International Journal of Medical Research & Health Sciences

www.ijmrhs.com Volume 2 Issue 1 Jan-Mar 2013 Coden: IJMRHS Copyright @2013 ISSN:2319-5886

Received: 20th Oct 2012 Revised: 19th Nov 2012 Accepted: 23rd Nov 2012

Original research article

COMPARISION OF PEAK EXPIRATORY FLOW RATE AND TOTAL BODY FAT AMONG THE SOUTH INDIAN CHILDREN AGED AROUND 6 TO 10 YEARS.

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ABSTRACT

Background: Many studies have proven the relation between the nutritional habit and respiratory functions in south Indian children. The increase in respiratory problems due to increase in Total Body Fat (TBF) in children has been a major worldwide problem. Deposition of fat over the chest wall alters the Peak Expiratory Flow Rate (PEFR) among pulmonary function test parameters. Among all the pulmonary function test parameters Peak expiratory flow rate (PEFR) directly indicates the nutritional status which is also an easy and non invasive method for estimating the lung function in children. **Aim:** To assess the effect of Total Body Fat (TBF) on PEFR in children aged 6 to 10 years of both the sexes. **Methods:** We recruited 258 children aged 6 to 10 years of both sexes for our study. The anthropometric parameters including height, weight, BMI and TBF were measured. PEFR was measured using the Peak Expiratory Flow Meter. The skin fold thickness was measured by using Digital skin fold caliper. The results were statistically analyzed by using Pearson Correlation coefficient test and ANOVA. **Results:** In our study as age progresses the height of the children in both sexes also increases. Our results showed positive correlation between height, BMI, SFT and TBF with PEFR. **Conclusion:** We concluded that among the factors determine the nutritional status including BMI and SFT effect of TBF on PEFR play an important role in the maintenance of normal pulmonary functions in children. Thus our study proved that the reason for the respiratory problem may be due to abnormal TBF.

Keywords: Peak expiratory flow rate, Body mass index, Skin fold thickness, Total Body Fat.

INTRODUCTION

There has been a worldwide increase in obesity among people of all ages. As many as 250 million people, or about 7% of the current world population, is obese. Two to three times more people are overweight.[1] According to the World Health Organization, the number of overweight and obese people worldwide will increase to 1.5 billion by 2015 if current trends continue. Clearly, overweight and obesity place a large public health burden on society.[2]

Childhood obesity is now an emerging worldwide health problem. The children as well the parents not having good knowledge about the obesity awareness is also the reason for it. In India the percentage of obesity increases due to physical inactivity and westernization in the diet.

Overweight and obese children are at increased risk of a range of medical conditions affecting cardiovascular health (hypercholesterolemia, dyslipidemia, hypertension), the endocrine system (hyperinsulinism, insulin resistance, impaired glucose tolerance, type 2 diabetes mellitus, menstrual irregularity), the pulmonary system, the musculoskeletal system, and mental health (depression, low self-esteem, distorted body image, eating disorders). In addition, obese children are at high risk for adult obesity.[3]

Obesity is now recognized as an important risk factor in the development of several respiratory diseases. Of these respiratory diseases, it has already been well established that obesity can lead to obstructive sleep apnea (OSA) and obesity hypoventilation syndrome (OHS). More recent data suggest that the prevalence of wheezing and bronchial hyper-responsiveness, two symptoms often associated with asthma, are increased in overweight and obese individual. Indeed, epidemiological studies have reported that obesity is a risk factor for the development of asthma.[4]

Obesity is capable of reducing pulmonary compliance, lung volumes, and the diameter of peripheral respiratory airways as well as affecting the volume of blood in the lungs and the ventilation-perfusion relationship. Furthermore, the increase in the normal functioning of adipose tissue in obese subjects leads to a systemic pro inflammatory state, which produces a rise in the serum concentrations of several cytokines, the soluble fractions of their receptors, and chemokines.

Excess body weight as in an obese or overweight person is normally due to accumulation of extra body fat.[5] However, it could also be due to other causes and can show variations in regional distribution.[6] Weight and body mass index (BMI) as measures of overall adiposity are used as predictors of pulmonary function in many epidemiological studies.[7-9] Abdominal or upper body obesity may influence pulmonary function mechanically25 by changes in compliance, work of breathing and the elastic recoil.[10-11]

MATERIALS AND METHODS

Study Population

For this study, we recruited the children of age group 6 to 10 years of both sexes from the relatives of patients attended the outpatient Department of Pediatrics, Sree Balaji Medical College and Hospital, from the primary schools in and around the Sree Balaji Medical College and Hospital. We recruited a total number of 258 children of age group 6-10 year, in those 156 (60.5%) boys and 102 (39.5%) girls. This study was approved by the institutional ethical committee. Informed consent was obtained from the parents of children who was participating in this study. The procedure to be performed was explained in detail in the local language to each child and their parents.

