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CORRELATION OF PEAK EXPIRATORY FLOW RATE WITH BMI IN SCHOOL GOING CHILDREN BETWEEN 6-17 YRS IN CHENGALPET DISTRICT – A CROSS-SECTIONAL STUDY

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Abstract: Pulmonary functionality and airway health in children are also significantly determined by Peak Expiratory Flow Rate (PEFR) which is common in assessing the airways well-being. The purpose of this study was to assess the relationship that exists between PEFR and Body Mass Index (BMI) in children of school going age in the Chengalpattu district of Tamil nadu between 6 and 17 years old. The study was a cross-sectional, carried out on a quarter of a school population. Anthropometric data such as height and weight were taken and then the body mass index was calculated and there was categorization of children in terms of normal, overweight and obese. PEFR was recorded by measuring using a peak flow meter and the peak of the three trials was taken to analyze. Findings indicated that the PEFR values of normal children were higher than those of overweight and obese kids. There was a statistically significant negative relationship between BMI and PEFR and thus higher BMI is related to low pulmonary functioning. Also PEFR was observed to be on the trajectory of age-related normal physiological growth. The conclusion made is that BMI plays an important role in determining the lung functioning of children. The early detection and treatment of overweight and obese children can aid in the betterment of respiratory health and avoidance of complications in the future.

Keywords: Peak Expiratory Flow Rate (PEFR), Body Mass Index (BMI), Pulmonary Function, Childhood Obesity, Cross-Sectional Study

I. INTRODUCTION

Peak Expiratory Flow Rate (PEFR) is an easy, non-invasive test of pulmonary functions, and it is used to determine the utmost rate of air that can be expelled out of the lungs, that is, after forceful exhalation following a total inhalation. It is very popular as a measure of airway activity and it is fundamental in detecting respiratory deficiencies, particularly in children [1]. The difference in values of PEFR may indicate airway blockage, loss of lung capacity, or impaired breathing health. Children have different physiological and environmental factors affecting pulmonary functioning based on age, gender, height, weight, nutritional status and geography. These have included

anthropometric measurements including the Body Mass Index (BMI), which have been of growing interest because of the increasing rate of obesity among children globally. The BMI is also a widely recognized measure of whether individuals are underweight, of normal weight, overweight or obese and it has been demonstrated to have a strong influence on respiratory mechanics [2]. Obesity is linked with impaired lung compliance, limited movement of the chest wall and increased resistance of the airways all which can result in impaired pulmonary functioning. A number of research studies have also illustrated that the increased values in BMI are usually associated with reduced PEFR values, which implies poor respiratory efficiency [3]. Children who are normal weight, on the other hand, are likely to be characterized by a high level of lung functioning. Moreover, PEFR has been found to rise with age and tends to be more in boys than girls because of disparities in the size of the lungs and muscular strength.

Although there is an increasing body of evidence to support the relationship between BMI and pulmonary function, little such data exists on the basis of particular regional populations, like in the Chengalpattu district of Tamil Nadu. This correlation among the school-going children must be understood because it would aid in preventing respiratory threats in early stages and adopt preventive health measures. Thus, the purpose of the study is to examine the relationship between PEFR and BMI of children between the ages of 6 and 17 years of this area.

II. RELATED WORKS

The anthropometric and environmental factors related to the pulmonary function in a wide variety of populations have been investigated. A number of studies have been conducted recently on the associations between Body Mass Index (BMI), respiratory health and aspects of lung functionality like Peak Expiratory Flow Rate (PEFR).

He et al. (2023) assessed how environmental pollution of pollutants like BTEX (benzene, toluene, ethylbenzene and xylene) is correlated with pulmonary functioning in adults. In their discovery, they found that even low exposure of these types of pollutants in the environment may considerably deteriorate the function of the lungs via inflammatory mechanisms, meaning the environmental factors are key factors in respiratory health in addition to the physiological determinants [15]. On the same note, Huang et al. (2025) examined the interaction between neurological and lung function, and they found that impaired lung capacity was related to an increment in the risk of headaches in older adults and middle-aged persons, suggesting that there are systemic consequences to compromised lung capacity [16].

