Original Article

A prediction equation for the estimation of vital capacity in nepalese young females

PINAKI CHATTERJEE[1], ALOK K. BANERJEE[2], PAULOMI DAS[3]

[1]*Sudha Rustagi College of Dental Sciences and Research, Faridabad, India*
[2]*University of Kalyani, West Bengal, India*
[3]*Department of Physiology, Nepalgunj Medical College, Nepal*

ABSTRACT

Chatterjee P, Banerjee AK, Das P. A prediction equation for the estimation of vital capacity in nepalese young females. *J. Hum. Sport Exerc.* Vol. 6, No. 1, pp. 27-32, 2011. Till date no effort has been made to evaluate vital capacity of children and young adults in Nepal. At present it is difficult to achieve accuracy in clinical diagnosis because of the lack of a unified standard of the normal reference value in young women's Vital capacity in Nepal. So, the present study was carried out to evaluate Vital capacity of healthy Nepalese young females, to formulate a prediction equation and to validate the applicability of the equation. One hundred and three young, non-smokers, female students of 17 to 22 years of age were recruited for this study. A stepwise, multiple, linear, regression equation was performed to derive a prediction equation. Validity of the prediction equation was studied using Bland and Altman method of approach for limits of agreement. The mean Vital capacity of Nepalese girls was 2648.05±378.26 ml. The difference between the mean (± standard deviation) vital capacity values of direct measurement and the predicted vital capacity (PVC=2647.12±319.92) was statistically insignificant. Analysis of data by Bland and Altman method of approach for limits of agreement reveals that the prediction equation may be used confidently in place of direct procedure. The regression equation based on height for the studied population is calculated as: Vital Capacity (ml)= 55.68×Height(cm)–6084.15. **Key words**: VITAL CAPACITY, SPIROMETRY, NEPALESE FEMALE, REGRESSION EQUATION.

Corresponding author. University of Kalyani, West Bengal, India.
E-mail: drpinakichattopadhyay@gmail.com
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INTRODUCTION

Spirometric prediction equations are widely accepted in the clinical assessment of spirometry results. Pulmonary function testing measures the function of lung capacity and lung and chest wall mechanics to determine whether or not the patient has a lung problem. However, the required instruments are relatively expensive. Vital capacity is an important index in pulmonary function. At present it is difficult to achieve accuracy in clinical diagnosis because of the lack of a unified standard of the normal reference value in younger women's Vital capacity in Nepal.

Many studies on Vital capacity in the general population have been carried out previously in India (Chhabra, 2009) and abroad (Singh et al., 1993; González-Camarena et al., 1993). No such study on normal Nepalese children and young adults was found. It is difficult to establish a national vital capacity norm in a country for healthy men and women as lung function varies with socio-economic (Raju et al., 2005), geographical, environmental (Virani et al., 2001) and nutritional conditions (Zverev & Gondwe, 2001). Previous studies have reported important racial difference in measurements of vital capacity so that prediction equations developed in one population may not be appropriate to be used for another population (Barcala et al., 2008).

The main independent variables used for spirometric prediction equations are anthropometric measurements such as height, body surface area (BSA), weight. Other anthropometric measurements like sitting heights, sum of skin-fold thickness or measures of muscle strength by dynamometer are also in practice.

In the present study an attempt has been made to evaluate Vital capacity of healthy Nepalese young females, to formulate a prediction equation and to validate the applicability of the equation.

MATERIAL AND METHODS

Subjects

The present study is a cross-sectional study carried out on 103 non-smoking, healthy female students of 17 to 22 years of age studying at the Nepalgunj Medical College in Chisapani, Banke, Nepal. Students of basic sciences (1st to 4th semester) during the year 2007 to 2009 participated in the present study. All the subjects were Nepalese by birth and brought up in Nepal. The subjects were delimited to different regions of Nepal. A detailed medical history of the subjects was taken and clinical examination was carried out by physician to exclude any disease, mainly respiratory diseases. A verbal consent of all the subjects were taken and they were explained the experimental procedure. An ethical approval to conduct the study was taken from the competent authority.

