International Journal of Biomedical Research
ISSN: 0976-9633 (Online); 2455-0566 (Print)
Journal DOI: 10.7439/ijbr
CODEN: IJBRFA **Original Research Article**

Arm span is a good predictor for Forced Vital Capacity (FVC) and Forced Expiratory volume (FEV1) in healthy children aged 8 to 12 years

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Abstract

Spirometry is the method of choice for evaluation of pulmonary function tests in adults and in children as well. Some dynamic pulmonary functions like forced vital capacity (FVC) and forced expiratory volume at the end of one second (FEV1) are the most common parameters for the assessment of restrictive and obstructive lung diseases. The FVC and FEV1 were measured in 400 normal healthy children in the age group of 8 to 12 years of Lucknow city. It was observed that there was a parallel progressive increase in the magnitude of arm span, a physical growth parameter and pulmonary functions like forced vital capacity (FVC) and forced expiratory volume at the end of one second (FEV1) per year increase in the age. A highly significant positive correlation existed between arm span and pulmonary functions. To predict FVC & FEV1 from arm span multiple and partial "Bivariate" prediction equations were calculated.

Keywords: Dynamic pulmonary function tests, FVC, FEV1, Arm span.

1. Introduction

Environmental pollution, passive smoking, restricted outdoor activities in the form of games and sports is reflected in the health of children in the present day living. In children, the respiratory tract is probably more often affected by disease than any other system of the body. The prevalence of childhood pulmonary diseases especially bronchial asthma is increasing worldwide [1-3]. This necessitates the need for establishing regression equations for predicting pulmonary functions in children. Spirometry is the method of choice for evaluation of pulmonary function test [4]. A number of studies of lung functions have been conducted in the adults [5-7] but there are very few studies that have established reference standards for pulmonary functions in Indian children[1,8]. Pulmonary function is known to vary with age, height, weight, arm span, sex and geographic locations [9,10]. India being a subcontinent change in the pulmonary functions can occur between different regions [8,11,12]. Therefore the aim of this study was to derive accurate prediction equations to predict FVC and FEV1 from arm span.

2. Material and methods

In this study FVC and FEV1, were measured in 400 normal healthy school going children in the age group of 8-12 years of Lucknow city. The children were excluded from the study that had sign/symptoms of;

- Structural deformity of thoracic cage like: Scoliosis, Kyphosis, Kypho-Scoliosis, Pigeons chest
- Major medical illness or deformity
- Evidence of grossly enlarged tonsils and adenoids.
- Acute upper and lower respiratory tract infection within seven days of the study.
- Chronic respiratory diseases like –Chronic bronchitis ,Bronchial asthma
- Allergic diseases.
- Any known cardiac disease
- Anemia
- Those having family history of Asthma in first degree relatives

Age was recorded in years. Arm span was measured in centimeters (cm) with upper extremities spread out laterally, as distance between tips of middle finger of one hand to another. The machine used for doing the pulmonary function tests was Spirolab - II a computerized Spirometer. Tests were performed in sitting position in the morning. Multiple and partial "Bivariate" prediction equations were obtained to predict FVC & FEV1, from arm span using the formula Y= a+bx.

3. Results

Table I Shows the mean values of arm span, FVC and FEV1, with standard deviation (SD), Table II shows the statistical analysis between arm span and pulmonary functions. Table III represents the coefficient of correlation between arm span and pulmonary functions.

Table I: Mean values of arm span, FVC & FEV1

Group	No. of Children	Age years	Arm Span (cms.)	FVC (L)	FEV1 (L)
I	100	8-9	120.96±5.04	1.29±0.21	1.11±0.17
II	100	9-10	128.00±5.01	1.39±.20	1.20±0.18
III	100	10-11	133.90±5.81	1.81±0.27	1.42±0.44
IV	100	11-12	142.46±7.50	2.01±0.29	1.70±0.41

Table II: Statistical analysis

Group	FVC	FEV1	Arm span
I vs II	HS	HS	HS
II vs III	HS	HS	HS
III vs IV	HS	HS	HS

HS- highly Significant (P<0.01)

Table III: Coefficient correlation (r) between arm span and pulmonary functions.

