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Original Research Article

# Respiratory compromise in overweight and obese children measured among school going children in Cuttack city, Odisha - A Community based cross sectional study

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DOI: <https://dx.doi.org/10.7439/ijbar.v8i4.4066>**Abstract**

To find out the correlation between Body mass Index and Peak Expiratory Flow Rate (PEFR) in overweight and obese school going children of Cuttack city. Total 480 children were studied which included 240 obese and overweight children and 240 normal age and height matched control group. PEFR was measured in all children using mini wright's peak expiratory flow meter. Statistical analysis was done using SPSS 16 and correlation co-efficient was calculated. PEFR was found to increase linearly with increasing BMI in all children. But PEFR in overweight and obese children was found to have negative linear correlation. In overweight children it was not statistically significant but in obese children with increasing BMI, PEFR was found to decrease and the correlation coefficient was statistically significant. PEFR is lower in obese and overweight children. There is increased predisposition to obstructive airway disease and childhood asthma in obese children. Hence weight management should be strongly encouraged in order to prevent respiratory morbidities in obese and overweight children.

**Keywords:** Peak expiratory flow rate, Body mass index, obesity, Lung function, Negative correlation

**1. Introduction**

The major epidemiologic transition in the 20<sup>th</sup> century was the shift from infectious to non infectious chronic diseases, cardiovascular ailments topping the list. The availability of abundant food and indulgence to sedentary life style has led to substantial state of surplus energy in recent times. At the beginning of the new millennium, a new threat has emerged-a marked increase in the prevalence of obesity with a parallel rise in the obesity associated health hazards among children, adolescents and young adults. A fat child is no longer pampered as an attractive one; rather the adverse consequences of childhood obesity are now dealt with a serious attitude [1,2].

Obesity can simply be defined as a condition of abnormal or excess body fat accumulation in adipose tissue to the extent that health may be impaired [1]. The

underlying defect is the undesirable positive energy balance and weight gain. Childhood obesity has now reached epidemic proportion. According to WHO (2000) at least 50% adults and 20% children in UK and USA were currently overweight. It does not seem to have spared the developing nations like India. Currently available school based data demonstrates an overweight and obesity range of 5.6% to 24% for the children and adolescents in India [3-5]. It is indeed an irony that the problem of 'plenty'- obesity is spreading over while still we are falling prey to under nutrition and infectious diseases. In this context the urban rural divide and upper vs. lower socio economic contrast is well documented.

Obesity is associated with significant health problems in the paediatric age group. It is also an important

risk factor for much of adult morbidity and mortality [6]. Importantly 50-80% of the obese children become obese adults and all the complications of the adult obesity become worse if the obesity begins in the childhood [7]. Until recently, the serious medical problems and consequences of overweight and obesity are superseded by cosmetic stigmatisation. But evidence is gathering that majority of overweight children have the indicators of organic diseases [8].

Many studies have been done regarding metabolic problems in children caused by obesity. But the problems those are remaining undetected in early stages and later on causing greater problem are the new challenges for physician. Respiratory complications associated with severe obesity have been consistently reported, including asthma and obstructive sleep apnea syndrome [3], but there is greater uncertainty about the association between lesser degrees of obesity and lung function.

Routine pulmonary function testing can detect some degree of airflow obstruction in obese children. Pulmonary function tests of various types are utilized clinically and epidemiologically to measure functional status of lungs and to assess their diseases [16]. Peak Expiratory Flow Rate (PEFR) is defined as the maximum airflow achieved during a forceful expiration after taking maximal inspiration [9]. It is measured in Litres/min. It has received general acceptance as a useful index of ventilator capacity. The PEFR measurement is a simple, reproducible and reliable way of judging the degree of airway obstruction in various obstructive pulmonary diseases, especially asthma; even in children.

Hence it was an endeavour to study the PEFR in overweight and Obese children in urban city like Cuttack and identify asymptomatic respiratory compromise in overweight and obese children and compare their PEFR value with normal children.

### 1.1 Objectives

#### Primary objective

To measure Peak expiratory flow rate (PEFR) in obese & overweight children and compare them with normal children.

#### Secondary objective:

To find out correlation of BMI with PEFR in Normal, Overweight and Obese children

## 2. Materials and Methods

This study was conducted in various sampled schools of Cuttack City (Odisha) during period from September 2012 to September 2013 (One Year) with a view to find out the prevalence of respiratory compromise as measured by PEFR, in Obese and Overweight school going

children students and to find out the correlation between BMI and PEFR.

Prevalence of obesity from other studies has been taken in school going age group i.e; 6-15 years as 6% . Sample size was calculated, taking level of significance ( $\alpha$ ) as 1.96, allowable error ( $\beta$ ) as 10% and confidence limit at 95%, as 239.04 (240). For comparison purpose another 240 normal students were selected after matching for Gender and Height. Hence the total sample size obtained was 480 (240+240).

Multi stage cluster sampling procedure was used. The schools were selected as clusters for this study purpose. Out of total 187 schools in Cuttack city 19 were taken by proportion probability to sample (PPS) size method. Obese, overweight students along with their controls in each school were taken by convenient sampling method. Predesigned and pretested questionnaire was used for data collection. Students were taken in this study after taking written consent of their parents or legal guardians during the survey period.

