"A COMPARATIVE STUDY OF PHYSICAL FITNESS AND PULMONARY FUNCTIONS IN RESIDENTIAL AND NON-RESIDENTIAL SCHOOL CHILDREN OF BIJAPUR."

By

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Under the guidance of

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LIST OF ABBREVIATIONS USED

(In alphabetical order)

Abd C- Abdominal Circumference

AAHPERD- American Association For Health Physical Education and Recreation

BHT- Breath Holding Test

BSA- Body Surface Area

BMI- Body Mass Index

bpm- Beats per minute

CC – Chest circumference

Cpm – Cycles per minute

Cms - Centimeters

DBP- Diastolic blood pressure

ENDT – Endurance Test

ERV – Expiratory Reserve Volume

FEV1 – Forced Expiratory Volume in First Second

FVC – Forced Vital Capacity

Gm/dl- Gram/ deci liter

HR – Heart Rate

HST – Harvard Step Test

Ht- Height

IRV- Inspiratory Reserve Volume

Kg/mt- Kilogram/meter

MAP- Mean Arterial Pressure

MAC- Mid Arm Circumference

ml- millimeter

ml/kg/min- millimeter/kilogram/minute

ml/kg- millimeter/kilogram

mmHg- millimeter of Mercury

O_2- Oxygen

PR- Pulse rate

PR1- Pulse rate after 1 minute

PR2- Pulse rate after 3 minutes

PR3- Pulse rate after 5 minutes

P max- Pulse Maximum

PEFR- Peak Expiratory Flow Rate

PFI- Physical Fitness Index

P value- Probability Value

%- Percentage

RR – Respiratory rate

SBP- Systolic blood pressure

Std- Standard

SE- Standard Error

SD- Standard Deviation

V_T- Tidal Volume

VC- Vital Capacity

VO_2 Max- Maximum Oxygen Uptake

Wt- Weight

% - Percent

ABSTRACT

Background & Objectives: The present study was conducted with a view to study and compare the effect of regular exercise and good nutritious diet on cardiopulmonary fitness and pulmonary functions among Residential (Sainik) and Non-Residential school children of age group 12 to 16 years.

Methods: The parameters included were Anthropometric, Physiological, Cardiopulmonary fitness parameters and Pulmonary functions. Cardiopulmonary fitness parameters (VO_2 Max in ml/kg/min and PFI in %) were performed by the Harvard's step test. By using the formula, the VO_2 Max and PFI were derived. The Recording spirometer was used to record the pulmonary function tests. The PEFR (lit/min) was recorded by Mini Wright's Peak Expiratory Flow meter and MEP (mmHg) was recorded by using modified Black's Apparatus. Physiological parameters included were PR (bpm), RR (cpm), SBP (mmHg), DBP (mmHg) and MAP (mmHg). Anthropometric parameters included were Ht (cms), Wt (kgs), BSA (m^2) and BMI (kg/m^2). Pulmonary parameters included were BHT (secs), 40 mmHg Endurance Test (secs), V_T (ml), IRV (ml), ERV (ml), FVC (ml), FEV1 (ml) and FEV1 (%). Mean $\pm$ SD, SE and 'Z' test used for statistical analysis.

Results: The following results observed were statistically significant:

1. VO_2 Max for Group I and Group II were 66.03$\pm$7.06 with SE 0.706 and 55.23$\pm$7.53 with SE 0.753 respectively. Group I Residential children had good VO_2 Max compared to Group II that is Non-Residential children.

2. PFI (%) for Group I was 54.96$\pm$8.38 (SE 0.838) and 44.75$\pm$5.05 (0.505) for Group II. Group I good PFI compared to Group II.

3. Mean V_T (ml) for Group I was 487.25±93.17 (SE 9.31) and that for Group II was 462.65±75.25 (SE 7.52), the Mean IRV(ml) for Group I was 908±311.38 (SE 31.13) and that for Group II 849.5±315.39, the Mean ERV (ml) for Group I was 834.5±276.2 (SE 27.62) and that of Group II524.5±191.15, the Mean VC (ml) for Group I was 2084±415.35 (SE 31.13) and that for Group II 1767.5±420.5, the Mean FVC (ml) for Group I was 2084±415.35 (SE 31.13) and that for Group II 1767.5±420.58, the Mean FEV1 in ml for Group I was 1991.35±424.78 (SE 31.13) and that for Group II 1608±412.60 and FEV1(%)for Group I was 91.21±7.53 (SE 0.75) and that for Group II 87.79±9.79(0.97). All the values are statistically significant in Group I compared to Group II.

4. The PEFR (lit/min) in Group I was 499.05±95.39(SE 9.53) and that of Group II 389.25±96.98(SE 9.69) and MEP (mmHg) in Group I was 90.1±17.05(SE 1.70) and that of Group II 73.83±25.50(SE 2.55). We could observe from our study that PEFR and MEP in Group I was higher than that of Group II.

Interpretation & Conclusion:

Significantly higher values in Group I than in Group II could be due to the regular exercises performed by the Group I. Other factors like diet, sleep, routine activities performed by them also contribute to VO_2 Max, PFI and pulmonary parameters.

Key words: Residential school children, Non-residential school children, VO_2 Max, Physical Fitness Index, PEFR, MEP, Pulmonary functions.

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INTRODUCTION

In ancient Vedas, importance of physical fitness has been emphasized by saying

" Shareermadhyam khalu dharma sadhanam"

i.e to achieve anything in life our body must be fit or healthy. Strong body is necessary for achieving anything in life.

The body fitness is achieved through sports. The history of which is probably as old as the history of man himself. In the ancient classic "Shrimat Bhagavatam", there are references of professional Wrestlers. Lord Krishna while still in his very early teens beat some of the greatest contemporary professional wrestlers in the court of the tyrant king Kamsa. Both the ancient Greeks and Romans were great sport loving people. They practiced Kangfu to protect themselves from the armed bandits. Animals in jungle perform various playful acts, teleology, perhaps, is this keeps them fit.[1]

Fitness at the Dawn of Civilization [2]

If several hundred years from now archaeologists were investigating our society, they would find endless examples of sport in the United States: stadiums, swimming pools, running shoes, hockey sticks, skis, baseball gloves, posters of sports stars, etc. Various forms of sport and physical education have been around since the late 1400's and have only gained momentum and recognition in the centuries that followed.[2]

Physical fitness history spans back to the dawn of man. At that time, formal exercise wasn't necessary because prehistoric man's way of life involved a great deal of exercise. During this era in physical fitness history, primitive man was constantly on the move as a hunter/gatherer. Because of this, there was no need to pursue physical fitness.[2]

In about 10,000 BC, man as a hunter/gatherer came to an end as human beings developed agriculture. It was during this period that man started to cultivate plants and domesticate animals for the purpose of food. It was also during this time that the plow was invented. The agrarian lifestyle during this period was the beginning of decreasing daily physical activity. There was still hard work involved in daily life and little emphasis was placed upon physical fitness.[2]

As man's innovation advanced, their natural activity levels decreased. In ancient China, Confucius recognized that physical inactivity was becoming a way of life and his teachings encouraged participation in regular activity. Because of this, Cong Fu was developed to keep the body in shape. Chinese also participated in other activities that were purely for the pursuit of physical fitness – such as wrestling and badminton.[2]

During this same period, the ancient Indian civilization was taking another route. Religious beliefs of the time discouraged the development of the body, emphasizing instead the development of the spirit. Yoga emerged as a means of reconciling these two things – moving the body in ways that opened up spiritual pathways.[2]

The Indian rulers like Shivaji Maharaj, Krishnadevaraya and Tamilnaadu emperors have started physical fitness training centers in their realms to train the youngsters to become physically fit. As realms were ruined, training programme came to an end.

Yet, physiology of exercise, in particular sports physiology is not a very old subject. Now, it is growing very fast. Probably, the reason for its rapid growth may be the patronage from the government, society and mass media network. The society hopes that prize winning in sports brings recognition to it. The modern sports have gained the demand due to their fierce competitions. Physical fitness and sporting activity are interdependent. [2]

Regular physical exercise is known to have beneficial effects on health. As diseases are related to lack of fitness, Americans realized that there is a need to counteract a sedentary lifestyle with planned physical activity through sports and formal exercise. This brought government's attention to the lack of fitness of its citizenry. This led to the establishment of minimum fitness standards in the country's public schools.[2]

One of the first men to recognize the importance of physical activity in school curriculum was Johann Bernard Basedow in Germany. He included gymnastics as part of the daily curriculum devoting up to three hours per day. Basedow required a specific uniform for his students so they could have unrestricted movement. He also offered a camp for two months during the summer for his students.

In 1810, Friedrich Jahn**,** "the father of gymnastics", began working outdoors with his students using simple exercises and games sometimes taking long hikes. Jahn motivated to develop a system of physical training as his deep sense of patriotism. Germany had been defeated in the Napoleonic wars. So, he developed his system with a hope of creating strong, sturdy and fearless youth who would help secure Germany's freedom and could defend the Fatherland from outside forces. Charles Beck who was a student, friend and follower of Friedrich Jahn teamed up with a friend and they made their way to Switzerland, France and eventually America. George Bancroft who had opened the Round Hill School in America had been looking at and studying the German system and immediately hired Beck to teach Latin and Physical Education in the form of

German gymnastics. So, Beck became the first official Physical Education teacher in America in 1825.[2]

"Survival of fittest" (Fit person will survive)

The above quotation indicates the importance of physical fitness. It is not only essential for an individual but also for the whole nation.

The nations which have realized the importance of physical fitness have started specific programmes. These programmes are aimed to hold up and build up the nationsS.

For those who strive to achieve and maintain a high quality of health, it must be recognized that physical activity is vital to optimal health. This is reaffirmed by numerous studies that have found an association between physical activity, health, longevity and an improved quality of life. In addition, the number of deaths related to sedentary living or obesity is approximately a half-million per year. Physical activity may impact quality of life in several ways: it can be used to improve self-image, self-esteem, physical fitness and health.

In our country, we are getting acquainted with the modern amenities at a very fast rate, so we are neglecting the natural physical activities. The present attractive education system has helped to improve the education standards. But the non active sedentary stressful life has made the youth physically unfit. Now the time has come to consider about the physical fitness and exercise in the adolescent age group. Realizing this fact, educationalists have recommended minimal physical exercise in the curriculum.[1]

The present study aims to confirm the effectiveness of the above recommended curriculum.

CARDIOPULMONARY FITNESS

According to Sunderrajan (1983),[3] Physical fitness is an intrinsically individualized index. It expresses the individual's biopotential, comprising functional and metabolic components and growth factors built up and maintained by exercise.

According to H.S Harrison Clarke (1971),[4] physical fitness is defined as ability to carry out daily tasks with vigor and alertness without undue fatigue with ample energy to enjoy leisure time pursuits, to meet unusual situations and unforeseen emergencies.

Physical fitness is ability to last to bear up to withstand stress and to pressure under difficult circumferences where an unfit person would be ineffective or would quit. [4]

The positive health is the terminal goal of the health planners where the physical fitness is the means to achieve the targets.

Children and physical fitness

The physical growth in boys and girls more or less is equal up to adolescence. The peak growth velocity is achieved earlier in girls than the boys.

The childhood between 6 to 12 years is an age comparison by competition (1st stage) and at the age of 12 to 15 years, the physique is changing (2nd stage). The third stage of growth is adolescence, where the gender identification is observed. But later year is a stage of separation. Maximum strength is obtained from approximately one year following peak period in growth of height and weight. Maximum aerobic capacity is obtained at this time.

Therefore, to achieve good fitness in children, sports programmes should be arranged accordingly. At 1st stage, priority of fun, recreation, skill development and opportunity for competition should be provided. At the 2nd stage, the exercise should be both competitive as well as more exhaustive than 1st stage, where as in the 3rd and 4th stages, the exercise should be severe enough to attain maximum fitness. Because at this stage, the muscle strength, cardio respiratory strength and endurance of the children are developed maximally.[5]

Physically fit have various advantages

1. Physical fitness increases the level of intelligence.
2. Physical fitness makes the children more extrovert, social, dependable, tolerant, active and competitive. Children with low fitness are emotionally unstable and defensive.
3. Physically fit children show better adaptability to stress, less neuromuscular tension and less fatigability.

Nutrition and Physical fitness [6]

Excess availability of food, low energy expending and highly mechanized life style increase body fat which is incompatible with the physical fitness. Therefore, active energy expending life is essential in order to achieve physical fitness.

It is necessary to include all energy substrates in the diet plus vitamins and minerals which provide the enzymes that catalyze energy production.

Life style and physical fitness

Regular active disciplined lifestyle will enhance physical fitness. Balance diet, exercise, work, relaxation and sleep will make the person happy and energetic.

PHYSICAL FITNESS PARAMETERS

1. Maximal Aerobic Power (VO_2 Max).

Fitness can be measured by volume of oxygen that can be consumed while exercising at one's maximum capacity.VO_2 Max is the maximum amount of oxygen in ml, one can use in one minute per kg of body weight. Those who are more fit have higher VO_2 Max and can exercise more intensely than those who are less fit.

Maximal Aerobic power is defined as the highest oxygen uptake, an individual can attain during exercise while breathing air at sea level.