Exclusion Criteria

1. Bronchial Asthma.
2. Acute or Chronic Respiratory Tract Infection (inclusion at least 3 months before testing).
3. Acute or Chronic Cardiac disease.
4. Any Systemic illness.
5. Structural deformity of the thoracic cage.

Methods

All tests were carried out in the morning after breakfast. For each child detailed history and physical examination was done. The Anthropometric parameters like height in centimeters, weight in kilograms were measured. These parameters were used to calculate BSA and BMI. Body mass index (BMI) was calculated using this formula. BMI = weight in kg / height in m^2.[12] Body surface area (BSA) was calculated using this formula. BSA = weight (kg) ^0.425 × height (cm) ^ 0.725 × 71.84 / 10000.[13] Total body fat (TBF)

was calculated using this formula. Total body fat (TBF) = weight (kg) × ((((sum of skin fold – 40)/20 × BSA (m^2) × 0.739) / weight (kg)) – 0.003).[14]

Peak Expiratory Flow Rate (PEFR)

The Predicted PEFR values for children in this age group 6 to 10 years was calculated by using this formula. Predicted value = constant + standing height in cm × height coefficient + weight in kg × weight coefficient. [15] Peak expiratory flow rate was recorded by using a peak expiratory flow meter. Before recording the procedure was demonstrated to each child. The subjects were asked to take a deep inspiration until he/she breathed in total lung capacity. Immediately he/she should wrap the mouth tightly around a mouth piece, and asked to breathe out to the maximum effort. The subjects were encouraged to put maximum effort while doing this maneuver. Three such readings were obtained from each child. The highest values obtained were taken as Peak Expiratory Flow Rate (PEFR).

Skin Fold thickness

An efficient and practical way to measure body fat is by measuring skin fold. Skin fold thickness of children was measured by using Digital Skin fold Caliper. The measurements were taken at six sites of the body including biceps, triceps, subscapular, suprailiac, knee and calf. These values were entered in the tabular column of both boys and girls of different ages.

Statistical Analysis

The entire data were tabulated and the values were expressed in mean ± standard deviation. The correlation between PEFR (Measured) and BMI of boys and girls were analyzed by using Pearson Correlation analysis, similarly ANOVA was used to compare within the groups.

Table: 1. Physical characteristic, Anthropometric, Peak Expiratory Flow Rate (PEFR) of Boys.*

Age	No	Height (cm)	Weight (Kg)	BMI(kg/m^2)	BSA(m^2)	PEFR(Measured)	PEFR(Predicted)
6	38	112.19 ± 6.6	17.17± 3.8	13.22± 1.9	0.71 ± 0.09	132.11 ± 26.7	101.65 ± 8.45
7	29	117.54 ± 5.4	20.88± 5.7	14.54± 3.0	0.80 ± 0.12	160.69 ± 34.5	160.69 ± 34.53
8	39	125.36 ± 8.1	24.05± 7.4	14.84± 1.8	0.90± 0.14	172.05 ± 37.1	118.53 ± 11.95
9	30	128.43 ± 4.4	25.30± 3.0	14.92± 1.8	0.93 ± 0.0	195.33 ± 37.0	121.11 ± 5.25
10	20	134.65 ± 5.5	30.15± 8.6	15.91± 4.1	1.02± 0.15	220 ± 30.44	128.54 ± 10.75

Table: 2. Physical characteristic, Anthropometric, Peak Expiratory Flow Rate (PEFR) of Girls.*

Age	No	Height (cm)	Weight (Kg)	BMI(kg/m^2)	BSA(m^2)	PEFR(Measured)	PEFR(Predicted)
6	27	110.39 ± 5.4	18.06± 4.9	14.27± 3.1	0.72 ± 0.1	109.26 ± 26.30	94.70 ± 7.39
7	11	120.54 ± 7.1	26.21± 8.6	16.14± 3.7	0.87 ± 0.1	170 ± 33.17	105.45 ± 12.24
8	26	126.54 ± 7.0	22.65± 6.7	16.98± 3.3	0.94 ± 0.1	138.46 ± 32.33	105.79 ± 9.95
9	22	129.68 ± 5.9	28.09± 6.3	18.67± 5.3	0.97 ± 0.1	183.64 ± 41.12	116.06 ± 9.16
10	16	135.75 ± 5.0	31.69± 7.2	16.35± 3.7	1.03 ± 0.1	191.25 ± 41.45	121.43 ± 8.06

