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A CROSS-SECTIONAL STUDY ON THE ASSOCIATION BETWEEN BODY MASS INDEX AND PEAK EXPIRATORY FLOW RATE IN CHILDREN

Dr RAJU VANNALA[1]; Dr KSL Sowmya[2]; Dr Dumpala Dinesh Reddy[3]; Syeda Arshiya Ferdoze[4]

[1]Assistant professor Surabhi institute of medical sciences Siddipet

[2]Assistant professor department of pediatrics Mahavir institute of Medical scienc

[3]Post graduate pediatrics malla reddy institute of medical sciences Hyderabad

[4]Assistant professor department of pediatrics malla reddy institute of medical sciences Hyderabad

*Corresponding author:

Syeda Arshiya Ferdoze, Assistant professor department of pediatrics malla reddy institute of medical sciences Hyderabad

Abstract A total of 100 children were screened; were finally included instudy and datataken up for statistical analysis . On analysing the demographic characteristics of the population studied, it was found that the age of the students varied from 8 to 15 years with a mean of 9.30± 0.54 years.Age-wise, frequency was 4% in 8 years, 62% in 9 years and 34% in 10 years ofage respectively.t was found that 59 (59%) of the students were male and 41 (41%) were femalein the study population Among the children in the study population, frequency of male was 59 (59%) andfemale was 41(41%) who were exposed to indoor smoking and the rest were not exposed.On analysing the family history of asthma, frequency of male was 59 (59%) andfemale was 41(41%) had a history of asthma On questioning on the presence of pets in the house, frequency of male was 59(59%) and female was 41(41%) of the children had pets, including dogs, cats, birds and other pets.The analysis of distribution of PEFR was done among males with a mean PEFRof 213.22± 40.87 L/min and in females with a mean PEFR of 188.04 ±34.65 L/min with a standard deviation of 5.32 and 5.41 respectively. The coefficient B for use of mosquito repellent is – 3.58, implying an expecteddecrease in PEFR by 3.58 for exposure to mosquito repellent, after other variables are controlled.

INTRODUCTION

According to KW Donald [1], the purpose of the lungs is to keep the concentrations and pressures of oxygen and carbon dioxide in the arterial circulation normal and largely constant, without causing discomfort while breathing or harm to the heart orother organs. He explains that this consists of the processes of ventilation (the movement of atmospheric air containing 21% oxygen into the lungs and movementof deoxygenated air out of the lungs), exchange of oxygen and carbon dioxide across the alveolar capillary membrane, and adequate circulation to ensure distribution of the well-oxygenated blood from the alveoli to the tissues and vice versa. He gave this famous series of lectures at the London University in the early1950s.

Joint statements from the American Thoracic Society and the EuropeanRespiratory Society (ATS/ERS) outline the general factors to be taken into account when performing lung function tests. 2 A history of myocardial infarction within the previous month, unstable angina, recent thoracic, abdominal, or ophthalmic surgery, an intra- thoracic or abdominal aneurysm, and pneumothorax are all contraindications to performingpulmonary function tests (PFTs). To avoid falls in the event of syncope during the procedure, PFTs should be carried out while sitting down.The patient should be instructed to refrain from smoking within an hour, consuming alcoholwithin 4 hours, engaging in strenuous activity within 30 minutes, eating a heavy meal within2 hours of the test, and donning clothing that restricts thoracic and abdominal expansion before the PFTs. In order to guarantee accuracy and reproducibility, each test is run three We undertook this study to study the correlation between BMI andPEFR in our study population.

AIMS AND OBJECTIVES

- To study the correlation between BMI and PEFR in children aged between 8 to 18years.
- To study the correlation between PEFR (peak expiratory flow rate) demographic andother anthropometric parameters and environmental factors.

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 07, 2022

MATERIALS AND METHODS

- Study Design: Hospital Based cross-sectional observational study
- Study Period: January 2021-June 2022
- Study Area: Schools and Department of pediatrics, Malla Reddy Institute of Medical Sciences.
- Sample Size: 100 Children.

INCLUSION CRITERIA:

- Children aged between 8 to 18 years of both the sexes coming to the OPD of Malla Reddy

  Institute of Medical Sciences

EXCLUSION CRITERIA:

- History of any febrile illness in the preceding 1 week.
- History of symptoms of upper or lower respiratory tract infection in the preceding 1 week.
- Chronic respiratory disease e.g., Bronchial asthma, Systemic disease like cardiac or renaldisorders.
- Obvious deformity of thorax or spine.
- Neuromuscular disorder

- The study will be conducted after taking scientific and Institutional Ethics CommitteePermission.
- The Patients/ guardian will be explained about the purpose of the study and a writtenconsent will be taken.
- Children between 8 and 18 years of age fulfilling the inclusion criteria will be taken intothe study following oral interview by using a predetermined proforma.
- A thorough clinical examination and anthropometric examination will be done.

- Standing height will be measured (without shoes) in centimeters with a standardstadiometer.
- Body mass index (BMI) will be calculated using the formula: Weight in kilograms/ (heightin meters).
- Peak expiratory flow rate will be measured using the Peak Flow Meter

- Data will be collected in a pre-designed, pre-structured, questionnaire which will includeDemographic details of children:
- Name, Age, Sex, Education, Occupation, Per-capita income,

RESULTS

- Table 1: Age distribution

	Frequency	Percentage
8	4	4%
9	62	62%
10	34	34%
Total	100	100%
Mean ± SD	9.30 ± 0.54	