Before puberty, girls and boys show no significant difference in Maximal Aerobic power.[7]

The maximal oxygen uptake increases during childhood and adolescence, as there is growth in all tissues of importance for strength and power.[7]

Maximal aerobic power is expressed in lit/min. It gives information about a person's potential for activity requiring a high aerobic power. It is highly correlated with the individual's Maximal stroke volume and cardiac output. It indicates person's potential to move the body during activity such as running, climbing upstairs etc for several minutes or longer.

Mean VO_2 Max for male athlete is 3.4lit/min. Training and regular physical activity can modify the maximal oxygen uptake. Top athletes in endurance events have a VO_2 Max that is about twice as high as that of an age matched average person.

Inactivity is another fact that decreases the functional range of oxygen transporting system. It decreases stroke volume and perhaps the efficiency of regulation of circulation during exercise.

An obese person due to overweight increases the energy cost of moving the body. VO_2 Max depends on chemical ability of muscular, cellular and tissue systems to use oxygen in breaking down fuels and combined ability of cardiovascular and pulmonary systems to transport oxygen to muscular tissue system.

Factors affecting VO_2 Max

Age :

The maximum oxygen uptake is not spared by the effect of ageing. The maximum oxygen uptake in lit/min rapidly increases during the growth stages of the early years and reaches its peak between 18 to 25 years. After the age of 25 years, the VO_2 Max declines steadily. By age 55 years, it is about 27% below the values reported for 20 years of age.

The effect of age has been extensively studied. It was shown by Robinson (1938)[8] and later by P.O Astrand (1956)[9] that maximal aerobic power increases during childhood to reach a peak in the late teens which is maintained until the mid twenties. The early increase is due to growth of muscles, heart and lungs and the later decline is due in large part to a gradual reduction in maximum cardiac efficiency with advancing age.

Sex :

VO_2 Max values for men typically exceed scores for women by 15% to 30%, even among trained athletes. The apparent sex difference is due to gender related change in the body composition and hemoglobin content.[6, 10]

Body composition:

It is estimated that 69% of the differences in VO_2 Max score among individuals can be explained by differences in body weight, 4% by differences in height and 1% by differences in lean body weight.[6]

State of training:

The VO_2 Max score must also be evaluated relative to the person's state of training at the time of measurement. An improvement in aerobic capacity with training ranges 6% to 20% above pretraining level.

Mode of exercise :

In various experiments where VO_2 Max was determined on the same subjects during different forms of exercise, the highest VO_2 Max was obtained with treadmill exercise. In the laboratory, the treadmill is the apparatus of choice for determining VO_2 Max.

In the field experiment or when funds are scarce, stepping or bicycle exercise is a suitable alternative. Stepping is a familiar form of exercise and is easily administered. Benches are simple to construct, do not require calibration and can be easily transported.

The simplest and most extensively applied way of testing the circulatory function capacity is to determine the heart rate/ pulse rate during and after exercise.

Harvard step test was developed during second World war as a scoring test to select the individuals according to their physical fitness by Brouha in 1943.[11]

Later on, this test was used for the cardiovascular fitness by American Alliance for Health, Physical Education, Recreation and Dance, (AAHPERD 956) for selection of sports in youth.[12]

The original Harvard Step Test (HST) has a 50 cm/20” height of bench, duration of 5min, with frequency 30 steps/min. So, only 1/3rd of subjects were selected.

It was observed that lower the number of heart beats during recovery, longer the work time and higher is the score. The original HST was only for highly physically active subjects, which was not suitable for normal healthy subjects of sedentary lifestyles in many countries as observed by Clarke HJ (1943).[13]

Several modifications of Harvard test were suggested. Clarke H.J (1943) used a bench of 16” high for college girls and found that the scoring formula could be applied without a change.[13]

Kaprovich[14] and his associates (1949) reduced the stepping rate from 30 to 24 per minute. This was done for two reasons,

1. This rate was easier for the subjects to maintain and
2. It was easier for the tester to keep the count without either pendulum or metronome.

A number of modified Harvard step tests had been recommended by number of workers either by lowering step’s height, frequency of up and down/min or by altering the duration of exercise instead of maximum period of 5 min.[15, 16, 17, 18]

The draw backs of original Harvard Step test was, it might produce acute local muscular fatigue and that the bench was too high.

Original evidence of validity for Harvard Test was based upon endurance in Treadmill running, Maximum Heart Rate per minute and Blood Lactate level.

Effect on Cardio Vascular Endurance

It is increased due to various structural and functional changes in the heart and vessels.

1. Myocardial hypertrophy: Variable with age, sex, type of exercise, and intensity and duration of exercise. If produced at an early age, it may be long lasting.[19]
2. Cardiac output: It is increased due to increase in stroke volume, which is more due to hypertrophic heart.[20]
3. Bradycardia : It depends on several interdependent factors.

a. Sympathetic tone: It is reduced. Training may increase myocardial concentration of Acetylcholine.[21]

b. Parasympathetic tone: It is increased due to training.[22]

c. Peripheral adaptations: They occur in skeletal muscles and peripheral circulation which will reduce the amount of stress from any absolute work load. Therefore, central sympathetic output is less and heart rate response is reduced. [23]

d. Intrinsic heart rate: The uninfluenced discharge of sino-atrial node is reduced after training.[24,25]

4. Coronary circulation: It is increased according to demand.[26]
5. Efficiency of Blood flow: It is increased due to increased capillarization and hypertrophy of existing blood vessels. The resting blood flow does not change, but the blood flow debt during recovery is reduced. It means vascular bed opens to a greater extent during exercise.[27]

Pulse Rate During Exercise :

At the beginning of the muscular exercise, the pulse rate increases rapidly. The greatest rise takes place within one minute. Half of this increase occurs within 15 seconds, gradually a pattern is reached. If the exercise is intensive, the secondary rise may be observed. The change in pulse rate is individualized.

The pulse frequency shows a linear relationship to the amount of oxygen absorbed during the period of work.[28]

Respiratory Endurance:

It is increased due to increased number of functioning alveoli and their dilatation. Capillary vascularisation and strength of respiratory muscles are also increased. As a result, there is an increase in both static and dynamic functions of the lungs and the diffusing capacity. The rate of respiration is reduced.[29]

Effect on Body Composition.

Total body fat reduces and lean body mass increases to some extent. Maximal oxygen uptake is proportional to body weight (lean body mass) and diminishes with advancing age. A peak in maximal oxygen uptake is observed between 15 to 20 years of the age. A gradual decline with advancing age is found in this group of the male individuals.[30]

Effect on Blood culture

The RBC count is increased and hemoglobin content too, by enhanced erythropoiesis. Daniel stated that during adolescence, developmental changes in hemoglobin or hematocrit are a function of the stage of sexual maturation in boys. Total hemoglobin is also related to maximum oxygen intake.[31]

Psychological Effects:

Regular exercise positively brings about an emotional stable mind. In a physically fit person, symptom alleviation of depression is greater. Moderate exercise is associated with enhanced cognitive function.[32]

Appropriate kind and amount of exercise constantly employed will develop muscular strength and endurance. In fact, properly directed exercise is the only means of aquiring the ability to engage in tasks demanding strong and sustained physical efforts.

PULMONARY FUNCTION TESTS: [33]

Pulmonary function testing is also a valuable tool for evaluating physical fitness of any individual. Conventionally, strength of respiratory muscles is evaluated by determining pulmonary function tests. There are various factors that influence the pulmonary function tests. The most important factors are age, height, weight, sex, race and proper physical training. Further more, individual factors such as environmental factors, socio-economic status, habits and differences in life style can also cause a change in values of pulmonary function tests.[34]

Evolution of pulmonary function tests:

Hutchison, a London Surgeon in 1846 in his classic treatise “On the capacity of lungs and Respiratory Function” introduced the concept of Spirometry. Recently with the inventions and evolutions, more sensitive and technologically excellent equipments such as Spirometer, Mini Wright’s peak flow meter, Medspiror etc, are being developed. Eventually handy instruments are designed and made available. Accordingly, pulmonary function tests have become more easier and more practicable.

The following are some of the important landmarks in the evolution of pulmonary function tests. The founders of experimental Physiology were Erasistratus (280 B.C) and Galen (131-201) who demonstrated the role of diaphragm as a muscle of respiration, the functions of the phrenic nerve and function of intercostal and accessory muscles.[35] The barrier to the passage of blood imposed by the interventricular septum was recognized by Ibn-al-Nafis (1210-1289) and Servetus(1511-1553). They separately proposed that blood passes from pulmonary artery through the lung to the pulmonary vein.

Function of the diaphragm was further explored by Da vinci (1452-1519) who observed that during inspiration the lung expands in all directions following the movement of thoracic cage. The collapse which follows puncture of the pleura was described by Vesalius (1514-1564).

The need for fresh air was recognized by Galen who believed that it reacted with the blood in the left part and arteries to produce the vital spirit. Boyle (1627-1691) demonstrated that the constituents of air which supports combustion also supports life. The information about the lung which was necessary for the birth of respiratory physiology was available by 1667. The stroke output of lung bellows or vital capacity was first index of function to be investigated and it was measured in 1679. It was a fully developed test by the year 1946.

During the 18th century, role of the lung as an organ of gas exchange was observed by Lavoiser (1777) and others. They observed that it was the site of combustion. Measurement of residual volume by a gas dilution method was first performed by Davy (1800).

Thackarah (1831) showed that volume of air is less in women than in men and is reduced among the workers in flax and other occupations due to the inhalation of dust. The measurement was assessed finally on a quantitative basis by Hutchison (1846).[33] Spirometer was invented as early as in 1846 by Hutchison to measure lung volumes in various groups of people in London.[35]

Hutchison defined vital capacity as the greatest voluntary expiration following the deepest inspiration. He only designed a spirometer for the estimation of vital capacity related to height such that for every inch of height (from 5ft to 6 ft) eight additional inches of air at 60 degree F are given out by forced expiration. He also further showed that the vital capacity decreased with age and was reduced by excess weight and by disease of the lung.

Role of elastic recoil of the lung in causing expiration was demonstrated by Donders (1849).[33] Exchange of gas in the lung was intensively studied during the period of 1890. The techniques for analyzing gases were improved by Haldane and described in "Method of Air Analysis"(1899).

The relationship of vital capacity to breathlessness was described by Peabody (1915). He also compared the ventilation during the inhalation of carbon dioxide with that during exercise. The use of forced vital capacity was introduced by Strohl(1919).

In 1925, Fleisch constructed Pneumotachograph. Jenson and Strombergen introduced maximal breathing capacity as a dynamic test of lung function in 1932. Jacobacus developed Bronchospirometry. Hermannsen first measured maximal voluntary ventilation. Maximum breathing capacity was introduced as a dynamic test of lung function by Tensen, Knipping and Stromberger (1932). Hermannsen calculated the equivalent minute volume from the Kymograph record maximum voluntary ventilation (MVV).

The role of changes in lung distensibility in causing breathlessness was explored by Christie (1934).[33] The use of the proportion of vital capacity which could be expired in the first one second (FEV1), as a guide to airways obstruction was introduced by Teffenman (1948) and Pinelli (1947) who called it "Capacite Pulmomaire Utilizable all effort."

This timed vital capacity is now generally referred as One Second Forced Expiratory Volume (FEV1). The usefulness of FEV1 was firmly established by Gaensler.[33]

The spirometer designed by Hutchison was a light bell shaped container immersed in water tank which forms a seal.[35] As the bell moves up during exhalation the pen moves down marking the chart. The disadvantage of this instrument is the inability to measure the Functional Residual Capacity (FRC) and Residual Volume (RV).

The snowbird workshop held in 1979 resulted in the first American Thoracic Society (ATS) statement on the standardization of spirometry.[36] This was updated in 1987 and again in 1994. A similar initiative was undertaken by the European community for steel and coal resulting in the first European standardization document in 1983.[37] This was then updated in 1993 as the official statement of the European Respiratory Society (ERS).[38]

According to Donald (1953), the Physician of last century who asked a patient with respiratory disease to whistle or blow a candle out was crudely assessing the maximum respiratory velocities. Donald suggested that "a simple whistle like instrument" might be developed and then might become a standard clinical tool.

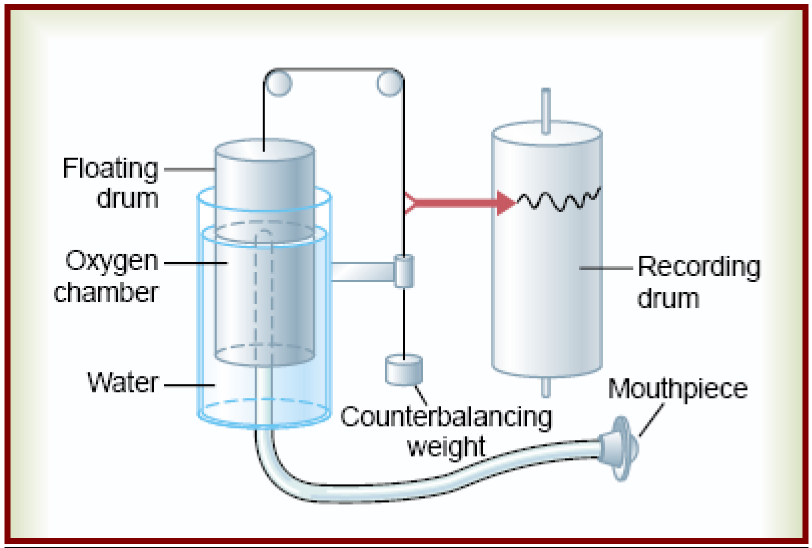
In 1959, Wright and M. C. Kerrow[39] first described the use of Peak flow Meter for measuring PEFR with advantages over the pneumometer and Puffmeter as it was simpler portable and had a lower resistance at higher flow rates. It was found to be convenient and reliable way of estimating ventilatory function and to produce results which co-relate with other recording methods.