Standing height was measured by using portable Stadiometer. Weight was measured by portable weighing scale. BMI was calculated using the formula  $BMI = Wt(kg)/ht(m^2)$ . Children were classified as overweight and obese after plotting their BMI in CDC growth chart [10]. BMI between 85<sup>th</sup>- 95<sup>th</sup> percentile were classified as overweight and  $BMI \geq 95^{\text{th}}$  percentile were classified as obese. Peak expiratory flow rate was measured by using Mini Wright's Peak Flow meter. Before measuring PEFR test procedure was explained to students & demonstrated to them.

### 2.1 Inclusion criteria

Any obese and overweight students in the sampled schools were taken along with their control for gender and height. The procedure was being explained to them elaborately in local language and English. Consent form and questionnaire was filled by their parents or local guardian.

### 2.2 Exclusion criteria

Unwilling or refusal from students, Unable to obtain consent from their parents was excluded from the study. Children with known chronic disorders like bronchial asthma, cystic fibrosis, sickle cell disease, Thalassemia, Cardiac abnormality, Chronic obstructive pulmonary disease ( COPD) were excluded from the study.

Statistical procedures like Frequency distribution, Proportion, Independent-t test and Co-relation methods were used to draw significant conclusions. Probability value (P-Value) less than 0.05 was taken as significant. Excel and SPSS-16 was used for analysis purpose.

### 3. Results and Discussion

**Table 1: Demographic distribution of the study participants**

Age Group In Yrs	N=480		
	Normal (240)	Over weight (156)	Obese (84)
6-7	28	18	10
7-8	22	13	09
8-9	29	18	11
9-10	28	15	13
10-11	35	26	09
11-12	24	22	02
12-13	25	16	09
13-14	26	16	10
14-15	23	12	11

In total 156 overweight students and 84 obese students were included in the study with their controls. The highest number (26) of overweight students was found in the age group 10-11 and in obese category maximum (13) students were in the age group 9-10. In a study conducted in Delhi NCR among adolescent school going children obesity was found maximally in this age range [11]. In normal category the mean BMI was found to be 18.5 with Standard deviation 3.01, whereas in Overweight group the mean and standard deviation was 26.43 & 0.89 respectively. Obese students had mean BMI of 38.8 and Standard deviation of 2.8.

Peak expiratory flow rates were measured as per discussed methodology and the result is given below

**Table 2: Comparison of PEFR of the study participants in different category**

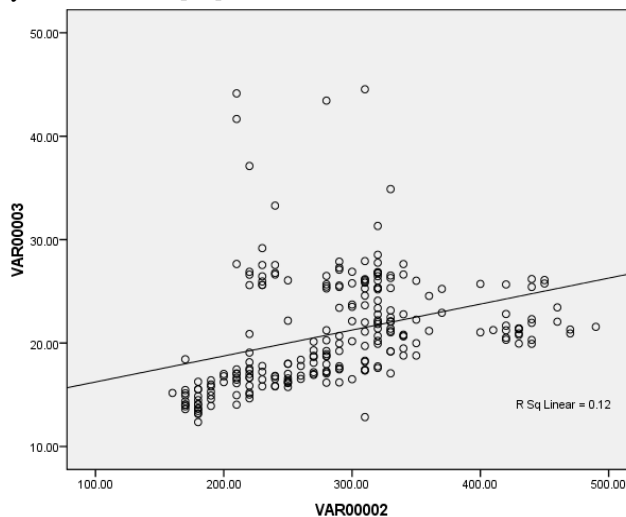
Category	Peak Expiratory Flow Rate (PEFR)					
	N	Mean	SD	SED	t-value	p-value
Normal	240	284.7	77.5	7.25	1.92	0.06
Over Weight	156	298.7	58.3	6.5	13.2	0.001
Obese	84	211.4	21.6	8.57	8.54	0.001

\*N=sample size, SD=Standard deviation and SED=Standard Error of Difference

The above table shows the Mean, Standard Deviation and Standard Error of Difference for Peak Expiratory Flow Rate obtained in 156 overweight, 84 obese and 240 normal students. As weight of student's increases from overweight to obese the mean of PEFR was found to be decreased from 298.7 to 211.4 in respective category. The different categories were compared by independent-t test and the calculated probability value is given in the above table. The comparison between normal and overweight category (t=1.92) was not statistically significant (p=0.06), however decrease in PEFR in overweight and obese category (t= 13.2) was statistically significant (p=0.001) at 95% confidence limit and appropriate degree of freedoms.