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 07, 2022

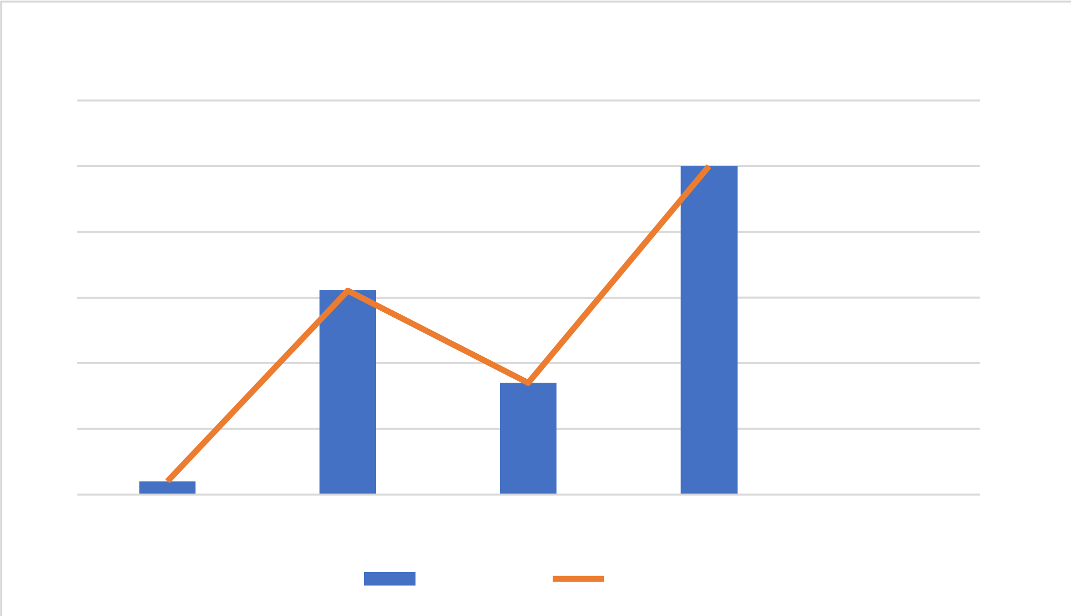


FIGURE 1: Age distribution

Table 2: Gender distribution

	Frequency	Percentage
Male	59	59%
Female	41	41%
Total	100	100%

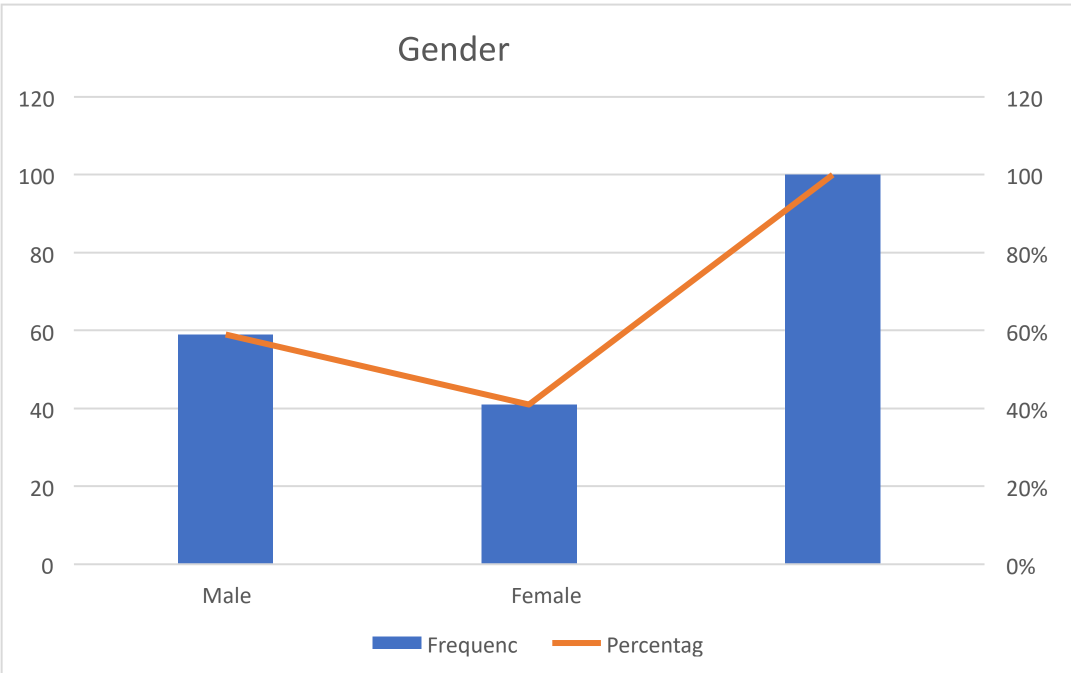


FIGURE 2 : Gender distribution

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 07, 2022

Table 3: Father literacy

	Frequency	Percentage
Illiterate	9	9%
Primary	12	12%
High school	12	12%
Higher secondary	19	19%
Graduate	22	22%
Postgraduate	15	15%
Professional	11	11%
Total	100	100%

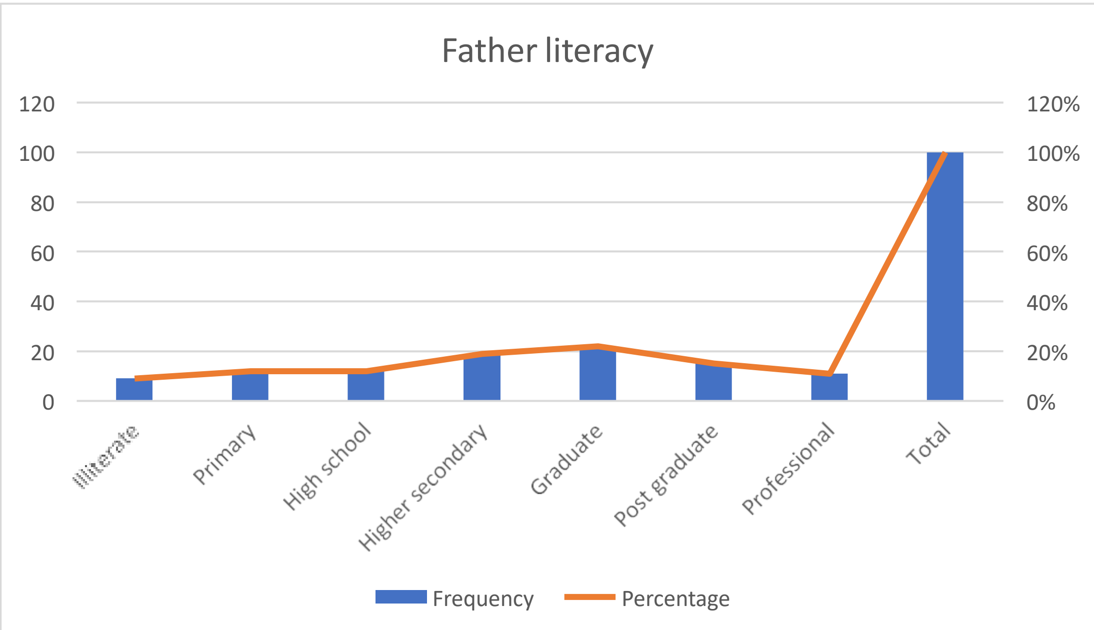


FIGURE 3: Father literacy

Table 4: Mother literacy

	Frequency	Percentage
Illiterate	8	8%
Primary	14	14%
High school	16	16%

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 07, 2022

Higher secondary	13	13%
Graduate	26	26%
Postgraduate	12	12%
Professional	11	11%
Total	100	100%