In 1978, Wright described a mini Wright's Peak Flow Meter which has advantage of being economical and smaller than the original model[40] and other models make similar measurement. For example De Bone Whistle,[41] even economical but end point is less accurate.

Dubios et al in 1956 introduced a very different method of measuring functional residual capacity (FRC) by Helium dilution in a "closed circuit" in a system that does not allow gases to escape.

Dubois et al in 1956 introduced a very different method of measuring FRC by Plethysmograph.[42] Along with technology enhancements in various fields of Medicine, the Spirometer has undergone dramatic changes. With the advent of computerization, revolutionary changes have been brought in Spirometers which have become user friendly and accurate.

Fig. 1: Showing diagram of Spirometer[43]



SPIROMETER

PULMONARY FUNCTION PARAMETERS : [44,45,]

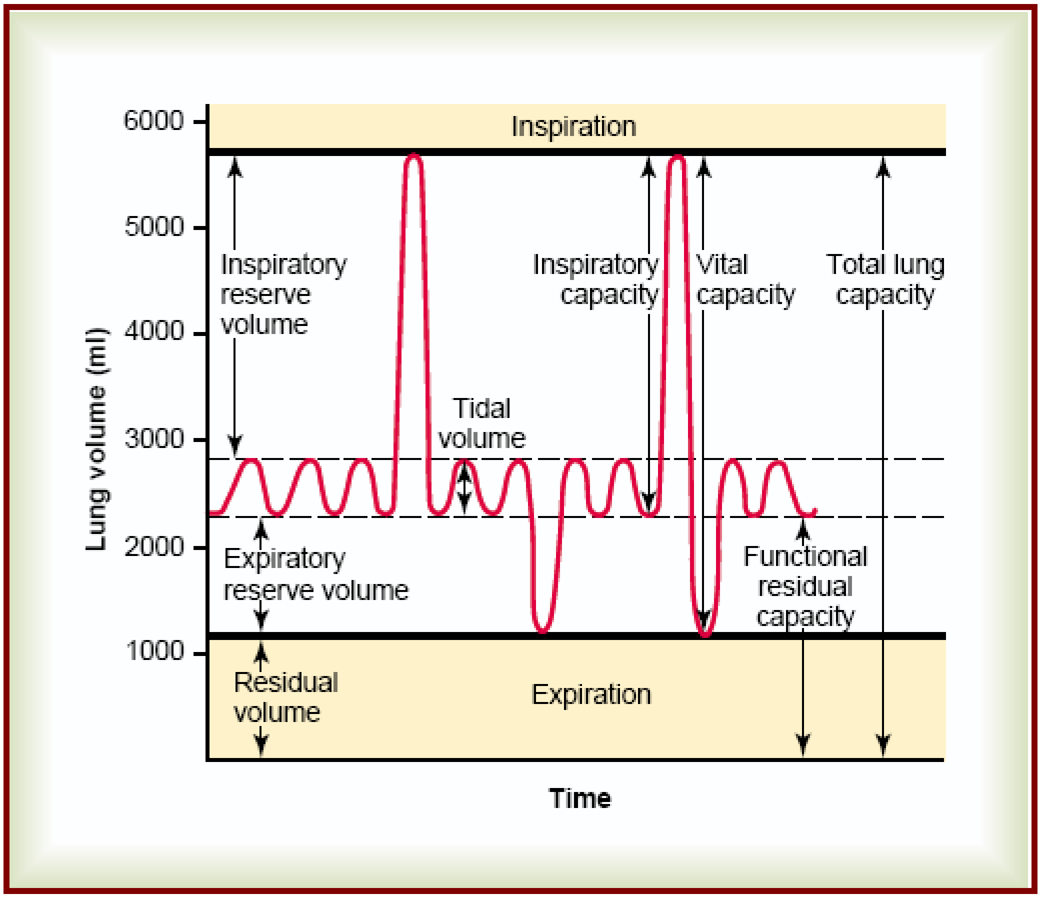
The static lung Function tests are…. Tidal Volume (VT), Inspiratory Reserve Volume (IRV), Inspiratory Capacity (IC), Functional Residual Capacity(FRC), Vital Capacity (VC) and Total Lung Capacity (TLC).

The dynamic lung function tests are … Forced Expiratory Volume or Timed Vital Capacity (FEV or TVC), Maximum Ventilatory Volume or Maximum Breathing Capacity (MVV or MBC), and Peak Expiratory Flow Rate (PEFR).

The lung volumes and capacities (V_T, IRV, ERV, IC & VC) and also FEV and MVV can be measured by Spirometer. Peak Expiratory Flow Rate can be measured by mini Wright's Peak Flow Meter (WPFM).

FRC cannot be measured by simple Spirometer. It can be measured by Nitrogen wash out or Helium dilution method.

Figure 2: Diagram showing Lung Volumes and Capacities[43]



To determine the importance of physical fitness in young children, we have designed a study comprising of residential and non residential school children. For assessing physical fitness, parameters like cardiopulmonary fitness parameters and pulmonary function tests are taken into account.

OBJECTIVES

1. To determine cardiopulmonary fitness parameters and pulmonary function parameters in Residential school boys in the age group of 12 to 16 yrs of Bijapur city, North Karnataka.
2. To determine cardiopulmonary fitness parameters and pulmonary functions parameters in Non-Residential school boys in the age group of 12 to 16 yrs of Bijapur city, North Karnataka.
3. To compare cardiopulmonary fitness parameters & pulmonary function parameters in residential and non-residential school children in the age group of 12 to 16 yrs of Bijapur city, North Karnataka.
4. To compare anthropometric parameters with cardiopulmonary fitness parameters and pulmonary function parameters among the above said groups.

REVIEW OF LITERATURE

Several studies well established that physical fitness & pulmonary functions of an individual are very necessary to carry out daily task.

Following studies have been done on cardiopulmonary physical fitness in healthy subjects.

Edward. L. Fox (1973)[46] in special communication concluded that Maximal Aerobic Power is single most valid measure of functional Capacity of Cardiopulmonary System. Their data were obtained from 876 healthy but untrained college male individuals in 17 to 19 years of age group.

P.K Dasgupta and A.K Das (1991)[47] in their article explained that high volume of VO_2 max in Athletes as a result of training may be due to some genetic endowment in them.

Training increases VO_2 max by increasing Cardiac Output secondary to high Stroke Volume and an increase in Arterio-Venous (AV) Oxygen difference. It appears that physical training increases VO_2 max by about 50% due to an increase in cardiac output and rest 50% due to increased extraction of Oxygen by working muscles which is reflected by increased AV difference.[48]

S.K.Das, S.Mahapatra, G.Bhattachaeryaand D.Mukherjee (1993)[49] in their study on 140 subjects with age group 20 to 25 years (78 male individuals and 62 female individuals) with modified Harvard's Step Test, observed that Mean PFI was 103 ± 12(%) in male individuals and 84 ± 07 (%) in females individuals.

P.K.Dasgupta, A.K.Makhopadhayay and A.K De (2000)[50] conducted a study in 17 subjects grouped under 2 groups and VO_2 max determined during gradual exercise in tread mill at 11 km/hr, Oxygen pulse by Oxygen consumption in ml/min by Heart Rate. In their study, they observed that several factors like heredity, environment, diet, training, hormone status, socio economic status, psychological trait etc contribute to the performance of sportsman. [51,52] And also they saw that training increases both Stroke Volume and Oxygen extraction by tissues.

Thierry Busso et al (2002) [53], in their study showed the reduction in recovery time increases between training sessions, yielded a progressive increase in the magnitude and duration of fatigue induced by each bout of training stimulus and also lead to a decrease in resultant adaptation. Reduced adaptation to training loads could arise from lower tolerance to exercise from higher fitness level or from a limitation on the body's capacity to adapt to greater training loads.

Satipati Chatterjee, Pratima Chatterjee and Amit Bandyopadhyaya (2004)[54], in their study evaluated cardiopulmonary fitness in terms of VO_2 max in obese boys of West Bengal of India. 49 Obese of 10 to 16 years age range were studied against 70 Non Obese counterparts.

They observed absolute VO_2 max was higher among Obese group because of higher values of Body Mass and Lean Body Mass, but VO_2 max per Kg of Body Mass was significantly higher among no obese groups (Obese 39.6$\pm$2.6 Vs Non obese 48.4$\pm$ 1.8 ml/kg/min). The VO_2 max per unit of Body Surface Area was significantly higher in obese group. They concluded that reduced oxygen utilization by adipose tissue during exercise reduces the overall VO_2 max.

Ravi Sankar P, Madanmohan, Kaviraja Udupa and E. Sankaranarayan Prakash (2005) [55] conducted their Study in apparently healthy 145 (105 male individuals and 40 female individuals) subjects aged 14 to 18 years. Data were showing correlation between BMI and BP indices, handgrip strength and handgrip enduarance, in underweight, normal weight, and overweight, adolescents.

Both systolic and Diastolic blood pressures were highest in overweight and least in underweight male subjects. In female subjects, Diastolic blood pressure alone showed statistically significant. Positive correlation was seen between BMI and HGS. Positive correlation was also seen between BMI and SBP in overweight female individuals.

They concluded that there is gender difference in correlation between BMI and BP indices especially in underweight and overweight subjects

Following studies have been done on pulmonary function tests in healthy subjects.

A study on Peak expiratory flow rate of residential and non-residential school children showed that, the children from Sainik school had the higher values of lung functions related by PEFR in comparison to non-residential school children. [56]

Choudari D, Aithala M, Kulkarni VA (2002) [57] did study on Maximal expiratory pressure in Residential and Non-Residential school children, observed that the children from Sainik school who underwent routine physical exercise, had higher values of maximal expiratory pressure in comparison to non-residential school children. This might be attributed to greater physical activities in children of Sainik school leading to greater Aerobic fitness.

Vijayan VK, Reetha AM, Kuppurao KV, Venkatesh P, Thlakavathy S (2000)[58] studied on Pulmonary function in normal south Indian children aged 7 to 19 years, observed that the height influences the prediction equation in males to a great extent, whereas age and weight had greater influence in girls. Regression equations were derived for boys and girls for predicting normal pulmonary functions for children in South India. The pulmonary function measurements in South Indian were similar to those reported for subjects from Western India and lower than those reported for Caucasians.

A study was conducted on Environmental and social factors as determinants of respiratory dysfunction in junior school children in Moscow comprising of 539 children aged 6-12 years who attended school and lived in one of three districts of Moscow with varying ambient pollution levels. It was concluded that children from areas of high environmental pollution had lower lung capacity.[59]

In a cross-sectional study in 861 healthy Danish schoolchildren aged 6-17 years, Peak Expiratory Flow (PEFR) was measured by using a mini Wright's peak meter. A strong correlation was found between PEFR and height, age and sex. Among healthy children without previous asthma, earlier episodes of recurrent wheezing were reported in 8.8%. A significantly lower PEFR was found in this group.[60]

A study on prediction equation for lung functions in South Indian children, observed that Lung volumes and flow rates were lower than North Indian and foreign boys. The decrease in lung functions in South Indian boys were due to their sea level dwelling, dietary habits and comparatively lower anthropometric measurements.[61]

A study was on Lung function in Malay children to measure the Peak expiratory Flow, FVC & FEV1 in primary school children aged 7-12 years. They found that PEFR was correlated with age & height of the subjects. But, FVC & FEV1 were correlated with height only. It was concluded from the study that before puberty lung indices increase with both age & height.[62]

A study on Peak Expiratory Flow Rate in 345 healthy South Indian school children aged 4-15 years, observed that PEFR increased progressively with age & showed a very good correlation with height, age & weight in both sexes. Their results showed that highest correlation was obtained between PEFR & height & weight. They constructed a nomogram from the linear regression using PEFR as the dependent & height as the independent variable. It was found that 75% of the variability in PEFR could be explained by height alone.[63]

Shivesh Prakash et al conducted a study on 20 randomly selected subjects belonging to Athletes, Yogi's and sedentary groups using a COSMED /micro Quark spirometer based on ATS Recommendations and observed the following:[64]

1. The groups differed significantly in FEV1 (p=0.047) and PEFR (p=0.022).
2. The highest Mean FEV1 (96.25%) and PEFR (116.77%) were observed in Yogi's.
3. Lowest FEV1 and PEFR values were observed amongst the sedentary workers and Athletes respectively.

4. Comparison of Athletes with sedentary workers revealed significantly higher FEV1 (p=0.038, 95%, 14.6; 4.2) and FEV1/FVC (p=0.02, 95% C1; 7.5; 0.6) parameters amongst the Athletes.

