

## Estimation of Spirometric Reference Values, Prediction Equations & Correlations in Children Living in Maharashtra Aged 6-15 Years By Using Anthropometric Indices & Its Comparison With National & International Published Values & Equations : A Hypothesis

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### Abstract

**Background:** PFT is commonly used investigation in order to diagnose respiratory diseases. Computerized PFT machines use software which consists of prediction equation developed from normal population data. The American Thoracic Society (ATS) has recommended that PFT laboratories should have their own set of prediction equation [12]. In India, prediction equations derived from Caucasian population is commonly used. Those equations are markedly heterogeneous in terms of ethnic composition & not suitable for Indian population [1, 12]. However, due to unavailability of such prediction equation in Indian children, the western equations are used in software of PFT machine. This study is designed to understand relation of anthropometric parameters & lung function, to establish standard reference data & design best statistical prediction model for 6 - 15 years aged 2000 primary & secondary school going children of rural & urban Maharashtra.

**Clinical Importance:** Normative data for pulmonary function parameters in pediatric population is needed in Indian population. Such data & prediction equations will help to understand a relationship between anthropometric measures like height, weight, BMI & age with 19 PFT parameters. Appropriate prediction equation has to be selected before its use in any population to be tested with PFT for accurate diagnosis & treatment. Already available Caucasian equations have to be validated with advanced statistical tests before using in Indian context. It will help in prevention of misdiagnosis of respiratory conditions in pediatric population.

**Future direction:** Multicentre studies can be carried out in adults, elderly to derive best prediction equation for lung function for all ages.

**Keywords:** Lung function, Indian children, prediction equation, reference data.

## THESIS SUMMARY

### Introduction

PFT is commonly used investigation in respiratory diseases as it gives reliable information about status of respiratory system. The most important step in diagnosing abnormality of lung function in individuals is to define whether they are within or outside the healthy subjects range. Computerized PFT machines use software which consists of prediction equation developed from normal population. The American Thoracic Society (ATS) has recommended that

laboratories should use the published reference equations that most closely describe the populations with a similar ethnic background tested in their labs [12]. Difficulties arise when either the patient population being investigated at a particular centre is markedly heterogeneous in terms of ethnic composition, or when no prediction equations are available for use in the patient population predominantly investigated at a centre [1, 12].

ATS – ERS Task Force appealed worldwide researchers to develop

reference values & equation for different population, ethnic groups, and regions [12]. They have recommended equations given by few authors for use in western countries (e.g.: Knudson, Crapo, ECCS, NHANES III etc) [12]. These equations are derived from the Caucasian & white population. In India most of the PFT machine manufacturers use these equations in their software. This is purely because of lack of such equations in Indian population [1]. The research to establish reference values & equations for different population is going on in different countries. But on contrary, it remained quite neglected area of research in Indian context.

Physiotherapists are involved in conducting PFTs in most of the hospitals & physiotherapy management completely depends up on diagnosis of patient. In Indian context Physiotherapists, Physicians and even researchers, rely on the results obtained from Caucasian prediction equations incorporated into the software of spirometers. But these Caucasian prediction equations & predicted values results in misinterpretation in significant proportion of patients in India [1]. Hence, these equations are not applicable for Spirometric interpretation in India. [1]

Nomograms predicting the FEV<sub>1</sub>, FVC, PEFR, and MVV from height, weight are available for western adult & paediatric population. In India, such data is available for North and South Indian adults but not for paediatric population. It is often essential and important to have regional values for predictions in a diverse country like India where diversity exist in culture, ethnicity, socioeconomic status, eating habits [1,8,10,11]. In our country, large number of sources for reference data of PEFR in children exists in the form of prediction regression equations. Most of these studies are from south India i.e. Andhra Pradesh, Tamil Nadu, Karnataka and few studies are from North & East India i.e. West Bengal, Delhi, Rajasthan, Punjab, Hariyana, Himachal Pradesh & Kashmir. Most of these studies have included PEFR & not other parameters of PFT. Surprisingly such data is not available in children living in Maharashtra. Therefore, it is necessary to have normal pulmonary function data in terms of prediction equations & values for children living in Maharashtra so that it will be easy to interpret accurately the pulmonary function changes in Childhood pulmonary diseases. Hence, to prevent misinterpretation, misdiagnosis & wrong categorization of childhood pulmonary disease in clinical practice, we designed this study to throw light on such neglected aspects of pediatric pulmonology research and practice. This study will be first of its kind to investigate 19 parameters of lung function in Indian context in a mixed population of both urban & rural children.