Spirometric Functions	Correlation coefficient with arm span
FVC	0.851*
FEV1	0.869*

*P<0.01; FVC= forced vital capacity; FEV1 = forced expiratory volume at the end of one second

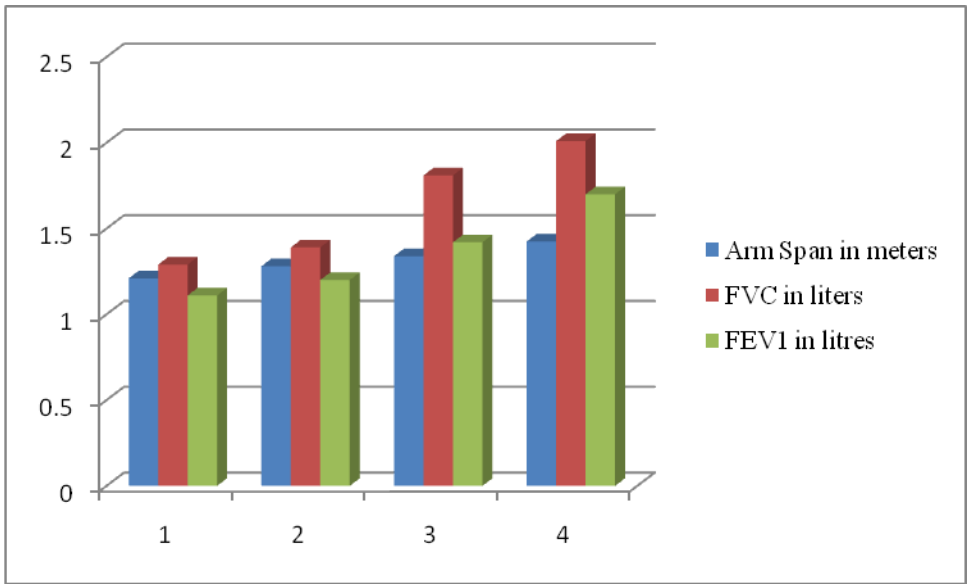

Figure 1: Association of FVC and FEV1 with arm span; at x axis 1=8-9; 2=9-10; 3= 10-11; 4= 11-12 years

4. Discussion

It was observed in the present study that there was gradual, parallel, progressive significant increase in the magnitude of arm span, FVC & FEV1 per year increase in children from 8 to 12 years of age. In the present study there was an increase in arm span in children as the age advanced. Our observation that there was a linear relationship between the spirometric functions and physical characteristics like arm span were similar to the studies reported earlier [1, 8, and 13]. The spirometric values increased with increase in age and arm span. The results of analysis of variance showed that FVC & FEV1 were significantly associated with arm span of children (p <0.01). These observation were similar to the studies reported earlier [1,8,13-15]. In the present study the

correlation between arm span and lung function test parameters (FVC & FEV1) were calculated. Highly significant positive correlation was observed between arm span and pulmonary functions. These observations were similar to the previous studies [13-15]. Multiple and partial "Bivariate" prediction equations were obtained to predict FVC & FEV1 from arm span. The equations are: FVC (L) = -2.188 + 0.029 x arm span (cm) FEV1 (L) = - 2.086 + 0.026 x arm span (cm)

Our values are in close agreement with the values of Chowgele *et al* [8], Shamssain[15], Singh [16] and vohra *et al*[12]. The values reported by Jain *et al* [17] and Bhattacharya *et al* [18] were lower than the present study. However our values are lower than the values reported by Morton *et al* [19], Rosenthal M *et al* [20] and some other workers [21-23]. The differences in values may be due to difference in physical parameter, physical activity, environmental condition, ethnic variation, socioeconomic status etc.[24-26].

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