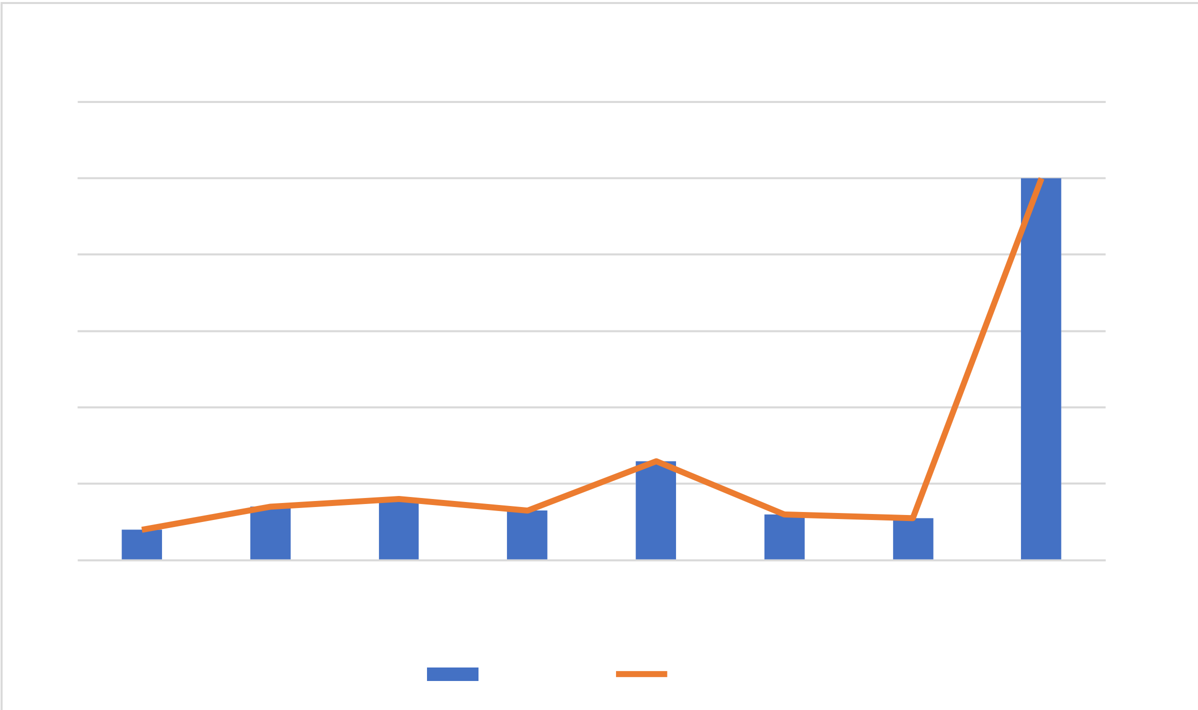


FIGURE 4: Mother literacy

Table 5: Mothers employment

	Frequency	Percentage
Professional	14	14%
Manager	5	5%
Clerk work	3	3%
Labourer	16	16%
Business	4	4%
Unemployed	9	9%
Total	100	100%

