ORIGINAL ARTICLE

PREDICTED AND RECORDED VITAL CAPACITY IN STUDENTS OF SHALAMAR MEDICAL AND DENTAL COLLEGE, LAHORE

Farida Munawar, Rizwan Ahmed Khan Niazi, Aniqa Mumtaz, Sundus Khan, Ammara Ansar, Sagheer Ahmed, Rais Nawaz

Department of Physiology, Shalamar Medical and Dental College, Lahore

Background: The study aimed at observing the difference in predicted and recorded Vital Capacity in young Pakistani adults. **Methods:** Female students (n=46) and male students (n=30) belonging to age group 18–20 years, height 150–190 Cm, and with no history of smoking or respiratory ailment participated in the study. Predicted Vital Capacity was calculated by using the formula based on age and height. Vital Capacity was recorded on Students' Spirometer of 9 L capacity. **Results:** A statistically significant difference between predicted and recorded Vital Capacity ($p<0.05$) for both female and male medical students was observed. In females, recorded Vital Capacity values were 22% less than predicted values, and in males they were 23% less than the predicted value. **Conclusion:** Vital Capacity is dependent on other factors besides age and height. Therefore recorded values 77–78% of predicted should be considered normal. The incorporation of weight in prediction equation would result in better estimation of Vital Capacity in Pakistan for different age groups.

Keywords: Predicted vital capacity, spirometer

INTRODUCTION

Vital capacity (VC) is maximal volume of air forcefully expelled from the lungs after a maximal inspiration. Vital Capacity is a critical component of good health. Measurement of VC is useful diagnostically and is an important pulmonary function test.[1] Predicted Vital Capacity formulas given by researchers for Caucasian population always overestimated the values for black races.[2,3] Lung function tests provide a clearer understanding of pulmonary function in subjects of different races, age, sex, occupation and profession. If there are functional abnormalities in the respiratory system, the deviation from normal can form a basis for diagnosis and assessment of progress in the management of chronic ventilatorydiseases.[4] Tests of lung function, of which spriometry is by far the most common, find application in diagnosis, assessment and management of patients with different lung diseases and also as outcome tools in research studies.[5] Interpretation of an observed value involves comparison with a reference value, defined as 'normal' derived from a representative sample of healthy subjects. Unlike most other measurements in medicine where universally applicable normal ranges are available, lung function shows wide variations even in 'normals'. Reference equations are used to determine a normal range of spriometry results. The sources of variation in lung function have been summarised by the American Thoracic Society (ATS).[1]

Besides technical factors related to equipment and procedures, biological and environmental factors are other sources of variation. These include racial and ethnic, sex and anthropometric factors as well as several other factors including environmental influences, nutrition and childhood infections, and other undefined factors. Significant differences are known to exist among the major ethnic groups in the United States. Several prediction equations have been described for northern, eastern, western and southern regions in India. These equations have limitations.[6,7]

Vital capacity is a measure of the maximum amount of air the lungs can breathe in or out. At rest, values vary from about 3–6 litres, according to age, sex, and height. Measurements of vital capacity are used as part of a fitness assessment. A person whose vital capacity is less than 75% of the expected value, is generally advised to consult a doctor for further testing before exercising. A normal adult has a vital capacity between 3 and 5 litres. After the age of 20 years the vital capacity decreases approximately 250 ml per 10 year.[8,9] Spirometry is pivotal in screening, diagnosing and monitoring respiratory disease and is increasingly advocated for use in primary care practice.[10] Most pulmonary function laboratories in the USA and Europe use reference values based on populations with predominantly European backgrounds.[11]

The objective of the present study was to observe the differences in predicted and recorded vital capacity in medical students in age range of 18–20 years.

MATERIAL AND METHODS

Seventy-six (46 female, 30 male) medical students of 1st year MBBS from Shalamar Medical and Dental College, belonging to age group 18–20 years and height ranging from 150–190 Cm having no history of smoking or respiratory ailment consented to participate in the study. Written consent from all subjects was taken after explaining the experimental procedure.

Age in completed years, and standing height in Cm was recorded. Predicted vital capacity was calculated using the following equations:[12,13]

Males:

VC= (0.052×Height in Cm) - (0.022×Age in years) - 3.6

Females:

VC= (0.041×Height in Cm) - (0.018×Age in years) - 2.69

Vital capacity was recorded by Students' Wet Spirometer having capacity of 9 litres. The subject sat comfortably facing the spirometer and was asked to inspire as deeply and as fully as possible to fill the lungs. While keeping the nostrils closed with a nose clip and the mouthpiece held firmly between the lips, the subject was instructed to expel all the air with maximum effort into the spirometer. Three acceptable spirograms were taken at intervals of 5 min and the highest among the 3 was taken as final.[14] The spirogram was obtained on a kymograph with drum speed 2.5 mm/Sec. The calculated vital capacities were compared as percentage of predicted values.