### Hypothesis

The lung function is quite well studied in Indian adult population & various researchers designed prediction equation for estimation of the lung function values. However it's not similar situation of Indian children. Most of the times the adult data is extrapolated & used in children. Larger studies, while providing useful preliminary data on the subject, have been pointed out to be biased because of unsubstantiated extrapolation of adult data to children in other diverse geographic regions where differences in nutritional status and racial anthropometric indices could affect the findings Agarwal A.N, Gupta D. et al [1] studied applicability of commonly used Caucasian equation in interpreting spirometry data in India & found that these equations resulted in poor agreement, misinterpretation & bias in Indian population. Charles Rossiter, Hans Weil [2] studied lung function in black African & white European & found that white European have 13.2 % higher lung volumes. They concluded that

ethnicity has great impact on pulmonary function. Chatterjee Satipati, Mandal Andita [3] studied pulmonary function in healthy school boys of West Bengal & developed prediction equations. They compared these values & equation with boys of Delhi, South India & America. They found that west Bengal boys have lower values than Delhi & American boys but more than South Indian boys Dugdale A.E, Moeri Margaret [5] studied FEV<sub>1</sub>, FVC, and PEFR in Australian children & found that there is strong correlation between anthropometric parameters & pulmonary function. Multiple regression equations are more accurate in predicting lung function than single regression equation. Kashyap S, Puri D.S et.al [8], studied & developed equations for PEFR of healthy tribal children living at high altitudes in Himalaya, Himachal Pradesh & found that these values are greater than values from Western countries Swaminathan S et.al [10] studied PEFR in South Indian children of Dravidian in origin & found that PEFR values correlates strongly with height & also found that South Indian children has lower values than Caucasian but equal to North Indian children Swaminathan Sumati, Diffey Bronwyn et.al [11] evaluated suitability of 18 linear predicted equations for lung function in Indian children & found that equation has to be validated & self tested before using for patient population in India.

The current research aims to derive reference values of lung function, establish a prediction model for lung function, understand relationship between age, height, weight, body surface area, BMI & lung function in children living in Maharashtra. A prospective, observational study with multistage cluster randomized sampling method will be carried out. Clusters will be formed at district, Tehsil, town or village level. Normal healthy children living in Maharashtra aged 6-15 years after their written consents will be recruited in study whereas children with pulmonary, cardiac endocrine disorders, malnourishment will be excluded. Standing Height, weight, age, BMI & body surface area will be documented. After proper demonstration, practice & trials PFT will be performed as per ATS guidelines at BTSPS. Best values out of three will be documented for statistical analysis. 19 PFT parameters will be documented for analysis. The data collected will be analyzed using inferential statistics. Range of PFT parameters among studied population will be derived from simple statistics. Mean values of these parameters will be compared with national & international published values. Correlation coefficients will be derived to determine relation between anthropometric measures & PFT parameters. Data will be analyzed by using Pearson product moment correlation tests. Multiple regression analysis will be done by using R statistical software & the best fitted model will be selected as prediction equation.

### Discussion

Use of inappropriate references for lung function may lead to erroneous clinical categorization, inaccurate interpretation, which may have consequences for an individual & is certainly important for research. The success of physiotherapy intervention highly depends on precise diagnosis of respiratory patient. When used in Indian patients, Caucasian prediction equation diagnosed Obstructive patients as restrictive & vice versa [1]. In such cases the obstructive patients will be treated on the lines of restrictive condition & will be loaded with inspiratory & lung expansion exercises. This wrong protocol due to wrong diagnosis will aggravate hyperinflation & will impact negatively

on patient's health status. So each ethnic group should ideally have its own reference values for better evaluation & comparison. Therefore, it is imperative that ethnic differences in lung function are acknowledged by development and use of appropriate reference values [3-6] [9] [11].

### Clinical Importance

Normative data for pulmonary function parameters in pediatric population is needed in Indian population. Such data & prediction equations will help to understand a relationship between anthropometric measures like height, weight, BMI & age with 19 PFT parameters. Appropriate prediction equation has to be selected before its use in any population to be tested with PFT. Already available Caucasian equations have to be validated before using in Indian context. It will help in prevention of misdiagnosis of respiratory conditions in pediatric population.

### Future Direction

Multicentre studies can be carried out in adults, elderly to derive best prediction equation for lung function for all ages.

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