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 07, 2022

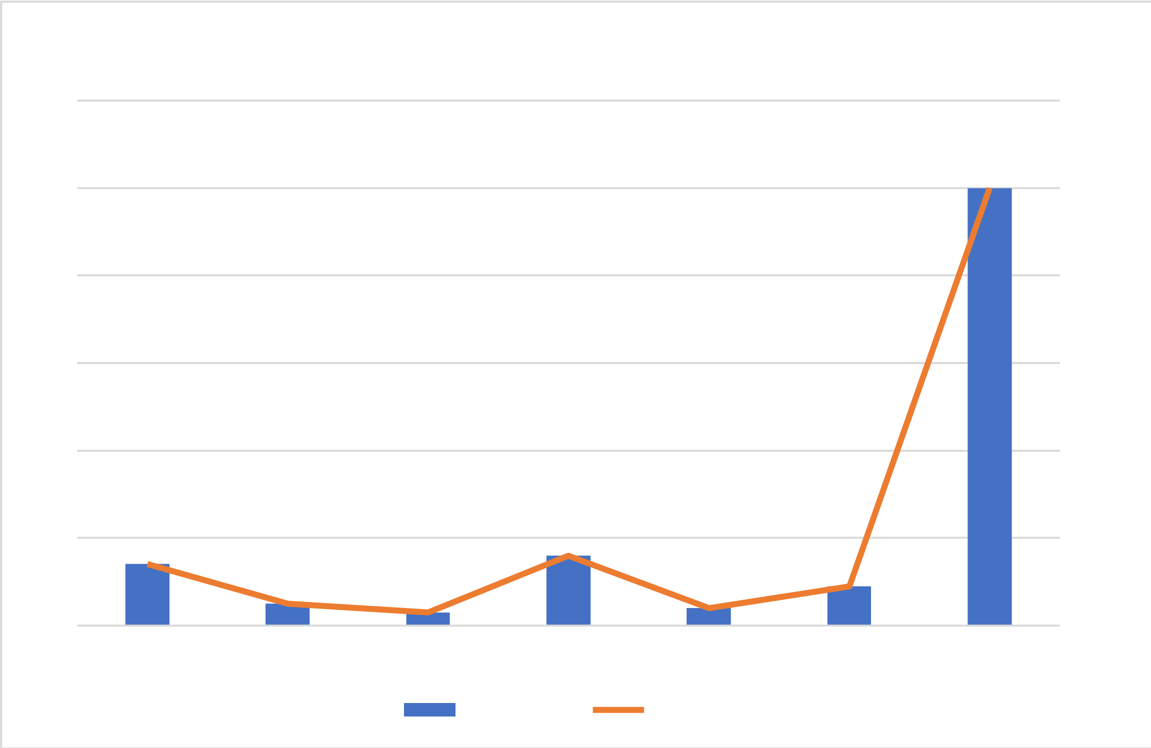


FIGURE 5: Mothers employment

Table 6: Exposure to indoor smoking

	Frequency	Percentage
Male	59	59%
Female	41	41%
Total	100	100%

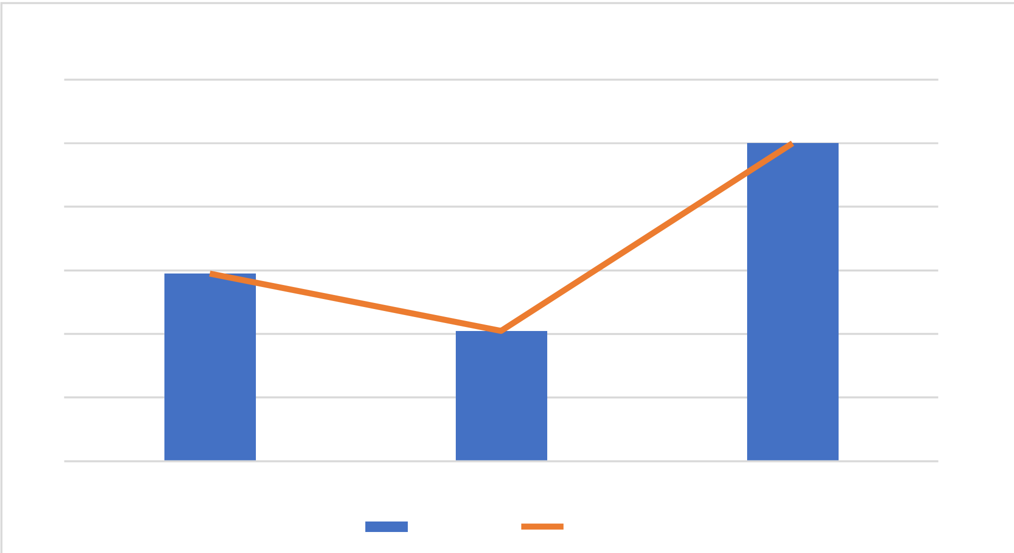


FIGURE 6: Exposure to indoor smoking

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 07, 2022

Table 7: Family history of Atopy

	Frequency	Percentage
Male	59	59%
Female	41	41%
Total	100	100%

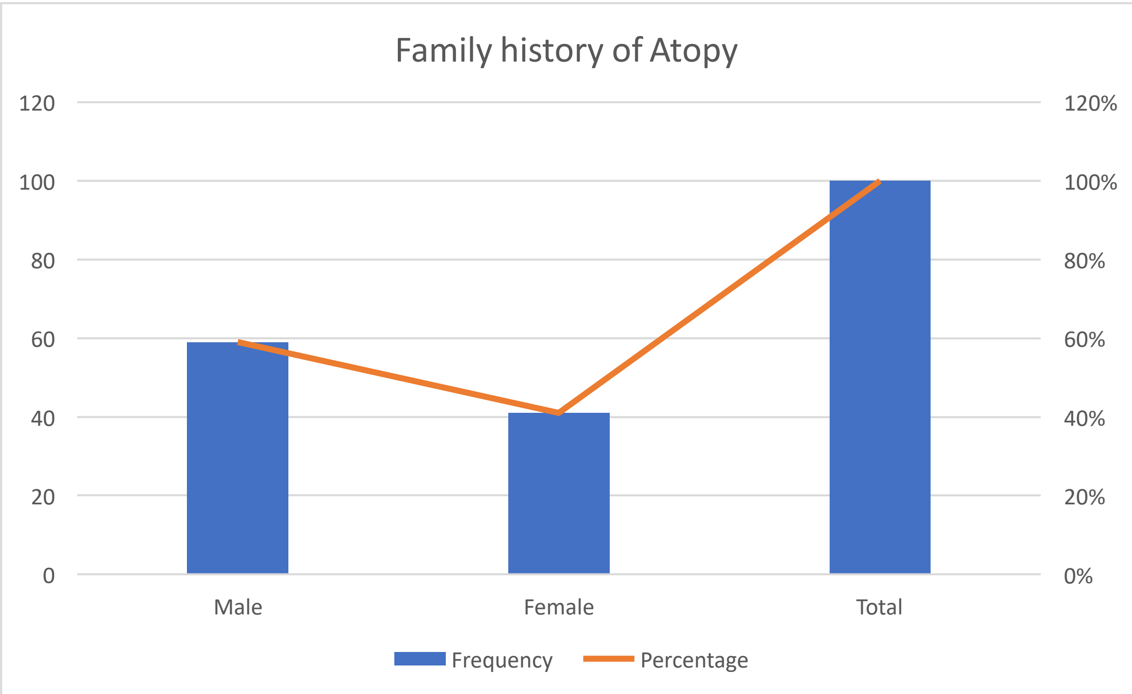


Figure 7: Family history of Atopy

Table 8: Exposure to pets

	Frequency	Percentage
Male	59	59%
Female	41	41%
Total	100	100%

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 07, 2022

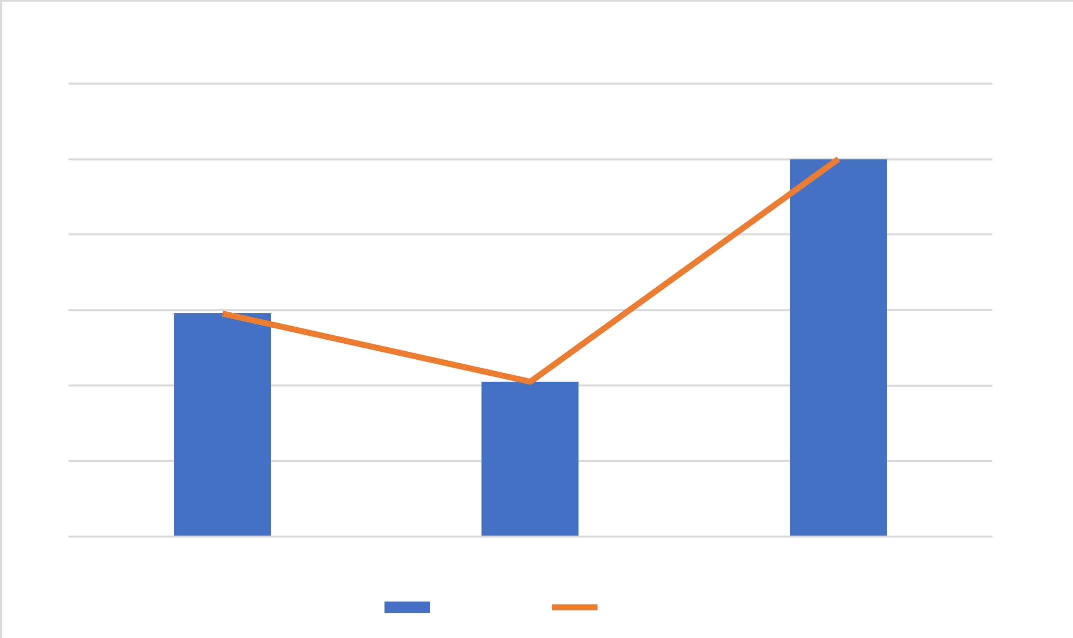


Figure 8: Exposure to pets

Table 9: Distribution based on PEFR in male and female

	Frequency	PEFR	Standard Error of mean
Male	59	213.22± 40.87	5.32
Female	41	188.04 ±34.65	5.41

