STUDY ON PEAK EXPIRATORY FLOW RATE ESTIMATION IN SCHOOL CHILDREN FROM MADURAI DISTRICT

by Thangavel 20103106 M.D. Paediatrics

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CHENNAI, TAMILNADU.

CERTIFICATE

This is to certify that Dissertation entitled "***STUDY ON PEAK EXPIRATORY FLOW RATE ESTIMATION IN SCHOOL CHILDREN FROM MADURAI DISTRICT***" is a bonafide work done by **DR.A.THANGAVEL**, Postgraduate student of Paediatric Medicine, Institute of child health and research Centre , Government Rajaji Hospital attached to Madurai Medical College, Madurai during the academic year 2010-2013.

G Mathevan 24.12.13

PROF. DR.G.MATHEVAN,M.D., D.C.H.,

Director (i/c) & Unit Chief
Institute of child health &
Research Centre
Madurai Medical College,
Madurai – 625 020

DIRECTOR I/C
INSTITUTE OF CHILD HEALTH &
RESEARCH CENTRE
GOVT. RAJAJI HOSPITAL
MADURAI - 625 020

DECLARATION

I declare that this Dissertation entitled " **STUDY ON PEAK EXPIRATORY FLOW RATE ESTIMATION IN SCHOOL CHILDREN FROM MADURAI DISTRICT** " has been conducted by me at the Institute of Child Health and Research Centre , under the guidance and supervision of my unit chief **PROF. DR.G.MATHEVAN, M.D., D.C.H.,**

It is submitted in part of fulfillment of the award of the Degree of M.D.,[Paediatrics] for the April 2013 examination to be held under the Tamil Nadu Dr. M.G.R. Medical University, Chennai. This has not been submitted previously by me for the award of any Degree or Diploma from any other university.

A. Thangavel

DR. A.THANGAVEL
Post Graduate Student
Department of Paediatrics,
Madurai Medical College
Madurai-625 020.

DATE 25/12/12.

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CONTENTS

INTRODUCTION

Asthma is a clinical syndrome characterised by hyper reactivity of airways to a variety of stimuli resulting in reversible broncho constriction & inflammation clinically manifest as cough, breathlessness and wheezing.

Worldwide 9.6 million children (13.1%) had been diagnosed as having asthma as per 2007 survey.

Worldwide prevalence of childhood Asthma is ranging from 0.8 to 37.6%. Prevalence of Asthma in Indian children is varied from 0.9 to 15.7%. Various studies conducted in different countries have reported an increase in Asthma prevalence of about 50% per decade.

PEFR recording is one among the many lung function tests helpful in Evaluation, monitoring, management and follow-up of patients with bronchial hyper reactivity.

PEFR is easily estimated using peak expiratory flow meter and is also handy for the children both at home and in clinic. It reflects the severity of outflow obstruction and was shown to anticipate early deterioration of patients conditions before it actually happens[1].

Bronchial asthma is a common respiratory disease of childhood which has fluctuations in airway diameter and PEFR values signal a forthcoming attack .

PEFR is an accepted index of pulmonary function. Personal best PEFR is a useful concept for asthma self management plan. Serial PEFR monitoring is a reliable investigation for the diagnosis of asthma. A variation of greater than 20 % of baseline may indicate airway reactivity [2].

Predictive normal values are essential for clinical interpretation of lung function tests. Normograms predicting PEFR from anthropometric measurements are available for various population groups.

While using lung function tests in epidemiology, it is important to ensure that the population from which the regression equation is derived is an appropriate one as predicted normal values are affected by many factors including ethnic, regional and environmental influences [3].

Importance of having reference normal values of PEFR in Madurai School Children is more so because of large incidence of Respiratory Diseases, especially Bronchial Asthma.

REVIEW OF LITERATURE

HISTORY [4]

Important landmarks in the evaluation of pulmonary function tests:

- In 1681, Borelli did study on single breath inspiratory volumes using a liquid in a cylindrical tube.
- In 1718 Jurin J. Using Archimedes principle measured the volume of air in a bladder.
- In 1749 Bernovilli D. described a method for measuring expired volume.
- In 1793 Abernethy measured vital capacity of 3150 ml.
- In 1796 Menzies R measured tidal volume using plethysmograph.
- In 1799 Pepys W.H. Jun. using gasometers measured the tidal volume as 270 ml.
- In 1800 Davy. H. found his vital capacity to be 3110 ml, tidal volume as 210 ml and residual volume as 590 ml by Hydrogen dilution method.
- In 1813 Kentish E. studied lung volumes
- In 1852 Hutchinson John found "water Spirometry"
- In 1854 Wintrich developed a modified Spirometer. He used parameters height, weight and age of the individual to determine the vital capacity.
- In 1859 Smith E. developed a portable Spirometer.
- In 1879 Gad J. Introduced Aeroplethysmography.
- In 1904 Tissot introduced a close circuit Spirometer.
- In 1929 Knipping H.W. introduced a standardized method for Spiroergometer.
- In 1948 Tiffnean introduced FEV as a useful lung function test
- In 1959 Wright B.M. and McKerrow C.B. introduced the peak flow meter.
- In 1990 Computerised Spirometer was introduced.

ANATOMY AND PHYSIOLOGY OF RESPIRATORY SYSTEM [5,6]

Lungs are the essential organs of respiration. They are cone shaped, situated on either side of the heart and other mediastinal contents. Each lung has a narrow upper end or apex, a broader inferior surface or base, a rounded lateral or coastal surface and a medial surface.

The principal bronchus, pulmonary artery , 2 pulmonary veins , bronchial and lymphatic vessels , broncho pulmonary lymph nodes are the structures at the hilum of the lung that form the pulmonary root.

The right lung is divided by the oblique and horizontal fissures into upper, middle and lower lobes whereas the left lung is divided into two lobes by the oblique fissure.

Lingula is a segment of left upper lobe corresponding to right middle lobe. The lobes are further divided into broncho pulmonary segments.

Blood supply:

Blood supply of the lungs is peculiar in that two sets of arteries carry blood to them.

- Pulmonary arteries carries deoxygenated blood from right ventricle to the lungs. This blood circulates through capillary plexus in the walls of the alveoli and the oxygenated blood then returns to the heart through the pulmonary veins.
- Bronchial arteries one on right side and two on left, supply bronchi and connective tissue of lung. Bronchial veins drains into Azygous and Hemiazygous veins.

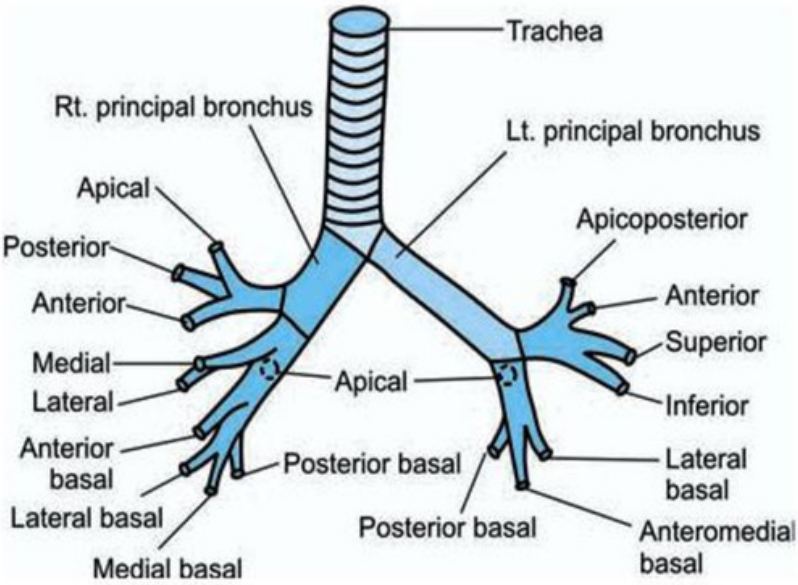
Lymphatic Drainage:

- Superficial vessels drain the peripheral lung tissue lying beneath the pulmonary pleura.
- Deep lymphatics drain the bronchial tree, pulmonary vessels, and connective tissue.

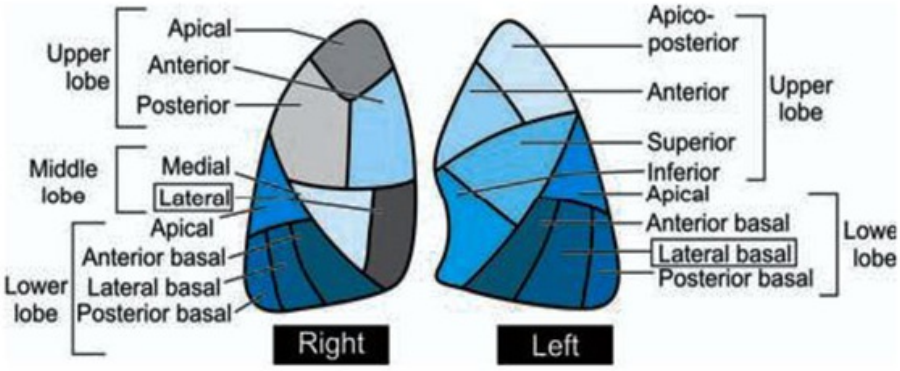
Both run towards hilum and drain into bronchopulmonary lymph nodes.

Nerve supply:

- Parasympathetic nerves derived from the vagus, whose stimulation causes bronchospasm, secretomotor to mucus glands and cough reflex.
- Sympathetic nerves derived from 2nd-5th spinal segments, stimulation leads to bronchodilatation.



The bronchial tree



The bronchopulmonary segments
(lateral aspect)

EMBRYOGENESIS [7,8]

The ventral wall of the foregut gives rise to the respiratory system . Its endodermal lining gives rise to the epithelium of the larynx, trachea, bronchi and alveoli. Cartilages, muscle and connective tissue arise from the mesoderm . during the fourth week of development, the trachea oesophageal septum develops thereby dividing the foregut into the lung bud anteriorly and the oesophagus posteriorly. Two main bronchi arise from the lung bud that further divide into three secondary bronchi on the right and two secondary bronchi on the left.

Maturation of lungs:

a) Pseudoglandular period (5-16 week)

Developing lung resembles branching of a compound exocrine gland. Branching has continued to form terminal bronchioles. No respiratory bronchioles or alveoli are present, the growth and branching of the endoderm epithelium is controlled by the splanchnopleuric mesenchyme.

b) Canalicular period (16-26 weeks)

This period overlaps the pseudoglandular period because cranial segments of lungs mature faster than caudal ones. Each terminal bronchiole divides into two or more respiratory bronchioles, which in turn divide into three to six alveolar ducts. Respiration is possible at the end of canalicular period because some thin walled terminal saccules (primordial alveoli) have developed at the end of respiratory bronchioles, and the lung tissue is well vascularised.

c) Terminal saccular period (26 weeks to birth):

More terminal saccules develop and their epithelium becomes very thin, capillaries begin to bulge in to these developing alveoli. The intimate contact between epithelial and an endothelial cell establishes the blood air barrier, which permits the gas exchange.

Differentiation of type I pneumocytes (thin, flat cells that make up part of blood air barrier) and type II pneumocytes (produce surfactant) begin. Premature fetuses born between weeks twenty-five to twenty-eight can survive with intensive care. This is the earliest point at which fetuses can survive.

d) Alveolar period (8 months – childhood)

Lung development continues after birth until childhood. Increase in size of lung after birth is caused by increased number of respiratory bronchioles and terminal sacs. Terminal sacs develop into mature alveolar ducts and alveoli.

Aeration at birth:

The following changes at birth make the transition from intra uterine life easier

a) Surfactant production.

b) Transformation of lungs from secretary into gas exchanging organ.

c) Establishing separate pulmonary and systemic circulations.

Pulmonary Mechanics [9,10]

Eupnoea refers to rhythmic inspiration and expiration at rest. Inspiration, an active process leads to an increase in size of the thoracic cage. When the lung expands , the pressure in the lung falls thereby drawing air into the lungs.

Expiration , a passive one is due to the elastic recoil of the thoracic wall and lungs.

Mechanism of Inspiration:

During inspiration , thoracic cavity increases in size due to

- ❖ Contraction of diaphragm, which pulls the lower surface of diaphragm down wards accounting for 75 % of the tidal volume.
- ❖ Movements of ribs outward and upward leading to a increase in anterioposterior diameter of the chest (Pump Handle Mechanism).

The lower ribs also swing outwards and upwards (Bucket handle Movements) leading to an increase in the transverse diameter of the thorax.

Muscles of inspiration are

- External intercostals.
- Sternocleidomastoid.
- Anterior serrate.
- Scaleni.

Mechanism of Expiration:

In quiet breathing, expiration is a passive process but during forced expiration, the muscles of the expiration contract and depress the chest cage. They include

a) Anterior abdominal wall muscles (Abdominal recti, transverse abdominis, internal and external oblique muscles).

b) Internal intercostal muscles.

Initiation of breathing after birth produces expansion of lungs that are literally dragged after the chest wall because of the adhesive and inexpansible properties of pleural fluid.

The expansion of lungs leads to a decrease in intrapulmonary pressure or intra alveolar pressure.

When one starts to inspire, the intrapulmonary pressure decreases but full atmospheric pressure is reached at the end of inspiration . During expiration, the intrapulmonary pressure starts to increase but returns to the atmospheric value at the end of expiration .

Pressure Changes during Ventilation

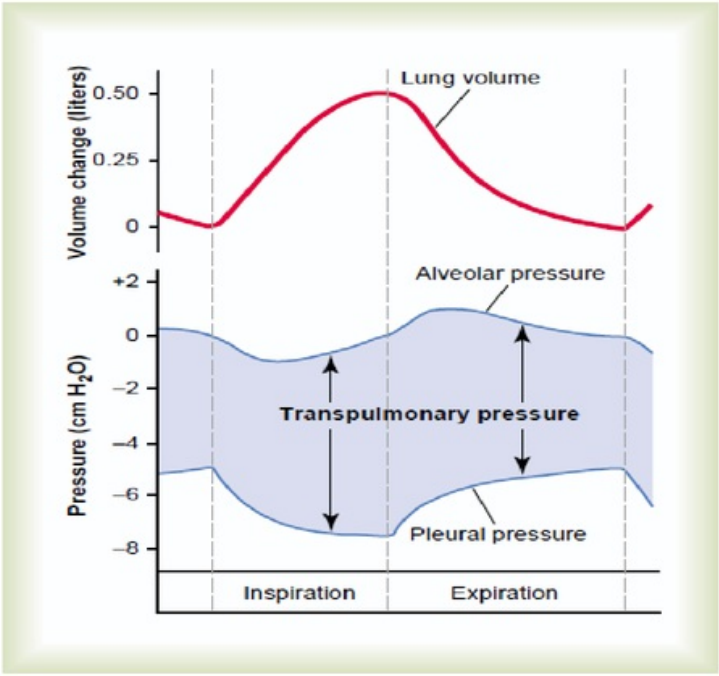


Fig. 2: Changes in volume of the lungs , pressure in alveoli and pleural cavity, and transpulmonary pressure during normal breathing.

The lungs and chest wall are elastic structures. At end expiratory position, the tendency of lungs to recoil from the chest wall is just balanced by the tendency of the chest wall to recoil in the opposite direction. The slight subatmospheric pressure that develops between the two layers of pleura at the start of inspiration called intrapleural pressure or intra thoracic pressure. The pressure difference between the alveolar pressure and pleural pressure is called the transpulmonary pressure and it is a measure of the elastic forces in the lungs that tend to collapse the lungs at each point of expansion called the recoil pressure.

REGULATION OF RESPIRATION [10,11]

The main function of respiration is to maintain normal blood gas homeostasis to match the metabolic needs of the body. Respiratory rate and tidal volume are regulated by a complex interaction of controllers, sensors and effectors. The mechanisms controlling breathing undergo multiple changes from the newborn period throughout infancy and child hood to make it a fine tuned process.

Controllers:

They consist of a group of neurons in the CNS for voluntary and automatic control. These areas of respiratory control can function independently but are also capable of interacting with each other.

Voluntary control of respiration resides in cerebral motor cortex and limbic forebrain structure. Information received from sensory neurons such as pain, touch, temperature, smell, vision and emotions, and impulses are directly sent to respiratory muscles through corticobulbar and corticospinal tracts.

Automatic control of respiration resides in brainstem. A group of 150-200 neurons designated as the Pre Botzinger Complex (Pre Bot C) are located in medullary region.

Pre Bot C is responsible for maintaining respiratory rhythmicity and can be considered the pacemaker for the automatic respiratory activity. The apneustic center in the lower pons ,stimulates Pre Bot C. pneumotaxic center in the upper pons is involved in inhibiting the activity of Pre Bot C.

The role of apneustic and pneumotaxic centers is to "fine tune" the rhythmic respiratory activity generated by Pre Bot C neurons.

Sensors:

Various receptors responsible for sensing afferent information that modulates the activity of the central respiratory controller. Receptors are sensory nerve endings that respond to changes in the environment. They are termed chemoreceptors or mechanoreceptors. Depending upon type of stimulus that is sensed, Chemoreceptors are classified as central or peripheral chemoreceptors.

1) **Central chemoreceptors**:

They are so termed because of their location within the CNS.

Chemoreceptors sense a change in the chemical composition of body fluids to which they are exposed. They respond to change in the H+ concentration, information sensing an increase in H+ concentration stimulates ventilator response of the controller. Where as a decrease inhibits it.

Blood brain does not permit the entry of H+ and HCO_3 - to cross it but readily allows CO_2 to cross it. This leads to an increase in CO_2 concentration in the cerebrospinal fluid.

The consequent fall in the CSF pH is sensed by central chemoreceptors causing stimulation of the controller and increase in ventilation. Changes in $PaCO_2$ result in stimulation or inhibition of ventilation by changes in CSF pH.

2) Peripheral chemoreceptors:

They are located in carotid and aortic bodies. The most important variable in determining the activity of carotid bodies is change in PaO_2. Stimulation of carotid bodies resulting in increased ventilation occurs when there O_2 supply is decreased below their metabolic requirement.

This occurs when there is –

a) Decreased PaO_2

b) Decreased blood flow

c) Impaired oxygen utilization.

The relationship and PaO_2 and stimulation of carotid bodies are more linear. Carotid bodies activated at a PaO_2 of <500 torr. At a PaO_2 of <100 torr carotid body stimulation increases significantly. At PaO_2 <50 torr carotid body stimulation increases exponentially. Important effect of carotid body stimulation is an increase in respiratory rate and tidal volume.

Peripheral chemoreceptors are also stimulated by an increase in $PaCO_2$. Peripheral chemoreceptors respond more quickly (within one sec) however, central chemoreceptors may take minutes to response. Thus peripheral chemoreceptors are important in the immediate rise in the ventilation in response to large and abrupt increase in $PaCO_2$.

a) Lung receptors:

Stretch receptors in the smooth muscles of the lung are stimulated by inspiration. They cause a decrease in the respiratory rate due to inhibition of inspiratory muscle activity and by an increase in the expiration time. This reflex is termed Herring Breuer inflation reflex.

Herring Breuer deflation reflex triggers inspiratory muscle activity in response to deflation of the lung. These receptors serve to decrease the work of breathing in pathological conditions. Irritant receptors are present in between the epithelial cells in airway mucus membrane. Stimulation of irritant receptors results in bronchoconstriction and hyperpnoea.

b) J receptors:

They derive their name because of their "juxta – capillary" location. They lie adjacent to the pulmonary capillaries. Pulmonary capillary engorgement and interstitial and alveolar wall oedema provide stimuli for activation of J receptors, resulting in shallow and rapid respirations and dyspnoea.

c) Muscles receptors:

They are important for regulation of respirations, which are those in the diaphragm and the intercostals. Stretch of the muscle sensed by the muscle spindle is used to control the strength of contraction.

d) Arterial baroreceptors:

They are located in aortic arch and carotid sinuses. They can influence respiration depending upon arterial blood pressure. A decrease in blood pressure results in hyperventilation and an increased blood pressure causes hypoventilation.

e) Pain and temperature receptor:

They Influence respirations in neonates and infants. A painful stimulus causes breath holding followed by hyperventilation. Increased skin temperature causes hyperventilation and hypothermia results in hypoventilation.

Effectors:

The most important effectors of respiration are the diaphragm, intercostals andabdominal muscles; they receive impulses from controllers and effect ventilation.

Regulation of respiration in special situations: In Fetus, newborns and young infants. At various stages and development, the response to chemoreceptor and mechanoreceptor stimulation and efficiency of effectors are markedly different.

When confronted with hypoxia, adults tend to hyperventilate immediately and it will be sustained . But in newborns after an initial brief period (1-2 min) of fast breathing , the neonate develops hypoventilation and apnoea when the hypoxemia is prolonged.

Lower gestational age of the infant is associated with a more pronounced and earlier apneic response to hypoxemia. Maturation of carotid chemoreceptors may be in explanation for the differences in hypoxic response at various stages of development. Sensitivity of CO_2 sensors also undergoes maturation.

Neonatal respiratory muscles cannot manage large workloads, get fatigued soon and this limits their capacity to maintain adequate ventilation in diseased states.

Many neurotransmitters involved in regulation of respiration also undergo developmental maturational changes.