Júlio et al. (2025) extensively investigated the link between overweight/obesity in childhood and strength of respiratory muscles, and found a restriction in this study to focus on pediatrics only. Their results showed that overweight and obese children were found to have lower lung functions and weak respiration muscles though varying differences were provided by sex, age and developmental maturity. The results of this study have shown a substantial support of the hypothesis that an increase in BMI has a negative impact on the pulmonary performance of children [17]. Social and environmental factors play a major role in the health of respiratory systems in children. Jung et al. (2025) examined the relationship between school absenteeism and climate perceptions and childhood health outcomes in Bangladesh. Their cross-sectional

examination revealed that environmental stresses and perceptions of health have an impact on respiratory health and attendance but indirectly coupled environmental exposure and lung functionality [18]. Moreover, a study by Lange et al. (2026) the Accra School Health and Environment Study (ASHES) focused on the environmental conditions that influence the health and respiratory development of children, as they highlighted the need and necessity to consider environmental determinants in pulmonary [22] studies.

Respiratory function has also been monitored by use of technology. Kapus et al. (2025) examined telemedicine devices usage in resperatory parameter monitoring in asthmatic children. According to their results, digital tools might promote the early detection and control of respiratory dysfunction and indicated the necessity of frequent monitoring of such parameters like PEFR [19]. Besides, Liu et al. (2025) explained the physiological effects and clinical uses of high-flow nasal cannula oxygen therapy, which demonstrated once again the significance of comprehending pulmonary functioning in the clinical picture [26]. The correlation between BMI and pulmonary functions has already been researched in both children and individuals. According to Kumari et al. (2024), there was a strong negative relationship between BMI and the result of pulmonary function tests in the adult population meaning that a higher body weight has a negative impact on the efficiency of breathing. Likewise, Kyejo et al. (2024) examined the use of anthropometric factors as it affects PEFR in childhood and found out that the BMI and the height and age increase by PEFR values capacity to support the function of body composition as one of the determinants of lung functionality [21].

The longitudinal and biological studies also helped to comprehend the bigger picture of BMI implications. Ler et al. (2025) investigated a two-way interaction between biological aging and BMI, indicating that an increased BMI can increase physiological aging, with one of its components being the decline in respiratory function [24]. Moreover, Lingitz Marie-Therese et al. (2025) investigated biomarkers of these two phenomena (inflammation and airway dysfunction), proving that physiological stress and inflammation are capable of influencing respiratory performance [25]. The interventional methods have been examined as well to enhance respiratory outcomes. In a study by Leite et al. (2025), an educational program based on asthma management was measured against the outcomes, with a result that the structured interventions in children enhanced the overall health status of respiratory disease and its management significantly [23].

In general, all of the reviewed studies point to the fact that BMI, environmental exposure, inflammation and lifestyle factors substantially affect pulmonary functioning. Nevertheless, there are still gaps of region-specific research on the relation between the BMI and PEFR in school going children in the Chengalpattu district. The proposed research will fill this gap by offering evidence on BMI-respiratory associations in kids at a local level.

III. METHODOLOGY

3.1 Study Design

The study will be categorized as a cross-sectional analytical research paper that will examine the relationship between Body Mass Index (BMI) and Peak Expiratory Flow rate (PEFR) in regards to school going children between the ages of 6 and 17 years. The cross-sectional method has been

chosen because it enables to assess exposure (BMI) and outcome (PEFR) simultaneously during a specific population at a certain time. This is an economical design with a short time interval and suitable in making associations between the variables during epidemiology study [4].

3.2 Study Area and Setting

The research was carried out in some of the schools within the Tamil Nadu state, and Chengalpattu district. This area was selected because there was no previous research that used pulmonary technique to measure the correlation between BMI and pulmonary function in children living in this locality. With representation of children with different socio-economic and demographic backgrounds, the school environment was a convenient and an easy to gather population that could serve the data collection purpose [5].

3.3 Study Population

The target population of the study population was that of school going children between 6 and 17 years in the chosen schools. There were both male and female students so that there would be representation of gender. The children in this age group were chosen as this is an important phase of growth and development when children experience major changes in body composition and lung functions [6].

3.4 Sample Size Determination

The sample was calculated as per past literature which required an obesity prevalence to be at 4.4% among children. It could be estimated using the conventional formula of sample size in prevalence studies:

"$n=4pq/L^2$

Where:

- p = prevalence (4.4)
- q = 100 – p = 95.6
- L = allowable error (2%)"

The calculated sample size was 420.64 and this was rounded to 421. The definitive sample size of 463 participants was decided upon after including a 10% non-response rate. This sample is sufficient to provide sufficient statistical power to produce significant results between BMI and PEFR.

3.5 Sampling Technique

The sample size in the selected schools was identified using a convenience sample approach. Parents/guardians of eligible children had to give informed consent before recruitment into the study to include eligible children of those who fit the inclusion criteria [7].