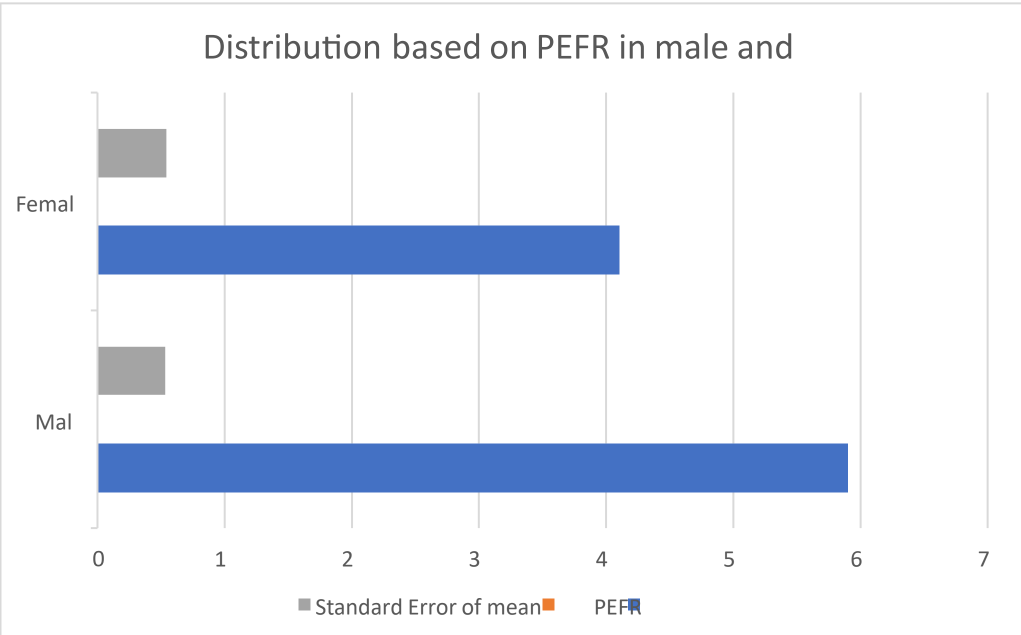


Figure 9: Distribution based on PEFR in male and female

Table 10: Simple linear regression analysis of peak expiratory flow rate

	Independent variable	Beta Coefficient	95% CI	P value
PEFR	Female gender	-41.12	-42.33 – 32.33	0.0001*
	Age	1.13	-13.7623 to 16.0381	0.007*
	Height	1.88	0.8107 to 2.9683	0.0001*
	Weight	0.91	-0.03407 to 1.8731	0.06
	BMI	1.5135	-1.0016 to 4.0285	0.23
	Atopy in father	-43.3333	-36.8513 to 123.5179	0.15
	Atopy in mother	-2.9592	-54.3588 to 60.2772	0.91
	Atopy in sibling	9.5789	-46.3498 to 27.1919	0.60
	Pets in house	27.6959	-3.2625 to 58.6542	0.07
	Use of mosquito nets	-5.0322	-21.6231 to 11.5587	0.54

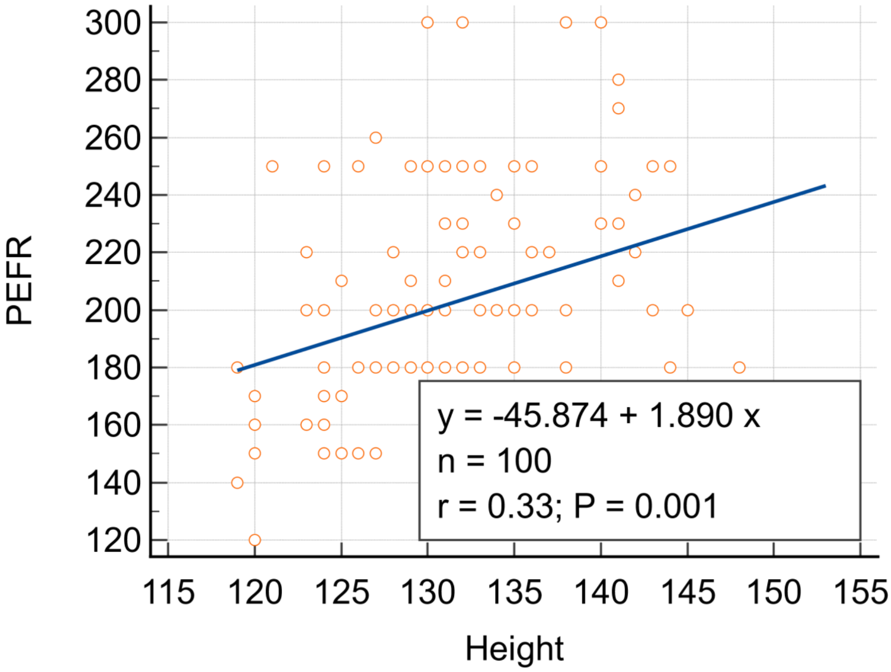


Figure 10: Simple linear regression analysis of peak expiratory flow rate

The above scatter plot shows the positive correlation between height and PEFR with a slope of 1.89 with a few outliers outside the line of best fit, with a coefficient of r2 of 0.33.

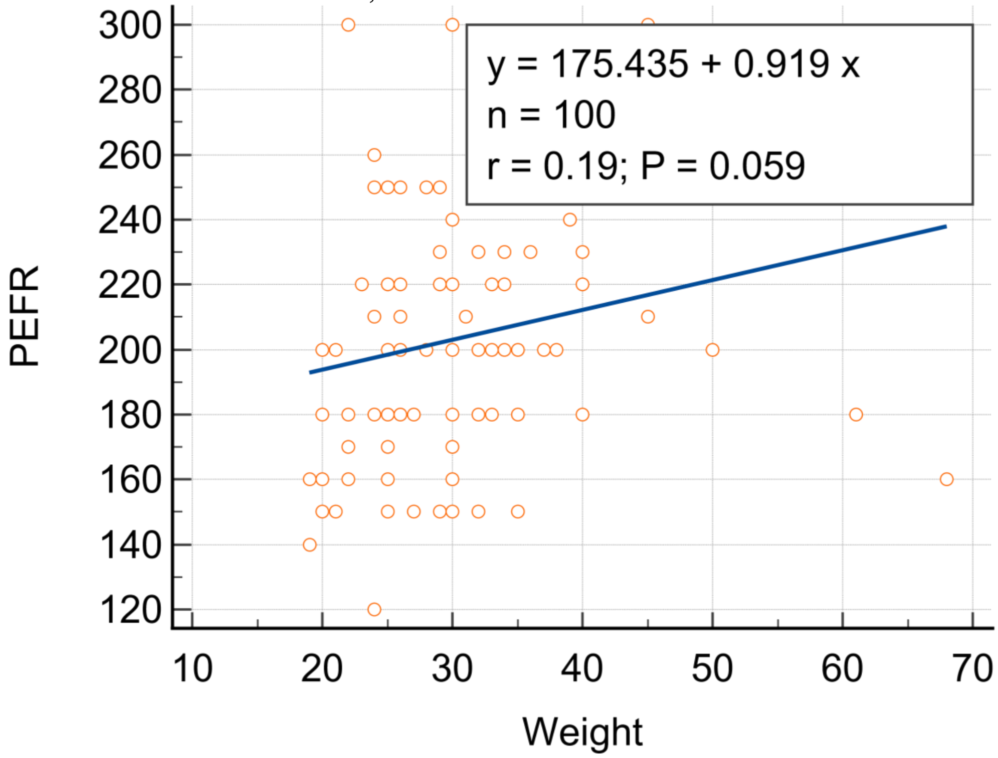


Figure 11: Simple linear regression analysis of peak expiratory flow rate

The above scatter plot shows a positive correlation between WEIGHT and PEFR with a slope of0.919 as already derived.