CLASSIFICATION OF PULMONARY FUNCTION TESTS

BASED ON LUNG FUNCTIONS9,12

A] Ventilatory Functions:

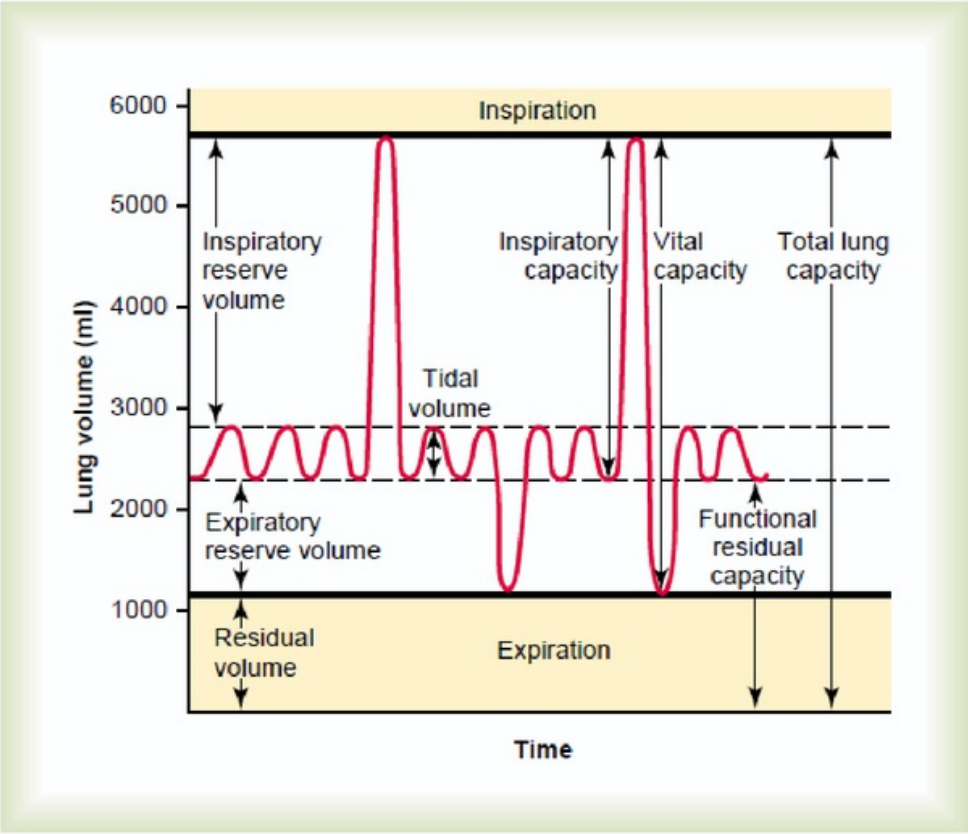


Fig. 3: Spirograph

Spirometry records the volume of air moving in and out of the lungs and the instrument used is known as SPIROMETER, the recording from this instrument is plotted on a graph paper with volume channels on the Y-axis and the time on X-axis is called a spirogram.

Lung volumes:

These includes

01] TIDAL VOLUME (TV) is the amount of air that moves inside and outside of the lings during each breath. At rest it is usually 6-7 ml/kg body weight.

02] INSPIRATORY RESERVE VOLUME (IRV) is the extra volume of air That one can inhale over and above the normal tidal volume on deep inspiration.

03] EXPIRATORY RESERVE VOLUME (ERV) is the maximum extra volume of air that one can forcefully exhale at the end of a normal tidal expiration.

04] RESIDUAL VOLUME (RV) is the volume of air remaining in the lungs after the most forceful expiration.

The lung capacities:

These includes

01] INSPIRATORY CAPACITY: It is the amount of air inspired by maximum inspiratory effort after tidal expiration. It equals tidal volume + inspiratory reserve volume.

02] FUNCTIONAL RESIDUAL CAPACITY: It is the amount of air left in the lungs after tidal expiration. It equals expiratory reserve volume + residual volume.

03] VITAL CAPACITY: It is the amount of air moved in and out of the lungs with maximum inspiration and expiration. It equals the inspiratory reserve volume + tidal volume + expiratory reserve volume.

04] TOTAL LUNG CAPACITY:It is the volume of gas occupying the lungs after maximum inhalation. It equals vital capacity + residual volume.

B) Mechanics of breathing:

In the process of ventilation certain forces are required to overcome the elastic recoil of the lung and thorax, the non elastic resistance caused by movement of tissues during breathing and the airway resistance

Compliance:

The compliance measures the relative stiffness and distensibility of the lungs and thorax. The elastic recoil of the lung, which is measured under static condition, is called compliance.

Airway Resistance:

It represents the frictional resistance to air flow through the conducting air passages. Measurement of the following parameters gives a fair idea of mechanics of breathing.

1] **Timed Vital Capacity (FEV1)**

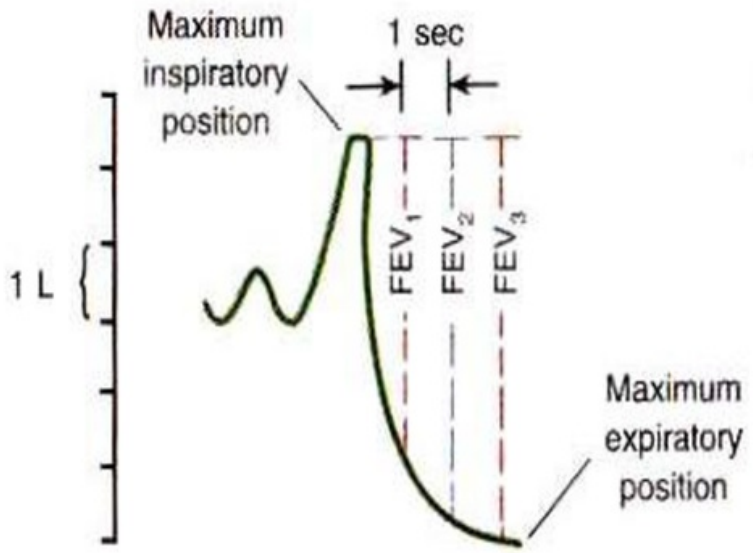


Fig. 4: Timed vital capacity record

Also called, forced expiratory volume in first second. It is the volume of air expired during the first second of FVC. Most commonly used screening test for airway disease. This is an index of flow rate. In normal condition 80-85% of FVC is expired in first second. It is one of the most useful tests to detect generalized airway obstruction.

02] **Maximum Mid Expiratory Flow Rate (MMEFR)**

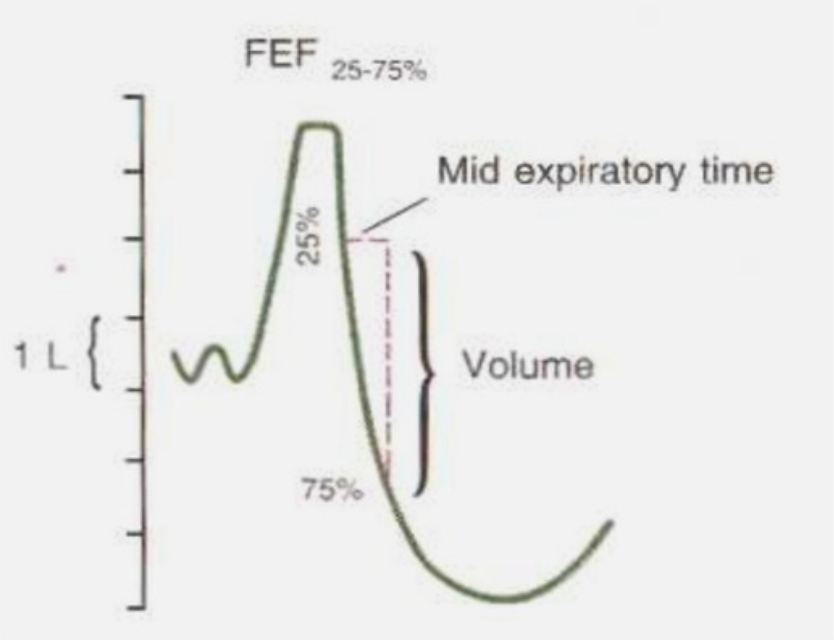


Fig. 5: Forced expiratory flow during 25-75% of expiration.

It is the mean expiratory flow during middle 50% of FVC. Expressed as forced expiratory flow at 25-75% of lung volume (FEF 25-75%). It indicates the patency of small airways.

03] **Maximum Voluntary Ventilation (MVV)**

Is the maximum volume of air that can be breathed out per minute by maximum voluntary effort, also called as maximum breathing capacity. Pulmonary reserve (PR) or breathing reserve: Pulmonary reserve refers to maximum amount of the air that can be breathed in and out of the lung above the minute ventilation (MV).

$$PR = MVV - MV$$

PR is usually expressed as percentage of maximum ventilation volume (MVV) and is known as percentage PR or Dyspneic index (DI).

$$DI = \frac{MVV - MV}{MVV} \times 100$$

Normal values of DI or percentage of PR range form 60-90% with an average of 95%. Dyspnoea is usually present where the volume of DI become <60%.

04] **Peak Expiratory Flow Rate [PEFR]**

It is the maximum velocity in L/min with which air is forced out of lungs.

Normal value of PEFR – 400-600 L/min or 6 to 10 L/sec in adults.

05] **Closing Volume (CV):**

This test detects the small airway obstruction by measuring the volume of gas remaining in the lung after closure of small airway in gravity dependent lung areas.

06] **Maximum Expiratory Flow Volume Curve (MEFVC)**

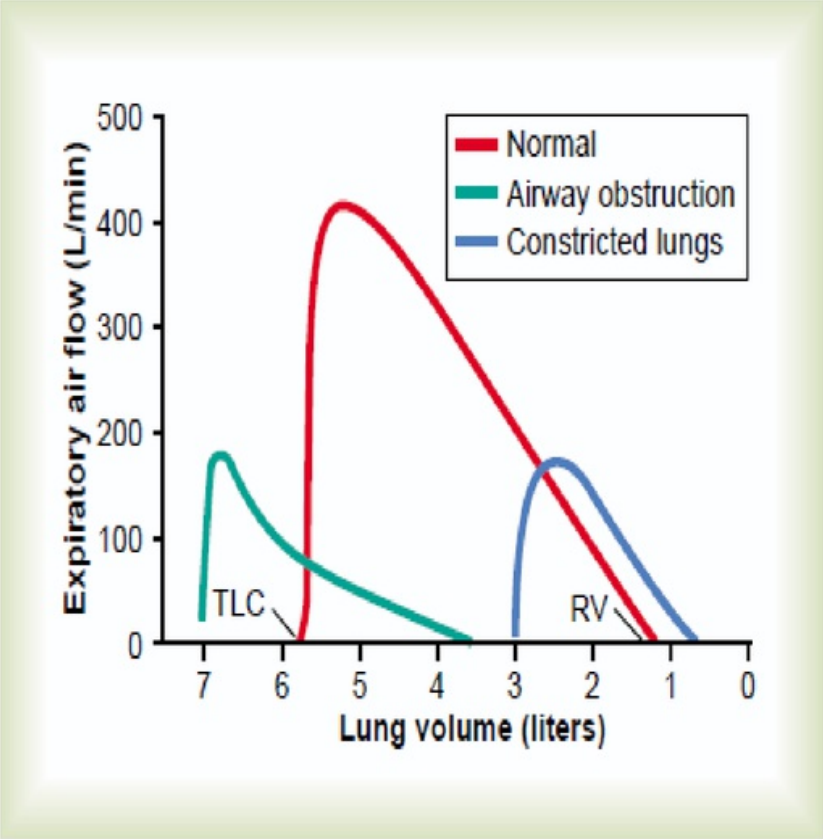


Fig. 6: Expiratory flow volume curve.

The flow rate is plotted against the lung volume to obtain flow volume curve. The subject expires maximally, and forcefully to residual volume following a deep inspiration (TLC) the flow rate quickly reaches a maximum and then falls slowly. In obstructive diseases, the volume is more because of air trapping and the flow rate is less in airway obstruction.

C] Study of Ventilation – Perfusion Relationship

The inspired air is not distributed evenly in normal conditions. In disease states, the distribution becomes more uneven resulting in hypo and hyper ventilated areas. Such non uniform distribution of inspired gas leads to decreased oxygen tension in the arterial blood.

The uniformity of distribution of inspired air is measured by

a) Nitrogen washout method (breath nitrogen test).

b) Radioactive xenon method.

D) Assessment of diffusion.

Diffusion is the physical process by which gas moves across a membrane from the region of higher partial pressure to the region of lower partial pressure. PaO_2 and $PaCO_2$ depend on the diffusion of the gases through the alveolocapillary membrane. It is difficult to measure the diffusing capacity of the gases. Therefore measurement of the arterial blood gas tension is essential in the evaluation of pulmonary functions.

Pulmonary function tests are incomplete without the study of pulmonary circulation. Measurement of pressures, vascular resistance, blood volume and distribution of blood flow in the pulmonary circulation help in detecting vascular occlusion and decreased pulmonary capillary volume.

PEAK EXPIRATORY FLOW RATE

Definition:

The fastest rate at which air moves through the lungs during a forced expiration that follows a full inspiration is referred to as peak expiratory flow rate . It is as easier and convenient test. It can be used in children > 5 years of age to assess about major airway patency.

Principle:

Peak flow meters work on the principle of measuring the airflow indirectly as air moves through a variable orifice. When one forcefully expires the pressure created causes a diaphragm or vane to move thereby opening a much larger area of the orifice. When the maximum pressure and peak expiratory flow has been attained , the diaphragm does not move further [14].

Factors Affecting PEFR [14]

01] Physiological factors :

When the lung grows the dimensions of the airway also increase

the calibre depends on the transbronchial pressure and hence on the volume , elastic properties and compliance of the airways.

Expiration depends on the force length relationship and hence varies with the level of lung inflation and on the speed with which the maximal alveolar pressure is reached, which depends on the force velocity properties of the expiratory muscles.

PEFR is dependent on

A] Pressure in the alveoli.

B] The resistance offered by the airway and the instrument.

The determinants are

A] The elastic properties of the large intrathoracic airways.

B] Lung elastic recoil.

C] The resistance of the smaller intrathoracic airways.

In healthy subjects, PEFR is determined by

a] The volume of the lungs and its elasticity

b] The power and co-ordination of expiratory muscles.

02] <u>Pathophysiological Factors</u>

The commonest pathology resides in the structure or function of the intrathoracic airways, which increases resistance to airflow within them [28].

PEF may also be impaired by

A] Obstruction in extra thoracic airways.

B] Muscular disorders due to limited chest expansion.

C] Nervous system disorders.

In restrictive lung disease, the increased lung elastic recoil may mask the effect of loss of lung volume while determining PEFR .

In severe airflow obstruction, PEFR may be falsely increased due to air coming from the collapsed airways in addition to the lungs .

Exclusion Criteria for Children Based on the American Society 1987 Recommendations:[15]

a) Acute or chronic disease of respiratory system.

b) Congenital anomalies, severe pneumonia or thoracic surgery in the past.

c) Systemic disease.

d) History of smoking.

e) Upper respiratory infection in the preceding three weeks.

In choosing reference standards care should be taken to make sure that age and height range, race and sex etc., are appropriate for the population studied. Height (for particular race) stands as the most appropriate variable for predicting lung function . Arm span can be used instead of height in certain circumstances (eg. Kyphoscoliosis).

Of the many instruments used for measuring PEFR , the most suitable for day to day use are the flow meters that measure peak expiratory flow only(14). International consensus report on asthma has made peak flow measurement one of the main stay of asthma management [18].

Guidelines For Selection of Peak Flow Meter According to of National Heart, Lung And Blood Institute (NHLBI) , USA : [18]

a) Peak flow meters should have a range of 100-400 L/min for children and a 100-700 l/min range for adults.

b) The meter must be accurate over the full range to ± 10%.

c) The reproducibility of the meter must be 10 L/min or ± 5% of the reading, whichever is larger [30].

d) Interdevice variability must be ± 5%.

e) The product labelling contains a statement on the useful life of the peak flow measurement.

Main requirements to record a correct PEFR with regard to the recording equipment are :

1) The accuracy of the readings must comply with values agreed upon.

2) The frequency response must be adequate.

3) PEFR should not be influenced by the internal resistance of the meters.

PEFR monitoring should be performed on a regular basis even when the patient is asymptomatic and also when respiratory symptoms develop.A variation of greater than 20% of baseline may indicate increased reactivity.

Steps for recording PEFR:

a) The peak flow meter should read zero or its lowest reading when not in use.

b) The child should be standing straight while using the flow meter.

c) Ask the child to inspire deeply.

d) Place the peak flow meter in the mouth, with the tongue under the mouth piece.

e) The peak flow meter should be held tight in the mouth.

f) Blow out as hard and fast as possible; do not lean forward while doing so.

g) The procedure has to be repeated two more times with few normal breaths in between and the highest of the three values is to be recorded.

Different studies showed different blows to get good values.

Hutchison in 1946 advised that for forced vital capacity, after a single training attempt, the mean of three satisfactory attempts should be taken as the most representative of the true value.

Medical Research Council advised taking the mean of the third, fourth and fifth of a serial of technically satisfactory expiration after rejecting the first two,while cotes and Tager et al recommended the mean of the best three of five.

Clearly therefore no real agreement on how these values should be determined. However most studies use the highest value from three attempts [21].

Serial measurements of PEFR are more useful than a single measurement for assessing the progress of the disease and the impact of treatment given. The maximal attained value (MAV) recorded by the patient is most important.

USES :

01] Quick diagnosis and assessment of asthma .

In asthmatics wide fluctuations and saw tooth appearance on PEFR plot for is seen for atleast three days .

Diurnal variation >20% in a week is consistent with asthma. Normal variation is <20%.

$$\text{Diurnal variability} = \frac{\text{highest PEFR} - \text{lowest PEFR}}{\text{highest PEFR}} \times 100$$

02] Broncho Dilator Reversibility Response

If PEFR improves by > 20% with inhaled salbutamol after 15 minutes it indicates reversible airway diseases like asthma.

Eg .Baseline PEFR = 150 l/min

Post salbutamol PEFR = 200 l/min

Improvement by 50 l/min

Percentage = 50/150 x 100 =33% indicates asthma

03] Home monitoring of Pulmonary Function Test is not posssible with Spirometry. Whereas it is possible with peak expiratory flow meter which can be interpreted by the parents themselves .

04] PEFR will have temporal relationship to triggers

05] PEFR should be measured before and after treatment by which it is possible to monitor the treatment.

06] If regularly done PEFR gives warning of an impending exacerbation. Therefore prevention can be done by stepping up the dose of preventors.

07] Strength of respiratory muscles can be measured by PEFR. In neuromuscular conditions like Guillian Barre syndrome, serial measurements of PEFR can be used to pick the warning of hypoventillation and will help in initiating early ventilatory support.

08] Admission and discharge criteria of asthma can be derived through PEFR. If it is >60 % of expected PEFR it unwarrants admission. If it is 40 – 60% of the expected value admission may be considered. If it is <40 % of the expected PEFR admission is warranted.

09] Some children have PEFR baseline readings well above or below the published standards. For this reason,an invidual's personal best reading is often used as the target. After determining the target PEFR reading , action plan incorporating the measure can be made.The most common model is that incorporating the traffic light analogs of green, yellow, and red zones corresponding to ALL CLEAR,CAUTION, EMERGENCY respectively.

	PEFR (predicted)	INTERPRETATION
GREEN	80 - 100 %	No symptoms, All Clear
YELLOW	50 - 80%	Symptomatic, indicates Impending Attack
RED	<50%	Symptomatic, indicate need for Immediate Medical Attention.

10] PEFR improvements serve as positive reinforcements to the child and family .

11] PEFR is one of the parameter in the evaluation of asthma exacerbation severity in the urgent/emergency care settings.

Classification of asthma severity using Lung Function Tests :[22]

For adult & children age >5 years who can use a spirometer or peak flow meter

PEFR (predicted)	variabilty	GRADING
>80%	<20%	Intermittent
>80%	20-30%	Mild persistent
60 – 80 %	>30%	Moderate persistent
<60 %	>30%	Severe persistent

Factors limiting the value of observed PEFR: [23]

a) Inadequate understanding of the test due to communication difficulties.

b) Inadequate effort if there is chest or abdominal pain or severe fatigue.

c) Inability to perform the test i.e., patients with neurological disorder who may be unable to initiate or co-ordinate fast movements.

d) Leakage of air around the mouth piece.

e) PEFR is reduced in the sitting or lying patient.

f) PEFR is reduced in obese patients and in patients with left ventricular failure.

The size of the lung determines the total lung capacity, its subdivisions and the indices including the forced expiratory flow. In children upto puberty, these indices are related to stature usually in a curvilinear manner reflecting a linear relationship to height raised to the power of about 2.6 [9].

Various biological factors also influence the lung function. In an individual the position of his body and head, effort taken to generate the maximum flow and circadian rhythm influence the function. Height , weight , age , ethnicity and socioeconomic factors influence the lung function . So it becomes necessary to have separate values for each region [24].