SPSS-17 was used for data analysis. The comparison of mean values between predicted and recorded vital capacities were performed by one sample *t*-test. Correlation between variables was established using one-tailed Pearson correlation.

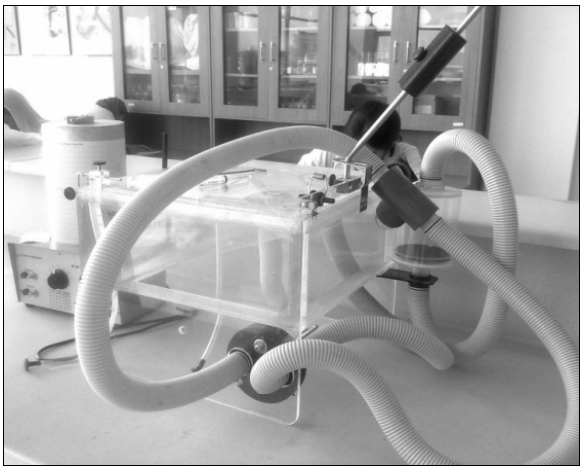

Figure-1: Water-sealed Wedge type Spirometer

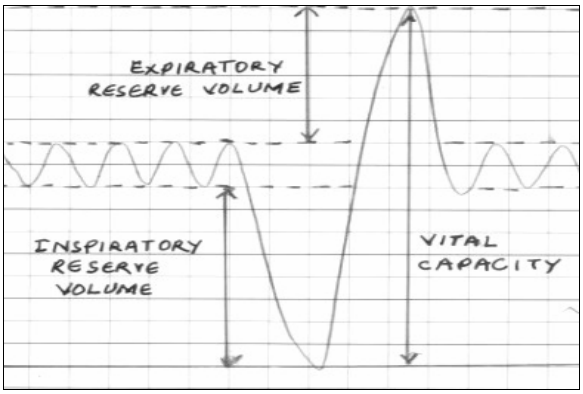

Figure-2: Typical Spirogram

RESULTS

The results are shown in Tables 1–4 and Figure-3.

There was a statistically significant difference (p<0.05) between predicted and recorded vital capacity in female medical students as shown in Table-1. The recorded vital capacity is 78% of the predicted value.

Table-1: Comparison of predicted and recorded vital capacity in female medical students

Predicted VC	Recorded VC	VC % Predicted	P value
3.39±0.40	2.67±0.42	78	<0.05*

Mean±SD, VC=vital capacity, *significant

Table-2 shows a statistical significant difference between recorded and predicted vital capacity in medical students and the percentage of recorded to predicted vital capacity is 77%.

Table-2: Comparison of predicted and recorded vital capacity in male medical students

Predicted VC	Recorded VC	VC % Predicted	P value
4.65±0.45	3.62±0.58	77	<0.05*

On comparison of age and height with predicted vital capacity both in male and female medical students a statistically significant relation is shown in Table-3 and Table-4 respectively. Highly significant correlation (r=0.96, p<0.01) existed between the height of the female subjects and vital capacity. Linear, regression analysis shows that height is the best predictor for vital capacity.

Table-3: Comparison of age with predicted vital capacity in female and male medical students

Gender	Age (Yr)	Predicted VC	P value
Female	19.06±0.92	3.50±0.24	<0.05
Male	19.5±0.84	4.85±0.30	<0.05

Table IV: Comparison of height with predicted vital capacity in female and male medical students

Gender	Height (Cm)	Predicted VC	P value
Female	159.63±5.7	3.50±0.24	<0.05
Male	170.9±5.9	4.85±0.30	<0.05

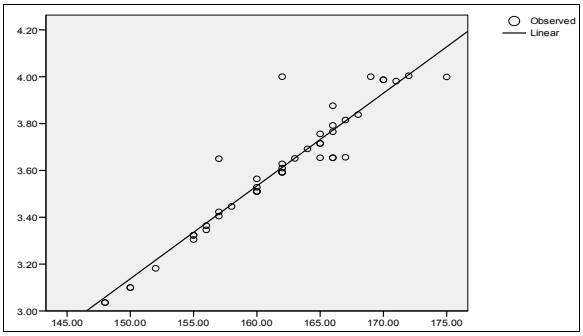

Figure-3: Correlation between height and predicted vital capacity in female medical students