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 07, 2022

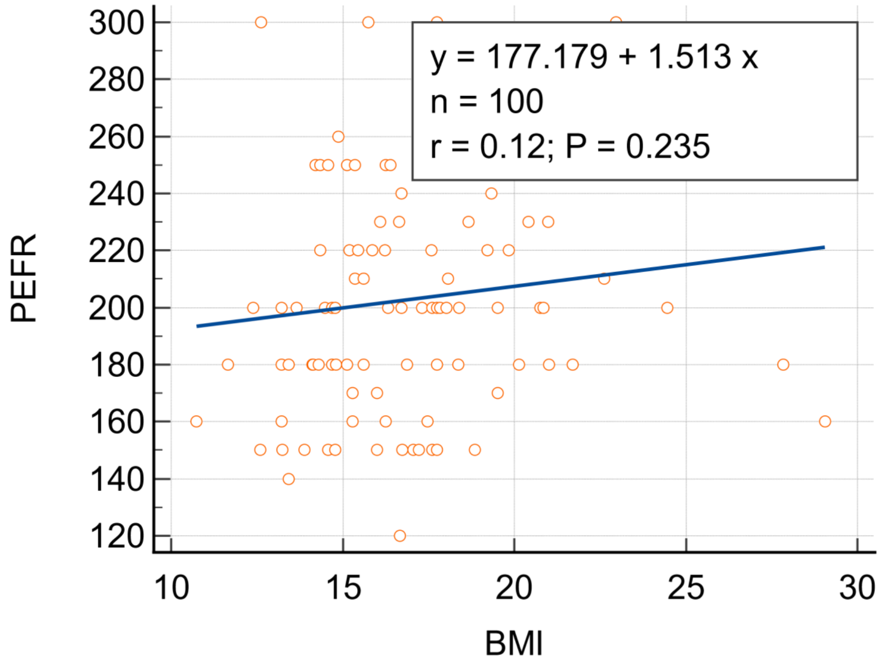


Figure 12: Simple linear regression analysis of peak expiratory flow rate

The above scatter plot shows a correlation between BMI and PEFR with a slope of 1.513 as already derived. But it also shows a large number of outliers, and the correlation is derived only by drawing the line of best fit. This implies that there is a very weak positive correlation between BMI and PEFR (r2 = 0.12)