Various studies done to establish the reference values of PEFR of healthy children of urban and rural areas showed that PEFR best correlated with height [25].

Studies done to compare the low socioeconomic children with well nourished urban children showed that PEFR of low socioeconomic children were lower as these children come from a large family , do not have access to good nutrition and live in unhygienic surroundings, which results in lower body proportions compared to well nourished urban children [26].

Studies showed that children with asthma and those with other respiratory diseases had lower PEFR than the healthy children of same age [27].

Studies show that children in whom the measurements done with and without nose clips had no significant difference in PEFR values [28]. Some studies have shown that PEFR correlated well with height, weight, age and body surface area [29].

Height has shown a significant linear relationship with PEFR and it provides the basis for building the normogram to estimate the value of PEFR in a given child. PEFR shows good correlation with weight. This can be explained by the fact that the weight gain during the period and growth is due to musculoskeletal growth and is also a reflection of total volume of all the tissues of the body which increases during periods of growth.

PEFR and body surface area (BSA) are positively related, as BSA is a function of both height and weight. A definite relationship between height and arm span and also between arm span and PEFR was proved.

PEFR and chest expansion are also positively related. This can be explained because approximately the first 1/3rd of forced expiratory maneuver from total lung capacity is effort dependent [29].

Studies show that PEFR correlates well with age, height, and weight and body surface area and also that the average of four PEFR values derived from age, height, weight and body surface area may give a more realistic estimate of an individual's value [30].

In some studies, the PEFR values of girls revealed a plateau effect after the age of 13 years, while that of boys did not show a similar effect [31].

It was shown that high altitude had no significant effect on PEFR as the values of healthy high land tribal children were similar to healthy low land urban north Indian children [32].

Studies shows that the PEFR values recorded in North Indian School children were at par with American children. Studies done among children from southern states of India showed that their PEFR was less than those from Caucasian children and from children of North India . PEFR values of children living in Chennai area (South India) were lower than the western children. These differences are probably attributed to ethnic and nutritional factors [2].

It was recommended that while using mini Wright's peak flow meter, predictive values should be drawn from the studies in which the same instrument has been used [31].

Diurnal variations in PEFR do exist. PEFR tends to be lowest during night and on waking while it reaches its high at noon or early evening. So PEFR needs to be measured at various times of the day. It is also imperative that children who take bronchodilators should take a reading prior to the drug inhalation.

Certain studies demonstrated that the values of all the parameters observed in boys were greater than that observed in girls at all ages more significant during puberty. The best equations for calculation of PEFR in children is obtained by considering separate equations for boys and girls [33].

Studies showed that the timing of the increase in the slope of PEFR against age, height or weight lines may depend on the timing of puberty and this varies in different countries. In view of these finding, it was suggested that centile chart approach to normal values of PEFR is a more appropriate representation of normal values than the conventional straight line graph usually used for children.

Charts of PEFR for age rather than height are probably more convenient for rapid reference in an accident and emergency department or a busy general practice where accurate height readings may not be available [27].

DISADVANTAGE

01] PEFR cannot be used in children less than 5 years. Though some of the studies reveal about the possibility, practically its applicability in children less than 5 years is limited.

02] Its reliability in assessing about the functional integrity of smaller airways is questionable.

03] Though it co relates with FEV1, it does not replace spirometry.

04] PEFR is quite effort dependent.

05] Some children learn how to deliberately adjust the readings by the effort used. So manipulation of the result is possible for the sake of taking leave from school.

PEFR CALCULATION

PEFR can be calculated from following simple equations.

PEFR = {(HEIGHT – 100)×5}+100

IF height is 130 cm, PEFR = (130 – 100) x 5 + 100 =250

PEFR = 100 + (50 for every 10 cm)> 100

If ht is 130 cm,PEFR = 100 + (50+50+50) =250

PEFR = (Height – 80) x 5

IF height is 130 cm,

PEFR = (130 -80) X 5 = 250.

They are useful in the rapid interpretation of PEFR value in routine clinical practice but scientifically they are not acceptable.

Background of the study

What is the normal PEFR for a child?

Predictive values for PEFR may be obtained from the height or an indivudual's personal best value . Which of these is better still remians an enigma. The personal best PEFR value is the highest measurement achieved when the child is free from signs and symptoms.

It is important that the personal best value can be determined only if efforts have been made to ensure that asthma is optimally managed at the time of the measurement.

It should be measured atleast twice a day during the monitoring period of 2 to 3 weeks. On these occasions PEFR recording should be done atleast 3 times per day and the highest of these values to be recorded .

Often it is difficult to have follow up of the children by their parents for very long periods to assess their personal best PEFR. From the clinician point of view, it is difficult to ask the parents with poor education to monitor a child suffering from asthma for a long period to find his personal best value. Hence for the practical purposes , the availability of PEFR normogram or the prediction equation for PEFR based on height is advisable.

Peak expiratory flow rate, a simple test that determines how much of air an individual can exhale has always been an essential tool in bronchial asthma. Studies have shown that peak expiratory flow rates are comparatively less in

asthmatics than in normal population. Normal reference curves have been formulated by studies in western population.

But one of the major determinants of PEFR is the height of the individual. The variability of PEFR in Caucasian and other populations is also well known. In India also, studies of PEFR may vary depending on the ethnicity and ancestry of the various indigenous and diverse population.

Studies of PEFR in Paediatric age groups have been done in certain cities in India and normal curves have been plotted. The studies have been confined to a particular geographical area or city and extrapolation of the studies to include children all over India would be inappropriate. No data is available about peak expiratory flow rate in and around Madurai District. This study aims to construct a normal peak expiratory flow curve in both sexes in the age group of 5 - 12 years according to height.

Aim

1. To estimate the peak expiratory flow rate in school children aged 5 – 12 years from Madurai District.
2. To correlate the PEFR values in relation to biological variables like height , weight , body surface area, and age and to arrive at predicted equations for PEFR as a local reference.

Methodology

961 children (493 boys and 468 girls) were randomly selected from six schools of Madurai district. These children represent a sizeable proportion of the school children from Madurai.

Proper consent was taken from the parents, school authorities before starting the study.

Subjects & Time line

Study Design

Descriptive study

Study Place

Urban and Rural schools from Madurai District

Study population

Healthy school going children from 5 – 12 years from Madurai District.

List of schools

Department - District School Education Department.

High / Higher Secondary School -

01] Gandhi Nikethan Higher Secondary School, T. Kallupatti.

02] Sengunthar Uravin Murai High School, Tallakulam.

03] Elango Corporation Higher Secondary School, Pangal Road .

Elementary School & Primary and Nursery School -

04] Subburayalu Elementary School, Alvarpuram.

05] Pattupochi Sengunthar M. Irulandi Memorial Elementary Tallakulam.

06] Maruthi Primary and Nursery School, Anna Busstand.

Study period

January 2011 – November 2012

Inclusion criteria:

School Children aged 5-12 years of both sexes.

Exclusion criteria

- H/o cough, cold, fever in the past 2 weeks.
- H/o wheezing in the past.
- H/o any significant drug intake in the past 1 week.
- H/o exercise induced asthma in the past.
- H/o any significant systemic illness.
- Children with muscular weakness. severe pallor, clubbing, cyanosis, pedal edema, chest, spine abnormalities.

Age was taken as per the completed years as on the school records. The children were subjected to full clinical assessment. The anthropometric measurements taken were height and weight.

Weight was measured in kilograms (kgs) using standard weighing machine. Weight was taken without footwear and with light clothes. Weighing Machine was kept on absolutely flat surface and was calibrated before taking Measurements. Accuracy of the weighing machine was upto 50 grams. Any fraction of weight thus measured was corrected to the nearest kilogram.

Standing height was measured by making the child to stand against a fixed calibrated rod with adjustable headrest. Height was measured without foot wear, with the children standing erect, looking forward with feet closed, back of head and body touching the rod. The measured height was then corrected to the nearest centimeter.

PEFR was measured by EU scale peak flow meter (60-800 l/min).

It is a plastic cylindrical tube with a graduated scale on the surface and a mouth piece. Graduation starts with 60 l/min to 800 l/min with accuracy of 10 l/min. Indicator of PEFR remains in place of reading unless brought back manually by the operator. All the measurements of PEFR are taken in the standing position.

The purpose of the test and procedure was explained to the children. Then the procedure was demonstrated in detail so as to familiarize them with the procedure and to get their full cooperation.

Each child was told to take a deep breath and then blow into peak flow meter as hard and as fast as possible through mouth piece and was closely watched to ensure that he/she maintained an air tight seal between the lungs and the mouth piece of the instrument.

The procedure was repeated thrice and the highest value of these 3 readings was taken as the observed PEFR. Disposable mouth pieces were used for recording the PEFR.

Regression analysis was used to calculate the predicted normal values of PEFR and also to assess its relation to weight and height.

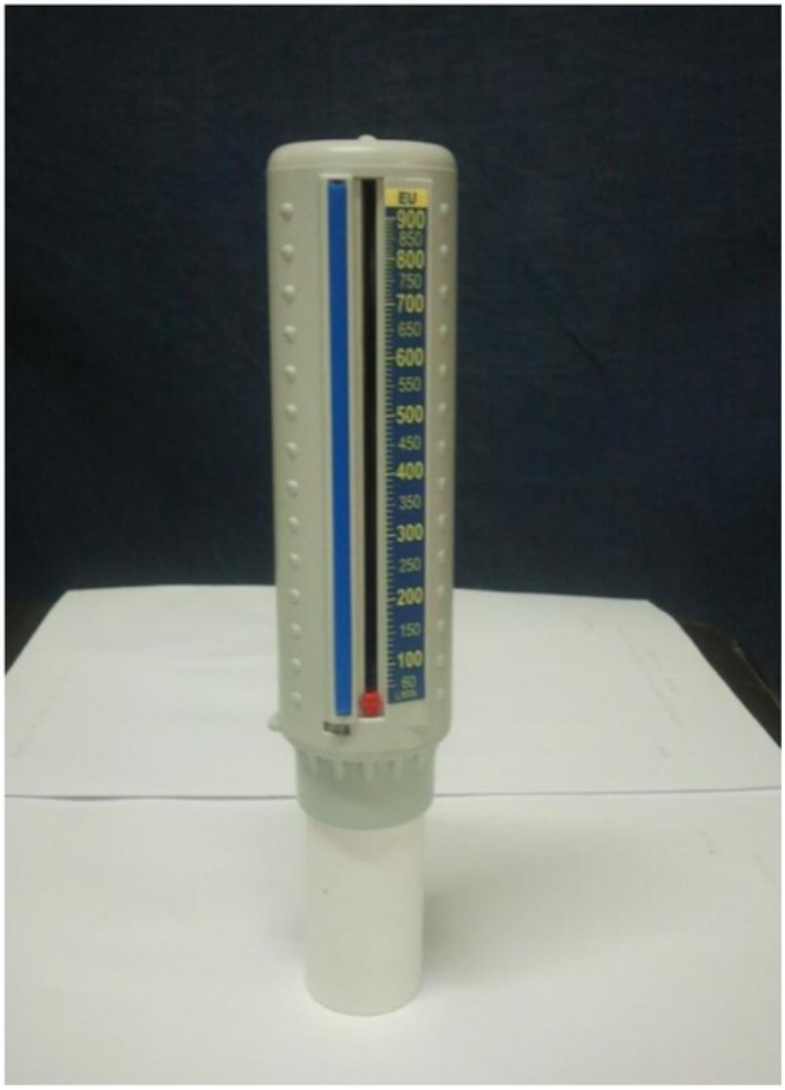


Fig 7: peak expiratory flow meter

Fig 8 : peak expiratory flow meter procedure

RESULTS

The data of 961 children (5-12 yrs) obtained by peak flow meter were analyzed with respect to age, sex, height and weight. Body surface area was calculated from measured height, weight by using Mosteller's formula.

Results of observations are shown in table i - xxiii and graphs i - xi.

The name, age, height and weight and PEFR of each individual is shown in the annexure.

STATISTICAL ANALYSIS

Statistical analysis was done using the SPSS (statistical package for social Science). Statistical methods used were karl pearson's correlation coefficient, student t test, P-value and linear regression analysis. Linear regression analysis was performed using age, weight, height and body surface area as independent variables and PEFR as the dependent variable. Prediction equation for PEFR was derived by using both univariate and Multiple Regression analysis. Since the difference in PEFR between boys and girls at any given height in the age group studied was small but statistically significant, data was analyzed both as a whole sample and separately for boys and girls. Hence separate normograms relating PEFR to height for boys and girls were constructed using the data.

TABLE 1

MEAN WEIGHT, SD & ITS RELATION WITH AGE IN BOYS

Age (years)	Number	Mean	Median	SD	Minimum	Maximum
5	15	15.87	16	2.99	12	22
6	46	16.82	17	2.20	11	24
7	48	18.98	19	3.29	15	26
8	50	20.38	20	3.01	15	30
9	32	21.20	21.75	3.59	14	28
10	57	25.47	25	3.93	16	36
11	128	27.04	26	5.15	19.5	47
12	117	31.50	30	6.47	19	58

Table 1 shows the mean weight, SD of boys in various age groups

TABLE 2

MEAN WEIGHT, SD & ITS RELATION WITH AGE IN GIRLS

Age (years)	Number	Mean	Median	SD	Minimum	Maximum
5	21	15.29	15	2.19	12	19
6	44	15.87	15	2.49	11	21
7	42	18.4	18.5	3.19	13	25
8	55	20.55	21	3.12	14	26
9	59	21.04	20	4.66	14	41
10	69	24.10	24	3.94	16	36
11	94	28.27	27.5	6.48	18	48
12	84	32.45	32	6.83	19.5	57

Table 2 shows the mean weight, SD of girls in various age groups

TABLE 3

MEAN HEIGHT, SD & ITS RELATION WITH AGE IN BOYS

Age (years)	Number	Mean	Median	SD	Minimum	Maximum
5	15	107.20	105.00	6.62	100.0	123.0
6	46	109.20	110.00	5.90	96.0	125.0
7	48	115.56	114.50	5.98	102.0	129.0
8	50	120.72	119.50	6.57	107.0	134.0
9	32	124.89	125.25	6.24	110.0	139.0
10	57	132.17	132.00	7.12	112.0	148.0
11	128	134.10	133.15	6.76	117.5	152.0
12	117	139.40	138.20	7.10	123.4	160.0

Table 3 shows the mean weight, SD of boys in various age groups

TABLE 4

Mean height, SD & its relation with age in girls

Age (years)	Number	Mean	Median	SD	Minimum	Maximum
5	21	102.90	103.00	3.97	97.0	110.0
6	44	106.61	105.25	6.58	95.5	121.0
7	42	115.16	115.00	5.41	107.0	132.0
8	55	119.92	122.00	5.58	106.0	130.0
9	59	124.02	124.00	7.83	106.0	150.0
10	69	128.13	127.00	6.42	116.0	144.0
11	94	134.05	133.00	6.97	120.0	148.0
12	84	139.14	138.75	7.33	123.0	157.0

Table 4 shows the mean height, SD of girls in various age groups

TABLE 5

MEAN BODY SURFACE AREA, SD & ITS RELATION WITH AGE IN BOYS

Age (years)	Number	Mean	Median	SD	Minimum	Maximum
5	15	0.69	0.67	0.069	0.6	0.9
6	46	0.71	0.72	0.063	0.5	0.9
7	48	0.78	0.77	0.077	0.7	1.0
8	50	0.83	0.83	0.086	0.7	1.1
9	32	0.86	0.86	0.089	0.7	1.0
10	57	0.97	0.95	0.098	0.7	1.2
11	128	1.00	0.98	0.112	0.8	1.4
12	117	1.10	1.07	0.131	0.8	1.6

Table 5 shows the mean body surface area , SD of boys in various age groups.

TABLE 6

MEAN BODY SURFACE AREA, SD & ITS RELATION WITH AGE IN GIRLS

Age (years)	Number	Mean	Median	SD	Minimum	Maximum
5	21	0.67	0.66	0.06	0.6	0.8
6	44	0.69	0.68	0.07	0.5	0.8
7	42	0.77	0.77	0.08	0.6	0.9
8	55	0.83	0.83	0.08	0.6	1.0
9	59	0.85	0.83	0.11	0.7	1.3
10	69	0.92	0.94	0.09	0.7	1.2
11	94	1.02	1.00	0.14	0.8	1.4
12	84	1.12	1.10	0.14	0.8	1.5

Table 6 shows the mean body surface area , SD of girls in various age groups. The mean weight is slightly higher in girls where as the mean height, BSA are Higher in boys in the most of the individual age group.

TABLE 7

MEAN WEIGHT, SD & ITS RELATION WITH PEFR IN BOYS

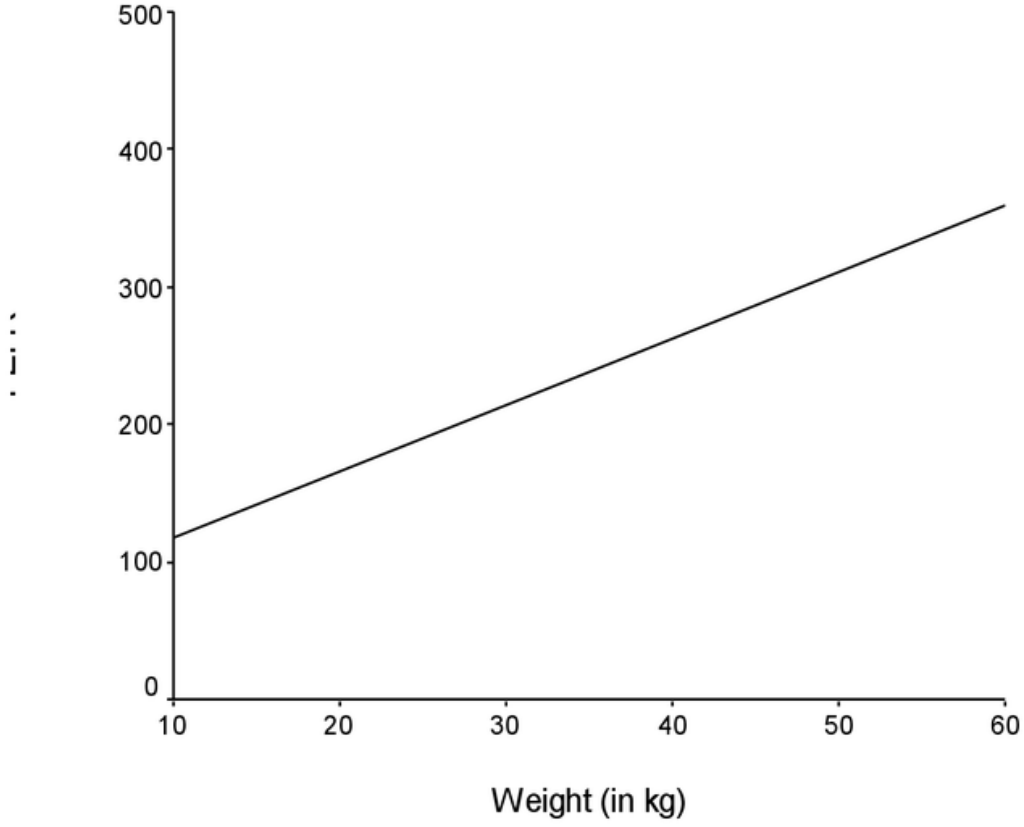
Age (years)	Number	Mean weight	SD	R value	Regression equation for PEFR wt. In.kg
5	21	15.29	2.19	0.202	1.798(wt) +78.144
6	44	15.86	2.49	0.615	8.154(wt) -17.332
7	42	18.4	3.19	0.473	4.895(wt)+45.005
8	55	20.55	3.12	0.303	2.987(wt)+99.938
9	59	21.04	4.66	0.147	1.229(wt)+172.994
10	69	24.1	3.94	0.447	5.035(wt)+79.451
11	94	28.27	6.48	0.251	1.530(wt)+169.168
12	84	32.45	6.83	0.377	2.168(wt)+154.750

Table 7 shows the mean weight, SD of boys in various age groups and its relation with PEFR.

In order to know the relation between weight and PEFR, correlation coefficients were determined for each weight with corresponding age. It can be seen that in all age groups PEFR was positively related with weight. Using this relationship, PEFR was predicted for each age group corresponding to mean weight.

GRAPH 1

PEFR FOR VARIOUS WEIGHTS WITH REGRESSION EQUATION IN BOYS



Graph 1 shows predicted PEFR plotted against various weights in boys from the regression equation for PEFR with weight as independent variables.

It can be seen that PEFR steadily increases with increase in weight.