Comparison of Yogi's with sedentary workers revealed significantly higher FEV1 (p=0.036, 95% C1;16.15, 0.06) PEFR (p=0.037, 95% C1; 19.0; 0.6) among the Yogi's. There are no significant differences in the other parameters mentioned. Lung functions of Yogi's and Athletes were similar expect for PEFR which was significantly higher among Yogi's. (p=0.019, 95% C1, 20.5; 1.08).

The lung Function tests, like other physiological tests must be of the utmost importance for measuring the fitness of an individual from a Physiological point of view. The Pulmonary Function Capacitors of normal sedentary individuals have been studied extensively in India [65,66,67,68,69] in the context of an athletic population by Singh, Rao and Gupta et al. Such studies are scanty and have also been carried out by the researchers on a small sample by Malhotra et al, De et al.[70,71]

Pande J. N et al (1997) [72] recorded PEFR in children (6 to 17 years, n=183) from Urban Delhi school and from another school (n=523) in Nellore, AP. The Study showed that Age, Sex, Height and Weight were independent predictors of PEFR in children from Nellore.

For boys from Delhi, Age, Sex and Height were independent predictors for PEFR, while for Delhi girls, Height recorded, PEFR from both regions of the country were lower than those reported from American white children.

Rajesh Sharma, Anil Jain, Achala Arya and B.R Choudari (2002),[73] in their study evaluated that PEFR in a group of rural school going children from Ajmer Dist of Rajasthan and compared the values with available from North India.

They conducted a study on 203 subjects (163 male individuals and 140 female individuals) aged 5 to 14 years, mostly from low socio-economic group were chosen. The Mean Height was 128±3.8 cms, Mean Weight 25.61 kg and PEFR measured ranged from 92 to 460 lit/min.

Emerson and Green (1921)7[4] published one of the first scale studies on vital capacity values in children. Their methods were acceptable. Yet, their values were considerably small. This fact was noted by Edward and Wilson[75] and by Ferris et al. (1952).[76] But, no full explanation could be given for their discrepancy.

Lange et al (1984),[77] observed in longitudinal study of Lung Volumes and growth in both Athletes and Non Athletes. It revealed that Lung Volumes and growth increased with Body Height.

In an another study conducted by S. C Lakhera, T. C Kain and P. Bandopadhayay (1994) [78] in 25 subjects (14 male individuals and 11 female individuals) of 13 to 17 years age group with 1 year training. They concluded that boys had slight higher Lung Function Values in comparison to those of girls. Males had significant effect on Lung Volumes and Capacities. Adolescent habituated to high level of physical activity, has an average greater level of Lung Volumes. These were compared with Age, Body Size of same age group. Therefore, training may be of greater importance in determining the ultimate dimensions of lungs. They also concluded that running training during growth may help in developing a reduced resistance to expiration and a greater endurance in respiratory muscles.

S. K. Malik and S K Jindal (1985),[79] in their study on 441 male individuals observed a linear relationship of Lung Functions with Age, Height and Body Surface Area. Lung Functions based on Age and Height were identical to those based on Age and Body Surface Area. They observed that the nomograms available in literature were largely from Western Countries and were not strictly applicable in Indian children because of ethnic and environmental factors.

Avinash Kumar et al in (1992),[80] observed in their study conducted on 177 male healthy children between age group of 10 to 18 years that there was a linear relationship for lung functions with age, height, weight and BSA. The values when compared with South Indian students were higher but closer to other North Indian students.

R Hari Kumaran Nair, et al (1997)[81] conducted a study on study on 109 South Indian school boys in the age group of 5 to 16 years on Lung Functions (VC, IC, FVC, $FEV_{0.5}$, FEV_1, PEF, PEF0.2 to 1.2, FEF25 to 75%, FEF75 to 85%, PIF, FMFT, MVV_{IND}, PEF at 25%, 50% and 75% of FVC, PIF at 75%, 50%, 25%).

They observed that the entire lung functions except FEF 75 to 85% and the Ratio between different Lung Volumes showed positive correlation with Age, Height and Weight.

The values obtained were, Age group 14 to 16 years (n=42), Mean Height (cms) 159.21±6.25, Mean Weight (kgs) 44.64±6.84, VC (lit) 2.45±0.41, IC(lit) 2.31±0.50, FVC (lit) 2.42 ±0.50 and PEF (lit/min) 260.85 ±56.44.

Peak expiratory flow rates (PEFR) were studied by Parmer et al (1977) in North Indian (Chandigarh) school children both girls and boys between 6 to 16 years of age.[82] The values showed positive correlation with age, height and weight. Singh and peri (1978) have used Wright Peak Flow meter to record the flow rates in children and adults of Tamilnadu.[83] The volume of air which a man can inhale during a single deep breath was measured by Borelli.

Following studies have been done on pulmonary function tests and cardiopulmonary physical fitness in healthy subjects.

A. K. Ghosh et al stated that the Physically trained individuals may have higher ventilator capacity as well as FEV1.[84] This might have been brought about by the fact that physical training not only improves the strength of skeletal limb and cardiac muscle, but also improves the accessory muscles for inspiration and expiration as stated by Stuart and Collings et al.[85] This denotes that the efficiency of the respiratory muscles may account for a high value of FEV1.

The vital capacity, maximum voluntary ventilation (MVV) and FEV1, were higher in Physically trained sportsperson than in the normal sedentary control individuals. This was observed in the study conducted by A. K. Ghosh, M.Sc., Ph.D; A.Ahuja, MB; BS and G.L.Khana, M.Sc., National Institute of Sports, Patiala, India, Pulmonary capacitors of different groups of sportsmen in India.[86]

METHODOLOGY

Experimental design

Our study included 100 healthy students from residential (Sainik) school & 100 healthy students from non-residential (Banjara) school, in the age range of 12 - 16 years of Bijapur, Karnataka state.

Materials and Methods :

1. Our study comprising of 100 boys in each of 2 groups.

Group I : Residential School boys (Sainik school)

Group II : Non-Residential School boys (Banjara school)

2. Age – 12-16 years.

The subjects are from 8^{th}, 9^{th} and 10^{th} Std Classes. The subjects represent almost all socio-economic sections and religious.

3. The ethical clearance for the study was obtained from ethical committee (Annexure: 1)

4. Before starting the study, written consent is taken from Principals of both schools, as the students are in the age range from 12 to 16 years (minor age group) and from the subjects too. Whole procedure was explained to them. (Annexure: 2)

5. Before including the subjects for the study, all the subjects were assessed clinically through history taking and detailed clinical examination. History taking included, all past, recent and acute illnesses of the subject and the family members.

6. Subjects were taken into confidence to relieve the apprehension. Data were collected at the school campus during working hours 12 noon to 2pm daily during their resting period.

7. Only those subjects who fulfilled the inclusion criteria were included in the study.

Inclusion criteria

Only healthy volunteer male students between 12-16 years were included in the study. The subjects without signs of cardiovascular, endocrinological, neurological, hematological & inflammatory diseases were selected for the study. The apparent health status of the subject was determined through clinical examination and history taking.

Exclusion criteria

The subjects with any of the following disorders were excluded from the study.

1) Subjects with any type of congenital heart diseases.
2) Subjects with any endocrine disorders.
3) Subjects with obesity or anemia.
4) Subjects with history of chronic diseases.
5) Subjects with history of respiratory tract infection, allergy etc.
6) Subjects with history of cardiac or respiratory disease.
7) Subjects with any type of congenital anomalies.

Each subject who volunteered to take part in the study after thorough physical examination was explained about the purpose and procedure to be adapted in the study.

Sample size:[87]

100 Residential-Sainik school boys were included. For stastistical purpose, 20% of the sainik school course study. In Sainik School, yearly on an average 100 students are seeking admission. Thus, a total of 500 students will always be available. Hence, 100 students are included in the study group. To compare with Sainik school students 100 Banjara school students included in this study.

Methods of Collection of Data

Following parameters were recorded in each subject apart from name, age, sex, address and date of birth. Information of each subject was entered in a Performa.

I. Recording of Physical Anthropometry:

For each subject the following parameters were recorded.

1. Height (in cms): This was measured with the subject in standing position without footwears, nearest to 0.1cms.

2. Weight (in kgs): The subjects were weighed in a standard machine with minimum of clothing, nearest to 0.1 kgs.

3. Body Surface Area (Square meters): This was calculated in each subject by using Dubois Nomogram.

4. Body Mass Index (Kilogram/meter^2): This was calculated for each subject from his height and weight by using formula BMI = Wt in Kg divided by Ht in m^2

5. **Mid Arm Circumference (MAC in cms):** It is measured in the right arm by the Standard Tailor Tape, where the girth of the muscle is maximum (Middle part of the arm).

6. **Chest Circumference (CC in cms) :** It is measured at deep inspiration position at the level of the nipple, with minimum clothing, with the help of standard Tailor Tape.

7. **Abdomen Circumference (Abd C in cms) :** It is measured at the level of umbilicus, with minimum clothing, with the help of Standard Tailor Tape.

II. Recording of Physiological Parameters: [88,89]

In each subject following physiological parameters were recorded.

a) **Respiratory rate (cycles/minute) :** Without the knowledge of the subject, the upward and downward excursions of anterior chest wall and anterior abdomen wall were confirmed by palpation for one minute.

b) **Heart rate (Beats/minute) :** Right radial artery pulsation recorded.

c) **Systolic and Diastolic blood pressure (mm of Hg)** by using Diamond mercury sphygmomanometer. SBP and DBP are recorded in the lying down position by both Palpatory and Auscultatory methods.

d) Mean Arterial Pressure (MAP in mmHg):

It is calculated by formula : DBP + 1/3 Pulse Pressure (PP)

III. Cardio pulmonary Fitness Parameters:

In the research laboratory, tests of Cardiopulmonary Endurance include maximum Oxygen uptake, EMG and Blood Sample analysis. But these require instruments which are sophisticated, costly and require trained person. So we have adopted most prevalent, routine and suitable test for large number of subjects like school children i.e Harvard Step Test.

1. **Physical Fitness Index (PFI in %):** [90]

It is calculated by using the following formula….

$$PFI = \frac{\text{Duration of exercise in sec}}{2\text{ (Sum of pulse counts during recovery)}} \times 100$$

The test is done on modified Harvard steps of 33 cms height

Procedure: The Subject is advised to step up on the modified Harvard steps of 33 cms height once every two seconds for 5 minutes. A total of 150 steps in total. One minute after completing the test, pulse rate is recorded as

(a) PR_1 (Pulse Rate 1) – 1 min after exercise

(b) PR_2 (Pulse Rate 2) – 3 min after exercise.

(c) PR_3 (Pulse Rate 3) – 5 min after exercise.

2. **Maximal Aerobic Power (VO_2 Max)**

It is obtained by using the formula: 111.33 – (0.42 X P max) [91]

P max: maximum pulse rate/min recorded immediately after 60 sec of the Harvard's Step Test exercise.

Table 1: VO_2 Max (ml/kg/min)[92] in Male Adolescents

Age (yrs)	Very Poor	Poor	Fair	Good	Excellent	Superior
13-14	<35.0	35-38.3	38.5-45.1	45.2-50.9	51.9-55.9	>55.9

IV. Recording of Pulmonary Parameters[93,94]

The subject well informed and explained the procedure, demonstrated and one or two trials taken for each parameter. For each test, three readings will be taken. The highest reading will be taken for calculation. All the tests will be recorded in a sitting posture at room temperature in afternoon hours.

Pulmonary function tests include

1. Breath Holding Test,
2. 40 mmHg Endurance Test
3. Lung Volumes and Capacities
4. Peak Expiratory Flow Rate
5. Maximal Expiratory Pressure

1. **BHT (Breath Holding Test) in seconds:** A subject is asked to take deep inspiration and then to hold it till the tolerance. Time is noted in seconds with the help of stop watch.
2. **40 mmHg Endurance Test in seconds by using Flack's Air Force Manometer:** A subject is asked to take a deep inspiration, close the nostril with the help of fingers and then to blow into the mercury manometer to raise the Mercury column to 40 mmHg and then to maintain it at that level. Time in seconds is noted. The subject is instructed not to blow the checks. The method employed is as suggested by Burger.
3. **Lung volumes and capacities :** They are recorded by Recording Spirometer.

i. **V_T, (Tidal volume in ml) :**It is the volume of air that is inspired or expired during each normal respiratory Cycle. Normal range…. 350 to 500 ml

ii. **IRV (Inspiratory Reserve Volume, ml)** :

It is the maximum volume of air that can be forcefully inhaled following a normal inspiration from end inspiratory position. Normal range… 2500 to 3000 ml.

iii. **ERV (Expiratory Reserve Volume, ml) :**

It is the volume of air that can be forcefully exhaled following a normal expiration from end expiratory position.

Normal range… 900 to 1100 ml.

iv. VC (Vital Capacity, ml):

It is the volume of air that can be forcibly exhaled after maximum inspiration. It ranges from 3500 to 5000 ml.

v. FVC (Forced Vital Capacity, ml):

Forced vital capacity (FVC) is recorded by using Benedict-Roth's recording spirometer in a sitting and relaxed position. Person was asked to exhale or blow out as rapidly and as forcefully as he can, record is taken on the graph paper.

vi. Forced Expiratory Volume (Timed Vital Capacity)

It is the fraction of Vital Capacity that is exhaled at the end of first (FEV1), second (FEV2) or third (FEV3) second.

$$FEV\ 1\% = \frac{\text{Volume of air exhaled in the first second}}{\text{Vital Capacity}} \times 100$$

Normal values

FEV1 = 85% (85% of air comes out of the lungs in first second x 100),

FEV2 = 96% and FEV3 = 100%.