Physical Measurements

The age in completed year, standing height in cm was measured with shoes removed, feet together and head in the Frankfort horizontal plane. Weight in kg was measured with shoes and Jackets removed. Body surface area (BSA) was calculated by Du-Bois and Du-Bois Formula (Du-Bois and Du-Bois, 1916).

$$BSA\ (m^2) = (\text{Body mass in kg})^{0.425} \times (\text{Body Height in cm})^{0.725} \times .007184$$

Determination of Vital capacity

Vital capacity was measured in the standing position with simple spirometer. The subject was asked to stand comfortably, facing the spirometer so that the subject can see the movement of the bell. The subject is asked to inspire as deeply and as fully as possible to fill the lungs. Then while keeping the nostrils closed with a nose clip and the mouthpiece held firmly between the lips, the subject is asked to expel all the air that she can with maximum effort into the spirometer. The forced expiration should be deep and quick but without haste. Three satisfactory readings were taken at intervals of five minutes and the highest among the three was accepted (Ghai, 2007).

Statistical Analysis

Statistical package for the social science (SPSS) version 11.5 was used for analysis. The results are expressed as Mean ± Standard deviation. Paired t-test, Pearson's product moment correlation, linear regression statistics and Bland and Altman approach for limit of agreement were adopted for statistical analysis of the data. A stepwise, multiple, linear, regression equation were performed to formulate the prediction equation for Vital capacity from age and anthropometric data.

RESULTS

Means and standard deviations of physical characteristics, Vital Capacity and predicted Vital Capacity using the prediction equation of the participants are presented in the table 1.

Table 1. *Physical parameters, predicted and measured vital capacity of the subjects (n=103).*

Parameters	Minimum	Maximum	Mean	Standard Deviation
Age (yr)	17.00	22.00	19.19	0.97
Height (cm)	145.00	171.00	156.81	5.74
Weight (kg)	40.00	76.00	52.52	6.87
BSA (m^2)	1.31	1.76	1.51	0.10
Vital Capacity (ml)	2200.00	3700.00	2648.06	378.26
Predicted Vital Capacity (ml)	1989.45	3437.13	2647.12	319.92

BSA= Body surface area

Stepwise, multiple, linear, regression analysis shows that height is the best predictor for vital capacity (Figure 1). In this present study, highly significant correlation ($r = 0.89$, $p < 0.01$) existed between the height of the subjects and Vital Capacity. The following equation, derived on the basis of present data may be used to predict Vital Capacity in young Nepalese females.

$$VC = 55.68 \times H - 6084.15$$

Where
VC= Vital Capacity in ml,
H = Height in cm.

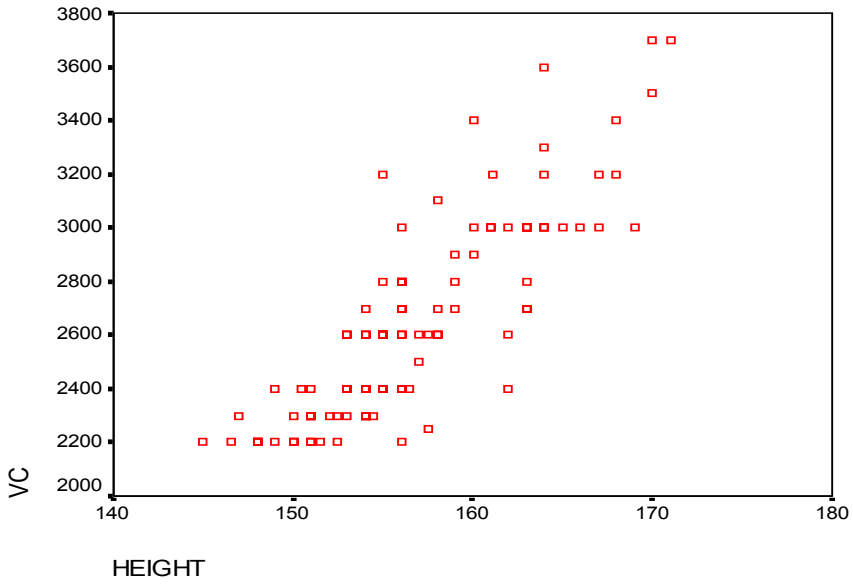

Figure 1. *Linear regression analysis depicting the prediction of Vital capacity (VC) from height of the Nepalese females.*