PEFR= 4.85 (Wt) + 68.51

r = + 0.664

TABLE 8

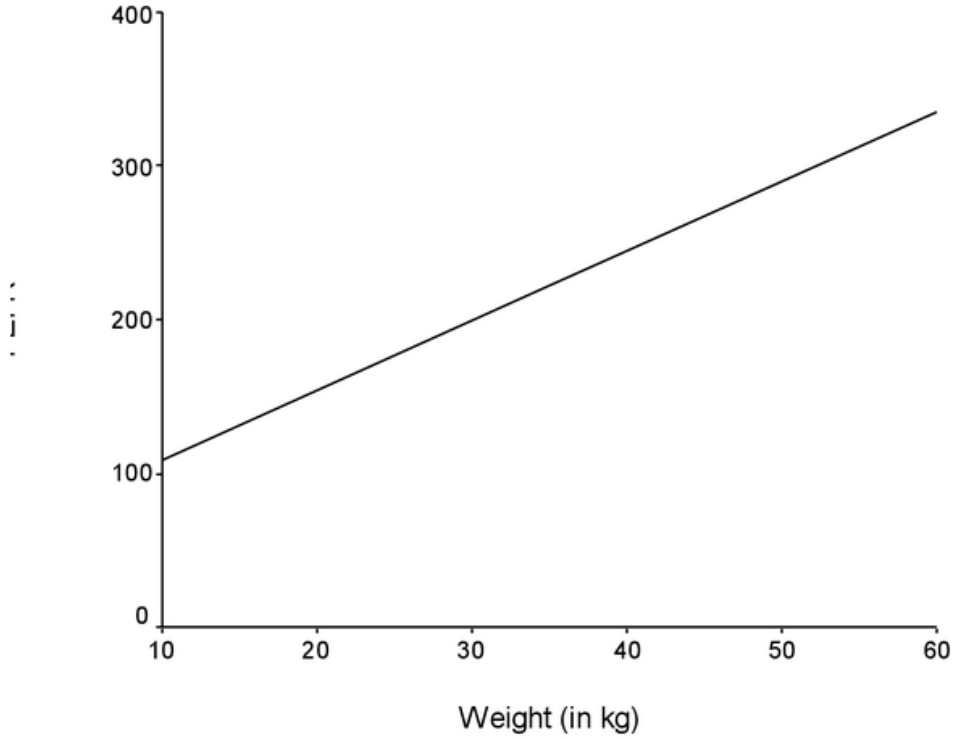
MEAN WEIGHT, SD & ITS RELATION WITH PEFR IN GIRLS

Age (years)	Number	Mean Weight	S.D	R value	Regression equation for PEFR wt in kg
5	21	15.27	2.19	0.27	1.677(wt) +65.801
6	44	15.87	2.49	0.50	5.473(wt) +15.225
7	42	18.4	3.19	0.17	1.571(wt) +105.614
8	55	20.55	3.12	0.18	1.999(wt) +112.200
9	59	21.04	4.67	0.41	2.469(wt) +126.012
10	69	24.10	3.94	0.34	2.615(wt) +122.919
11	94	28.27	6.48	0.43	2.301(wt) +135.912
12	84	32.45	6.82	0.33	1.938(wt) +150.585

Table 8 shows the mean weight, SD of girls in various age groups and its relation with PEFR. In order to know the relation between weight and PEFR, correlation coefficients were determined for each weight with corresponding age. It can be seen that in all age groups PEFR was positively related with weight. Using this relationship, PEFR was predicted for each age group corresponding to mean weight.

GRAPH 2

PEFR FOR VARIOUS WEIGHTS WITH REGRESSION EQUATION IN GIRLS



Graph 2 shows predicted PEFR plotted against various weights in girls from the regression equation for PEFR with weight as independent variables.

It can be seen that PEFR steadily increases with increase in weight.

PEFR= 4.85 (Wt) + 68.51

r = + 0.685

TABLE 9

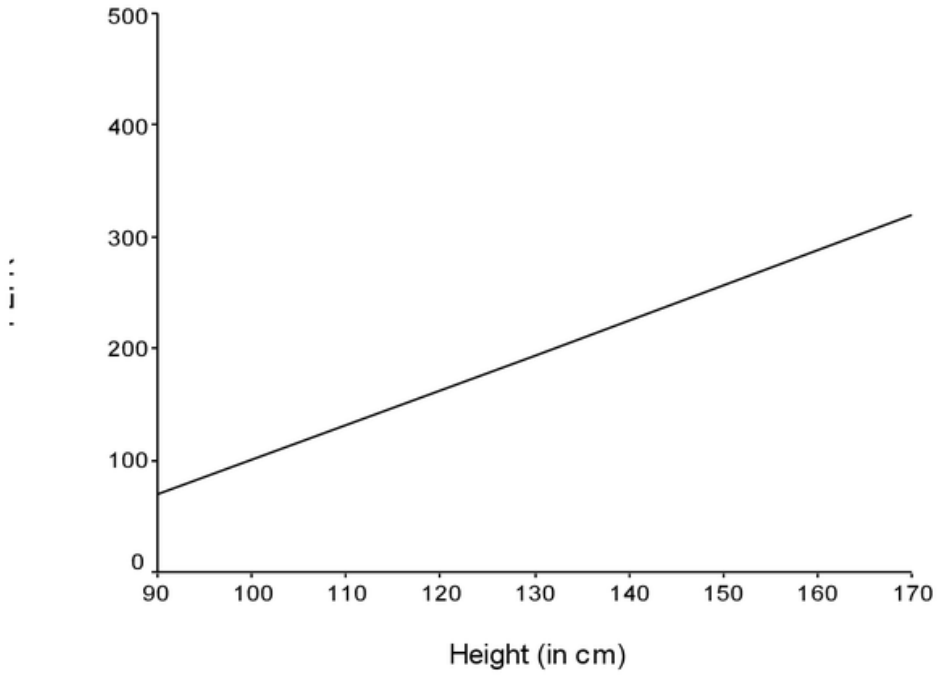
MEAN HEIGHT,SD & ITS RELATION WITH PEFR IN BOYS

Age (years)	Number	Mean Height	SD	R value	Regression Equation for PEFR Ht in cm
5	15	107.20	6.62	0.16	0.506(ht)-160.888
6	46	109.12	5.90	0.53	2.628(ht)-167.227
7	48	115.57	5.98	0.57	2.942(ht)-202.056
8	50	120.72	6.57	0.18	0.874(ht)+55.291
9	32	124.89	6.24	0.44	2.132(ht)-67.254
10	57	132.17	7.12	0.54	3.350(ht)-235.009
11	128	134.02	6.76	0.38	1.784(ht)-28.689
12	117	139.32	7.10	0.37	1.974(ht)-52.186

Table 9 shows the mean height, SD of boys in various age groups and its relation with PEFR. In order to know the relation between height and PEFR, correlation coefficients were determined for each height with corresponding age. It can be seen that in all age groups PEFR was positively related with height. Using this relationship, PEFR was predicted for each age group corresponding to mean height.

GRAPH 3

PEFR FOR VARIOUS HEIGHTS WITH REGRESSION EQUATION IN BOYS



Graph 3 shows predicted PEFR plotted against various heights in boys from the regression equation for PEFR with height as independent variables.

It can be seen that PEFR steadily increases with increase in height.

PEFR= 3.12(Ht) – 211.85

r = + 0.762

TABLE 10

MEAN HEIGHT, SD & ITS RELATION WITH PEFR IN GIRLS

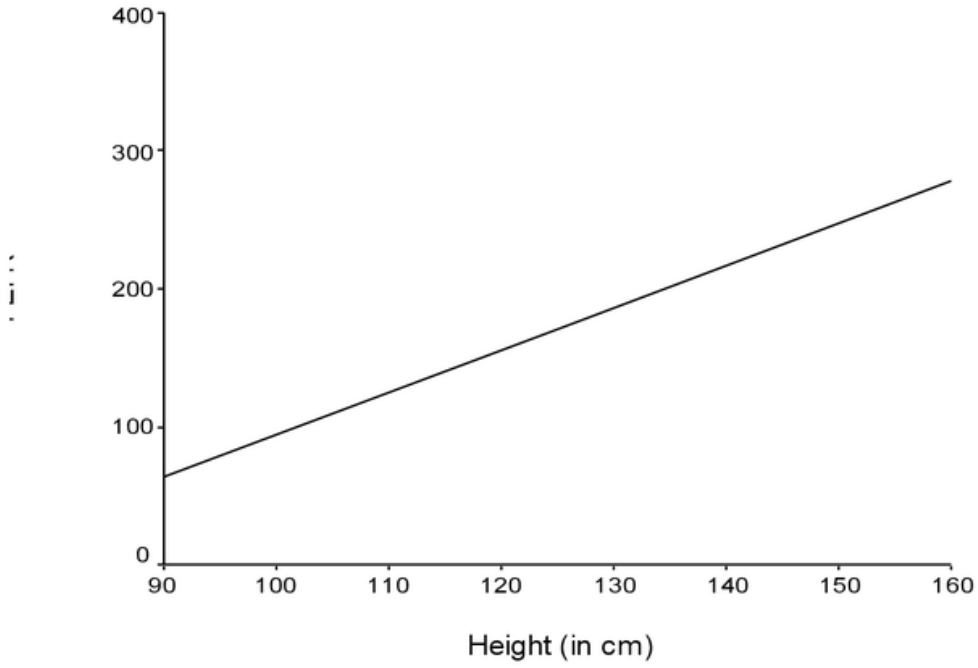
Age (years)	Number	Mean height	S.D	R value	Regression equation for PEFR Ht in cm
5	21	102.90	3.97	0.21	0.724(ht)+16.947
6	44	106.61	6.58	0.61	2.509(ht)-165.416
7	42	115.16	5.40	0.35	1.959(ht)-91.093
8	55	119.92	5.58	0.44	2.693(ht)-169.628
9	59	124.01	7.83	0.42	1.510(ht)-9.248
10	69	128.13	6.42	0.36	1.723(ht)-34.795
11	94	134.05	6.97	0.49	2.417(ht)-123.084
12	84	139.14	7.33	0.41	2.071(ht)- 74.720

Table 10 shows the mean height, SD of girls in various age groups and its relation with PEFR.

In order to know the relation between height and PEFR, correlation coefficients were determined for each height with corresponding age. It can be seen that in all age groups PEFR was positively related with height. Using this relationship, PEFR was predicted for each age group corresponding to mean height.

GRAPH 4

PEFR FOR VARIOUS HEIGHTS WITH REGRESSION EQUATION IN GIRLS



Graph 4 shows predicted PEFR plotted against various heights in girls from the regression equation for PEFR with height as independent variables.

It can be seen that PEFR steadily increases with increase in height.

PEFR= 3.07 (Ht) – 212.3

r = + 0.793

TABLE 11

MEAN PEFR, SD & ITS RELATION WITH AGE IN BOYS

Age (years)	Number	Mean PEFR	SD	Minimum	Maximum
5	15	106.67	21.269	80	130
6	46	119.78	29.249	70	200
7	48	137.92	31.145	70	210
8	50	160.80	32.504	90	230
9	32	199.06	30.092	150	270
10	57	207.72	44.281	120	290
11	128	210.55	31.456	130	290
12	117	223.03	37.179	150	400

Table 11 shows the mean PEFR , SD of boys in various age groups

It is evident that mean PEFR increases as age increases in boys

TABLE 12

MEAN PEFR, SD & ITS RELATION WITH AGE IN GIRLS

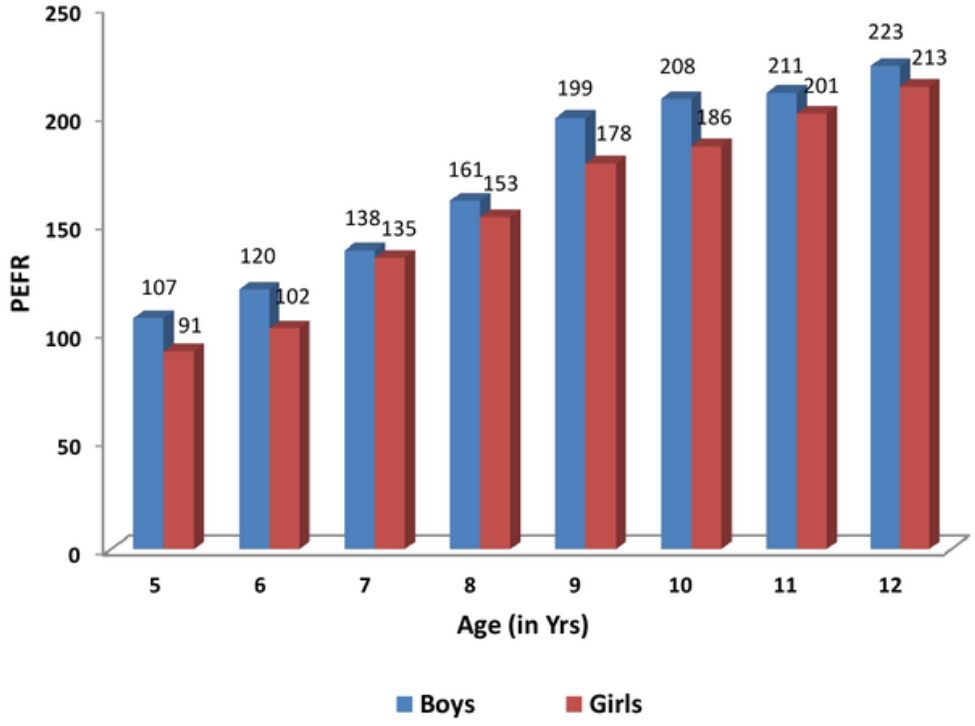
Age (years)	Number	Mean PEFR	SD	Minimum	Maximum
5	21	91.43	13.52	70	120
6	44	102.05	27.16	60	190
7	42	134.52	30.14	80	200
8	55	153.27	34.16	100	220
9	59	177.97	27.96	100	250
10	69	185.94	30.65	110	240
11	94	200.96	34.67	140	300
12	84	213.45	36.59	120	350

Table 12 shows the mean PEFR , SD of girls in various age groups

It is evident that mean PEFR increases as age increases in girls.

GRAPH 5

MEAN PEFR LEVELS WITH RESPECT TO AGE



Graph 5 shows the mean PEFR values of boys and girls in various age groups. It can be seen that PEFR increases as the age increases. Though there is only minimal increment in PEFR values in boys at 6 and 7 years of age than girls, boys had higher levels of mean PEFR than girls in the other age groups.

TABLE 13

MEAN PEFR WITH RELATION T0 HEIGHT

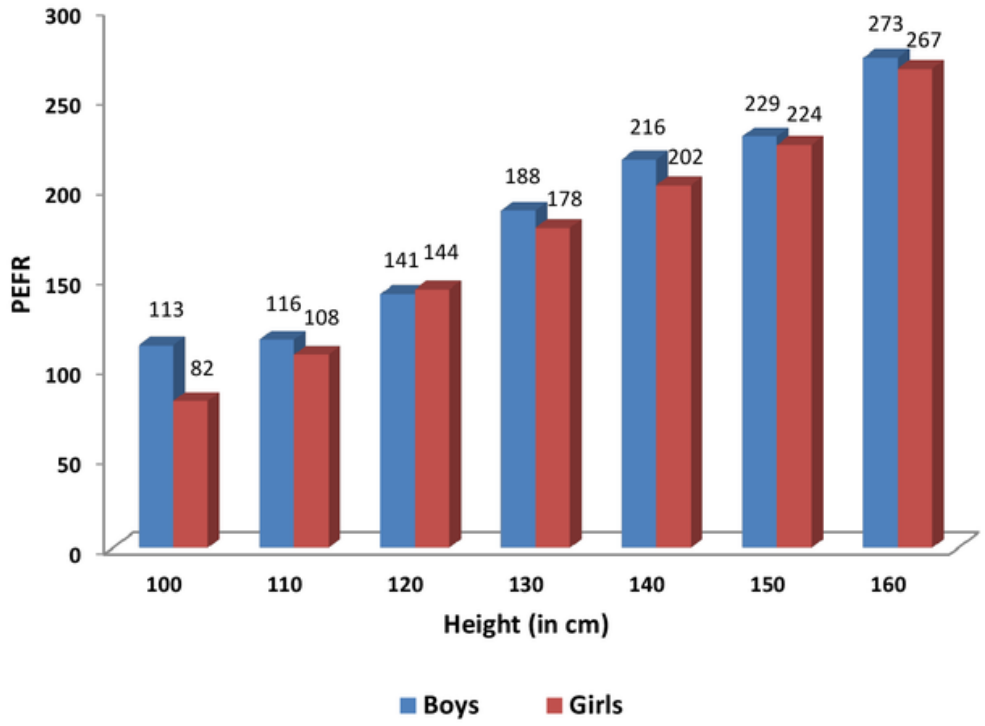
Height	PEFR	
	Boys	Girls
90 -100	112.86	81.88
101-110	116.05	107.69
111-120	141.33	143.91
121-130	187.80	178.19
131-140	216.21	201.89
141-150	229.13	224.36
151-160	272.86	266.67

Table 13 shows the mean PEFR for boys and girls In relation to height.

It can be seen that mean PEFR increases as height increases in both boys and girls.

GRAPH 6

MEAN PEFR LEVELS WITH RESPECT TO HEIGHT



Graph 6 shows the mean PEFR of boys and girls with respect to various heights. It can be seen that mean PEFR increases as height increases in both boys and girls. Boys had a higher value of mean PEFR than girls at a given height.

TABLE 14

PREDICTED PEFR & OBSERVED PEFR IN BOYS

Age (years)	PEFR from regression for weight	Mean PEFR (l/min)	PEFR from regression for height
5	105.7	106	106.6
6	112.3	119.8	119.8
7	135.1	137.9	138
8	161.2	160.8	160.8
9	198.8	199.1	199
10	200.8	207.7	07.9
11	212.5	210.5	210.5
12	225	223	223

Table 14 shows the comparisons of PEFR predicted from mean values of weight and height with that of observed mean PEFR in various age groups in Boys.

Regression equations of PEFR

For weight, PEFR= 4.85(Wt) +68.51

For height, PEFR=3.12 (Ht) – 211.85

TABLE 15

PREDICTED & OBSERVED PEFR IN GIRLS

Age (years)	PEFR from regression for weight	Mean PEFR (l/min)	PEFR from regression for height
5	91.5	91.4	91.4
6	102.2	102.1	102
7	134.5	134.5	134.6
8	153.2	153.3	153.3
9	177.9	177.9	178
10	185.9	185.9	185.9
11	200.9	200.9	200.8
12	213.5	213.5	213.4

Table 15 shows the comparisons of PEFR predicted from mean values of weight and height with that of observed mean PEFR in various age groups in Girls.

Regression equations of PEFR.

For weight, PEFR= 4.85 (Wt) +68.51.

For height, PEFR= 3.07 (Ht) – 212.3.

TABLE 16

REGRESSION EQUATION OF PEFR IN RELATION TO HEIGHT

	Regression equation	P value	r	R2
Boys	PEFR =3.12(ht in cm)-211.85	<o.oo1	0.762	52.7%
Girls	PEFR = 3.07(ht in cm)-212.30	<o.oo1	0.793	57.9%
Entire sample	PEFR = 3.13(ht in cm)-216.22	<o.oo1	0.780	60.8%

TABLE 17

REGRESSION EQUATION OF PEFR IN RELATION TO WEIGHT

	Regression equation	P value	R	R2
Boys	PEFR =4.85(wt inkg)+68.51	<o.oo1	0.664	44.1%
Girls	PEFR = 4.52(wt inkg)+64.07	<o.oo1	0.685	46.9%
Entire sample	PEFR = 4.73(wt in kg)+65.5	<o.oo1	0.673	45.3%

Table 16,17 show the regression lines for PEFR in boys, girls and the entire sample(boys + girls) using weight and height as independent variables respectively. It also shows the correlation coefficient values with different independent variables.

TABLE 18

REGRESSION EQUATION OF PEFR IN RELATION TO AGE

	Regression equation	P value	R	R2
Boys	PEFR =17.07(age in years)+23.99	<o.oo1	0.728	52.9%
Girls	PEFR = 17.4(age in years)+9.79	<o.oo1	0.756	57.2%
Entire sample	PEFR = 17.49(age in years)+9.79	<o.oo1	0.741	55%

TABLE 19

REGRESSION EQUATION OF PEFR IN RELATION TO BSA

	Regression equation	P value	R	R2
Boys	PEFR = 214.3(BSA in m2)-11.73	<o.oo1	0.728	52.9%
Girls	PEFR =200.52 (BSA in m2)-9.83	<o.oo1	0.756	57.2%
Entire sample	PEFR =209.503 (BSA in m2)-12.48	<o.oo1	0.726	52.8%

Table 18,19 show the regression lines for PEFR in boys, girls and entire sample (boys + girls) using AGE and BSA as independent variables respectively. It also shows the correlation coefficient values with different independent variables.