FEV1 is limited by speed with which gas can be forced through the airways. It is reduced in Obstructive Lung Diseases. As magnitude of FEV1 is always reduced in parallel with reduction in Forced Vital Capacity (FVC), even in the absence of obstruction, diagnostically FEV1/ FVC is useful.

Normally, it is more than 75% (0.75) in healthy people and below 50% (0.5) is encountered in increased airway resistance as seen in case of Asthma.

4. PEFR (Peak Expiratory Flow Rate, lit/min): It is the amount of air that can be blown out of fully inflated lungs as rapidly as possible.

Peak Expiratory Flow Rate achieved is recorded with a Peak Flow Meter. PEFR is the measurement that measures efficiency of lungs by recording maximum flow of air. The subject is asked to take deep inspiration and exhale forcefully as fast as possible into the apparatus with nasal clip applied. Three readings are taken at interval of one minute .Highest reading is taken for calculation.

Peak Expiratory Flow Rate is dependent upon Age, Sex, Build.

It is about 10 L/Sec (6 to 15 l/sec)

In a young adult, it is about 400 L/min

It falls dramatically in cases of Chronic Obstructive Lung Diseases (COPD).

5. MEP (Maximum Expiratory Pressure) in mmHg:

The strength of respiratory muscles is assessed by measuring Maximal Expiratory Pressure (MEP) by using a Modified Black's apparatus[88].

The apparatus consisting of a small cylinder of dimension specified by Black. The cylinder is connected to an aneroid pressure gauge. A three way connector connects the cylinder and pressure gauge to a Mercury Manometer. This allows the calibration check in the instrument.

Maximal Expiratory Pressure is measured near Total Lung Capacity (TLC) after a maximal inspiration in sitting position. The pressure measured is maintained for at least one second. Three maximal expiratory efforts are to be done by each subject with rest period of one minute between each effort. The highest reading is accepted for statistical analysis.[95]

STATISTICAL ANALYSIS:

All statistical analysis is done by using SPSS software version 9 under the guidance of Biostatistician of Shri B M Patil Medical College. All values are presented as Mean, Standard Deviation and SE . Comparison of mean values of parameters between group I and group II is done by ‘Z’ test.[96]

1. p Value >0.05 is taken as not significant.
2. p Value <0.05 is taken as significant.
3. p Value <0.01 is taken as highly significant.
4. p Value <0.001 is taken as very highly significant.

Figure 3: Showing instrument used: Benedict-Roth's recording spirometer.

Figure 4: Other instruments used: Peak flow Meter, Black's Apparatus, BP apparatus, stethoscope etc.

Figure 5: Subject performing Modified Harvard Step Test.

Figure 6: Recording of Maximal expiratory pressure in subject.

Figure 7: Recording of lung volumes and capacities in a subject.

Figure 8: Recording of Peak expiratory flow rate in a subject.

RESULTS

The comparative study of physical fitness and pulmonary functions was conducted on healthy students in the age range of 12-16 years of residential (Sainik) and non-residential (Banjara) school children of Bijapur. Total number of subjects in each group is as follows:

Group I: Residential school : 100 students

Group II: Non-Residential school : 100 students

Recording of various anthropometric, Physiological, physical fitness and pulmonary function test parameters in Group I (Residential school children) and Group II (Non-Residential school children) are represented in Annexure: 4a and 4b individually.

1. **Anthropometric Parameters:**

The Mean Value, Standard Deviation (Mean±SD), SE and Level of Significance (p value) of eac parameter is calculated for each group and presented in table- 2.

Height (cm):

Group I (Residential): Mean ± SD is 160.31± 7.6cm and SE 0.76.

Group II (Non-Residential): Mean ± SD is 150.36±6.84cm and SE 0.68.

Mean Height (cm) is more in Group I than that of Group II.

There is very highly significant p value ($p < 0.001$).

Weight (Kg):

Group I (Residential) Mean ± SD is 44.35 ± 6.7kg and SE 0.67.

Group II (Non-Residential) Mean ± SD is 39.31±8.08kg and SE 0.80.

Mean Weight (Kg) is more in Group I than that of Group II.

There is very highly significant p value ($p<0.001$).

Mid Arm Circumference (MAC in cms):

Group I (Residential) Mean ± SD is 21.68±2.3cms and SE 0.23.

Group II (Non-Residential) Mean ± SD is 20.39±7.04cms and SE 0.70.

Mean MAC (cm) is slightly more in Group I and in Group II.

There is significant p value (p: 0.05).

Chest Circumference (CC in cm):

Group I (Residential) Mean ± SD is 74.17±6.45cms and SE 0.64.

Group II (Non-Residential) Mean ± SD is 66.82±6.11cms and SE 0.61.

Mean CC (cms) is more in Group I than that of Group II.

There is very highly significant p value ($p<0.001$).

Abdominal Circumference (Abd C in cm):

Group I (Residential) Mean ± SD is 62.54±5.89cms and SE 0.58.

Group II (Non-Residential) Mean ± SD is 58.92±9.08cms and SE 0.90.

Mean Abd C (cm) is more in Group I than that of Group II.

There is very highly significant p value ($p<0.001$).

Body Surface Area (BSA in Square meter):

Group I (Residential) Mean ± SD is 1.43±0.132m^2 and SE 0.013.

Group II (Non-Residential) Mean ± SD is 1.28±0.13m^2 and SE 0.013.

Mean BSA (square meter) is more in Group I than that of Group II.

There is very highly significant ($p<0.001$)

Body mass index(BMI in kg/m^2):

Group I (Residential) Mean ± SD is 18.26±1.79Kg/m^2 and SE 0.17.

Group II (Non-Residential) Mean ± SD is 17.52±3.4579Kg/m^2 and SE 0.34.

Mean BMI (kg/m^2) is more in Group I Group II.

There is significant p value (p: 0.05).

II Physiological Parameters

Recording of various Physiological parameters in Group I and Group II are represented in table 3. The values are presented as Mean ± SD and SE of each parameter in Group I and Group II.

Resting Pulse Rate (beats/min):

Group I (Residential) Mean ± SD is 79.4± 8.71bpm and SE 0.87.

Group II (Non-Residential) Mean ± SD is 82.50±7.42bpm and SE 0.74.

Mean resting Pulse Rate of subjects is more in Group I than Group II.

There is a highly significant p value (p=0<01).

Resting Respiratory Rate (cycles/min)

Group I (Residential) Mean ± SD is 18.56±2.92cycles/min and SE 0.29.

Group II (Non-Residential) Mean ± SD is 19.48±2.33cycles/min and SE 0.23.

Mean resting Respiratory Rate of subjects is more in Group I than Group II.

There is a highly significant p value ($p<0.01$).

Resting Systolic Blood Pressure (mm of Hg)

Group I (Residential) Mean ± SD is 112.74±10.81mmHg and SE 0.10.

Group II (Non-Residential) Mean ± SD is 109.76±8.54mmHg and SE 0.85.

Mean resting Systolic Blood Pressure of subjects is more in Group I than Group II.

There is a highly significant p value ($p<0.05$).

Resting Diastolic Blood Pressure (mm of Hg)

Group I (Residential) Mean ± SD is 72.18±8.16mmHg and SE 0.81.

Group II (Non-Residential) Mean ± SD is 69.28±7.54mmHg and SE 0.75.

Mean resting Diastolic Pressure of subjects is more in Group I than Group II.

There is a highly significant p value ($p<0.01$).

Mean Arterial Blood Pressure (mm of Hg)

Group I (Residential) Mean ± SD is 84.70±7.86mmHg and SE 0.78.

Group II (Non-Residential) Mean ± SD is 82.73±7.63mmHg and SE 0.76.

Mean Arterial Blood Pressure of subjects is more in Group I than Group II.

There is a insignificant p value ($p>0.05$).

III. Cardiopulmonary Fitness Parameters

Recording of various Cardiopulmonary Fitness parameters in Group I and Group II are represented in table 4. The values are presented as Mean ± SD, SE and p value.

PFI (Cardiopulmonary Fitness Index in %):

Group I (Residential) Mean ± SD is 54.96± 8.38bpm and SE 0.83.

Group II (Non-Residential) Mean ± SD is 44.75± 5.05 and SE 0.50.

Mean CPFI is more in Group I than Group II.

There is very highly significant p value ($p<0.001$).

VO_2 Max (in ml/kg/min):

Group I (Residential) Mean ± SD is 66.03± 7.06 and SE 0.70.

Group II (Non-Residential) Mean ± SD is 55.23± 7.53 and SE 0.75.

Mean VO_2 Max is more in Group I than Group II.

There is very highly significant p value ($p<0.001$).

IV. Pulmonary Function Parameters

Recording of various Pulmonary function parameters in Group I and Group II are represented in Table 5. The values are presented as Mean ± SD, SE and p value.

BHT (Breath Holding Test in secs):

Group I (Residential) Mean ± SD is 37.38± 7.63 and SE 0.763

Group II (Non-Residential) Mean ± SD is 31.23±10.14 and SE 1.014.

Mean BHT is more in Group I than Group II.

There is a highly significant p value ($p<0.001$).

ENDT (40 mmHg Endurance test in secs):

Group I (Residential) Mean ± SD is 36.51± 9.23bpm and SE 0.92.

Group II (Non-Residential) Mean ± SD is 24.84± 11.50bpm and SE 1.15

Mean ENDT is more in Group I than Group II.

There is a highly significant p value ($p<0.001$).

V_T (Tidal Volume in ml):

Group I (Residential) Mean ± SD is 487.25± 93.17 ml and SE 9.31.

Group II (Non-Residential) Mean ± SD is 462.65±75.25bpm and SE 7.52.

Mean TV is more in Group I than Group II.

There is a significant p value ($p<0.05$).

IRV (Inspiratory Reserve Volume in ml):

Group I (Residential) Mean ± SD is 908± 311.38 and SE 31.13.

Group II (Non-Residential) Mean ± SD is 849.5±315.39 ml and SE 31.53.

Mean IRV is more in Group I than Group II.

There is a insignificant p value (p>0.05).

ERV (Expiratory Reserve Volume in ml):

Group I (Residential) Mean ± SD is 834.5± 276.22 and SE 27.62.

Group II (Non-Residential) Mean ± SD is 524.5± 191.15 and SE 19.11.

Mean ERV is more in Group I than Group II.

There is a highly significant p value (p<0.001).

VC (Vital Capacity in ml):

Group I (Residential) Mean ± SD is 2084± 415.35 ml and SE 41.53.

Group II (Non-Residential) Mean ± SD is 1767.5±420.58 and SE 42.05.

Mean VC is more in Group I than Group II.

There is a highly significant p value (p<0.001).

FVC (Forced Vital Capacity in ml):

Group I (Residential) Mean ± SD is 2192.5 ± 424.78 and SE 42.47.

Group II (Non-Residential) Mean ± SD is 1897±444.77 and SE 44.47.

Mean FVC is more in Group I than Group II.

There is a highly significant p value (p<0.001).

Recording of various Pulmonary (Dynamic) function parameters in Group I and Group II are represented in Table 6. The values are presented as Mean ± SD, SE and p value.

FEV1 (Forced Expiratory Volume in 1 second in ml):

Group I (Residential) Mean ± SD is 1991± 424.78 and SE 42.47.

Group II (Non-Residential) Mean ± SD is 1608±412.60 and SE 41.26.

Mean FEV1 is more in Group I than Group II.

There is very highly significant p value (p<0.001).

FEV1 (Forced Expiratory Volume in 1 sec in %):

Group I (Residential) Mean ± SD is 91.21± 7.53 and SE 0.75.

Group II (Non-Residential) Mean ± SD is 87.79± 9.79 and SE 0.97.

Mean FEV1 in % is more in Group I than Group II.

There is very highly significant p value (p<0.001).

PEFR (Peak Expiratory Flow Rate in L/Min):

Group I (Residential) Mean ± SD is 499.05± 95.39bpm and SE 9.53.

Group II (Non-Residential) Mean ± SD is 389.25± 96.98 and SE 9.69.

Mean PEFR is more in Group I than Group II.

There is very highly significant p value (p<0.001).

MEP (Maximal Expiratory Pressure in mmHg):

Group I (Residential) Mean ± SD is 90.1± 17.05bpm and SE 1.70.

Group II (Non-Residential) Mean ± SD is 73.83± 25.50 and SE 2.55.

Mean PEFR is more in Group I than Group II.

There is a very highly significant p value (p<0.001).

Comparison of Anthropometric parameters between Groups I (Residential) and II (Non-Residential).

It is observed from graph I, Mean Height (cms), Weight (kgs), CC (cms), Abd C(cms) and BSA (m^2) in Group I are higher than that of Group II.It is observed from graph I, Mean MAC (cms), BMI (kg/m^2) are almost same, in both the Groups.