Table: 3. Skin fold thickness and Total body fat in a study population of Boys & Girls*

Boys				Girls		
Age	No	Skin Fold Thickness (mm)	TBF(gms)	No	Skin Fold Thickness (mm)	TBF(gms)
6	38	31.18 ± 10.2	0.25± 0.26	27	38.12 ± 15.55	0.02 ± 0.4
7	29	36.89 ± 7.41	0.11 ± 0.2	11	47.24 ± 17.33	0.36 ± 0.75
8	39	49.77 ± 11.75	0.34 ± 0.47	26	46.87 ± 16.64	0.25 ± 0.66
9	30	58.39 ± 14.48	0.63 ± 0.53	22	81.85 ± 16.56	1.6 ± 0.77
10	20	72.13 ± 18.76	1.32 ± 0.89	16	89.03 ± 15.08	2.05 ± 0.81

*Data presented in Mean ± SD.

As shown in table-1&2 the height and weight of the children are found to be matched in both sexes in our results. Body mass index (BMI) of the boys at the age of 6, 7, 9, 10 were lower than the girls however BMI of the boys at the age of 9 was statistically significant than the girls. The Body surface area (BSA) in all the age group (6 to 10 years) remains the same in both the sex in our study group. The Peak expiratory flow rate (PEFR-Measured) of the boys at the age of 6, 8, 9, 10 were higher than the girls however PEFR of the boys at the age of 7 was not statistically significant than the girls. The Peak expiratory flow rate (Predicted) of the boys at the age of 6, 7, 8, 9, 10 were higher than the girls however PEFR of the boys at the age of 8, 9, 10 were not statistically significant.

As shown in table -3 Skin fold thickness (SFT) of the boys at the age of 6, 7, 9, 10 were lower than the girls however SFT of the boys at the age of 8 was not statistically significant. Total body fat (TBF) of the boys at the age of 6 was the same as the girls it is not statistically significant. TBF of the boys at the age of 7, 10 were lower than the girls it is statistically significant. TBF of the boys at the age 8, 9 higher than the girls it is statistically significant.

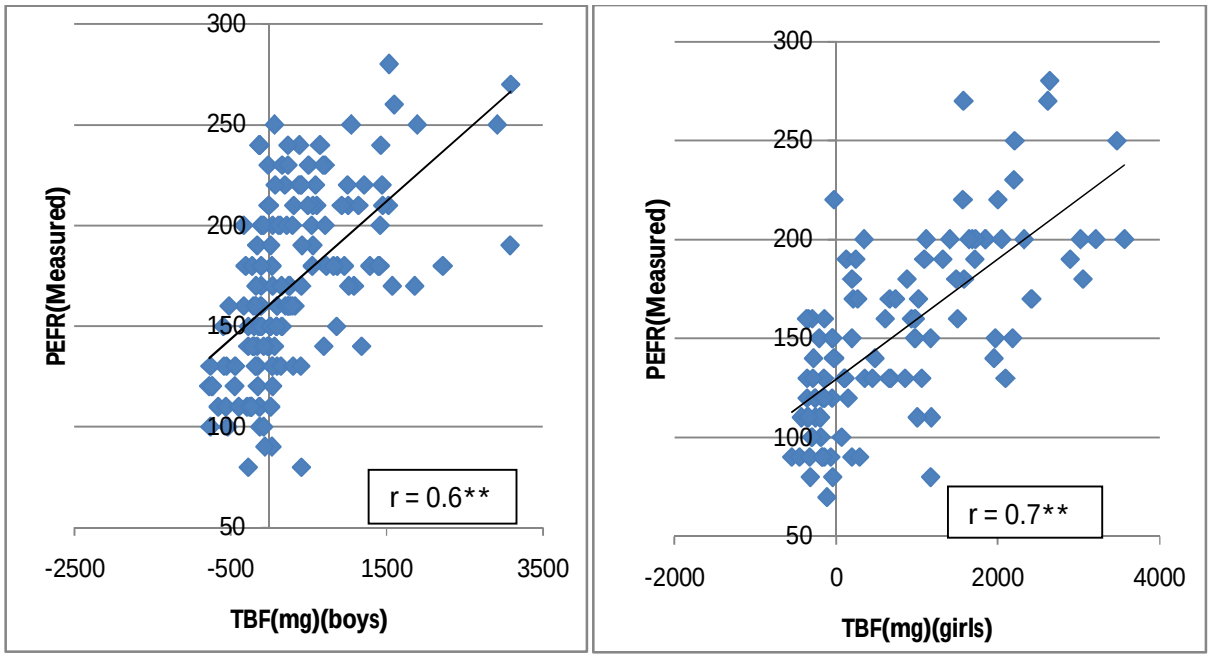

Fig: 1. Correlation between TBF and PEFR at the age of 6 - 10 yrs in both sexes.