The finding of this study was similar to findings obtained from the study done by Farida *et al* in 2009[12];

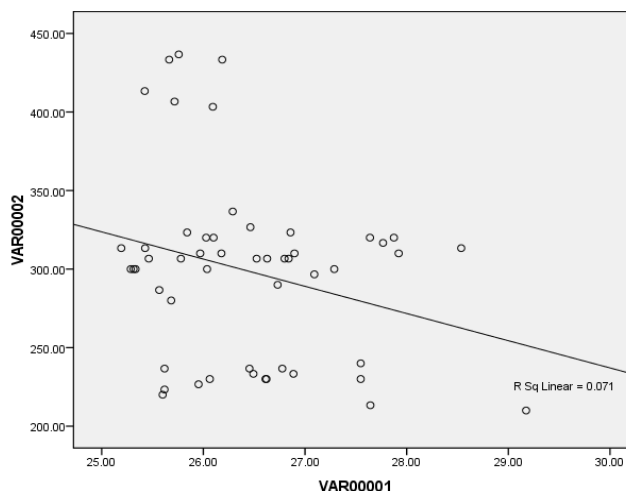
They found out that obese children have significant restrictive pulmonary defect, evident small airway obstruction, defect in respiratory musculature, weak effort & coordination with increased airway resistance. Hence PEFR is lower in obese children as compared to normal children. However pulmonary capacities and lung function test parameters increase with increasing height The increase in PEFR from normal to overweight category found in this study was in accordance with observations of research done by Tantisira *et al*[13].



\*VAR001-BMI, VAR002-PEFR in 480 study participants

**Figure 1: linear correlation between BMI & PEFR in all respondents**

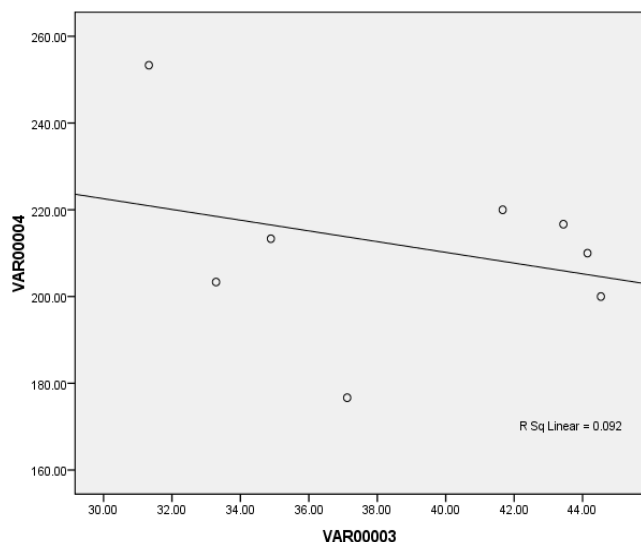
The above diagram describes the linear correlation between PEFR and BMI of all 480 study respondents. The Pearson coefficient was found to be 0.34 (Positive) at 1 df and 95% confidence limit. Hence BMI and PEFR was found to be positively correlated which was statistically significant (P<0.001).



\*VAR001-BMI, VAR002-PEFR In Over category in 156 study participants

**Figure 2: linear Negative correlation between BMI & PEFR in overweight category**

The Pearson's Correlation Coefficient was found to be -0.26 at one degree of freedom and 95% confidence limit. The probability value ( $p=0.05$ ) obtained was statistically significant. Hence as BMI was increased in overweight category the PEFR was found to be decreased or it can be told they inversely correlated to each other. This finding was similar to the results of study done by Joey C Eisimann *et al* on Navajavo & Hopi children [14].



\*VAR003-BMI, VAR004-PEFR in Obese in 84 study participants

**Figure 3: Linear Negative correlation between BMI & PEFR in obese category**

The Pearson correlation coefficient was found to be -0.3 at one degree of freedom and 95% confidence limit with probability value ( $p=0.006$ ), which was statistically significant. Hence BMI & PEFR inversely correlated with each other in obese category. As BMI was increased the PEFR will decreased in obese category. This finding is similar to the results of the study done by Gundogdu *et al* in Turkish children [15]. They have found that PEFR was lower in obese children.

#### 4. Summary

Comparison of PEFR in Normal, Overweight and Obese category shows that with advancing weight PEFR was also increasing up to a certain level then it decreases. The mean difference found in normal and overweight category was not found to be statistically significant where as between overweight and obese category the difference was found to be highly significant.

The correlation between BMI and PEFR was found to be linear and positive for total 480 students. However in overweight and obese category of students this correlation was found to be negatively related. Children having normal weight, BMI and PEFR bears linear correlation i.e. pulmonary capacity was better in children with normal

weight and BMI. In overweight and obese category there was negative correlation between BMI and PEFR which could be due to the mechanical effect of diaphragm on ventilatory function, increased propensity to hyper reactive airway disease as a consequence of chronic inflammatory state in obesity, and mechanical obstruction in large airways.

#### 5. Limitation of the study

- The PEFR being taken as a proxy indicator of lung function was an effort dependent procedure, which may not indicate the true lung function
- PEFR may get affected by exercise and short term illness
- Study conducted in urban students only, hence generalization to the whole population may be a problem

#### 6. Conclusion

Peak expiratory flow rate in children increases with increase in BMI in normal children. But in overweight and obese children PEFR is lower as compared to normal children with same height. This indicates compromised lung function in obese children in the form of obstructive airway disease. Hence in order to reduce the prevalence of childhood asthma and hyper reactive airway disease advice regarding weight reduction should be given and awareness should be spread among physicians and parents regarding the adverse effects of obesity on lung functions.

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