It is observed from graph II, Mean Pulse Rate (bpm), Respiratory Rate (cycles/min), Systolic Blood Pressure (mmHg) and Diastolic Blood Pressure (mmHg), in Group I are higher than that of Group II.

It is observed from graph II, Mean Arterial Pressure (mmHg) is almost same, in both the Groups.

It is observed from graph III, Mean PFI (%) and VO_2 Max in Group I are higher than that of Group II.

It is observed from graph IV, Mean BHT (sec), ENDT (sec), TV(ml), ERV (ml), VC (ml) and FVC (ml) in Group I are higher than that of Group II.

It is observed from graph III, Mean IRV (ml) is almost same, in both the Groups.

It is observed from graph V, Mean FEV1 (ml), FEV1 (%), PEFR (l/min) and MEP (mmHg) in Group I are higher than that of Group II.

Table 2: Comparison of Anthropometric Parameters between Group I (Residential School) and Group II (Non-Residential School).

Parameters	Group I		Group II		Z Values	P Values
	Mean $\pm$ SD	SE	Mean $\pm$ SD	SE		

Height (cms)	160.31 ± 7.64	0.764	150.36 ±6.84	0.684	9.70	0.0002***
Weight (cms)	44.35 ±6.78	0.678	39.31 ±8.08	0.808	4.77	0.0002***
MAC (cms)	21.68 ± 2.31	0.231	20.27 ±6.98	0.698	1.91	0.056*
CC (cms)	74.17 ±6.45	0.645	66.82 ±6.20	0.620	8.26	0.0002***
Abd C (cms)	62.54 ±5.89	0.589	58.92 ±9.08	0.908	3.34	0.0002***
BSA (sq mt)	1.43 ±0.13	0.013	1.28 ±0.14	0.014	7.89	0.0002***
BMI (kg/mt^2)	18.26 ±1.80	0.180	17.52 ±3.46	0.346	1.90	0.056*

*p: <0.05: Significant,

** p: <0.01: Highly significant,

*** p: <0.001: Very highly significant.

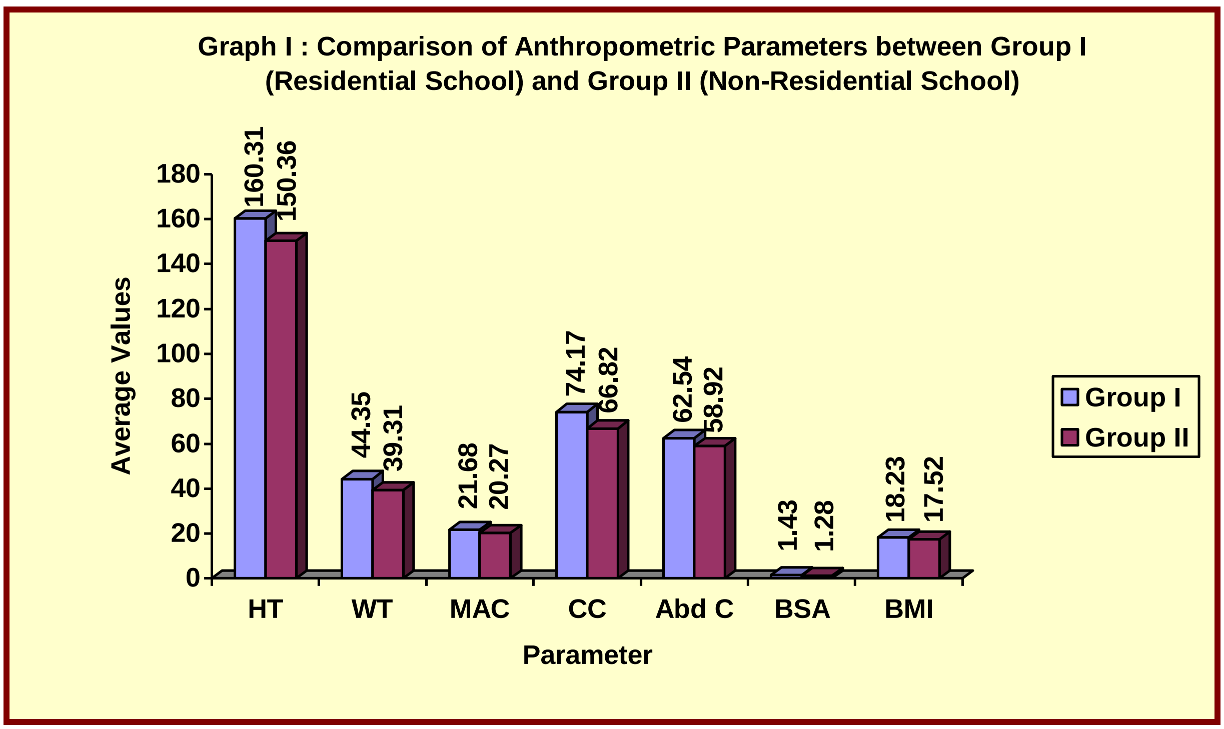


Table 3: Comparison of Physiological Parameters between Group I (Residential School) and Group II (Non-Residential School).

Parameters	Group I		Group II		Z Values	P Values
	Mean ± SD	SE	Mean ± SD	SE		
PR (bpm)	79.4 ± 8.72	0.872	82.5 ± 7.42	0.742	2.70	0.0142**
RR (cycle/mi)	18.56 ± 2.92	0.292	19.48 ± 2.34	0.234	2.45	0.0142**
SBP (mmhg)	112.74 ± 10.81	1.081	109.76 ± 8.54	0.854	2.16	0.0308*
DBP (mmhg)	72.18 ± 8.17	0.817	69.28 ± 7.45	0.745	2.62	0.0142**
MAP (mmhg)	87.70 ± 7.87	0.787	82.73 ± 7.63	0.763	1.79	0.0734

*p: <0.05: Significant,

** p: <0.01: Highly significant,

*** p: <0.001: Very highly significant

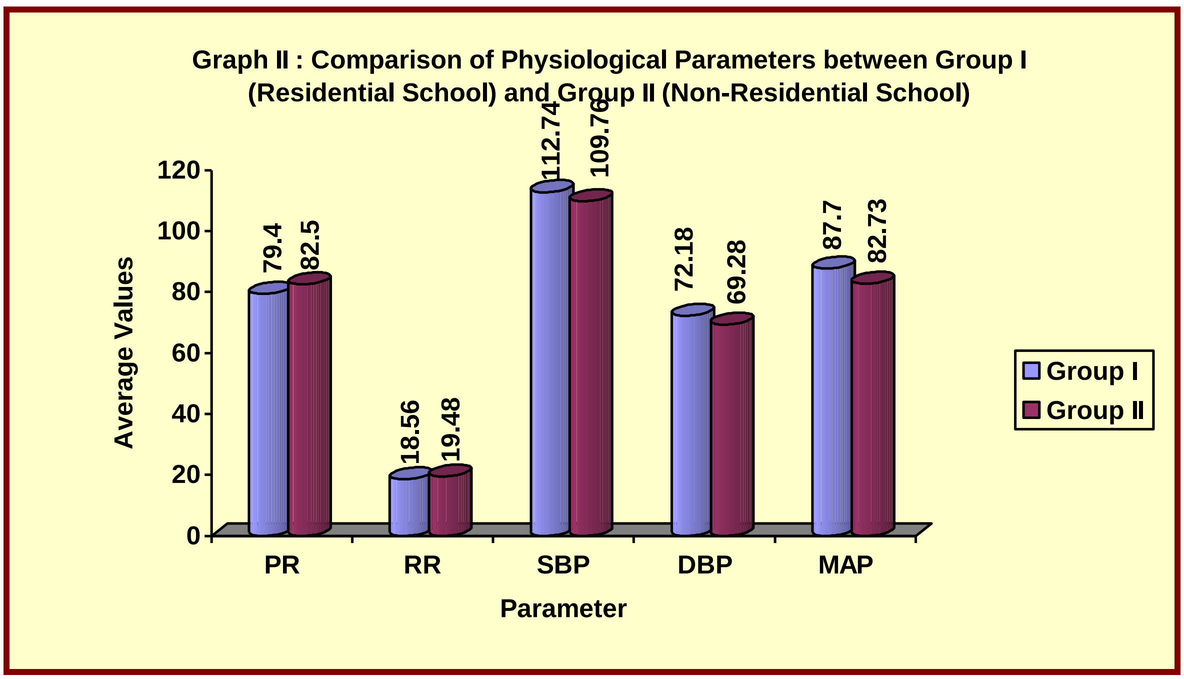


Table 4: Comparison of Cardiopulmonary Fitness Parameters between Group I (Residential School) and Group II (Non-Residential School).

Parameters	Group I		Group II		Z Values	p values
	Mean ± SD	SE	Mean ± SD	SE		
PFI(%)	54.96 ± 8.38	0.838	44.75 ± 5.05	0.505	10.44	0.00001***
VO2 Max(ml/kg/min)	66.03 ± 7.06	0.706	55.23 ± 7.53	0.753	10.44	0.00001***

*p: <0.05: Significant,

** p: <0.01: Highly significant,

*** p: <0.001: Very highly significant

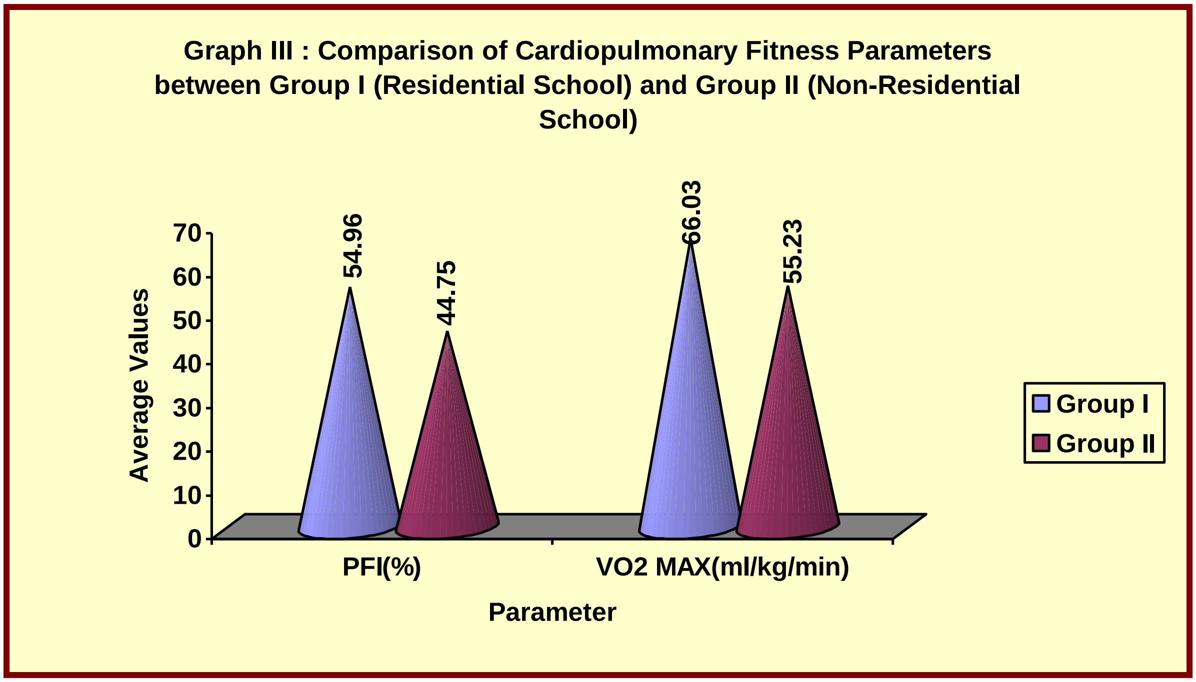


Table 5: Comparison of Pulmonary Parameters between Group I (Residential School) and Group II (Non-Residential School).