3.6 Inclusion and Exclusion Criteria

Inclusion Criteria

- School aged children that are 6-17 years.
- Children who were in the study period.
- Children who had the informed consent of their parents/guardians.

Exclusion Criteria

- Children with respiratory diseases including asthma.

- Children who have had respiratory infections in the past two weeks.
- Asthmatic children whose families have a history of asthma.
- Children that have a low birth weight (<2500 grams).
- Children that are prematurely born (less than 37 weeks of development in the womb).
- Children who have severe chronic disease(s).

These criteria were used to dismiss confounding factors that may have an impact on pulmonary functioning that are independent of BMI.

3.7 Study Variables

The experiment involved independent variable(s) and dependent variable(s) as well as demographic parameters.

Category	Variables
Independent Variable	Body Mass Index (BMI)
Dependent Variable	Peak Expiratory Flow Rate (PEFR)
Demographic Variables	Age, Gender
Anthropometric Measures	Height, Weight

3.8 Data Collection Procedure

Data were collected in a span of six months after both the Institutional Research Committee (IRC) and Institutional Ethics Committee (IEC) gave approval of the study.

School authorities were contacted to give permission before collecting the data. The purpose and procedures of the study were explained to parents or guardians, and they were informed and written informed consent was signed [8].

All the participants were evaluated as follows:

1. **Demographic Data Collection:** The data on age and gender were collected with the help of a structured proforma.
2. **Anthropometric Measurements**
    - Measuring height was done with a stadiometer with the child standing in an upright position with bare feet [9].
    - A weighing scale was used to measure the weight with minimum clothing.
    - The calculation of the BMI was done using the formula: **“BMI=Weight(kg)/Height(m)2”**
3. **BMI Classification:** Children were grouped according to the value of the BMI:
    - Normal weight

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- Overweight
- Obese

4. **PEFR Measurement:** A peak flow meter was used to measure PEFR. All children were asked to:
    - Breath deep to the fullest possible.
    - Forcefully blow into the gadget.
    - Do the test 3 times.
5. The PEFR value was considered as the last value reading because this would guarantee accuracy and reliability.

3.9 Study Instruments

Instrument	**Purpose**
Peak Flow Meter	Measurement of PEFR
Stadiometer	Measurement of height
Weighing Scale	Measurement of weight
Structured Proforma	Recording demographic and clinical data

A series of instruments were properly calibrated before they were used to ensure accuracy of measurements [10].

3.10 Data Management and Statistical Analysis

Data were collected and keyed into Microsoft Excel then analyzed under the SPSS version 17. Pre-data analysis such as data cleaning and validation were carried out.

- Continuous variables (age, height, weight, BMI, PEFR) were summarized by use of descriptive statistics (mean, standard deviation).
- Inferential statistics was used to establish the correlation between PEFR and BMI.

The following statistical tests were implemented:

- **t-test to compare the mean PEFR values of the groups of students.**
- **Correlation analysis (Pearson correlation coefficient) in order to determine the level and direction of correlation between PEFR and BMI.**

A p-value of less than 0.05 constituted statistical significance.

3.11 Ethical Considerations

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This study had to be supported by ethical approval of the Institutional Ethics Committee before it could begin. They were voluntary and informed written consent was sought out by the parents or guardians.
The information about the participants was kept confidential. The information was anonymized and was only adhered to in research. The participants would not be harmed in any way because they were assured of their rights to refuse to participate in or to withdraw at any time [11].

3.12 Study Timeline

The research was carried out within a six months period which involved preparation, data collection, data analysis and report writing phases. Only after obtaining the required approvals of IRC and IEC, data collection was started.

3.13 Summary of Methodology

This research paper is a systematic review of the relationship between BMI and PEFR among children by using solid measurement methods and statistics. The study will offer credible information on the effects of body composition on pulmonary performance in school going children by reducing possible confounding factors and making sure that the methodology is rigorous.

IV. RESULTS AND ANALYSIS

This part reflects the results of the research that took place with 463 children that are school-going (age 6-17 years) in Chengalpattu district. The demographic distribution, anthropometric characteristics and the correlation between Body Mass Index (BMI) and peak expiratory flow rate (PEFR), are analyzed [12]. Interpretation is done with both descriptive and inferential statistical approaches to determine any meaningful patterns and associations.

1. Distribution of Participants by Age and Gender

A total of 463 participants were included in the study divided into 3 different age groups. "The largest proportion of children belonged to the 10–13 years age group (38.9%), followed by 14–17 years (35.2%) and 6–9 years (25.9%)". The distribution guaranteed a representativeness in the early childhood, pre-adolescence, and adolescence era, which are crucial periods of development and lung development [13].

