, Lung function, Predicted values.

Introduction

In the last few decades, pulmonary function tests have emerged as a clinical tool performed routinely in the clinical setup for assessing pulmonary function status.Besides clinical case management, they have become a part of routine health examinations in respiratory, occupational

and sports medicine and in public health screening. Pulmonary function tests (PFTs) are non-invasive diagnostic test that helps in providing valuable information about the function of the lungs and identifying the severity of pulmonary dysfunctionsuch as dyspnea (breathlessness) cough, asthma, chronic obstructive pulmonary disease,restrictive lung disease,preoperative testing, and neuromuscular disorders involving respiratory muscles[1].

The variables of pulmonary function tests are interpreted in relation to normal reference values but they can be affected by procedure, observer bias and biological variations like inter-individual variability. Besides this, the most important variability are age, sex, weight, ethnic group, environmental conditions as well as wide variations in socio-economic, geographical, climatic and nutritional conditions[2-6].Therefore, in our present study, we have tried to establish and introduce our own Nepalese population specific reference range of Lung Function Test parameters for the clinical interpretation rather than using the reference range and prediction equations provided in commercial equipment done in different races which does not match up with Nepalese population. In addition to this, we have also tried to find out the relationship of Lung Function Tests parameters with age, sex, height, body weight and different ethnic groups of Nepalese population.

Materials and Methods

The study population consisted of 300 healthy volunteers aged 18 to 60 years belonging to different ethnic groups ofNepal. They included healthy staffs of Rangeli Hospital and also the healthy relatives of patients accompanying them from the period of June, 2016 to August, 2016.Informed consent was taken from the participants and was asked to complete a questionnaire togather the information on age, sex, health, height and weight.Subjects with tobacco smoking (current or past smokers including occasional), pregnancy, history of current or past cardiorespiratory diseases or abnormal symptoms like chronic coughing, dyspnea, hemoptysis and other diseases like neuromuscular disease, thoracic wall deformities, systemic disease etc. were excluded from the study.

The subject was asked to be sited on chair with a nose clip and avoid extension and flexion of neck. The subjects were instructed to perform three acceptable and reproducible maneuvers so as to get highest possible peak flows. The best of the three repeated forced expiratory maneuvers obtained from maximum expiratory flow volume were considered for Forced vital capacity (FVC) and Force Expiratory Volume in first second (FEV_1). Thus, pulmonary function parameters like Vital Capacity (VC),Forced vital capacity (FVC), Forced expiratory volume in one second (FEV1), Peak Expiratory Flow (PEF), Peak Expiratory Flow at 25%(PEF_{25}) and Peak Expiratory Flow at 75% (PEF_{75})which are frequently used by clinicians to differentiate restrictive and obstructive airways diseases and overall respiratory health were taken for analysis.

Different pulmonary function parameters were expressed in terms of Mean ± SD. Pearson correlation coefficient was calculated to observe the correlation between dependent pulmonary variables and independent physical and anthropometric variables.

Results

The characteristics of the study participants are presented by physical and anthropometric measurement in Table 1, by pulmonary function parameters of actual measured value and predicted value in Table 2, by different ethnic groups in Table 3 and by correlation between physical and anthropometric variables with pulmonary variables in Table 4.In present study, comparison of pulmonary function parameters between actual measured values of Nepalese population with the predicted value provided in commercial equipment shows significant difference in the values i.e. the pulmonary function parameters like VC, FVC, FEV_1, PEF, PEF_{25} shows significant decrease in actual measured value ($p<0.05$) while significant increase in FEV_1 % in Nepalese population as compared to that of predicted values (Table 2). Also, the study revealed that all the pulmonary function parameters like TV, VC, FVC, FEV_1,

PEF, PEF_{25} and PEF_{75} is significantly greater in non-mongoloid than compared to mongoloid ethnic group of Nepal (Table 3). Likewise, the correlation analysis of age was significantly negatively (P<0.001) correlated with VC, FVC, FEV_1, PEF, PEF_{25} and PEF_{75} while significantly positively correlated (P<0.001) with height. Likewise, weight and body surface area were significantly positively correlated with TV,VC, FVC, FEV_1, PEF and PEF_{25}(Table 4).

Table 1: Physical and anthropometric measurements of normal subjects

Observations	Mean ± S D
Age (years)	24.6±10.32
Height (cm)	162.6± 7.026
Weight (kg)	59.5 ± 10.35
BSA(m2/kg)	1.7±0.16

Table 2: Comparison of pulmonary function parameters between actual measured value and the predicted value of healthy subjects

Parameters	Measured value (Mean ± SD)	Predicted Value (Mean ± SD)	P Value
TV (L)	0.54± 0.36	0.5 ± 0.15	NS
VC (L)	3.47 ± 0.72	3.86 ±0.77	0.0001*
FVC (L)	3.25 ± 0.69	3.86 ±0.76	0.0001*
FEV1 (L)	2.97± 0.89	3.48 ±0.66	0.0001*
FEV1 %	92.02± 6.35	83.88 ±3.3	0.0001*
PEF (L/s)	6.15 ±2.6	7.88 ±1.33	0.0001*
PEF25 (L/s)	5.71 ± 2.6	7.25 ±1.1	0.0001*
PEF75 (L/s)	2.51 ± 0.97	2.62 ±0.84	NS

*P<0.05; TV: Tidal volume; VC: Vital Capacity; FVC: Forced Vital Capacity; FEV1: Forced Expiratory Volume in 1st second; PEF: Peak Expiratory Flow; NS: Non-Significant.