TABLE 20

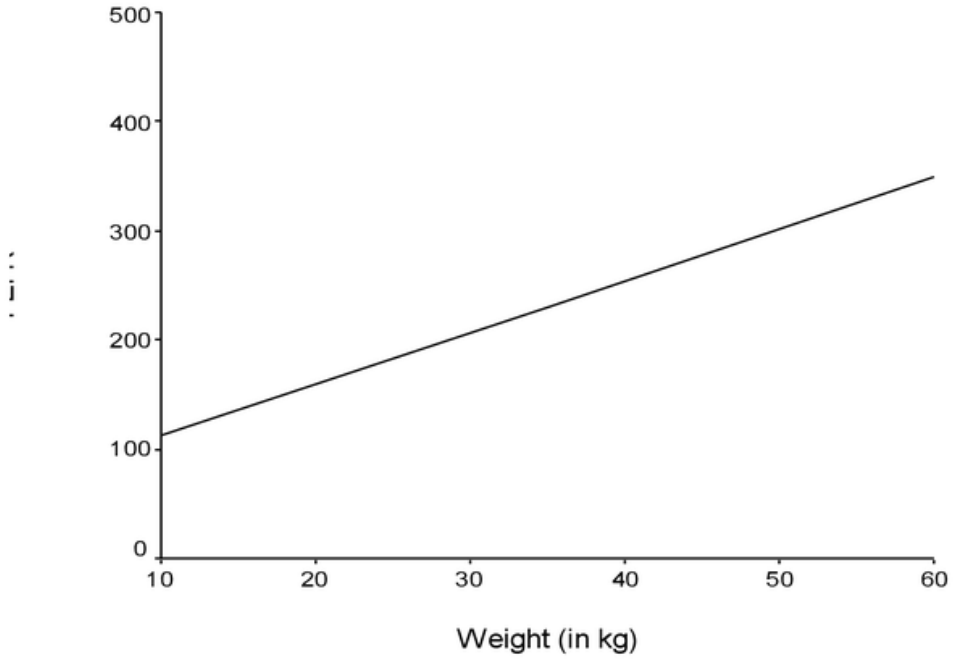
MEAN & SD OF VARIABLES IN VARIOUS GROUPS

Variables	Mean	SD
weight (kg)		
Boys	24.784	6.9584
Girls	23.951	7.4768
Entire sample	24.378	7.2237
Height (cm)		
Boys	128.231	12.4083
Girls	125.491	12.7671
Entire sample	126.897	12.6522
PEFR		
Boys	188.69	50.832
Girls	172.31	49.328
Entire sample	180.71	50.745

Table 20 shows the mean and SD of variables in boys, girls and entire sample (boys + girls) for weight, height and PEFR.

GRAPH 7

PEFR FOR VARIOUS WEIGHTS WITH REGRESSION EQUATION IN ENTIRE SAMPLE



Graph 7 shows the predicted PEFR plotted against various weights in the entire sample (boys+ girls) from the regression equation for PEFR with weight as independent variables.

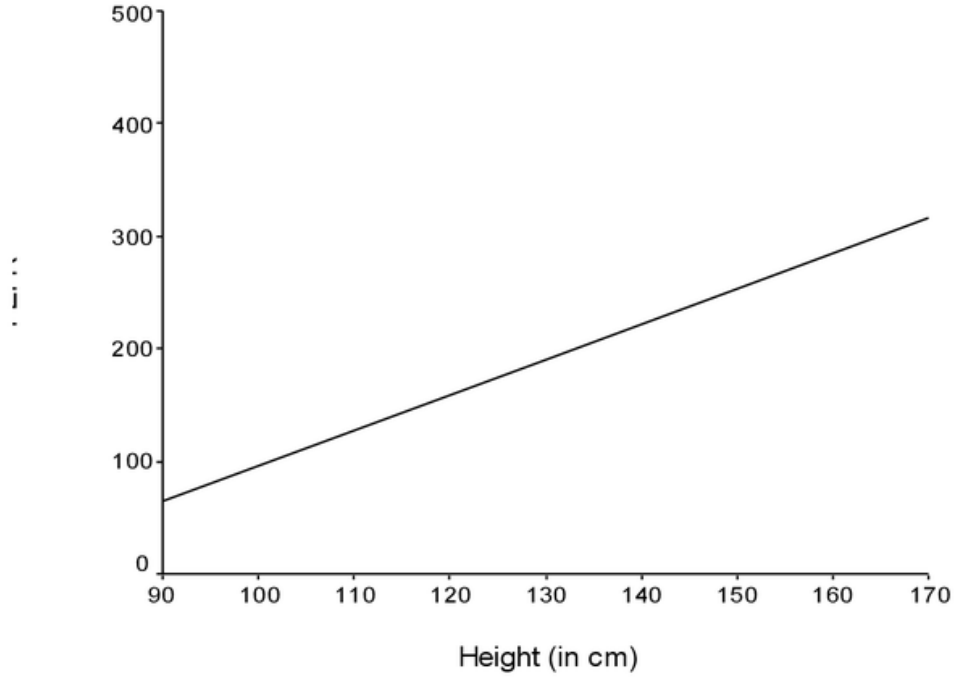
It can be seen that PEFR steadily increases with increase in weight.

PEFR= 4.73(wt in kg)+65.5

r = +0.673

GRAPH 8

PEFR FOR VARIOUS HEIGHTS WITH REGRESSION EQUATION IN ENTIRE SAMPLE



Graph 8 shows predicted PEFR plotted against various heights in entire sample (boys+ girls) from the regression equation for PEFR with height as independent variables.

It can be seen that PEFR steadily increases with increase in height.

PEFR= 3.13(ht in cm)-216.22

r = +0.780

TABLE 21

MEAN PEFR & SE WITH RESPECT TO HEIGHT IN BOYS

Height (cm)	Lower limit Mean -2 se	Mean	Upper limit Mean + 2 se
90-100	100.7	112.9	125.0
101-110	107.4	116.0	124.7
111-120	134.0	141.3	148.6
121-130	181.6	187.8	194.0
131-140	211.0	216.2	221.5
141-150	221.7	229.1	236.6
151-160	228.0	272.9	317.7

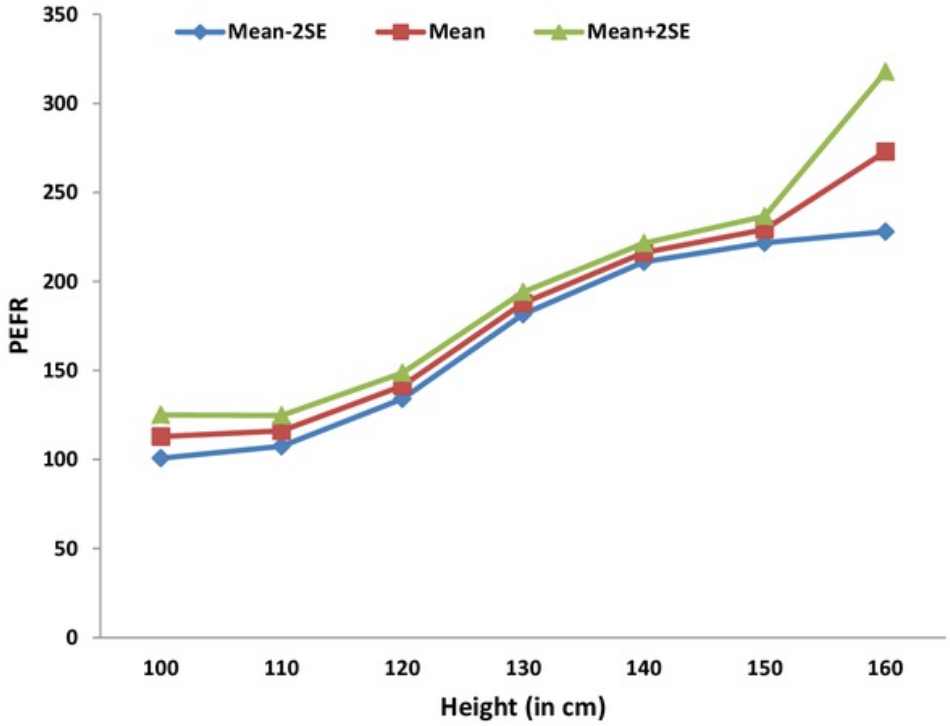
Table 21 shows the mean PEFR & SE with respect to height in boys

Mean -2SE (Lower limit) = - 95% C I

Mean +SE (upper limit) = + 95% C I

GRAPH 9

PEFR NORMOGRAM FOR BOYS (5-12 YRS)



Graph 9 shows the PEFR Normogram from various heights for boys (5-12 yrs) The upper and lower levels denote the +2 SE (+95%) & -2 SE (-95%) around the mean respectively. Middle line denotes the mean PEFR. The mean PEFR value was plotted using the regression equation

PEFR=3.12(Ht in CM)-211.85

r = + 0.0.762

TABLE 22

MEAN PEFR & SE WITH RESPECT TO HEIGHT IN GIRLS

Height (cm)	Lower limit Mean -2 SE	Mean	Upper limit Mean + 2 SE
90-100	73.1	81.9	90.7
101-110	100.6	107.7	114.8
111-120	137.0	143.9	150.9
121-130	173.2	178.2	183.2
131-140	195.5	201.9	208.3
141-150	216.2	224.4	232.5
151-160	183.1	266.7	350.2

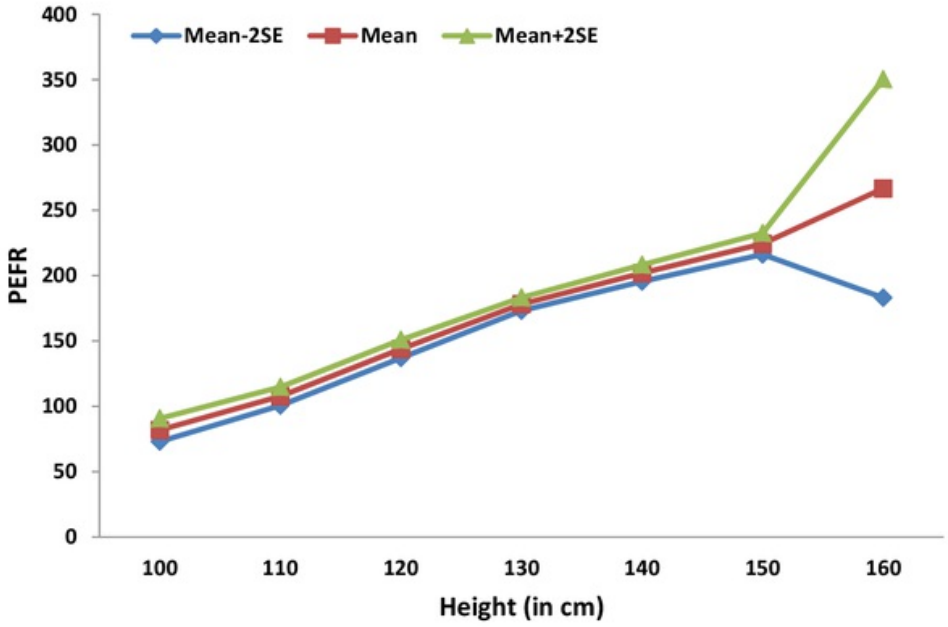
Table 22 shows the Mean PEFR & SE with respect to height in girls

Mean - 2SE (Lower limit) =- 95% CI

Mean + SE (upper limit) =+ 95% CI

GRAPH 10

PEFR NORMOGRAM FOR GIRLS (5-12 YRS)



Graph 10 shows the PEFR Normogram from various heights for girls (8-18 yrs) The upper and lower levels denote the +2 SE (+95%) & -2 SE (-95%) around the mean respectively. Middle line denotes the mean PEFR. The mean PEFR value was plotted using the regression equation PEFR=3.07(ht in cm)-212.30.

r= + 0.793

P < 0.001

TABLE 23

MEAN PEFR & SE WITH RESPECT TO HEIGHT IN ENTIRE SAMPLE(BOYS +GIRLS)

Height (cm)	Lower limit Mean -2 se	Mean	Upper limit Mean + 2 se
90-100	82.0	91.3	100.6
101-110	105.9	111.5	117.0
111-120	137.6	142.6	147.7
121-130	178.7	182.7	186.7
131-140	206.1	210.3	214.4
141-150	221.5	227.0	232.5
151-160	233.5	271.0	308.5

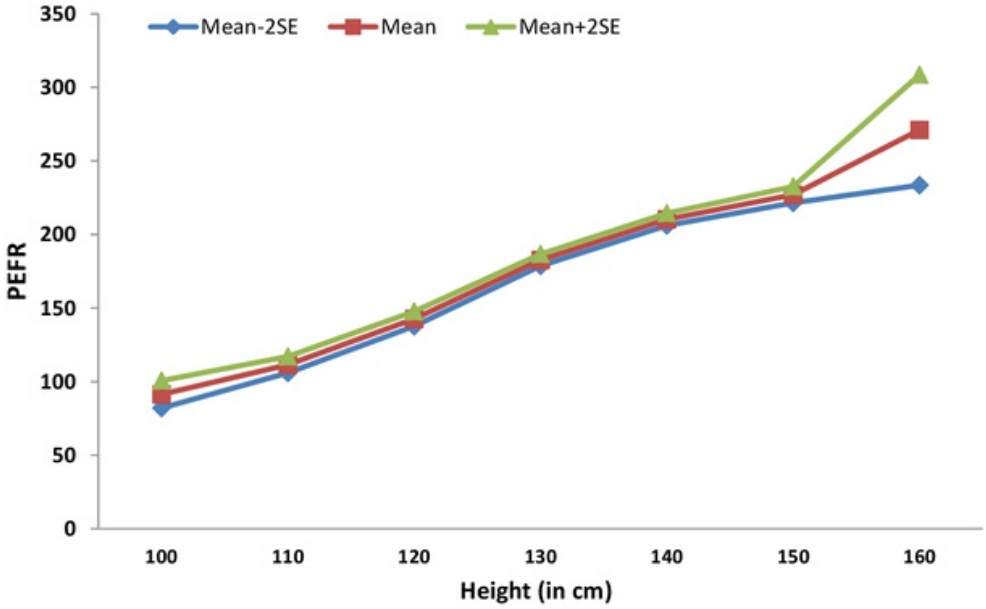
Table 23 shows the Mean PEFR & SE with respect to height in entire sample (boys+girls)

Mean - 2SE (Lower limit) =- 95% C I

Mean + SE (upper limit) =+ 95% C I

GRAPH 11

PEFR NORMOGRAM FOR CHILDREN (5-12 YRS)



Graph 11 shows the PEFR Normogram from height of children (5-12 yrs) of MADURAI DISTRICT. The upper and lower levels denote the +2 SE (+95%) & -2 SE (-95%) around the mean respectively.

PEFR for various heights ranging from 100-180 cms were plotted and thus the mean line was obtained. Middle line denotes the mean PEFR.

The mean PEFR value was plotted using the regression equation

PEFR= 3.13(ht in cm)-216.22

R = + 0.780.

P < 0.001.

MULTIPLE REGRESSION ANALYSIS

Univariate analysis revealed that PEFR was significantly related independently with age, weight and height in both girls and boys separately and combinedly. Hence PEFR was estimated using these variables separately.

In order to know the combined effect of all these independent variables (age, Height and weight) multivariate analysis was performed and the PEFR was estimated.34.

Multiple regression equation was found to be -

For boys: PEFR=20.7(age) +1.43(height) +0.95(weight)-158

For girls: PEFR=11.6(age) +2.34(height) +0.31(weight)-189

DISCUSSION

In our discussion regarding the diagnosis and management of asthma in children at our asthma clinic ,we found lot of difficulties to find out the normal PEFR of a particular child. Then we came to know about the standardisation of peak flow meter instrument. There are a number of non-equivalent scales used in the measurement of peak flow.

- Wright scale
- EN 13826 or EU scale
- A.T.S.(American thoracic society) scale

In this study, EU scale was used which is a log-linear scale and measures peak expiratory flow rate in litres/minute. The peak flow meter used in our study is the breath-o-meter, manufactured and distributed by cipla respiratory, India. It is a handy, compact device that has gradations in litres per minute. It's scale ranges from 60 l/min to 800 l/min. The EU scale is a highly sensitive and accurate flow measuring technique, which minimizes any error in the values obtained using the earlier Wright's scale.

The predicted value of PEFR was given in the pamphlet of the instrument. The values plotted in that pamphlet are mentioned in the following table.

TABLE 24

Height(cm)	**85**	**90**	**95**	**100**	**105**	**110**	**115**	**120**	**125**
PEFR(l/min)	**87**	**95**	**104**	**115**	**127**	**141**	**157**	**174**	**192**
Height(cm)	**130**	**135**	**140**	**145**	**150**	**1550**	**160**	**165**	**170**
PEFR(l/min)	**212**	**233**	**254**	**276**	**299**	**323**	**346**	**370**	**390**

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We felt inconvenient to use this chart as we were unable to calculate normal PEFR for each centimeter of the height .Subsequently on searching the literatures we found that PEFR is dependent on various biological factors like height ,weight, age, body surface area, and chest circumference.

Even though statistical correlation is established between these independent variables and PEFR , height was found to be statistically correlating well compared to the other parameters.

So , height based prediction equation is available for PEFR. But the known fact is that PEFR is variable to each race and ethnicity. So researchers went on doing studies for the establishment of local reference values of PEFR based on height world wide. Some of the interesting observations in those studies are mentioned in the following table

Table 25

Study	Observations on PEFR
Kasim al dawood et al [1]	**Saudi arabian children < other Arab, Europe, North American children**
Sagher et al [16]	**Libyan children > europe and and American children**
Won hee seo et al [13]	**Korean children < european and srilankan children > african, t urkish Children**
Mahajan et al [19]	**Haryana children > other state children**
Parmer et al [20]	**North Indian children = western Children**
Singh et al [30]	**South Indian children < North Indian, western children**

The table 25 indicates the need for region specific local reference values of PEFR in each country. Indian studies showed higher PEFR values for North Indian children compared to South Indian Children.

In south Indian children reference values for PEFR is available for the children of Tamil Nadu , Karnataka, and Kerala in the literatures. The representing samples were taken from Chennai, Davangere District, and Palakad District respectively.

Their results are comparable and children of Palakad district are found to have less PEFR value than the other two group of children.

This kind of inter country , inter state and even inter district variability can be explained by the factors that influence PEFR like biological factors(age, height, weight), geographical pollution ,socio economic status, nutritional status and even the home environmental factors like the type of house ,the fuel used for cooking ,presence of overcrowding in the house, effect of passive smoking on the child. Some of the studies were undertaken to study the effect of pet animals in the house and effect of family history of asthma on the PEFR of children. But they failed to prove any such influence .

TABLE 26

Study	Height					
	120		140		160	
	Boys	Girls	Boys	Girls	Boys	Girls
Carson [27] (Dublin)	250	244	344	332	469	457
Amar taksande[37] (Maharashtra)	217.4	178.9	311.4	251.7	405	324.5
Malik[38] (Punjab)	222	216	320	314	418	412
Pulikal [17] (Kerala)	154.2	139.36	243.1	199.2	333.8	258.1
Swaminathan[2] (Chennai)	205	193	286	272	368	350
Present study (Madurai)	162.6	156.1	224.1	213.3	287.4	278.9

On comparing the PEFR for the children of Madurai District with children of Palakad District and Chennai, the present study group shows lower values . But the girls of Madurai District show higher PEFR values than the girls of Palakad District. The probable reason could be the mean height of the female children from Maduarai District is higher than that of the female children from Palakad District.

PEFR values from Punjab school children were at higher levels compared to the Present study. These studies have slight variation in the PEFR at different heights [38].

PEFR values from Dublin (western) school children were at higher levels Compared to present study [27].

The PEFR values obtained in this study were lower than those of children from North India and the other southern states of India . But Madurai girls had a higher PEFR compared to girls from Pallakad District .

It was also lower than the values obtained from the western world.

Therefore it would be more appropriate for each region to have its own value [24]. Above comparative analysis revealed that the present study results were on par with the studies conducted at different places.

Even Though there is a slight Variation in the PEFR levels at different heights still they are with in the reference range of normal limits predicted in the present study. PEFR increases with increase in height and boys had higher PEFR levels than girls at a given height.

From the present study the correlation co efficient between the independent variables and the dependent variable is mentioned in the following tables.

TABLE 27

Biological Variable	OUTCOME VARIABLE(PEFR)	
	Coefficent Correlation(r)	Statistical significance(p)
Height	0.762	P < 0.001
Age	0.728	
Body surface area	0.717	
Weight	0.664	

Table 27 shows correlation coefficients between the studied variables in boys.

TABLE 28

Biological Variable	OUTCOME VARIABLE(PEFR)	
	Coefficent Correlation(r)	Statistical significance(p)
Height	0.793	P < 0.001
Age	0.756	
Body surface area	0.736	
Weight	0.685	

Table 28 shows correlation coefficients between the studied variables in GIRLS.

TABLE 29

Biological Variable	OUTCOME VARIABLE(PEFR)	
	Coefficent Correlation(r)	Statistical significance(p)
Height	0.780	P < 0.001
Age	0.741	
BSA	0.726	
WEIGHT	0.673	

Table 28 shows correlation coefficients between the studied variables for the ENTIRE SAMPLE(boys + girls).

In the present study statistical correlation is found between height, age, BSA, and weight in all groups. Weight is having less correlation coefficient compared to others.BSA was found to have good correlation that would need separate calculation by using précised formula. The age may be a biased one as it could have been wrongly given by the parents in the school records for various reasons.

So for practical purposes ,the scientific judgement can be made possible by using height or weight based predicted equations. Similar to the previous studies, our study also has highest correlation of PEFR with height by which we also insist upon height based predicted equations for PEFR.

In our study PEFR increases with increase in weight in both boys and girls. In Boys the mean PEFR varies from 106.7 l/min in 15.9 kgs to 223 l/min, in 31.5 kgs, where as in girls PEFR varies between 91.4 l/min in 15.3 kgs to 213.5 l/min in 32.5 kgs.