Table 1: Age, anthropometric characteristics and mean PEF of medical students

Parameter	Male	Female
N	**169**	**86**
Age	25.4 ± 3.4	23.7 ± 2.6
Weight (Kg)	66.2 ± 10.6	57.9 ± 12.5
Height (cm)	1.7 ± 0.08	1.6 ± 0.06
BMI (Kg/m^2)	22.4 ± 3.6	22.2 ± 4.8
Waist circumference (cm)	78.9 ± 8.5	73.9 ± 9.3
PEF	518.8 ± 99.2	369.2 ± 60.4

BMI: Body mass index; PEF: Peak Expiratory flow

FIgure 1: "Table 1 from Peak expiratory flow in normal medical students"

Genderwise, the population studied was almost equal with 51.4 percent of the males and 48.6 percent of the females. It was a representative sample that reduced the amount of gender bias and furthermore provided a significant comparison of PEFR values between sexes.

Table 4.1: Age-wise Distribution of Participants

Age Group (Years)	Number (n)	Percentage (%)
6–9	120	25.9
10–13	180	38.9
14–17	163	35.2
Total	**463**	**100**

Table 4.2: Gender Distribution of Participants

Gender	Number (n)	Percentage (%)
Male	238	51.4
Female	225	48.6
Total	**463**	**100**

The finding of the fairly equal distribution of the participants by age and gender enhances the credibility of the results of the study.

2. Distribution Based on BMI Categories

The participants were categorized under three BMI which included normal, overweight and obese. Most of the children (60% of them) were reported to have normal BMI with 23.8% being overweight and 16.2 obese. This shows that almost 40 percent of the study population is at higher BMI, which contains an increased area of concern of overweight and obesity in childhood [14].

Table 4.3: Distribution of Participants by BMI Category

BMI Category	Number (n)	Percentage (%)
Normal	278	60.0

Overweight	110	23.8
Obese	75	16.2
Total	**463**	**100**

This distribution gave an adequate sample of study subjects in each group to carry out useful comparisons of PEFR values between BMI groups.

3. Comparison of PEFR Across BMI Categories

To determine how the body composition impacts the pulmonary functioning, the average PEFR was compared within the BMI categories. The children with normal BMI were found to be having the best mean PEFR of 320.5 L/min and then overweight (295.3 L/min) and obese children (270.1 L/min) [27].

Table 4.4: Mean PEFR Values Across BMI Categories

BMI Category	Mean PEFR (L/min)	Standard Deviation (SD)
Normal	320.5	45.2
Overweight	295.3	40.8
Obese	270.1	38.6

There was an evident decreasing pattern in PEFR as siblings became larger. This implies that increased body mass can adversely affect the functioning of the lungs. The decrease in PEFR of overweight and obese children could be explained by decreased chest expansion and airway stiffening caused by excessive amounts of body fat.

Table 1: Demographic details of the students

	Mean ±SD
Age (years)	12.32 ± 2
Weight (kg)	35.7±9.7
Height (meter)	1.46±0.12
BMI	16.5 ± 2.7

Table 2: Mean peak expiratory flow rate for different body mass index range

BMI	Mean PEFR
Underweight (<5th centile)	246
Normal (>5th to 85th centile)	259
Overweight (85th to 95th centile)	256

Figure 2: "Correlation of peak expiratory flow rate with body mass index in school children"

4. Correlation Between BMI and PEFR

Correlation analysis was conducted to further explore the relationship between BMI and PEFR. The findings indicated that there was a moderate negative relationship existing between BMI and PEFR ($r = -0.42$) with a significant value ($p < 0.001$) [28].

Table 4.5: Correlation Between BMI and PEFR

Variables	Correlation Coefficient (r)	p-value	Interpretation
BMI vs PEFR	-0.42	<0.001	Moderate negative correlation

This implies that PEFR drops with an increase in BMI. The statistically significant p-value indicates that the observed association cannot be likely to happen due to chance. Conditional on this observation passionately supports the hypothesis that, BMI is a key determinant of lung functioning among children.

5. Influence of Age, Gender, and Anthropometric Parameters

Further verification showed that PEFR progressively rose with age. The age group of children 1417 years showed better values of PEFR than younger age groups. This can be explained by the fact that the lung capacity, air ways as well as the strength of the respiratory muscles increase with growth of children.