Table 3: Comparison of pulmonary parameters between mongoloid and non- mongoloid ethnic groups

Parameters	Ethnic Group		P Value
	Non-Mongoloid	Mongoloid	
TV (L)	0.50 ± 0.25	0.44 ± 0.25	0.0385*
VC (L)	3.49 ± 0.7	3.19 ± 0.78	0.00*
FVC (L)	3.37 ± 0.74	2.88 ±0.81	0.00*
FEV1 (L)	3.36 ± 0.72	2.68 ± 0.83	0.00*
FEV1 %	93.17 ± 5.91	91.74 ± 6.67	0.05*
PEF (L/s)	6.44 ± 2.56	5.53 ± 2.56	0.002*
PEF25 (L/s)	5.98 ± 2.42	5.11 ± 2.44	0.002*
PEF75 (L/s)	2.65 ± 0.91	2.15 ± 0.41	0.001*

*P<0.05; TV: Tidal volume; VC: Vital Capacity; FVC: Forced Vital Capacity; FEV1: Forced Expiratory Volume in 1st second; PEF: Peak Expiratory Flow

Table 4: Pearson correlation coefficients between physical and anthropometric variables with pulmonary variables

Parameters	Age(years)		Ht. (cm)		Wt. (kg)		BSA(m2/kg)	
	rho	P value	Rho	P value	rho	P value	rho	P value
TV (L)	-0.11	0.094	.235**	0.00	.309**	0.00	.328**	0.00
VC (L)	-.301**	0.000	.529**	0.00	.353**	0.00	.497**	0.00
FVC (L)	-.323**	0.000	.548**	0.00	.369**	0.00	.506**	0.00
FEV1 (L)	-.367**	0.000	.542**	0.00	.323**	0.00	.454**	0.00
FEV1%	-.321**	0.000	.182**	0.006	.069	0.299	-0.031	0.636
PEF (L/s)	-.244**	0.000	.329**	0.00	.318**	0.00	.342**	0.00
PEF25 (L/s)	-.246**	0.000	.323**	0.00	.326**	0.00	.347**	0.00
PEF75 (L/s)	-.349**	0.000	.375**	0.00	-0.002	0.974	0.125	0.057

*P<0.05, **p<0.001; TV: Tidal volume; VC: Vital Capacity; FVC: Forced Vital Capacity; FEV1: Forced Expiratory Volume in 1st second; PEF: Peak Expiratory Flow; Ht: Height; Wt.: Weight; BSA: Body Surface Area.

Discussion

In present study, comparison of pulmonary function parameters between actual measured values of Nepalese population with that of predicted value provided in commercial equipment shows significant difference. Similar findings can be found in other studies [7, 8] which revealsage, sex, weight, ethnic group, environmental conditions as well as wide variations in socio-economic, geographical, climatic and nutritional conditions are responsible for such variability.

Likewise, the study revealed that all the pulmonary function parameters like TV, VC, FVC, FEV_1, PEF, PEF_{25} and PEF_{75} is significantly greater in non-mongoloid than compared to mongoloid ethnic group of Nepal. This might be due to the differences in body build in these two ethnic groups[9]. Also, the result showed significant negative correlation of age with pulmonary variables. The aging progress is a degenerative change. These are associated with a decline in lung function. Literature considered age as a possible influential variable for pulmonary function. An inverse relationship between age and pulmonary function older than 30 years of age, have been reported[10].Further, elastic recoil of the lung tissue reduces with increase in age. Residual volume increases but total lung capacity does not increase significantly[11].

Likewise, our present study revealed that the weight, height and body surface area positively correlated with pulmonary parameters. These findings with healthy subjects are consistent with previous studies measuring pulmonary parameters[2, 12-14]. The relationship of ventilatory function from childhood through late adolescence to adulthood is not linear. In boys, height and vital capacity are often not maximal by age of 17 yr. of age[15]. Vital capacity continues to increase after height in growth ceases and may not be maximal until after 25 year of age. Girls however, seems to attain their maximal values at about 16 years of age[16, 17]. The opposing effect of increasing muscularity and obesity have been involved to explain the observed increase in ventilator function that parallels increase in body mass and the decline in lung function beyond the optimal weight[18]. Likewise an increase in lung volumes and body mass when growth in height had stopped has been attributed to an increase in muscle mass and the consequent increase in respiratory muscle force[19, 20].

In conclusion, from our study, we can say that there cannot be any single universal equation that can be predictor for all groups of people. The use of normative data of pulmonary function parameters from one ethnic group to another is also not relevant and can give a misleading picture.

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