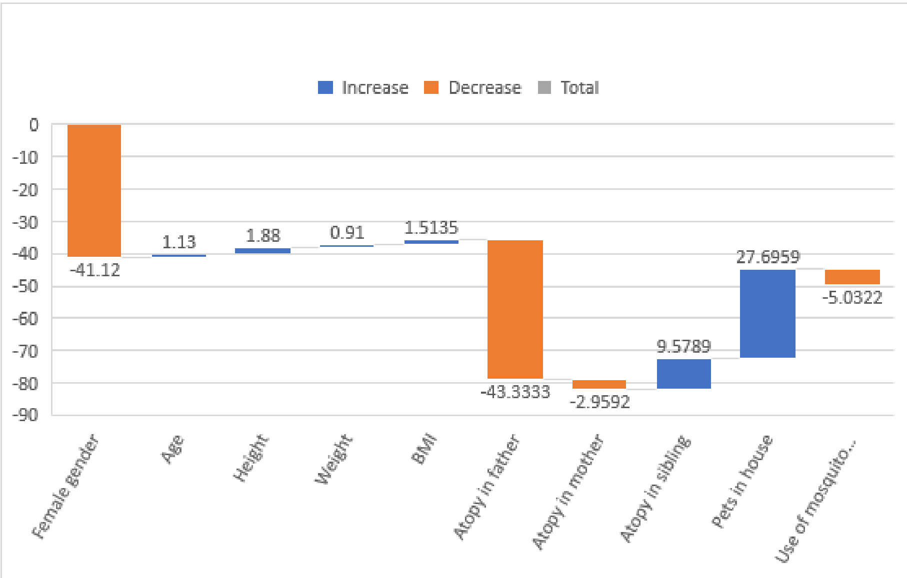


Figure 13; Simple linear regression analysis of peak expiratory flow rate

Table 11: Correlation between age, weight, height, BMI and PEFR

	Weight	BMI	PEFR	AGE	HEIGHT
WEIGHT	-	0.93	0.19	0.24	0.78
BMI	0.93	-	0.12	0.17	0.54

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 07, 2022

PEFR	0.19	0.12	-	0.01	0.33
AGE	0.24	0.17	0.01	-	0.32
HEIGHT	0.78	0.54	0.33	0.32	-

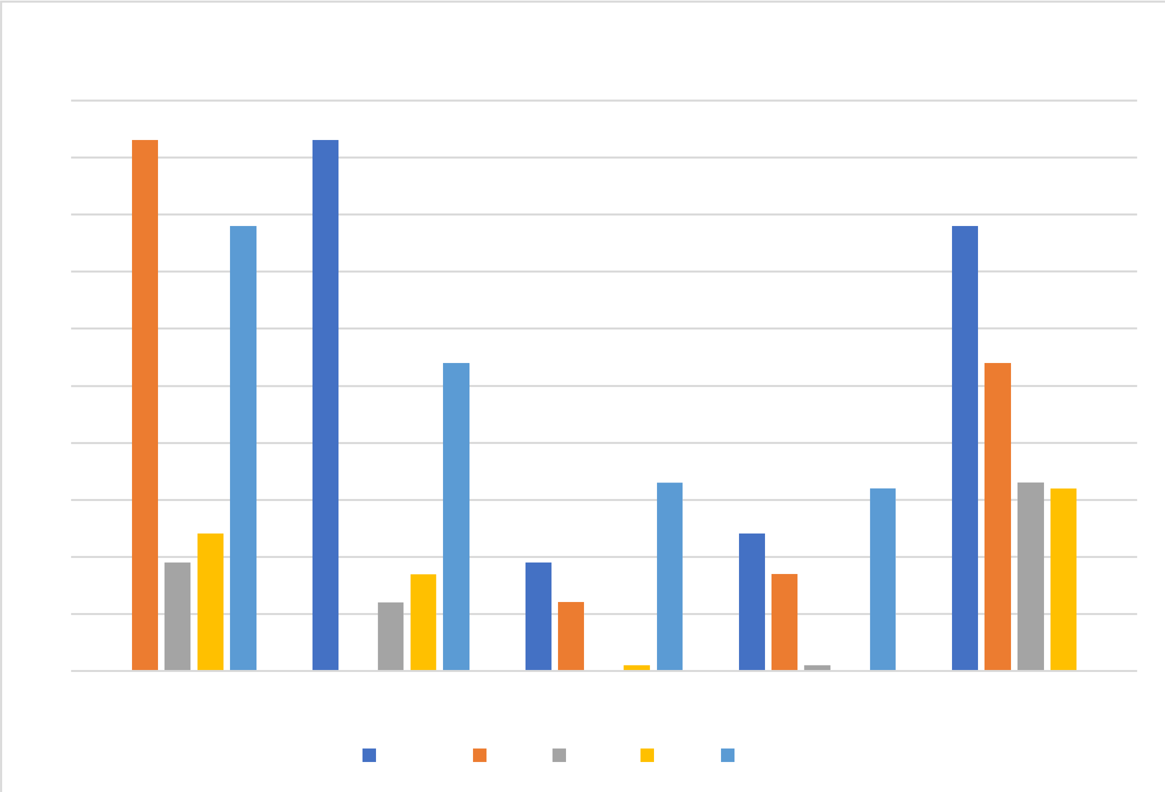


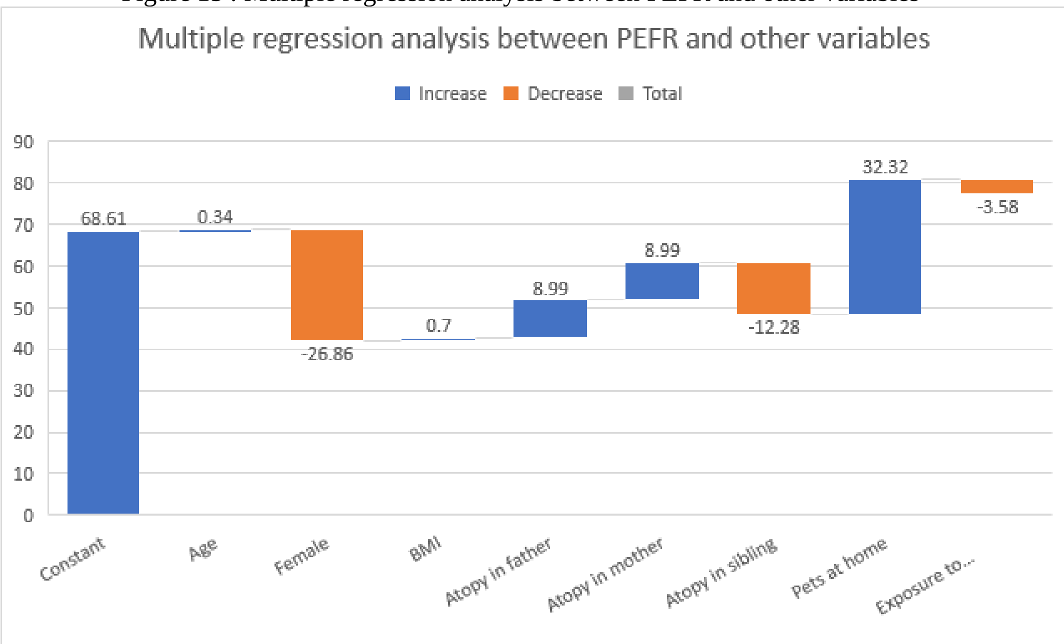
Figure 14: Correlation between age, weight, height, BMI and PEFR

Table 12: Multiple regression analysis between PEFR and other variables

	Independent variable	Beta Coefficient	P value
PEFR	Constant	68.61	-
	Age	0.34	0.001*
	Female	-26.86	0.001*
	BMI	0.70	0.57

	Atopy in father	8.99	0.75
	Atopy in mother	8.99	0.75
	Atopy in sibling	-12.28	0.51
	Pets at home	32.32	0.03*
	Exposure to mosquito repellent	-3.58	0.04*

Figure 15 : Multiple regression analysis between PEFR and other variables



Discussion

In the past ten years, there has been an increase in interest in using a child's peak expiratory flow rate to self-monitor their asthma and track their treatment's effectiveness. This is because portable peak flow metres, which are more widely available and more affordable than conventional spirometers, make the test simpler to administer and interpret. The peak expiratory flow rate, on the other hand, can be used as a screening test to rule out airflow obstruction but not to detect obstructive airway disease when measured in a healthy child [6].The peak expiratory flow rate, as was already mentioned, is significantly influenced by anumber of variables. Because there are so many contradictory reports in the literature, we specifically set out to look into the connection between BMI and PEFR. We also tried to look into how other factors affected this measurement in order to properly interpret the value. In conclusion, we found that while BMI has a positive linear relationship with PEFR on itsown, this relationship is not statistically significant when we take into account other variables like age, gender, parental history of asthma, exposure to indoor smoking, and presence of pets in the home. Additionally, in this more recent model, a child's PEFR is significantly impacted by variables like age, gender, insect repellent use, and indoor smoking. Therefore, rather than the effect of BMI on PEFR alone, these other factors rather than just themselves are probably responsible. Additionally, we showed that there is no significant relationship between BMI and PEFRat the extremes of the former, such as obesity and extreme thinness, but there is a significant correlation in the intermediate BMI categories.

<u>Relationship between BMI and PEFR</u>

In a related study conducted in 1987 in Latium, Italy, by Pistelli et al[19], it wasdiscovered that loge (BMI) and loge (PEFR) had a weakly positive correlation when compared separately (r=0.109) and when respiratory illnesses were considered (r=0.114), but that there was no relationship when loge (FVC), a proxyfor lung size, was controlled. Other studies[17,18,20,21] found a weakly positive correlation between BMI and PEFR when using simple linear regression (r ranging from 0.13 to 0.30).Chu et al[26] studied 14, , Paralikar et al[28] looked at 60 adolescent boys from the former Gujarati city of Baroda, ranging in age from 12 to 17. Between theobese and control groups, the PEFR did not significantly differ. Additionally, therewas no discernible relationship between BMI and PEFR ($p > 0.05$). Significantly negative correlations were found between FEV1/FVC, MVV, and FEF25-75

The relationship between height and PEFR:

Height and peak expiratory flow rate have a well-documented and established relationship. Height has been shown to be a reliable predictor of PEFRand is frequently used to build regression equations in various studies. Due to thedistinct factors affecting PEFR in each population, these equations are different ineach study.In a study conducted in Madras on 345 healthy schoolchildren, Swaminathan et al[44] found a significant positive correlation between PEFR and thevariables height (r=0.84), weight (r=0.81), and age (r=0.79). It was found that [42], 75% of the variability in PEFR can be attributed to height alone. As a result, nomograms and regression equations were created. Height was found to be the best predictor of lung functions, including PEF, FVC, FEV1, FEV1/FVC, MEF25, MEF50, and FEF 25-75, in the study by Pistelli et al[45] in Latium, Italy.Height and PEFR have a strong direct correlation (r=0.93), according to a study by Nairn et al on 421 healthy schoolchildren between the ages of 6 and 18 years. Another study by Chowgule et al[43] conducted on 632 healthy children in theformer Bombay showed that among the factors of age, weight, and height, height has the greatest impact on a child's lung functions, with a linear positive correlation.