Parameters	Group I		Group II		Z Values	P Values
	Mean + SD	SE	Mean+ SD	SE		
BHT (sec)	37.38 + 7.63	0.763	31.23 +10.14	1.014	4.84	0.0001***
ENDT (sec)	36.51 + 9.23	0.923	24.84+11.50	1.150	7.91	0.0001***
TV (ml)	487.25 + 93.17	9.317	462.65+ 75.25	7.525	2.08	0.037*
IRV (ml)	908 + 311.38	31.138	849.5+315.39	31.539	1.31	0.1902
ERV (ml)	834.5 + 276.22	27.622	524.5+191.15	19.115	9.22	0.0001***
VC (ml)	2084 + 415.35	41.535	1767.5+420.58	42.058	5.35	0.0001***
FVC (ml)	2192.5 + 424.78	42.478	189 + 444.77	44.477	4.80	0.0001***

*p: <0.05: Significant,

** p: <0.01: Highly significant,

*** p: <0.001: Very highly significant

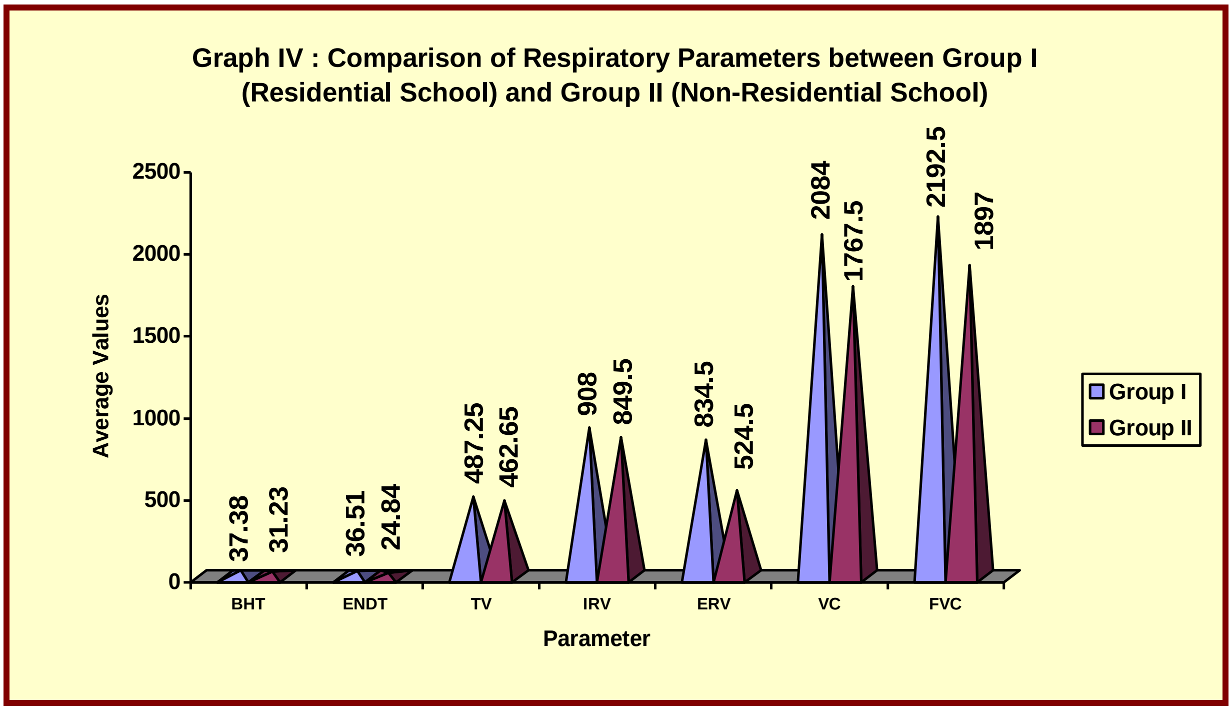


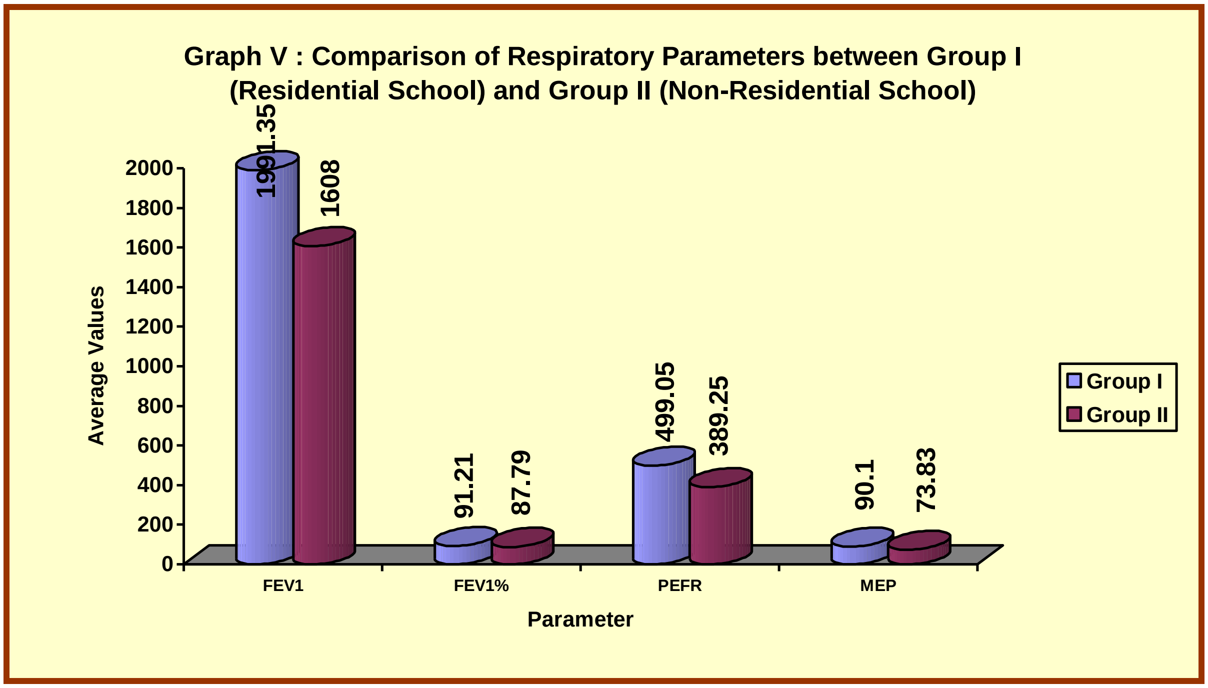
Table 6: Comparison of Respiratory Parameters between Group I (Residential School) and Group II (Non-Residential School).

Parameters	Group I		Group II		Z Values	P Values
	Mean + SD	SE	Mean + SD	SE		
FEV1 (ml)	1991.35+ 424.78	42.478	1608 + 412.60	41.260	6.65	0.0001***
FEV1 (%)	91.21+ 7.53	0.753	87.79 + 9.79	0.979	5.19	0.0001***
PEFR (l/m)	499.05+ 95.39	9.539	389.25 + 96.98	9.698	8.07	0.0001***
MEP mmHg	90.1+ 17.05	1.705	73.83 + 25.50	2.550	5.30	0.0001***

*p: <0.05: Significant,

** p: <0.01: Highly significant,

*** p: <0.001: Very highly significant



DISCUSSION

Several studies have established that physical fitness is necessary to carry out daily task.

Importance of physical fitness has been mentioned in history of mankind including Vedas. Yet, physiology of exercise is a recent advancement and is an open field for research. The effect of regular physical exercise is known to have beneficial effect on health. Gymnastic activity in a school curriculum was introduced by John Bernard Basedow of German.[2]

In 1810, Friedrich Jahn, “the father of Gymnastics” introduced outdoor exercise and games for his students. It had improved self image, self esteem, physical fitness and health of students. [2]

In our country, there are residential and non-residential schools. Residential schools like Sainik school, Navodaya school and many others have implemented regular exercise for their students. Nutritious food is also provided under the guidance of qualified dieticians and doctors in such schools. In non-residential schools, education is being provided but regular exercises are not monitored regularly and no dieticians are there to guide for the nutrition for the students.

Regular exercise and nutritious food are known to produce effects on development and physical fitness in growing children. Hence the present study is undertaken to assess these effects and to compare them with those of students who are devoid of above said facilities. The students of sainik school (Residential) and students of Banjara school (Non-residential) in the age group of 12 to 16 years are included in the study.

For the comparison, the study group has been divided into Group I and Group II after scrutinizing the students carefully. In each Group, sample size is 100 as per statistical criteria.

The analysis of the anthropometric parameters like Ht, Wt, BSA, BMI, CC and Abd C in both groups differs. Group I shows very highly significant increase in all parameters ($p<0.001$) compared to Group II.

Increase in anthropometric parameters indicates significance of regular physical exercise given to them and also nutritious food. Economic status, environmental factors and education pattern remain same for both the groups. Thus, variation in anthropometric parameters is related to physical exercise and nutritious food.[97,98]

The physiological parameters have been compared between Groups I and II. Excepting for PR and RR, all other physiological parameters such as SBP, DBP and MAP have been significantly increased in Group I compared to Group II. ($p=0.0142$, 0.0142, 0.0308, 0.0142 and 0.0734 respectively)

Decrease in PR in Group I may be attributed to increased parasympathetic discharge to heart. This is in turn due to regular exercise.[22]

Decrease in RR in Group I is probably due to increased compliance of respiratory muscles due to training.[29]

SBP, DBP and MAP are increased in Group I due to increase in the cardiovascular endurance. This is because of regular exercise which brings changes on myocardium, cardiac output, coronary circulation, increased efficiency of blood flow and bradycardia.[19, 20, 26, 27]

Physical fitness is assessed by cardiopulmonary efficiency tests as well as pulmonary function tests. Cardiopulmonary fitness parameters included PFI and VO_2 max. They are very highly statistically significant in Group I compared to Group II. ($p<0.001$)

The mean PFI (%) obtained for Group I and Group II were 54.96 $\pm$ 8.38 and 44.75 $\pm$ 5.05 respectively, indicating that students of residential (trained) school had higher values than that of students of non-residential (untrained) school. These values correlate with observations made by Chatterjee et al (2001)[99]. Their study also showed higher PFI score in trained (athletics) than those of untrained (non-athletics) but comprising of female subjects only.

Sunil KR. Das et al also studied PFI with modified Harvard test in young men and women. Their study restricted to untrained subjects only.[100]

We found very highly significant increase in VO_2 max of the subjects from Group I compared to Group II. The obtained values were 66.03 $\pm$ 7.06 and 55.23 $\pm$ 7.53 respectively.

This observation corresponds with the finding made in study involving athletes and non-athletes by Das Gupta et al (1991)[101].

Pulmonary function tests including BHT, 40mmHg endurance test, V_T, IRV, ERV, VC, FVC, FEV1%, PEFR and MEP. The values as shown in table:5&6 were significantly higher in Group I compared to Group II. ($p<0.001$)

Similar observations were reported regarding lung function tests by different authors all over the world at different age groups.

Mc curdy and Larson in their study showed increased BHT in swimmers (trained).

R. Harikumaran et al [102] studied PFTs in 42 untrained school boys of 14-16 years. These values tally with the values of our non-residential school boys.

Lakhera et al (1994) [78] observed in their study that lung volumes, lung capacities and FEV1 (%) were consistently higher in athletes than those of non-athletes due to lower air way resistance. These observations were very much correlated with those of Group I subjects in our study. It could be concluded that training definitely improves the Lung Volumes and Capacities in growing children.

There was a wide variation in PEFR as reported by various workers in South Indian children.

The values of MEP obtained in Residential and Non-Residential school children by Choudari D et al (2002)[57] correlate with our present study.

CONCLUSION

The physical fitness and pulmonary functions are influenced by various factors, such as the mode of exercise, person's heredity, state of training, age, sex and body composition. In our study we have considered the mode of exercise, age, sex and the body composition. We have conducted the study on Residential and Non-Residential school children of age group of 12 to 16 years. We could conclude from our study that the cardiopulmonary fitness and pulmonary function parameters are higher in the Residential than those of the Non-Residential group.

The higher values of cardiopulmonary fitness and pulmonary functions among the Residential school children may be due to their regular exercise, high nutritious diet etc.

SUMMARY

The study was conducted on Residential (Sainik) Group I and Non-Residential (Banjara) Group II school children of age group 12 to 16 years, who were apparently healthy. After general physical examination and history taking, the selection of students was done. Cardiopulmonary fitness tests were done by using modified Harvard's Step test. CPFI of each subject was then calculated by applying the concerned formulae. Other parameters like anthropometric, physiological and pulmonary functions were included in the study. Statistical test was derived for 'p' value and 0.001 was considered to be highly significant. It was observed that all the parameters (Cardiopulmonary fitness, anthropometric, physiological and pulmonary functions) were significantly higher in Group I than those of Group II subjects. It could be thus summarized from these observations that higher values in Group I subject may be due to the regular exercises, diet, sleep and routine activities performed by them.

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ANNEXURE- 1

B.L.D.E.A'S SHRI B.M.PATIL MEDICAL COLLEGE , BIJAPUR.
INSTITUTIONAL ETHICAL COMMITTEE

Dr. Vijay Ganjoo
Chairperson, I.E.C.
B.L.D.E.A'S Shri B.M.Patil Medical college
Bijapur-586103

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this college met on 22-09-2008

at 03-15pm **to scrutinize the Synopsis / Research projects of post graduate student / undergraduate student / Faculty members of this college from ethical clearance point of view. After scrutiny the following original / corrected & revised version Synopsis of the Thesis/ Research project has been accorded Ethical Clearance.**

Title A comparative study of physical fitness & pulm-onary functions in residential & non-residential school children of Bijapur

Name of P.G / U.G student / Faculty member Dr. Jyoti Khodnapur.

Name of Guide Dr. G. B. Dhanakshirur Prof of Physiology

Dr. Vijay Ganjoo
Chairperson
Institutional Ethical Committee

Chairman
Ethical Committee
BLDEA's Shri. B.M. Patil
Medical College
Bijapur-586103

Date:

Following documents were placed before E.C. for scrutinization:
1) Copy of Synopsis / Research project
2) Copy of informed consent form
3) Any other relevant document/s

ANNEXURE-2

B. L. D. E. A'S SHRI B.M. PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTRE, BIJAPUR

RESEARCH INFORMED CONSENT FORM

Title of the Project:

"A COMPARATIVE STUDY OF PHYSICAL FITNESS AND PULMONARY FUNCTIONS IN RESIDENTIAL AND NON-RESIDENTIAL SCHOOL CHILDREN OF BIJAPUR."