A study showed mean PEFR levels of 237 l/min in weight range 20-25 kgs and 430 l/min in 45-50 kgs for boys, PEFR of 225l/min in weight range of 20-25 kgs and431 l/min in 45-50 kg for girls [27].

A study showed mean PEFR levels of 264 l/min in weight range 25-29 kgs and 355 l/min in 40-44 kgs for boys, PEFR of 256l/min in weight range of 25-29 kgs and 348 l/min in 40-44 kgs for girls [33].

These studies indicate positive correlation between weight and PEFR.As weight increases PEFR also increases. At a given weight boys had higher levels of PEFR than girls.

From the observations of our study it is noticed that PEFR increases with increase in height and highest correlation was obtained between PEFR and height. (r = + 0.762for boys, r =+ 0.0.793 for girls).

The regression equation based on height for both sexes are

Boys: PEFR = 3.12 (height) – 211.85

Girls: PEFR = 3.07 (height) – 212.3

It is seen that the regression equation for PEFR with height as the independent variable was the best predictor of PEFR.

Thus, the findings of this study correlates well with other studies for a given age, sex, height and weight. Height and weight have strong correlation with PEFR. Therefore it is possible to derive prediction equations for PEFR from three independent variables.

For boys: PEFR = 6.93 (age) + 2.05 (height) + 0.12 (weight) – 143.58.

For girls: PEFR = 6.79 (age) + 2.09 (height) + 0.23 (weight) – 153.9.

CONCLUSION

At the end of the study following conclusions were drawn -

01] Peak expiratory flow rate measurement is a reliable, simple and cost effective Method for assessing the severity of airway obstruction in a child with Obstructive airway diseases like asthma. It helps in the earlier prediction of exacerbations and in monitoring the response to treatment.

02] It is necessary to have separate reference value of PEFR for each region because of ethnic and environmental influences.

03] Children of 5-12 years from Madurai district were included in the study. Regression equations and PEFR normogram were derived for them.

04] The variables which show significant positive relationship with PEFR are height(r=0.78),age(r=0.74),BSA(r=0.73),weight(r=0.67) of which height shows the most significant correlation.

05] Though BSA & age correlate well with PEFR in our study ,some difficulties exist in their practical application for predicting PEFR .They are that BSA needs further formula based calculation& age may be falsely given in the school records or may be forgotten by uneducated parents. So this study recommends.

Deriving predicted equation for PEFR based on height& weight for both genders.

06] Boys have higher PEFR value than girls in our study at a given age.

07] PEFR values of Madurai children were lower than those of children from other southern states & North India but were high when compared with values of female children from Pallakad. It was also lower than those of western children.

08] As age, height and weight have significant corelation with PEFR , multivariate analysis was performed using these independent variables . they are as follows.

For boys: PEFR = 6.93 (age) + 2.05 (height) + 0.12 (weight) – 143.58.

For girls: PEFR = 6.79 (age) + 2.09 (height) + 0.23 (weight) – 153.9.

09] Correlating height alone as an independent predictor of PEFR, equations Would be –

Boys: PEFR = 3.12(ht in cm)-211.85.

Girls: PEFR =3.07(ht in cm)-212.3.

I hereby conclude that the prediction equations for PEFR obtained in this study can be used as local reference for the follow up of children with respiratory disorders in and around madurai district.

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PROFORMA FOR ESTIMATION OF PEAK EXPIRATORY FLOW RATE IN SCHOOL CHILDREN FROM MADURAI DISTRICT.

No :

Date :

Name :

Age :

Sex : male / female

Name of the school:

Residential address: / phone number

Home details

Type of house: kucha/semi pucca/pucca

Number of rooms:

Number of persons in the house:

1. Adults –
2. Chidren-

Type of fuel used for cooking in the house: biomass/kerosene/LP gas

Past history of allergy to any of the following :

A. House dust- yes/no

B. Pollens- yes/no

C. Fumes- yes/no

D. Strongsmell- yes/no

E. Food- yes/no

F. Drug- yes/no

G. Others- yes/no

Family history of asthma or allergy ? Yes/no

History of smoking in the family? Yes/no

Questions regarding medical condition of the child:

H. History of cough/cold/fever in the past 1week?yes/no

I. History of wheezing episodes in the past?-yes/no

J. History of drug intake in past 1 week?-yes/no

K. If so the details about the drug taken?

L. History of exercise induced asthma in the past? -yes/no

M. History of significant systemic illness in the past? -yes/no

General examination

Pallor :

Icterus :

Cyanosis :

Clubbing :

Lymphadenopathy :

Height : cms

Weight : kgs

Exam:

Ear : normal/abnormal

Nose : normal/abnormal

Throat : normal/abnormal

Respiratory system

Rate : normal/abnormal

Shape of the chest : normal/abnormal

Spine : normal/abnormal

Air entry : equal/unequal

Added sounds : absent/present

Cardiovascular system : normal/abnormal

Gastrointestinal system : normal/abnormal

Central nervous system : normal/abnormal

PEFR

1 ……l/min

2 ……l/min

3 ……l/min

MASTER CHART

HEIGHT, WEIGHT, PEFR AND BSA OF CHILDREN AGED 5 YRS FOR BOYS

S.NO	NAME	Ht	Wt	PEFR	BSA
1	ALAGU MUTHU M	100	16	130	0.7
2	ALAGUMUTHU M	100	16	130	0.7
3	RAJA MANIKKAM R	102	15	130	0.7
4	RAJA MANICKAM	102	15	130	0.7
5	KARTHIK S	103	12	90	0.6
6	SANJAY A	104	15	90	0.7
7	SAKTHI P	105	16	80	0.7
8	SURYA PANDI S	105	14	90	0.6
9	DEVA SENA A	105	14	120	0.6
10	PONVIJAY	108	15	80	0.7
11	RYAS KHAN S	111	16	120	0.7
12	SANTHOSH RAJA E	111	16	110	0.7
13	KARUPPASAMY M	114	16	80	0.7
14	SARAVANAKUMAR M	116	20	90	0.8
15	VASANTH V	123	22	130	0.9

HEIGHT, WEIGHT, PEFR AND BSA OF CHILDREN AGED 5 YRS FOR GIRLS

S.NO.	NAME	Ht	Wt	PEFR	BSA
1	DIVYA DARSINI K	97	12	70	0.6
2	GOBIKA SREE P	98	14	120	0.6
3	SOBANA S	98	12	100	0.6
4	GOPIKA SHREE P	98	14	80	0.6
5	PANJU P	98	12	80	0.6
6	MONIKHA R	100	19	100	0.7
7	MONIKA R	100	19	100	0.7
8	SANDHYA K	102	14	80	0.6
9	MUTHUMEENA P	102	14	80	0.6
10	SANDHYA K	102	14	80	0.6
11	KAVITHA K	103	15	90	0.7
12	MUTHEESWARI M	103	16	80	0.7
13	SANDHIYA K	105	15	80	0.7
14	SANDHYA K	105	15	80	0.7
15	MUNEESWARI J	106	15	110	0.7
16	MUTHUPRYA E	106	17	90	0.7
17	SENDUR MEENATCHI P	107	15	110	0.7
18	SENTHUR MEENAKSHI P	107	15	110	0.7
19	SREE KARTHIKA K	108	17	90	0.7
20	LAVANYA P	108	19	90	0.8
21	KARPAGAM N	110	18	100	0.7

HEIGHT, WEIGHT, PEFR AND BSA OF CHILDREN AGED 6 YRS FOR BOYS

SNO	NAME	Ht	wt	PEFR	BSA
1	SUSHITHRA	96	11	100	0.5
2	PERARASU PANDI S	98	15	90	0.6
3	CHITRAI SELVAM M	100	14	100	0.6
4	SEENU KANNAN P	100	16	120	0.7
5	SEENUKANNAN P	100	16	120	0.7
6	CHITRA SELVAM M	101	14	100	0.6
7	MUTHUKRISHNAN V	101	15	100	0.6
8	TAMILARASAN V	101	16	100	0.7
9	KARTHICK S	103	12	90	0.6
10	CHANDRU E	103	15	100	0.7
11	RAM R	104	15	90	0.7
12	AKASH K	106	15	70	0.7
13	DANUSH KUMAR M	106	17	110	0.7
14	BALA MAREES S	107	17	130	0.7
15	BOOMI K	108	15	80	0.7
16	SENBAGARAJ S	109	16	130	0.7
17	VARATHARAJ	109	17	120	0.7
18	SHENBAGARAJ	109	16	130	0.7
19	JEEVA SURYA S	110	17	100	0.7
20	JEEVASURYA S	110	17	100	0.7
21	SAKTHIVEL M	110	17	110	0.7
22	SONAI PANDI V	110	18	150	0.7
23	SONAIPANDI	110	18	150	0.7
24	MADHESH K	110	21	130	0.8
25	GURU PRASAD S	111	17	100	0.7
26	THAYUMANAVAN P	111	17	100	0.7
27	MUTHUMANI	111	16	120	0.7
28	SRIDHAR S	111	17	160	0.7
29	THIMANUVAN P	111	17	100	0.7
30	RAHUL V	112	15	110	0.7
31	RAHUL V	112	18	110	0.7
32	NAGARAJA E	112	18	100	0.7
33	ARAVINDAN M	113	17	150	0.7
34	ARAVINDHAN M	113	17	150	0.7
35	VISHWA P	113	18	100	0.8
36	VISWA V	113	18	100	0.8
37	RAMAKRISHNAMOORTHY	114	16	140	0.7
38	SUBRAMANI V	114	19	150	0.8
39	ANNAVIMADAN P	115	19	160	0.8
40	SRIDHAR S	115	17	160	0.7
41	MAHESKANNAN	115	19	200	0.8
42	PARATHVAJ.S	115	18	150	0.8
43	SARAVANAKUMAR	116	22	160	0.8
44	DHANABALAN	116	18	90	0.8
45	MUKILAN S	118	17	90	0.7
46	HARISH	125	24	190	0.9

HEIGHT, WEIGHT, PEFR AND BSA OF CHILDREN AGED 6 YRS FOR GIRLS

SNO	NAME	Ht	Wt	PEFR	BSA
1	SUSITHRA M	96	11	100	0.5
2	KAVITHA M	96	13	70	0.6
3	KAVYA K	97	14	70	0.6
4	REENA J	98	15	70	0.6
5	KALISWARI K	100	12	70	0.6
6	KEERTHANA P	100	15	60	0.6
7	KALISWARI K	100	12	70	0.6
8	KEERTHANA P	100	15	60	0.6
9	SOPNA M	101	12	90	0.6
10	SOOPNA M	101	12	90	0.6
11	BAVANA.P	101	13	150	0.6
12	ADHI SATHYA M	101	14	80	0.6
13	SONIYA K	102	15	80	0.7
14	SONIA K	102	15	80	0.7
15	YOGA PRYA DARSINI A	104	16	90	0.7
16	YOGA PRIYA DRSHINI A	104	16	90	0.7
17	MONIKA M	104	18	120	0.7
18	HARSINI P	105	15	90	0.7
19	RINABANU	105	15	100	0.7
20	MAHA LAKSHMI V	105	15	120	0.7
21	DEVA SONAI	105	14	120	0.6
22	HARSHINI P	105	15	90	0.7
23	SANDHIYA S	106	18	100	0.7
24	VIJAYA LAKSHMI A	106	15	120	0.7
25	VIJAYA LAKSHMI A	106	15	120	0.7
26	SANDHYA S	106	18	100	0.7
27	PANDI SELVI P	107	15	100	0.7
28	ANITHA M	107	17	90	0.7
29	VIDYA SAEE A	109	17	110	0.7
30	VIDYA SREE A	109	17	110	0.7
31	KEERTHANA M	110	15	110	0.7
32	SANKARESWARI L	112	18	110	0.7
33	KANIMOZHI M	114	15	90	0.7
34	SWETHA P	114	20	110	0.8
35	SWETHA P	114	20	110	0.8
36	KANIMOHZI M	114	15	90	0.7
37	KABEEBA A	114	18	100	0.8
38	KESHIKADEVI	114	18	190	0.8
39	MUTHUMEENA M	115	19	120	0.8
40	MUTHU MEENA M	115	19	120	0.8
41	KEERTHANA S	116	20	140	0.8
42	MEENAKSHI	118	20	100	0.8
43	HARI PRABA N	118	16	110	0.7
44	HAMEDJASMIN.K	121	21	180	0.8

HEIGHT, WEIGHT, PEFR AND BSA OF CHILDREN AGED 7 YRS FOR BOYS

SNO	NAME	Ht	Wt	PEFR	BSA
1	GANGADEVI.M	102	21	110	0.8
2	ATHITHYA.S	106	15	140	0.7
3	KARTHIK RAJA K	108	15	110	0.7
4	MHOMED SULTHAN R	108	16	100	0.7
5	GANESH PANDI K	110	15	100	0.7
6	VISNU RAJ	110	16	110	0.7
7	KARTHIKEYAN.K	110	15	160	0.7
8	VAIRAPANDIAN P	111	18	100	0.7
9	SAKTHIVEL P	111	16	120	0.7
10	KARAN.K	111	17	110	0.7
11	THANGAPANDIYAN.M	111	17	170	0.7
12	VIRA PANDIAN P	111	18	100	0.7
13	BALAMURUGAN M	112	18	140	0.7
14	SARAVANAKUMAR A	112	22	150	0.8
15	BARANI M	112	16	100	0.7
16	JEGADEES R	112	19	70	0.8
17	RAJAVEL K	112	19	120	0.8
18	ANBARASAN.K	112	19	170	0.8
19	SAKTHIVEL	112	20	140	0.8
20	JEGADESHWARAN	112	15	90	0.7
21	JEGADEESWARAN	112	15	90	0.7
22	VASANTHARAJ	113	19	150	0.8
23	RAJAPANDI P	114	17	180	0.7
24	RAJA PANDIAN P	114	17	180	0.7
25	RAJAVELU	115	17	140	0.7
26	RAJESH.K	116	21	130	0.8
27	MUJBUR RAHMAN	116	16	130	0.7
28	SURESH KONGAYA P	117	20	100	0.8
29	BALAMURUGAN M	117	17	150	0.7
30	MEENATCHI SUNDRAM.K	118	17	150	0.7
31	PRASATH SABARI KRISHNAK	118	20	160	0.8
32	SAMPATHKUMAR	118	21	170	0.8
33	PONRAJ M	119	19	100	0.8
34	KANNAN S	119	19	130	0.8
35	GOKUL	119	20	150	0.8
36	VARATHARAJ K	119	20	140	0.8
37	VIGNESH	120	20	150	0.8
38	SUDALAMANIYAN.A	121	22	160	0.8
39	SURYAPRAKASH	121	24	170	0.9
40	GANESH.V	121	18	150	0.8
41	YOGESH WARAN	121	20	180	0.8
42	SAMAYAN P	122	25	140	0.9
43	YOKESH.S	122	19	120	0.8
44	JAYAPRAKASH.M	125	25	170	0.9
45	VETRIVELAN	126	26	150	1
46	SANTHOSH	127	23	170	0.9
47	SELVAPANDI	128	22	210	0.9
48	ANANDHA RAMAN.R	129	26	190	1

HEIGHT, WEIGHT, PEFR AND BSA OF CHILDREN AGED 7 YRS FOR GIRLS

SNO	NAME	Ht	Wt	PEFR	BSA
1	SELVARANI.S	107	13	160	0.6
2	MONISHA.C	107	14	120	0.6
3	MALINA M	107	15	80	0.7
4	PANDIMEENA K	108	18	110	0.7
5	ARTHI.S	109	14	140	0.7
6	REKA.K	109	13	130	0.6
7	BAVITHRA.A	109	14	150	0.7
8	PAVITHRA P	110	16	80	0.7
9	SELVAPARATHI.K	110	16	140	0.7
10	KARTHIKA KALYANI	111	20	140	0.8
11	SATHYA P	112	15	80	0.7
12	SELVI.K	112	17	160	0.7
13	BARANI M	112	21	100	0.8
14	JEYABARATHI C	113	16	120	0.7
15	TAMILAN.P	113	17	110	0.7
16	SATHIYALEKSHMI.K	113	18	150	0.8
17	SATHYALAKSHMI K	113	18	150	0.8
18	KOPIKA.K	114	15	170	0.7
19	VIGNESWARI P	114	16	180	0.7
20	DHARSHINI.S	115	20	160	0.8
21	JOTHI R	115	15	120	0.7
22	KEERTHANA S	115	20	120	0.8
23	ROGINI.L	115	22	110	0.8
24	SIVARARANJANI U	116	17	130	0.7
25	KRISHNAVENI N	116	16	100	0.7
26	SIVA RANJANI U	116	17	130	0.7
27	NANDHINI M	116	24	80	0.9
28	PRIYA.P	117	19	170	0.8
29	ADHILAKSHMI M	117	20	100	0.8
30	JEEVITHA.T	117	19	120	0.8
31	MANGAYARKARASI	118	19	120	0.8
32	SANTHIYA.M	118	20	170	0.8
33	KARTHIKA P	118	21	120	0.8
34	LOGANAGI.S	118	19	120	0.8
35	SEYA KAVYASI	119	20	160	0.8
36	KARTHIKAI DHARSHNI.D	120	21	160	0.8
37	JAPA ALAGI.M	121	22	200	0.9
38	SONIYA.A	123	23	180	0.9
39	TAMILSELVI.P	123	25	160	0.9
40	ESWARI I	124	23	140	0.9
41	FATHIMA BANU	126	21	170	0.9
42	NIVETHA	132	24	140	0.9

HEIGHT, WEIGHT, PEFR AND BSA OF CHILDREN AGED 8 YRS FOR BOYS

SNO	NAME	Ht	Wt	PEFR	BSA
1	KARTHIK.O	107	15	180	0.7
2	MUTHUMARI M	109	16	130	0.7
3	SANKAR PANDY.M	109	16	180	0.7
4	SATHISHKUMAR.R	110	17	170	0.7
5	SURYA M	112	15	160	0.7
6	PALPANDY.A	113	17	170	0.7
7	SANTHOSH K	113	17	140	0.7
8	MANIVIJAY M	114	16	110	0.7
9	LAKSHMANA NARAYANAN T	115	17	110	0.7
10	MUNIANDI K	115	20	150	0.8
11	SANTHOSH A	116	18	200	0.8
12	JEYAGANESH	117	17	170	0.7
13	MHOMED ARIF KHAN A	117	20	180	0.8
14	BARTH.P	117	20	150	0.8
15	SUNDAR.P	117	21	140	0.8
16	CHIN RAJ V	117	17	130	0.7
17	BALA DARSINI P	117	20	100	0.8
18	ESWARPANDI.M	117	21	170	0.8
19	SUNDRAPANDIYAN	118	22	170	0.8
20	KEERTIVASAN.A	118	18	190	0.8
21	SARAVANAKUMAR L	119	21	170	0.8
22	MANIKANDAN S	119	20	160	0.8
23	VAIRAPANDI	119	24	150	0.9
24	PRIYA S	119	19	150	0.8
25	SIVARAMAKRINAN.K	119	20	190	0.8
26	ARJUN K	120	16	150	0.7
27	SYED IBRAHIM S	122	17	100	0.8
28	SANTHOSH KUMAR.R	122	18	150	0.8
29	MASANAM,A	122	21	170	0.8
30	MUNIYANDI K	123	19	150	0.8
31	DINESH R	123	20	130	0.8
32	PRAPAGARAN.R	124	20	150	0.8
33	PON MADA SAMY P	124	23	120	0.9
34	DINESH.O	125	21	200	0.9
35	ARUNKUMAR M	125	21	170	0.9
36	KARTHIKEYAN.M	125	22	190	0.9
37	PRAVEEN.P	125	21	160	0.9
38	PARTHASARATHI M	126	23	180	0.9
39	TAMILINIYAN M	126	24	230	0.9
40	KATHIRAVAN R	126	25	160	0.9
41	MUNEESHWARAN.S	126	25	220	0.9
42	KARNA	128	25	210	0.9
43	KARTHIK M	129	21	150	0.9
44	THANGAPANDI.V	129	20	170	0.8
45	ABISEK M	130	24	200	0.9
46	MUNEESWARAN K	130	25	160	1
47	THANUSH PANDI M	131	24	90	0.9
48	NESAMANIKANDAN R	131	25	100	1
49	SABARIVEL M	133	25	200	1
50	JAYA RAMAN.A	134	30	210	1.1