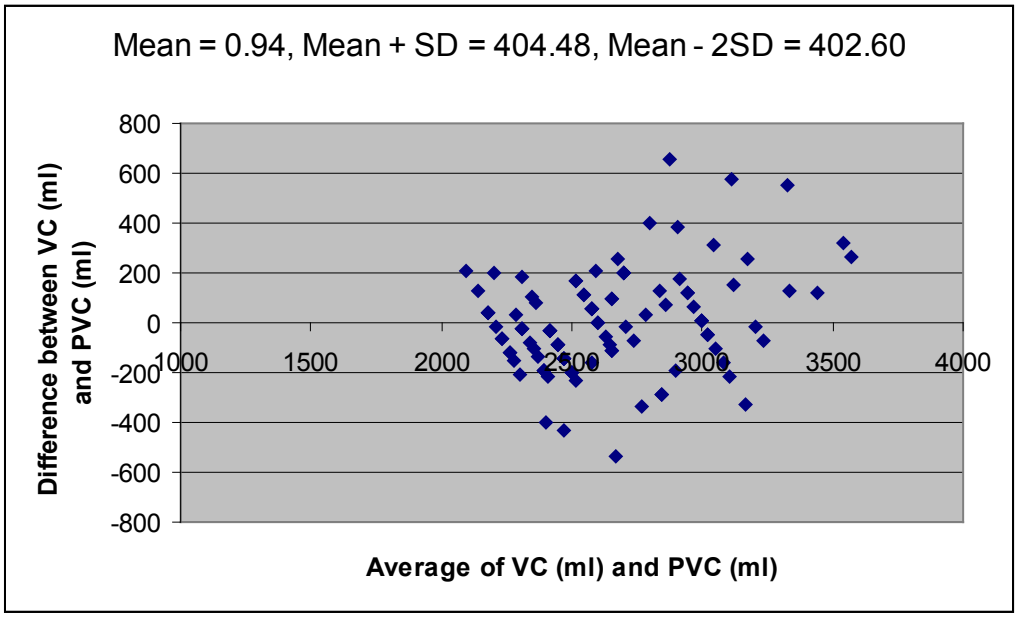

Figure 2. *Plotting of difference between Vital Capacity values against their means (Bland and Altman method).*

The mean value (± SD) of the Vital Capacity determined by direct method and the predicted Vital Capacity using this newly derived equation show no significant variation (P>0.10). The mean difference between Vital Capacity and predicted Vital Capacity was 0.94 ml with 95% confidence interval -38.49 to 40.37 ml indicating that the equation predicts the Vital Capacity within a range of -38.49 to 40.37 ml.

DISCUSSION

Various workers have studied the vital capacity values in healthy individuals. There is no such work performed primarily to measure Vital capacity of Nepalese females. Therefore, it has been tried to formulate the prediction equation by different physical parameters of Nepalese females by stepwise multiple linear regression analysis. It was found that height was the best predictor to measure Vital capacity. This finding is in agreed with Indian studies where height was the best predictor to formulate Vital capacity (Raju et al., 2004; Virani et al., 2001).

No significant difference is observed (p>0.10) between the values of Vital Capacity measured by direct method and predicted by newly derived equation.

Analysis of data by Bland and Altman method (Bland & Altman, 1986) of approach for limits of agreement between Vital Capacity and predicted Vital Capacity reveals that limits of agreement are 404.48 and -402.60 (Figure 2). These are small enough parameter for the predicted equation to be used confidently in place of direct procedure. Limits of agreement analysis suggest that application of the present form of the prediction equation from height may be justified for the studied population.

CONCLUSION

Therefore, from the present observations it is concluded that the newly derived equation based on the present data as a valid method to evaluate Vital Capacity within young Nepalese females. However, as this is a pioneer attempt in this population; we recommend the validity of the newly derived equation may be studied in other group of subjects of the same population. From the present study, it may also be concluded that height is the best predictor for the measurement of Vital capacity within the population studied.

Key Messages

* The equation developed on the basis of present data is recommended to be used for the assessment of vital capacity in Nepalese females (17~22 years age).

* This is particularly most useful method when a large number of subjects are to be evaluated without the help of a well-equipped laboratory, in less expense and within a short period of time.

* The prediction equation for the estimation of vital capacity of different populations of Nepal may be derived and the same can be used to obtain a reference norm of vital capacity which would be helpful in clinical diagnosis.

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