The following is an explanation for the strong positive correlation between standing height (stature) and PEFR. One explanation is that as a person grows taller, their lungs grow along with them, increasing their lung capacity and peak expiratory flow rates[52]. When compared to peak expiratory flow, the forced vital capacity increased the most among these. This indicates that the development of the lung's airways and alveoli are not growing at the same time[45]. The nutritional status is also thought to increase with height, which is thought to be related to a greater effort required to produce a forceful expiratory maneuver.

Relationship between weight and PEFR:

Weight and PEFR have been found to have a positive linear correlation thatvaries significantly between studies, ranging from a weak correlation to a strong correlation. A large number of other researchers have discovered this. In their investigation of 345 healthy schoolchildren in Chennai, Swaminathan et al[44] discovered a strong positive correlation between weight and PEFR (r=0.81). The correlation between weight and PEFR was found by Gupta et al[50] to vary from strong (r=0.88 in boys and 0.81 in girls) to weak (r=0.20 in men) to insignificant ($p>0.05$) in women. The study included 1239 adults and children. Mohammedzadeh et al[47] found that PEFR had a significant correlation withage, weight, and height, but that the correlation with weight (r2=0.299) was weakerthan that with height (r2=0.413), according to Shamssain[51] study. Weight's stronger correlation with lean body mass (r=0.74) than with height (r=0.31)[50] is thought to be the cause of the correlation between weight and PEFR.A person's muscle mass can be seen in their lean body mass. Increased muscle mass is thought to result in an increase in PEFR because PEFR measures how forcefully an individual exhales.

Relationship between age and PEFR:

Additionally, we discovered a strong relationship between age and PEFR. Other studies also revealed this. According to a study by Nairn et al[42] on 421 healthy schoolchildren in Inverness, UK, PEFR was correlated with age in bot boys and girls up to about 10 years old. After that, in boys, PEFR decreased with age up to about 13 years old, after which there was a significant correlation with age. After about 11 years, the PEFR in girls showed a slight positive correlation. This was explained by the fact that boys in the 11–13 age range varied greatly in height, and PEFR is much more strongly correlated with height. In addition, due todue to the earlier onset of puberty and the subsequent closure of epiphyses and plateauing of height, the PEFR does not increase much further.Age and PEFR have a significant positive correlation, according to Taksande et al[20]. With a correlation coefficient of r=0.388, Pistelli and colleagues[45]discovered that there is a weak to moderate correlation between loge (PEF) and loge (age). Additionally, they discovered that lung volumes are less affected by age than flows are.

Age and PEFR had a very strong positive correlation (r=0.79), as shown by Swaminathan et al[44]. In their study, Gupta and colleagues[50] discovered that thereis a strong negative correlation in adults (r=-0.46 in men and -0.45 in women) between PEFR and age, but a strong positive correlation in children (r=0.86 in boysand 0.80 in girls). Age and PEFR had a moderately correlated relationship,according to Mukhtar et al[46] study of a group of Libyan children and teenagers. Age has a small but significant impact on PEFR in girls but no discernible effect onPEFR in boys, according to the study by Chowgule et al[43]. In their study, Vijayan and colleagues[48] showed a significant positive correlation between age and PEFR. (r=0.84 in boys and 0.77 in girls)A group of 2828 healthy schoolchildren from Dublin, Ireland were the subject of a study by Carson et al. They discovered that the slope of the PEFR-age curve began to rise at ages 12 for girls and 14 for boys, continued for two to three years, and then began to fall. In a similar vein, they discovered an increase in the slope of the PEFR- height curve in

ISSN: 0975-3583, 0976-2833 VOL13, ISSUE 07, 2022

girls at 145 cm and 155 cm, which persisted for 15 cm before declining. Again, puberty was blamed for this, but not in line with the other somatic changes.They discovered that linear regression analysis tends to underestimate PEFR by about 30 L/min in boys and 19 L/min in girls, blunting this peri-pubertal acceleration. They discover that, in simple regression, centile charts perform better at estimating the PEFR than regression equations. Therefore, the subsequent increase in body size and changes brought on by puberty appear to act as a mediating factor in the effect of ageing on PEFR.

Relationship between gender and PEFR:

According to the results of the current study, PEFR is significantly different in men compared to women and is also significantly higher in men. Numerous otherstudies also discovered this. In their study of 469 healthy schoolchildren between the ages of 7 and 19, Vijayan et al.[48] found that while PEFR is similar between boys and girls, it is higher in boys between the ages of 18 and 19 than it is in girls.Under the height of 152.6 cm, Rosenthal and colleagues[52] found no statistically significant difference between boys and girls in the PEF. It was found that the PEFis 7.4% higher between the heights of 152.6 cm and 162.5 cm in girls when compared to boys. This was the height coinciding with the growthspurt in girls.And further, above the height of 162.5 cm, it was found that the PEF of males is significantly higher than that of females. This was the time coinciding with the growth spurt in boys.Additionally, when compared to females, it was discovered that the thoracicdimensions, such as chest circumference and depth, increased to a greater extentin males during puberty, causing an asynchrony in the thoracic to somatic growth

Relationship between PEFR and mosquito repellent exposure:

In the current study, it was discovered that exposure to insect repellent at home was associated with a significant decrease in PEFR. Different types of mosquito repellents, such as coils, liquidators, and mats, were also used. Other studies have also shown this effect to exist. To examine how indoor air pollution affects respiratory illness, Azizi et al[54] studied 1501 Malaysian schoolchildren between the ages of 7 and 12. It was discovered that exposure to mosquito coil smoke for at least three nights a week increases the risk of developing chronic wheezing and asthma. The association between breathing in mosquito mat smokeand respiratory ailments was insignificant. Also, it was predicted that 29% of wheeze and respiratory illness could be reduced by preventing exposure to mosquito coil smoke. The same authors[54] cross-sectional study on 1414 kids aged7 to 12 years found no correlation between exposure to insect repellent and a decrease in spirometric or peak flow measurements

Conclusion

In conclusion, we comprehend that, when age, gender, and use of mosquito repellent are considering, there is a comparatively small but significant influence of BMI on a child's PEFR, which is in comparison to what we have previously observed.

As a result, it appears that other factors like age and gender indirectly mediate the effectof BMI on the PEFR.BMI, in its extremes, has no significant influence on PEFR, whereas there is a significant influence in the intermediate BMI categories. Contrarily, the PEFR is significantly influenced by female gender, age, height, the presence of pets in the home, and exposure to insect repellent, which is still evident

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