HEIGHT, WEIGHT, PEFR AND BSA OF CHILDREN AGED 8 YRS FOR GIRLS

SNO	NAME	Ht	Wt	PEFR	BSA
1	GAYATHIRI.S	106	14	150	0.6
2	MUTHULEKSHUMI.S	107	16	120	0.7
3	JEEVA ARUL SONIA	107	14	100	0.6
4	JEEEVA ARUL SONIYA A	107	14	100	0.6
5	MADHU BALA K	111	24	110	0.9
6	ANANDHI K	112	18	120	0.7
7	SIVARARANJANI P	114	15	150	0.7
8	KAVYA M	115	19	120	0.8
9	MADHU BALA.S	115	20	170	0.8
10	ABINAYA.K	116	16	130	0.7
11	JEYAPRIYA R	116	22	150	0.8
12	ABIYA V	116	19	100	0.8
13	KARTHIKAI RANI.M.P	116	18	210	0.8
14	LATHA.P	116	21	150	0.8
15	PRIYA.N	117	17	150	0.7
16	ANADAVALLI M	117	22	160	0.8
17	ANU PRIYA.K	117	18	180	0.8
18	SANGEETHA.P	118	18	120	0.8
19	SNEHA V	118	20	110	0.8
20	MEENATCHI S	118	21	160	0.8
21	SHARMILA.K	119	20	140	0.8
22	PRIYA S	119	19	150	0.8
23	PRYA MEENATCHI	119	24	140	0.9
24	DHARANI.K	120	19	200	0.8
25	NITHISH KUMAR.S	120	21	180	0.8
26	PANDESHWARI.M	120	25	170	0.9
27	DHARSHINI.A	121	19	150	0.8
28	SOWNDARYA.M	122	20	140	0.8
29	YAMUNASREE	122	18	160	0.8
30	NITHYA	122	19	170	0.8
31	GANGA DEVI M	122	23	100	0.9
32	SANDHYA M	122	25	100	0.9
33	SAKTHIPRIYA K	123	21	110	0.8
34	MOGANABARATHI P	123	18	170	0.8
35	MAGALEKSHMI.S	123	19	220	0.8
36	PRABHAVATHI	123	21	180	0.8
37	SOUNDRANAYAKI R	123	23	140	0.9
38	VAISNAVI K	123	18	170	0.8
39	VIJAYALAKSHMI T	123	23	150	0.9
40	SARA ALIF K	124	25	210	0.9
41	ANEESH FATHIMA A	124	21	200	0.8
42	ARTHI.A	124	20	160	0.8
43	RAJESWARI K	124	22	150	0.9
44	MADUMITHA N	124	24	200	0.9
45	MUTHUMARI K	125	21	100	0.9
46	KAVYA LAKSHMI P	125	24	110	0.9
47	PAVITHRA.S	125	24	200	0.9
48	SHARUMATHY	125	22	170	0.9
49	BUVANESHWARI.P	126	24	170	0.9
50	DHARSHNA SHREE	126	26	180	1
51	KARTHIKA DEVI M	127	26	110	1
52	SARMILA A	127	21	190	0.9
53	SANJAY KUMAR.R	127	21	190	0.9
54	SRIDEVI.V	128	25	200	0.9
55	NIVETHA.S	130	24	190	0.9

HEIGHT, WEIGHT, PEFR AND BSA OF CHILDREN AGED 9 YRS FOR BOYS

SNO	NAME	Ht	Wt	PEFR	BSA
1	BALAMURUGAN.M.N.	110	17	180	0.7
2	ALAGESWARAN M	115	18	150	0.8
3	RAANJITH T	116	14	220	0.7
4	BAGAVATH SINGH S	118	16	170	0.7
5	TAMILSELVAM M	118	16	190	0.7
6	MUKUPANDIYAN A	119	17	230	0.7
7	BOOPATHI M	121	19	240	0.8
8	BAVARASU.A	121	23	160	0.9
9	RAJAPANDI.S	122	18	180	0.8
10	SAGILI KARUPPU G	122	18	190	0.8
11	JEYAPANDI M	122	22	180	0.9
12	JEYAPANDI M	122	22	180	0.9
13	NANDAKUMAR KARTHIK N	124	18	200	0.8
14	THIRUGAJENDRA MOORTHY	124	24	220	0.9
15	N.THIRUGAJENDRAMOORTHY	124	24	220	0.9
16	SARANGARAJ S	125	26	210	1
17	PANDIVENKATESAN G	126	22	170	0.9
18	T.SOMASUNDARAM	126	20	200	0.8
19	L.SIVASHANKAR	126	21	220	0.9
20	SANGILI MUTHU V	127	22	170	0.9
21	PRASANNA DARSAN B	127	24	170	0.9
22	BALAMURUGAN A	127	19	180	0.8
23	MOHA KANNAN T	128	20	200	0.8
24	P.SHAKTHIVEL	129	23	150	0.9
25	MUNEESWARAN	129	20	230	0.8
26	RAVEENDRA SURYA R	129	28	180	1
27	R.RAVEENDRA SURYA	129	28	180	1
28	SIKKANDAR BASHA A	133	23	220	0.9
29	MANIRAJA.S	133	22	220	0.9
30	VIJAY M	134	26	270	1
31	KRISHNA	135	25	240	1
32	BUVANESWARAN A	139	25	250	1

HEIGHT, WEIGHT, PEFR AND BSA OF CHILDREN AGED 9 YRS FOR GIRLS

SNO	NAME	Ht	Wt	PEFR	BSA
1	BAVANI P	106	17	160	0.7
2	P.BAVANI	106	17	160	0.7
3	PRIYADARSINI S	109	14	170	0.7
4	VIJAYALAKHMI M	114	20	130	0.8
5	SARMILA B	115	17	200	0.7
6	AKILA DEVI.K	116	15	170	0.7
7	PANDI MEENA S	116	18	110	0.8
8	MEENATCHI J	116	16	180	0.7
9	J.MEENATCHI	116	16	180	0.7
10	SWETHA M	118	18	190	0.8
11	R.SHARMILABANU	118	19	120	0.8
12	NANDHINI P	118	20	210	0.8
13	NANDHINI P	118	20	210	0.8
14	SATHYABAMA S	119	17	170	0.7
15	MONISHA V	119	20	160	0.8
16	SWETHA K	120	16	150	0.7
17	PAVITHRA	120	21	170	0.8
18	SAKTHEESWARI A	120	21	160	0.8
19	VEYLA NEELAVENI	121	17	190	0.7
20	MAHALAKSMI S	121	20	170	0.8
21	HEMALATHA K	122	16	170	0.7
22	RATHI S	122	20	170	0.8
23	RATHI S	122	20	170	0.8
24	M.SELVI	122	22	200	0.9
25	KIRTHANA	122	20	180	0.8
26	PAVITHRA	123	18	150	0.8
27	K.ALEX PANDI	123	21	170	0.8
28	SATHYA M	124	16	170	0.7
29	RANJANI M	124	18	170	0.8
30	R.ABDUL HADI	124	20	180	0.8
31	SOPHIYA V	124	22	170	0.9
32	SOPHIYA V	124	22	170	0.9
33	P.BHAVANI	124	25	150	0.9
34	VAIDESWARI M	124	20	190	0.8
35	VAIDEESWARI M	124	20	190	0.8
36	INDHU M	125	18	190	0.8
37	K.DURGADEVI	125	20	100	0.8
38	PRIYADARSINI S	125	22	200	0.9
39	MONIKA M	126	22	200	0.9
40	MONIKA M	126	22	200	0.9
41	JEYALAKSMI	127	29	200	1
42	SELVI S	127	21	210	0.9
43	SUGANTHIPRIYA	128	25	170	0.9
44	PRABA SREE C	128	28	190	1
45	VIJAYALAKSHMI S	128	24	150	0.9
46	RAJESHWARI	128	22	170	0.9
47	KAVYA M	129	19	170	0.8
48	A.SUGANDHI	131	20	150	0.9
49	AYYAMML	131	25	240	0.9
50	A.MEERA JASMINE	132	24	200	0.9
51	M.SANTHANAMARI	132	30	220	1
52	MUTHUMEENA M	132	19	200	0.8
53	S.SWATHI	133	25	200	1
54	MUTHUSELVI	134	22	230	0.9
55	MAHA LAKSMI	136	25	160	1
56	R.MAHALAKSHMI	136	25	160	1
57	DURGA T	136	26	190	1
58	SWETHA S	140	34	190	1.1
59	ABIRAMI A	150	41	250	1.3

HEIGHT, WEIGHT, PEFR AND BSA OF CHILDREN AGED 10 YRS FOR BOYS

SNO	NAME	Ht	Wt	PEFR	BSA
1	C.AMSURAJ	112	16	120	0.7
2	AMSU RAJ C	112	16	120	0.7
3	KRISHNA MOORTHY	122	22	220	0.9
4	K.KRAISHNA MOORTHY	122	22	220	0.9
5	SELVAKUMAR.J	122	20	150	0.8
6	SURYAPRAKASH T	123	21	130	0.8
7	SURYA S	126	23	220	0.9
8	VEERAMANI	127	22	200	0.9
9	KISHORE KUMAR	128	23	260	0.9
10	B.KISHOREKUMAR	128	23	260	0.9
11	SANKAR GANESH R	128	24	250	0.9
12	SANKAR GANESH R	128	24	250	0.9
13	S.GANESH BABU	128	25	200	0.9
14	MADHESWARAN	129	22	230	0.9
15	MADHESWARAN S	129	24	230	0.9
16	SITHIRAI SELVAM P	129	25	220	0.9
17	P.CHITHIRAISELVAM	129	25	220	0.9
18	K.VENKATESWARAN	129	32	150	1.1
19	V.AYYANAR	130	22	160	0.9
20	AYYANAR V	130	22	160	0.9
21	PREMKUMAR.S	130	22	150	0.9
22	MUTHUMEENA M	130	24	180	0.9
23	AVIMANI M	130	24	210	0.9
24	AVIMANI	130	25	210	0.9
25	MUNIASAMY.S	130	27	130	1
26	PRADEEP KUMAR	131	25	200	1
27	D.DEEPAN	132	27	200	1
28	BALA GANESH S	132	24	230	0.9
29	BALA GANESH S	132	24	230	0.9
30	SILAMBARASAN M	132	24	160	0.9
31	M.SATHISH KUMAR	132	25	160	1
32	P.SURYAPRAKASH	132	25	220	1
33	S.SANKAR GANESH	132	23	200	0.9
34	SANJAYKUMAR	133	25	210	1
35	PANDYARAJAN P	134	23	130	0.9
36	GOKUL P	134	25	230	1
37	P.GOKUL	134	25	230	1
38	MANIVASAGAN	134	27	150	1
39	UDAYABARATH V	134	26	160	1
40	R.AJAY	135	26	200	1
41	T.YABESH	135	27	210	1
42	DINESH KUMAR.A	136	27	240	1
43	A. DINESH KUMAR	136	27	240	1
44	SANTHOSHKUMAR	136	30	210	1.1
45	RATHISELVAM P	136	26	170	1
46	MUNEESWARAN. K	136	29	240	1
47	MUKESH KUMAR S	138	29	260	1.1
48	MOHAN RAJ S	138	28	270	1
49	MOHAN RAJ S	138	28	270	1
50	SARAVANA GANAPATHY	140	29	260	1.1
51	VISHNU	140	28	250	1
52	RAJA . B	141	34	200	1.2
53	JOSEPH	142	31	180	1.1
54	AKASH TAMILAN M	146	36	250	1.2
55	AKAS TAMILARASU M	146	36	250	1.2
56	KRISNA MOORTHY S	148	30	290	1.1
57	KRISHNA MOORTHY S	148	30	290	1.1

HEIGHT, WEIGHT, PEFR AND BSA OF CHILDREN AGED 10 YRS FOR GIRLS

SNO	NAME	Ht	Wt	PEFR	BSA
1	R.SURIYA	116	19	150	0.8
2	PRIYA P	116	21	170	0.8
3	P.PRI YA	116	29	170	1
4	J.KANAGADURGA	118	16	150	0.7
5	S.PANDEESWARI	118	18	150	0.8
6	M.DHANAKAKSHMI	119	20	200	0.8
7	NAGA LAKSMI M	120	22	180	0.9
8	NAGA LAKSHMI M	120	22	180	0.9
9	S.SENBAGAVALLI	120	16	170	0.7
10	SENBAGA VALLI	120	16	130	0.7
11	NAGANANDHINI R	122	21	140	0.8
12	SWETHA A	122	21	180	0.8
13	MEENATCHI R	123	21	150	0.8
14	RATHI MEENA	124	26	190	0.9
15	P.RATHIMEENA	124	26	190	0.9
16	K.MUNEESWARI	124	26	170	0.9
17	MUNEESWARI.K	124	26	170	0.9
18	NAGAJOTHI.K	124	21	170	0.9
19	KALEE MEENATCHI M	124	27	240	1
20	KALIMEENATCHI M	124	27	240	1
21	VAISHNAVI S	125	20	150	0.8
22	BANU PRIYA M	125	24	150	0.9
23	DHANALAKSMI D	126	20	220	0.8
24	DHANA LAKSHMI T	126	20	220	0.8
25	K.MANIKAVALLI	126	20	210	0.8
26	NANDHINI R	126	21	180	0.9
27	R.NANADHINI	126	21	180	0.9
28	JAMUNA B	126	24	180	0.9
29	MEENATCHI C	126	24	170	0.9
30	MEENATCHI C	126	24	170	0.9
31	M.GAYATHRI	126	25	170	0.9
32	ANANDA JOYTHI	126	22	160	0.9
33	S,VINITHA	127	22	230	0.9
34	PANDI SELVI R	127	24	220	0.9
35	PANDI SELVI R	127	24	220	0.9
36	P.ANGALEESWARI	128	20	160	0.8
37	KARTHIKAJOTHI	128	24	160	0.9
38	GOWSALYA P	128	25	220	0.9
39	GOWSALYA P	128	25	220	0.9
40	K.VIGNESHWARI	128	26	170	1
41	RAJESWARI C	129	26	160	1
42	K.NAGESWARI	130	20	160	0.8
43	MUTHUMEENA M	130	24	180	0.9
44	BUVANESHWARI D	130	25	150	1
45	P.SATHYA	130	21	220	0.9
46	MEENA DEVI P 10	130	27	170	1

47	DHANALAKSHMI N	131	21	240	0.9
48	VINITH T	131	24	160	0.9
49	ABARNA.P	131	24	230	0.9
50	UMA BARATHI R	132	24	210	0.9
51	UMA BARATHI R	132	24	210	0.9
52	LAVANYA MP	132	24	180	0.9
53	V.RAMYA	133	24	180	0.9
54	M.PONNUSELVI	133	30	170	1.1
55	M.NAGALAKSHMI	134	28	210	1
56	RAJAREKA	134	28	160	1
57	M.PRIYADHARSHINI	134	28	110	1
58	MAGATNELAVU R 10	134	26	150	1
59	NANDHINI M	134	26	220	1
60	PANDESWARI S	136	29	220	1
61	YOGESWARI A	136	31	220	1.1
62	MEENATCHI R	138	26	180	1
63	R,MEENAKSHI	138	26	170	1
64	GAYATHRI PRIYA.R	138	27	210	1
65	R.GAYATHRI PRIYA	138	27	210	1
66	USHA DARANI R	138	36	230	1.2
67	USHA DARANI R	138	36	230	1.2
68	S.SUBASREE	144	28	220	1.1
69	SUBA SREE S	144	28	220	1.1

HEIGHT, WEIGHT, PEFR AND BSA OF CHILDREN AGED 11 YRS FOR BOYS

SNO	NAME	Ht	Wt	PEFR	BSA
1	ARUN K	118	21	150	0.8
2	MUTHUVEL.R	120	21	150	0.8
3	SUDHARSAN.P	121	23	250	0.9
4	ESWAR	122	20	160	0.8
5	CHANDRU.S	123	21	230	0.8
6	KRISHNAN.M	124	21	180	0.9
7	N.GURUPARSAD	124	24	210	0.9
8	PRAVVEN KUMAR . R	125	20	160	0.8
9	GUNASEKARAN. M	125	20	180	0.8
10	MARISELVAM.K	125	22	200	0.9
11	MUTHUPANDI K	125	20	170	0.8
12	KARHIK . S	126	22	160	0.9
13	SARAVANA KUMAR A	126	23	180	0.9
14	JETAVELAN V	126	23	200	0.9
15	SELVAM S	126	20	130	0.8
16	VAIRAVEL.M	126	23	170	0.9
17	NANDAKUMAR . K	127	27	230	1
18	SURESKUMAR A	127	24	180	0.9
19	PRAKASH	127	24	180	0.9
20	MANOJPANDIYAN S	127	24	160	0.9
21	SANKARALINGAM.A	127	23	170	0.9
22	RAMKUMAR S	128	26	240	1
23	PAL PANDI A	128	26	200	1
24	PAUL PANDI A	128	26	200	1
25	S.ARAVINDH	128	21	200	0.9
26	KALIRAJ	128	24	220	0.9
27	KALIRAJ.P	129	23	180	0.9
28	VIJAPANDI.T	129	24	210	0.9
29	BALAJI.S	129	24	170	0.9
30	RAMSH BABU. R	129	23	200	0.9
31	LINGESWARAN A	129	25	210	0.9
32	MUTHUVEL.M	129	29	190	1
33	SATHSH	129	25	260	0.9
34	PREM KUMAR .M	130	24	230	0.9
35	TAMILENEYAN.A	130	26	200	1
36	SHANMUGAPANDIAN.P	130	27	220	1
37	SUNDAR.P	130	27	180	1
38	AMARNATH.M	130	25	240	1
39	MUTHUSARAVANAN S	130	25	180	1

40	KARTHIK.K	130	25	200	1
41	SUBRAMANIAN.R	130	33	200	1.1
42	KARUPASSAMY.P	131	26	200	1
43	RAMAKRISHNAN	131	26	240	1
44	VEERAPANDI	132	23	240	0.9
45	MUTHUPANDI .R	132	25	210	1
46	AJAY. K	132	24	170	0.9
47	MANOJ KUMAR P	132	23	160	0.9
48	ARUN.N	132	23	160	0.9
49	MUTHUMUNIANDI.P	132	25	190	1
50	PANDIAN S	132	31	220	1.1
51	PALANISAMY .K	132	20	240	0.9
52	E. RAMACHANRAN	132	24	190	0.9
53	TAMILSELVAN.P	132	26	180	1
54	SYED ALI.R	132	26	230	1
55	R.SYED ALI	132	26	230	1
56	KARTHIK.S	132	24	210	0.9
57	VIGMESH M	132	28	250	1
58	MANOJ KUMAR .S	133	23	230	0.9
59	KARTHIK RAJA M	133	25	250	1
60	P.RANGITH KUMAR	133	25	220	1
61	MURUGAN.K	133	27	250	1
62	MAHENDRAN.S	133	27	260	1
63	VIJAYAPANDI.A	133	29	210	1
64	MUTHUKUMAR M	133	25	240	1
65	GOPINATH P	133	26	160	1
66	ROHITH .M	134	25	250	1
67	THANGAPANDI.R	134	25	240	1
68	MUKESHKANNAN A	134	27	180	1
69	SHIVA	134	24	250	0.9
70	NAGENDRAKUMAR	134	30	180	1
71	NAGESWARAN N	135	26	220	1
72	SHAKTIVEL.K	135	27	200	1
73	TAMILSELVAN.E	135	26	290	1
74	K.MUKESH	135	26	240	1
75	SRIDHAR.M	135	29	240	1
76	SATHISH KUMAR P	135	31	200	1.1
77	SARAVANAN.L	135	23	180	0.9
78	K.VASANTHARAJ	135	25	250	1
79	ANDROSE N	135	29	260	1
80	JANAKIRAMAN .R	135	26	250	1
81	SIVARAMAKRISHNAN R	135	22	210	0.9

82	N. JEYARAM	136	28	240	1
83	KARTHIK.P	136	27	170	1
84	RAJESH.P	136	33	170	1.1
85	SANTHOSH.P	136	26	180	1
86	BALAJI.K	136	27	200	1
87	RAHUL V	136	25	250	1
88	CHANDRU .B	137	30	210	1.1
89	SURYA. K	138	27	190	1
90	VEERABATHRAN.K	138	32	170	1.1
91	PRIYADHARSAN	138	40	190	1.2
92	JOEL	138	40	190	1.2
93	BALAKRISHNAN K	138	29	210	1.1
94	GNANAPRAKASH K	138	29	250	1.1
95	M.KARTHIKSELVAM	139	25	230	1
96	RAJAPANDI.P	139	27	210	1
97	RAJKUMAR	139	26	220	1
98	GNANASEKAR .C	139	29	200	1.1
99	K.PONNURAJ	139	25	210	1
100	SATHISH KUMAR.K	140	28	210	1
101	MOHAMMED SHAM.K	140	27	190	1
102	KEERTHI VASAN.E	140	28	250	1
103	V.GOKULPRASAD	140	26	250	1
104	K.MUTHUKRISHNAN	140	27	180	1
105	SETHUPATHI.M	140	31	220	1.1
106	R.VINODH RAMAN	141	27	250	1
107	TAVASIPANDI	141	45	210	1.3
108	THIRUPATHI.T	141	26	210	1
109	S.RIYAS	141	30	230	1.1
110	KRISHNA KUMAR K	142	32	260	1.1
111	SRI VISHNU .A	142	28	240	1.1
112	SANJAY.S	142	29	200	1.1
113	A.SAABRI RAVI KUMAR	142	29	250	1.1
114	SURESHKANNAN.G 11	142	31	230	1.1
115	RAVI ANAND.V	142	28	210	1.1
116	M.MURUGAN	144	30	240	1.1
117	M.VIGNESH	144	47	240	1.4
118	SAMSUDDIN H	144	34	260	1.2
119	NISHANTH .T	145	34	200	1.2
120	SIVAKUMAR M	146	36	240	1.2