DISCUSSION

Over the past 30 years, pulmonary function testing has been put to widespread clinical use and is presently considered an essential prerequisite to diagnose various obstructive and restrictive disorders. Spirometry is the most widely used screening test for lung function or pulmonary function studies. It is usually the first test to be performed and interpreted. Spirometry can be carried out in the ambulatory setting, physician's office, emergency department or inpatient setting.[15]

Our study highlights the importance of obtaining normative values for lung function in medical students and comparing them with the predicted values. Lower results of recorded vital capacity than predicted in male students could be due to lack of correct history of smoking which the students may not have informed due to social stigma. In one study it was observed that smoking in all likelihood modified vital capacity over time but not in recent smokers.[16]

The values we observed are different from those recorded in Caucasians of the same age group. The present study shows a statistically significant relationship between height, predicted and recorded vital capacity in both male and female medical students.

CONCLUSION

Vital Capacity is dependent on other factors besides age and height. Therefore, the recorded values can be considered normal. The incorporation of weight in prediction equation would result in better estimation of Vital Capacity in Pakistan for different age groups.

REFERENCES

1. Williams DE, Miller RD, Taylor WF. Pulmonary function studies in healthy Pakistani adults. Thorax 1978;33:243–9.
2. Hankinson JL, Odencrantz JR, Fedan KB. Spirometric reference values from a sample of the general US population. A J Respir Crit Care Med 1999;159:179–87.
3. Van Ganse W, Billet L, Ferris BG. Medical criteria for the selection of normal subjects. In: Arcangeli P, Cotes JE, Cournand A, *et al*, editors. Introduction to the definition of normal values for respiratory function in man. Alghero, Panminerva Medica, 1969;pp.15–27.
4. Mevo Khan Zurdari, Mir Muhammad Sahto, Syed Tousif Ahmed, Ali Akbar Rahu, Ahmed Badar. Pulmonary Function Tests in Chronic Obstructive Pulmonary Disease with and without Cardiac Failure. J Ayub Med Coll Abbottabad 1999;11(1):17–9.
5. Golshan M, Nematbakhsh M, Amra B, Crapo RO. Spirometric reference values in a large Middle Eastern population Eur Respir J 2003;22:529–34.
6. Bland MJ, Altman DJ. Statistical methods for assessing agreement between two methods of clinical measurement. Lancet 1986;1:307–10.
7. Nku CO, Peters EJ, Eshiet AI, Bisong SA, Osim EE. Prediction formulae for lung function parameters in females of south eastern nigeria. Niger J Physiol Sci 2006;21(1-2):43–7.
8. Pellegrino R, Viegi G, Brusasco V, Crapo RO, Burgos F, Casaburi R, *et al*. Interpretative strategies for lung function tests. Eur Respir J 2005;26:948–68.
9. Cotes JE, Chinn DJ, Reed JW. Body mass, fat percentage, and fat free mass as reference variable for lung function: Effects on terms for age and sex. Thorax 2001;56:839–44.
10. Dikshit MB, Raje S, Agrawal MJ. Lung functions with spirometry: an Indian perspective–II: on the Vital capacity of Indians. Indian J Physiol Pharmacol 2005;49(3):257–70.
11. Virani N, Shah B, Celly A. Pulmonary function studies in healthy non-smoking adults in Sri Aurobindo Ashram, Pondicherry. Indian J Med Res 2001;114:177–84.
12. Memon MA, Sandila MP, Ahmed ST. Pulmonary function test in a cohort of older Pakistani population. Pak J Physiol 2006;2(1):34–7.
13. Heydarpour F, Mousavinasab SN, Nahidi AR, Alipour M, Rostami A, Heydarpour P. The effect of long-term exposure to particulate pollution on the lung function of Teheranian and Zanjanian students. Pak J Physiol 2007;3(2)4–8.
14. Miller MR, Hankinson J, Brusasco V, Burgos F, Casaburi R, Coates A, *et al*. Standardisation of spirometry. Eur Respir J 2005;26(2):319–38.
15. Chhabra SK. Regional variations in vital capacity in adult males in India: comparison of regression equations from four regions and impact on interpretation of spirometric data. Indian J Chest Dis Allied Sci 2009;51(1):7–13.
16. Pinaki Chatterjee, Paulomi Das, Parimal Debnath, K. Alok Banerjee**.** A comparative study of vital capacity of Indian and Nepalese young female. Journal of Physical Education and Sports Management 2010;1(2):25–7.

Address for Correspondence:

Professor Farida Munawar, 191-T, Phase II, Defence Housing Authority, Lahore, Pakistan. **Cell:** +92-300-4204470
Email: faridamunawar2004@yahoo.com