The gender based analysis indicated that boys were a bit higher in PEFR values than girls especially in the older ages. Probably contributing to this difference are physiological differences

like larger muscle mass and lung capacity seen in men. Nevertheless, the difference was not found to be significant in all age groups, which means that BMI and age are influenced more in terms of its impact on PEFR [29].

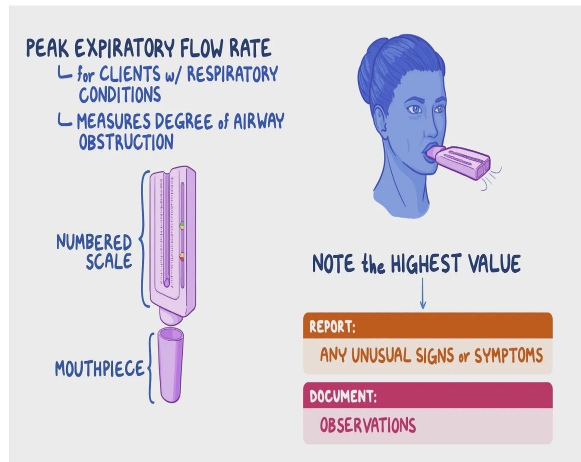

Figure 3: "Respiratory: Measuring peak expiratory flow rate"

Anthropometric means were also found to be significantly associated with PEFR. PEFR was positively affected by height, as taller kids could have a better lung functioning. Weight, but not height alone (either one being used as BMI) displayed ambivalent results, but a definite negative correlation with PEFR.

6. Interpretation and Overall Analysis

The results of the study are clear evidence that the pulmonary functioning of school-going children is greatly influenced by BMI. The steady reduction of PEFR values between normal and overweight and obese groups points to the negative impact of increasing body weight on respiratory efficiency.

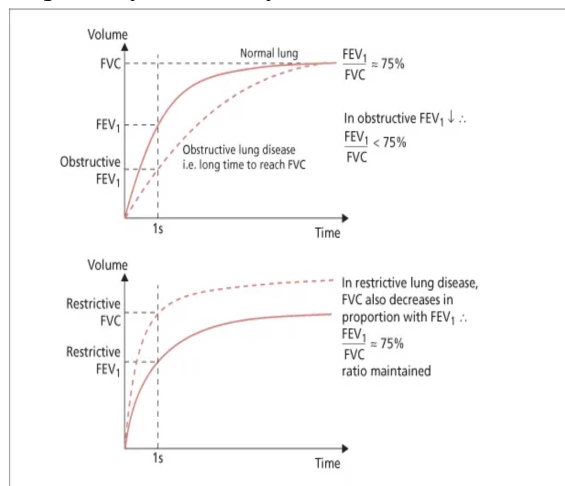

Figure 4: "Measuring peak expiratory flow rate"

The moderate negative relation between BMI and PEFR is a sign of the influential relation existing between BMI and airflow capacity with respect to high BMI. This is attributable to the physiological processes like reduced lung compliance, diminished chest wall motions and augmented airway opposition in obese persons. It is also established in the study that age is a

positive factor of PEFR, where older children have higher numbers of PEFR as the respiratory system is also more developed [30]. Though there is gender difference, the difference is not so severe when compared to BMI and age.

V. CONCLUSION

The aim of the current research was to measure the relationship that exists between the government of the body mass index (BMI) and the peak expiratory flow rate (PEFR) in school going children aged between 6 and 17 years of age in Chengalpattu district. The results clearly indicate that there exists a strong correlation between pulmonary function and BMI. There was an overall decreasing trend in PEFR values as the BMI increased and thereby it can be observed that overweight and obese children comparatively exhibit lower respiratory efficiency as compared to children with normal BMI. Another point raised by the study is that PEFR correlates with age as a result of the physiological development and the capacity to have greater lung capacity. Despite the small gender variations that were found, BMI proved to be a more dominating variable that has an impact on pulmonary functioning. The medium negative relationship between BMI and PEFR highlights how it is influenced by excess body weight on the respiratory mechanics, such as limited chest expansion and airway resistance. These results highlight the significance of healthy BMI in childhood to be able to keep a good lung functioning and well being. Early data collected about the child with increased BMI and low PEFR may help in the timely application of health interventions like promotion of physical activity, promoting balanced nutrition and routine health check-ups at school. Finally, the present research will be advantageous in offering region-specific data on the correlation between the BMI and PEFR. It underscores the importance of preventive measures to combat childhood obesity and how it would affect respiratory health, thus playing a role in delivering better pediatric health outcomes.

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