121	ASHWIN	146	31	260	1.1
122	R.PON VIGNESH	146	35	200	1.2
123	N.AJITH KUMAR	147	36	250	1.2
124	T.ALAGARSAMY	147	29	200	1.1
125	MANI T	148	37	180	1.2
126	MUTHUSELVAM.P	149	40	240	1.3
127	KARTHIKEYAN K	150	46	220	1.4
128	MALAIARASAN	152	38	230	1.3

HEIGHT, WEIGHT, PEFR AND BSA OF CHILDREN AGED 11 YRS FOR GIRLS

SNO	NAME	Ht	Wt	PEFR	BSA
1	K.SNEHA	120	20	150	0.8
2	M.SATHYADEVI	121	20	140	0.8
3	M.KOKILA	122	20	140	0.8
4	S.SUBASHREE	122	20	170	0.8
5	V.GEETHA	123	23	150	0.9
6	VAIDEGI P	124	24	160	0.9
7	S.VIMALA	125	21	200	0.9
8	KAMATCHI	125	20	220	0.8
9	S . MUNEESWARI	125	21	150	0.9
10	BANUPRIYA .S	125	24	200	0.9
11	RAMUTHAI.J	125	22	180	0.9
12	THARANI.A	126	18	200	0.8
13	A.THARANI	126	18	200	0.8
14	DURGADEVI M	126	22	180	0.9
15	BANUPRIYA.P	127	25	170	0.9
16	S.SUDHA	127	25	180	0.9
17	K.PAVITHRA	127	24	220	0.9
18	VIJAYALKSHMI. K	127	25	170	0.9
19	K.REVATHI	128	25	150	0.9
20	DIVYA G	128	30	180	1
21	N.NANDHINI	128	21	200	0.9
22	VALARMATHY B	128	24	210	0.9
23	BHUVANESWARI V	128	25	160	0.9
24	KOWSALYA M	129	20	220	0.8
25	G.BHUVANA	129	25	200	0.9
26	S. MAHALAKSHMI	130	19	200	0.8
27	M.MUTHULAKSHMI	130	25	240	0.9
28	MUTHUKAVITHA . S	130	20	220	0.8
29	VAIDEESWARI P	130	26	190	1
30	P.NITHYA	130	26	200	1
31	KAVIARASI V	130	25	210	1
32	S.SUMATHI	130	28	180	1
33	K.ALAGUMEENA	130	28	270	1
34	R. KRISHNAVENI	130	28	190	1
35	R.SARAVANAKUMARI	131	20	170	0.9
36	C.CHANDRELEKHA	131	29	210	1
37	J. SUVALAKSHMI	132	26	210	1
38	P. KRISHNAPRIYA	132	21	160	0.9
39	R.SEETHALAKSHMI	132	22	190	0.9

40	N.PANDIMEENA	132	25	200	1
41	BHUVANESWARI R	132	25	160	1
42	KAVITHA K	132	35	210	1.1
43	MUTHU PRIYA V	132	30	200	1
44	REVATHI S	132	25	190	0.9
45	S.KAVYA	133	23	160	0.9
46	N.DHIVYA	133	30	140	1.1
47	K.MAHESWARI	133	25	170	1
48	ANUPRADHA P	133	25	160	1
49	S.NAGAJOTHI	134	25	210	1
50	ZENIYT M K	134	32	200	1.1
51	JOTHIKA S	134	33	210	1.1
52	TAMILARASI	134	24	220	0.9
53	JAYASHRI	134	28	190	1
54	M.SUNDARI	134	30	200	1.1
55	KAVYA. V	135	26	300	1
56	T.UMA	136	26	200	1
57	M.MAHAMAYEE	137	29	290	1
58	D.DHIVYA	137	27	170	1
59	JENIFER FATIMA C	137	30	200	1.1
60	K.PAVITHRA	137	30	220	1.1
61	K. ANGALEESWARI	138	30	230	1.1
62	S.ISHWARIYA	138	30	210	1.1
63	R. ROJA	138	32	170	1.1
64	SANDHAYA S	138	34	160	1.1
65	SUJITHA	138	35	160	1.2
66	KEERTHANA P	138	37	240	1.2
67	M.SANTHANAMARI	138	44	190	1.3
68	M.DHANAKAKSHMI	139	28	180	1
69	.CHELLAMAL.P	139	28	170	1
70	P.KALEESWARI	139	30	250	1.1
71	S.UMAMAHESWARI	139	34	230	1.1
72	K.THILAGAVATHY	139	29	210	1.1
73	M.DEVI	140	30	200	1.1
74	KOWSALYA	140	48	280	1.4
75	M.KEERTHIGA	140	27	180	1
76	G.KOWSALYA	141	33	210	1.1
77	KARPAGASELVI	141	35	170	1.2
78	P.ALAGUMUTHU	141	44	260	1.3
79	S.VIJAYALAKSHMI	142	36	210	1.2
80	KALESWARI A	142	28	240	1.1
81	S.ALAGUSANDHIYA	142	30	200	1.1

82	S.SRIDEVI	143	37	210	1.2
83	K.HEMAVATHY	143	32	270	1.1
84	A.ANITHA	143	39	270	1.2
85	P.KAVYASHREE	143	32	230	1.1
86	VAISHNAVI S	144	40	190	1.3
87	S.DHIVYA	145	38	240	1.2
88	INDUJA K.P	145	30	210	1.1
89	SANGARESWARI M	146	33	240	1.2
90	S.NAVEENA	146	37	210	1.2
91	MAASANIAMMAL M	148	35	240	1.2
92	VAITHEESWARI	148	40	270	1.3
93	GAYATHRI S	148	40	220	1.3
94	P.NAGESWARAN	148	42	200	1.3

HEIGHT, WEIGHT, PEFR AND BSA OF CHILDREN AGED 12 YRS FOR BOYS

SNO	NAME	Ht	Wt	PEFR	BSA
1	RANJTIH KUMAR	123	20	170	0.8
2	KARUTHAPANDI . P	124	19	170	0.8
3	LOGESHWARAN	127	20	200	0.8
4	SANKAR GANESH P	128	25	190	0.9
5	AYYANAR S	128	24	200	0.9
6	KANNAN M	128	26	210	1
7	DILIP KUMAR D	129	24	250	0.9
8	GUNASEKARAN.P	130	24	250	0.9
9	ALAGURAJAN.M	130	25	210	1
10	R.MANIKANDAN	131	29	270	1
11	PONSURYA K	131	30	150	1
12	KRISHNA PRABU K	131	23	160	0.9
13	DINESH KUMAR ,M	131	30	200	1
14	VENKATES KUMAR M	132	32	190	1.1
15	SONAIYA.M	132	23	200	0.9
16	ANDISAMY.A	132	27	240	1
17	RAMAR . P	132	30	210	1
18	SUNDARA PANDI S	132	25	180	1
19	ARUNPANDI S	133	27	160	1
20	DINESH MARUTHI	133	24	210	0.9
21	THANDA PANI S	134	39	240	1.2
22	KONDAL SAMY V	134	32	160	1.1
23	KARTHI	134	25	180	1
24	M.ABDUL MAHID	134	28	230	1
25	GANESHPANDI.R	134	35	290	1.1
26	DHANABALAN.A	134	39	240	1.2
27	NATHESH KUMAR K	134	40	220	1.2
28	VISHNUKUMAR.G	134	25	250	1
29	MARI GANDHI	134	28	240	1
30	ELAVARASAN.S	135	26	190	1
31	BOOMIRAJAN.K	135	27	200	1
32	PRAVEENKUMAR.K	135	26	270	1
33	M. SAVARIMUTHU	135	44	275	1.3
34	ABOOHURAIRA.K	135	25	220	1
35	SATHISKUMAR S	136	30	250	1.1
36	BALASUBRAMANI R	136	26	210	1
37	MUTHUPANDIAN S	136	30	210	1.1
38	VELUPANDI A	136	26	200	1
39	NAGA RAJ S	136	27	170	1

40	VELRAJ.K	136	28	210	1
41	SUBRAMANI R	136	29	220	1
42	VINODKUMAR.N	136	31	210	1.1
43	KARUPPASAMY.G	136	29	170	1
44	SARATHKUMAR.S	136	27	270	1
45	MUTHUPANDI.K	136	30	240	1.1
46	ARUN PANDI K	137	32	220	1.1
47	SURYAPRAKASH S	137	28	210	1
48	DHINESHPANDI.P	137	25	200	1
49	M.DIVAKAR	137	30	260	1.1
50	SIVA P	137	29	230	1.1
51	MANIKANDA PRABU .S	138	30	190	1.1
52	ANADARAMAN J	138	27	200	1
53	P.PANDI KUMAR	138	25	230	1
54	SRIDHAR A	138	29	230	1.1
55	D.VIKRAM	138	30	240	1.1
56	KARTHEESWARAN P	138	28	200	1
57	ARUNPANDIYAN.K	138	30	260	1.1
58	PRAVEEN T	138	42	210	1.3
59	SHYAM SUNDAR R	138	27	210	1
60	SELVAKUMAR. R	139	29	200	1.1
61	PERIYARAJ	139	30	210	1.1
62	NIVAS.V	139	28	200	1
63	AJITHKUMAR.M	139	28	210	1
64	RAMAKRISHNAN.M	139	31	240	1.1
65	MUTHUPANDI P	139	35	200	1.2
66	SARAVANAKUMAR P	140	30	220	1.1
67	MINIYASAMY P	140	28	250	1
68	S.VIKRAM	140	29	310	1.1
69	GOPINATH.R	140	37	160	1.2
70	MARUDHUPANDO.R	140	29	210	1.1
71	M.VELMURUGAN	141	30	260	1.1
72	RAVI PRASATH R	141	40	240	1.3
73	NIJANTHAN R	142	28	230	1
74	VIGNESH KUMAR M	142	34	240	1.2
75	MAHESWARAN P	142	35	240	1.2
76	SYEDSALMAN.S	142	31	210	1.1
77	DHAVASIMUTHU.A	142	36	260	1.2
78	PRABAKARAN R	142	30	210	1.1
79	THANGAPANDI S	142	30	220	1.1
80	SANKAR S	143	31	160	1.1
81	RAVI CHANDRAN A	143	30	230	1.1

82	SENDHURAPANDIAN	143	27	190	1
83	SETHU.S	143	35	260	1.2
84	MURUGANANDHAM	144	33	290	1.1
85	SURYA C	144	40	240	1.3
86	SRIDHAR.A	144	34	260	1.2
87	SIVA	144	30	200	1.1
88	NAVANEETAHAN. S	144	42	310	1.3
89	JEGANATHAN M	145	31	240	1.1
90	KARUTHAPANDI . S	145	44	240	1.3
91	RAMKUMAR T	145	37	160	1.2
92	S.VENKATESHWARAN	145	33	190	1.2
93	S.KALANDHAR SADIK	145	34	200	1.2
94	HARIHARASUDHAN P	145	31	170	1.1
95	KOSALARAMAN	146	43	210	1.3
96	VIGNESH.M	146	30	210	1.1
97	MADANKUMAR P	146	35	250	1.2
98	SHANMUGARAJA.S	146	34	200	1.2
99	ACHUDAN .	146	32	240	1.1
100	AJITH KUMAR M	147	36	240	1.2
101	ELAVARNAN E	147	33	250	1.2
102	MANOJKUMAR.M	147	34	260	1.2
103	VIGNESHVARAN.K	147	39	200	1.3
104	V. MUTHUPANDI	148	28	200	1.1
105	SANTHOSHKUMAR	148	29	230	1.1
106	PRABU KANTH . M	148	48	200	1.4
107	MUKESH KUMAR .S	148	33	270	1.2
108	HARIKRISHNAM K	148	44	250	1.3
109	TAMILSELVAN.P	148	36	220	1.2
110	HARIKRISHNAN.K	149	37	230	1.2
111	VIJAYA RAGAVAN R	149	40	220	1.3
112	KARTHICK.T	152	50	240	1.5
113	NITHIN SHARON	154	58	260	1.6
114	ASHWIN R	157	40	270	1.3
115	R ROHIT SUBBIAH	158	44	400	1.4
116	VISNURAM G	160	42	280	1.4
117	M.BALAMURUGAN	160	36	230	1.3

HEIGHT, WEIGHT, PEFR AND BSA OF CHILDREN AGED 12 YRS FOR GIRLS

SNO	NAME	Ht	Wt	PEFR	BSA
1	A. ANNALAKSHMI	123	20	120	0.8
2	K.ANGALEESWARI	125	25	200	0.9
3	AMIRTHAPANDIAMMAL K	126	25	160	0.9
4	GOWREIMARI P	126	25	170	0.9
5	DURGA DEVI S	127	25	180	0.9
6	YOGESWARI	128	34	220	1.1
7	KRISNA VENI M	129	25	170	0.9
8	NANDHAKUMARI A	129	32	180	1.1
9	M.PUVITA	130	29	200	1
10	RAJALAKSMI K	130	26	170	1
11	PANJAVARNAM P	130	25	170	0.9
12	A.KOKILA	131	23	170	0.9
13	VIJAYA LAKSHMI V	132	23	190	0.9
14	MUTHUMARIAMMAL M	132	28	230	1
15	KALAI SELVI K	132	23	230	0.9
16	DURGA DEVI R	132	29	200	1
17	BRINDA P	133	31	200	1.1
18	ANADA ESWARI A	133	30	210	1.1
19	BAKYA LAKSHMI K	133	25	210	1
20	ALAGU RAKKU.K	133	27	270	1
21	ANNA LAKSHMI V	133	27	210	1
22	DIVYA M	134	35	150	1.1
23	SANKARESWARI S	134	30	240	1.1
24	SANKARESWARI S	134	30	240	1.1
25	PRIYADARSINI V	134	33	180	1.1
26	PRYADARSINI V	134	33	180	1.1
27	S.AJITH	135	23	200	0.9
28	MANJULA P	136	33	260	1.1
29	VAISNAVI S	136	30	200	1.1
30	SWETHA K	136	25	200	1
31	S.KAMALI	136	30	240	1.1
32	MUTHU MARI P	136	35	150	1.1
33	MADHU BALA N	136	29	250	1
34	KAVITHA M	137	26	170	1
35	KOWSALYA.R	137	30	230	1.1
36	RAMALAKSHMI K	137	32	190	1.1
37	PUSPALATHA	137	34	240	1.1
38	MUTHULAKSHMI K	138	30	220	1.1
39	MUTHULAKSHMI K	138	30	220	1.1
40	VIJAYARANI M	138	35	240	1.2

41	THAMARI.M	138	33	210	1.1
42	M.HARIVISALATHCHI	138	35	180	1.2
43	J . RAMALAKSHMI	140	28	240	1
44	S.DHANALAKSHMI	140	35	260	1.2
45	KALESHWARI R	140	37	200	1.2
46	NAGASUNDARI.S	141	26	240	1
47	N.RAMYA	141	40	260	1.3
48	S.VIAYALAKSHMI	141	30	160	1.1
49	ARCHANADEVI P	141	28	170	1
50	MAHA LAKSHMI P	141	34	260	1.2
51	MAREESWARI A	142	35	280	1.2
52	A.IRANIYAN	142	32	200	1.1
53	SUSIYHRA	143	33	210	1.1
54	G.VENKATESWARI	143	32	190	1.1
55	UMA MAHESWARI P	143	34	250	1.2
56	S. SHAKTHI	143	41	240	1.3
57	PUNITHA LAKSHMI S	143	33	250	1.1
58	RAMA LAKSHMI R	143	34	210	1.2
59	INDRA PRYADARSINI V	143	30	250	1.1
60	MUTHU PANDIYAN K	144	57	180	1.5
61	DIVYA BARATHI P	144	29	210	1.1
62	MUTHU MEENA K	144	40	190	1.3
63	P.MUTHUMARI	145	45	230	1.3
64	VIJAYARANI S	145	30	220	1.1
65	RANJITHA R	146	39	270	1.3
66	VIJAYALAKSHMI A	146	45	220	1.4
67	MUTHULAKSHMI V	146	31	250	1.1
68	K.BHAVANI	146	42	250	1.3
69	SHANTHI.S	146	24	220	1
70	MEENA A	146	35	260	1.2
71	JENIFER M	146	32	210	1.1
72	M.DEEPA	147	44	270	1.3
73	NALLAMMAL M	148	34	220	1.2
74	VINIDHINI R	148	35	180	1.2
75	VANI SHREE	148	38	240	1.2
76	ASWINIS	148	32	200	1.1
77	ABIRAMI . P	148	37	170	1.2
78	A.CHITRA	149	44	240	1.3
79	YOGA SREE A	149	36	190	1.2

80	R.JOTHIKA	150	49	190	1.4
81	SUBSLAKSMI M	151	38	200	1.3
82	VENNILA M	153	38	230	1.3
83	ARIYANACHI	154	52	350	1.5
84	K.KAVITHA	157	40	220	1.3

LIST OF ABBREVIATIONS USED

ERV – Expiratory Reserve Volume

FRC – Functional Residual Capacity

Ht – Height

IC – Inspiratory Capacity

IRV – Inspiratory Reserve Volume

n – Number of sample size

PEFR – Peak Expiratory Flow Rate

r – Correlation coefficient

RV – Residual Volume

SD – Standard Deviation

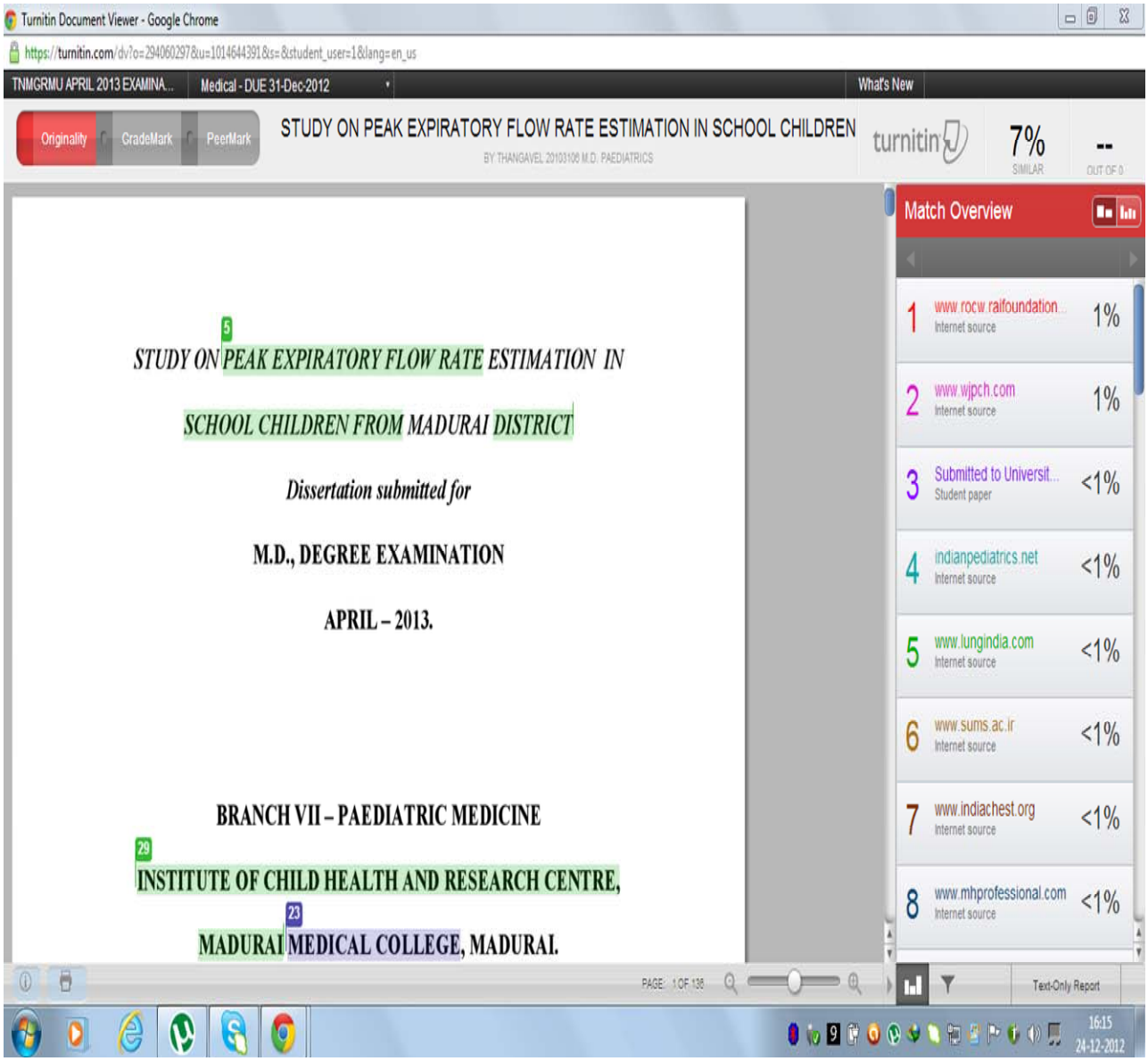
SE – Standard Error

TLC – Total Lung Capacity

VC – Vital Capacity

VT – Tidal Volume

Wt – Weight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