The PEFR (Measured) and TBF at the age of 6 to10 in boys (r=0.6*) and girls (r=0.7*). PEFR and TBF were positively correlated which has statistically significant.

DISCUSSION

The height and weight consistently increased with the age of the children as revealed byVijayann et a .l[15] in south Indian children. But our study showed at the age of 6 to 10 years when compared to boys, height and weight of the girls significantly increased in their values. This may be due to gender differences in nutritional status in between boys and girls at the age of 6 to 10 years may influence this variation. However in contrast to our study many studies stated that nutritional status appeared to be gender neutral only in the South.[16] Furthermore it has been assumed that earlier puberty in girls was the reason for an increase in

weight and height of the girls when compared to the boys.

The results of analysis of variance provided evidence of significant (P< 0.000) interaction, thus indicating that BMI and BSA were not independent in their influence on their age and sex. [9] Our result showed an increase in BMI and BSA in both the sexes which was consistent with age. However the BMI and BSA of the boys showed lesser values than the girls. The reason may be due to differences in the distribution of fat and physical activity among the gender.

As shown in previous studies height being an important factor for determining the PEFR, height was significantly correlated with PEFR in our study in both sexes. The PEFR (Measured) values increased in linear relation to age and height at the age of 6 to 10 years. Our study also showed that height influences the prediction equation in males to a greater extent whereas weight and skin fold thickness had greater influence in girls. Wang et al[17], concluded that for the same height boys have greater lung function values than girls. Similar to our study Chowgule et al[18] measured PEFR in children age between 6 to10 years. The PEFR variables showed a linear positive correlation with height and age. Boys show higher values for lung function variables than girls. Height proved the maximum variations in PEFR. These results were similar to the findings of our study. As age, height, weight, BMI and BSA have all been used in studies either alone or in combination to predict PEFR.[19-22]

The present study reported that PEFR have shown significant correlations with BMI. Similar findings were reported by some authors.[23,24] The PEFR (Predicted) values as per the height of the children are lesser than the PEFR(Measured) values. This indicates that height determines the PEFR (Predicted) values but BMI and SFT also has an influence in PEFR (Measured) values. Height is indirectly proportionate with BMI and BSA. Children having lesser BMI and SFT, the PEFR (Measured) values were higher. In our study the boys had lesser values of BMI and SFT than the girls as the result of it the PEFR (Measured) values of the boys were higher than the girls.

Skin fold thickness (SFT) is also one of the parameter which influences the PEFR (Measured) values of the children. As shown in table 4 there was a steady increase in SFT in both sexes as age progresses from 6 to 10 years. SFT is inversely proportionate to the PEFR (Measured) values. The girls had higher SFT values than boys as a result the PEFR (Measured) values of the girls were lesser than the boys.

Total Body Fat (TBF) is one of the important parameter which influences the PEFR (Measured) values of the children aged 6 to 10 years. It was hypothesized that lung functions in the obese children would be lower; the extra fat would exert a mechanical effect on the movement of the chest or abdomen. Since more accumulation of fat reduces the muscle strength and there is a slight decrease effort in stretching of respiratory muscle. The reason for this is may be due decreased physical activity and exercise, traditional customs, modified sedentary lifestyle and increased intake of junk foods influence in deposition of more fat. Similarly significant difference was observed in previous studies, that adiposity has a significant positive correlation with PEFR.[14] In our study, as shown in table 4 there was a steady increase in TBF in both sexes of the children aged 6 to 10 years. The girls had higher TBF values than the boys as a result the PEFR values of the girls were lesser than the boys.

CONCLUSION

Our study proved the positive correlation between BMI, SFT and TBF with PEFR. So we concluded that excessive deposition of fat in children is associated with the decrease in PEFR values. With a better nutritional status of the children and good exercise, there will be better growth of skeletal muscle system of the thorax and lung tissue resulting in improved PEFR values. In order to ensure the health of the children it is essential to

advise the children to have regular exercise, swimming, yoga, meditation, folk dance etc. to maintain optimal weight of the upcoming generation.

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