Principal investigator/ P.G.Guide's name: **DR.GOPAL. B. DHANAKSHIRUR $_{\mathbf{MD}}$**

PROFESSOR DEPARTMENT OF

PHYSIOLOGY.

1: PURPOSE OF RESEARCH: I have been informed that this study will assess the Physical Fitness and pulmonary functions in residential and non-residential school children. This study will be useful academically as well as for clinically to find out Physical Fitness and pulmonary functions in residential and non-residential school children.

2: PROCEDURE: I understand that, the procedure of the study will involve recording of various physiological physical parameters. The procedure will not interfere with any of my physiological parameters and they are noninvasive.

3: RISK AND DISCOMFORTS: I understand determination of Physical Fitness and pulmonary functions will not cause any discomfort to me and do not involve any risk to my health.

4: BENEFITS: I understand that my participation in the study may not have a direct benefit to me but this may have a potential beneficial effect in the field of Physical Fitness and pulmonary functions childhood and early adulthood in future.

5: CONFIDENTIALITY: I understand that medical information produced by this study will become part of institutional records and will be subject to the confidentiality and privacy regulation of the said institute. Information of a sensitive personal nature will not be a part of medical record, but will be stored in investigators research file and identified only by a code number. The code key connecting name two numbers will be kept in a separate secured location.

If the data are used for publication in the medical literature and for teaching purposes no names will be used and other identities such as photographs, audio and video tapes will be used only with my special written permission. I understand I may see the photographs and the video tapes and have the audio tapes before giving this permission.

6: REQUEST FOR MORE INFORMATION:

I understand that I may ask more questions about the study at any time.

Concerned researcher is available to answer my questions or concerns. I understand that I will be informed of any significant new findings discovered during the course of this study which might influence my continued participation. If during the study or later, I wish to discuss my participation in all concerns regarding this study with a person not directly involved, I am aware that the social worker of the hospital is available to talk with me. A copy of this consent form will be given to me to keep for careful re-reading.

7: REFUSAL OR WITHDRAWAL OF PARTICIPATION: I understand that my participation is voluntary and may refuse to participate or may withdraw my consent and discontinue participation in the study at any time without prejudice to my present or future care at this hospital. I also understand that researcher may terminate my participation in this study at any time after she/he has explained the reasons for doing so and had helped arrange for my continued care by my physician or physical therapist if this is appropriate.

8: INJURY STATEMENT: I understand that in unlikely event of injury to me resulting directly from my participation in this study, if such injury were reported promptly, then medical treatment will be available to me, but no further compensation would be provided. I understand that by my agreement to participate in this study I am not waiving any of my legal rights.

I have explained to ____________________________ (Patient/Relevant guardian)

the purpose of the research, procedures required and the possible risk and benefits to the best of my ability.

Investigator/ PG (Guide) Date

I confirm that ________________________________ (Name of the P.G. Guide /Chief researcher) has explained to me the purpose of research, the study procedure that I will undergo, and the possible risk and discomforts as well as benefits that I may experience. Alternative to my participation in the study have also been to give my consent from. Therefore I agree to give consent to participate as a subject and this research project.

Participant / Guardian Date:

Witness to signature Date:

Modified from Portney L.G, Watkins M.P., in Foundation of Clinical Research, Second Edition, New Jersey, Prentice Hall Health 2000. (APPENDIX – E)

ANNEXURE – 3

BLDEU SHRI B.M.PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTRE, BIJAPUR

DEPARTMENT OF PHYSIOLOGY

"A COMPARATIVE STUDY OF PHYSICAL FITNESS AND PULMONARY FUNCTIONS IN RESIDENTIAL AND NON-RESIDENTIAL SCHOOL CHILDREN OF BIJAPUR."

PROFORMA

Name: Age: Sex:

Occupation: Religion/Caste

Address: Diet Habits

GENERAL HEALTH CONDITION

Past history;

Ischemic heart (IHD) Hypertension Surgery

Tuberculosis Any significant Chronic illness

Family history:

Diabetes mellitus Obesity Hypertension

IHD Any other illness COPD

(Chronic Obstructive Pulmonary Diseases)

Personal history:

Appetite | Diet (Veg/Non-Veg) | Sleep

Nourishment | Bowels | Bladder

Habits: Chewing pan/Gutkha, history of smoking & alcohol intake.

GENERAL EXAMINATION

Built | Temperature | Pallor

Cyanosis | Edema feet | Abnormal pigmentation

JVP | Lymphadenopathy

ANTHROPOMETRIC MEASUREMENTS

1. Height (cms):

2. Weight (Kgs):

3. Mid Arm Circumference (cms)

4. Chest Circumference (cms)

5. Abdominal Circumference (cms)

6. Body Surface Area (Sq m):

7. Body Mass Index (Kg/m^2):

PHYSIOLOGIACAL PARAMETERS

1. Respiratory Rate (cycles/min):

2. Pulse Rate (bpm):

3. Systolic Blood Pressure (mmHg):

4. Diastolic Blood Pressure (mmHg):

5. Mean Arterial Pressure (mmHg):

PULMONARY PARAMETERS

Parameters	I	II	III	Highest Reading
1. BHT (in secs)				
2. 40 mmHg Endurance Test (in secs)				
3. V_T (in ml)				
4. IRV (in ml)				
5. ERV(in ml)				
6. VC (in ml)				
7. FVC (in ml)				
8. FEV1 (in ml)				
9. $FEV_{1\%}$ (in %)				
10. PEFR (in L/Min)				
11. MEP (in mmHg)				

CARDIO PULMONARY PARAMETERS:

1. Cardio Pulmonary Fitness Index :

PR 1(bpm)	PR 2(bpm)	PR 3(bpm)

2. VO_2 max (ml/kg/min)

Sign of Guide **Sign of H.O.D**

Annexure-4a Group I – Residential School children (Sainik School)

Master chart (Anthropometric, Physiological, Physical fitness, And Pulmonary Function Parameters in Group I 12-16 years)

Sl. No	Age in Yrs	Sex	Ht in cms	Wt in kgs	MAC in cms	CC in cms	AC in cms	BSA Sqm	BMIKg/m^2	RR cycles/min	PR bpm	SBP mmHg	DBP mmHg	MAP mmHg	BHT in sec	40mmHg Endurance Test in sec	V_T in ml	IRV in ml	ERV in ml	VC in ml	FVC in ml	FEV_1 in ml	FEV_1 in %	PEFR L/min	MEP mmHg	CPFI	VO2 Max ml/kg/min
1.	14	M	166	54	25	86	73	1.6	20.8	12	70	120	82	94	40	38	550	1100	1300	2850	3200	2800	88	550	120	59	72.6
2.	15	M	152	38	19	58	50	1.28	16.8	16	76	120	76	90.66	37	38	400	1400	550	2050	1500	1400	93.3	350	80	48.0	62.6
3.	14	M	166	43	22	76	52	1.5	19	12	70	120	80	93	35	22	450	550	1000	2500	2500	2400	96	400	80	67.5	77.7
4.	14	M	150	38	21	59	52	1.26	16.88	17	84	116	90	98.66	32	32	625	1050	550	2050	1850	1700	91.8	400	80	53.5	69.3
5.	15	M	139	32	22	70	60	1.4	16	12	80	114	78	90	32	22	450	500	400	1500	1600	1500	94	400	100	65.9	50
6.	14	M	157	47	26	76	68	1.68	23	14	80	112	84	86	36	52	600	1450	500	2350	2100	2000	95.2	400	100	50	64.2
7.	15	M	156	39	22	61	55	1.32	17.33	18	78	118	70	93	30	48	450	1300	1100	2400	2300	2200	97	450	50	60.9	45.2
8.	14	M	168	58	25	86	70	1.5	19	22	72	132	64	86	46	40	450	600	800	2200	2500	1400	56	400	80	81.9	74.3
9.	14	M	171	58	26	85	69	1.52	19	14	76	118	78	87	48	40	500	900	800	1800	2600	2500	96	500	80	68.9	56.8
10.	14	M	163	41	23	81	59	1.4	17	14	78	122	84	91	43	30	500	600	1000	2100	2000	1800	90	460	100	79.4	63.5
11.	14	M	155	35	19	75	60	1.38	18	18	76	118	78	97	38	48	400	600	1100	1950	2150	1950	90.6	525	80	65.9	51.7
12.	14	M	156	41	23	77	66	1.4	20	18	80	122	80	91	36	40	600	1100	500	2000	2250	1750	78	500	80	67.6	52.1
13.	14	M	159	44	26	75	63	1.42	18	14	78	110	80	94	40	30	400	700	800	1850	1650	1500	90.9	500	80	69.3	52.1
14.	14	M	172	53	24	82	69	1.36	19	16	80	110	70	90	48	45	600	1200	800	2100	2100	2000	95	400	72	69.3	55.5
15.	15	M	158	45	23	77	68	1.42	18	24	86	100	80	80.33	35	46	600	800	650	2350	2200	2000	90.9	700	70	48.0	53.2
16.	14	M	162	48	24	80	65	1.5	19.2	14	78	112	72	86.66	38	49	500	700	900	2200	2800	2100	75	400	80	65.7	57.6
17.	13	M	153	43	24	79	64	1.34	18.6	20	80	110	60	85.33	34	45	450	1100	900	2400	2400	2300	95.9	700	90	43.6	70.2
18.	14	M	171	51	24	80	69	1.6	17	18	76	122	60	76.66	47	40	550	1200	900	2800	2900	2600	80.7	500	90	53.1	60.9
19.	14	M	153	40	22	78	63	1.32	17.77	20	80	112	68	78	32	48	400	600	700	1850	2000	1900	95	600	90	49.0	65.1
20.	14	M	157	43	23	73	65	1.4	17.2	21	98	116	78	82.66	30	35	400	500	650	1600	1750	1600	91.4	400	80	48.0	59.3
21.	14	M	154	43	22	72	62	1.38	17.91	14	62	98	60	90.66	29	37	500	500	450	1600	2000	1900	95	400	90	59.5	64.3
22.	14	M	156	38	21	72	63	1.32	15.2	18	62	112	72	68.66	33	22	550	650	650	1900	1550	1400	90.3	460	80	73.5	66.8
23.	14	M	164	51	26	81	68	1.54	19.61	22	88	108	60	77.33	32	25	400	550	900	2100	2500	2200	88	500	80	50.6	79.4
24.	14	M	153	40	20	72	60	1.3	20	22	74	90	70	84	26	50	700	1200	1100	2550	2950	2600	88.1	700	80	63.0	61.8
25.	14	M	153	40	22	72	61	1.32	17.77	15	88	110	74	70	39	40	600	800	750	1900	1750	1650	94	450	74	50.6	73.5
26.	14	M	165	45	24	80	68	1.46	17.30	16	96	130	72	87.33	38	37	400	1000	1100	2500	2725	2675	98.2	400	82	43.6	64.3
27.	14	M	167	44	22	77	61	1.48	16.29	18	64	110	66	92.66	40	42	550	550	800	1500	1600	1585	99	700	82	51.2	60.1
28.	14	M	168	51	24	81	68	1.58	17	18	72	110	60	84.66	37	40	500	800	1000	2100	2300	2200	95.6	400	112	51.0	56.7
29.	13	M	158	46	24	80	69	1.42	18.4	18	86	112	68	60.66	35	40	650	600	750	1600	2600	2300	88.5	500	72	55.5	65.9
30.	14	M	167	55	28	83	75	1.62	19.64	20	76	136	74	73.33	32	40	550	1100	950	2500	2800	2800	99	480	80	46.8	71.8
31.	15	M	169	43	21	73	59	1.48	14.33	16	72	112	64	85.33	42	21	600	900	600	1800	2000	1950	97.5	575	80	45.7	64.3
32.	14	M	174	55	26	85	69	1.64	18.33	18	72	130	80	82.66	36	50	500	800	1200	2400	2850	1900	66.6	500	80	47.1	60.9
33.	14	M	154	46	26	79	71	1.46	17.69	20	78	108	70	92.66	42	50	600	700	1100	2400	2100	2200	91.6	450	150	48.3	61.8
34.	15	M	150	34	20	72	52	1.2	15.11	20	80	122	70	78.66	46	20	400	1400	1100	2850	2850	2500	87.7	430	124	48.7	83.4
35.	15	M	164	47	23	77	63	1.5	18.07	24	86	130	70	94	48	26	700	500	1000	1800	1900	1550	81.5	350	90	45.4	59.3
36.	14	M	150	35	21	70	60	1.2	15.55	22	88	110	70	90	43	33	450	850	700	1600	1800	1750	99	400	124	54.7	57.6
37.	13	M	164	43	22	72	65	1.46	16.53	22	84	110	72	83.33	38	30	500	650	1100	2100	2300	2200	95.6	400	98	58.1	67.6

Annexure-4a Group I – Residential School children (Sainik School)
Master chart (Anthropometric, Physiological, Physical fitness, And Pulmonary Function Parameters in Group I 12-16 years)

Sl. No	Age in Yrs	Sex	Ht in cms	Wt in kgs	MAC in cms	CC in cms	AC in cms	BSA Sqm	BMIKg/m^2	RR cycles/min	PR bpm	SBP mmHg	DBP mmHg	MAP mmHg	BHT in sec	40mmHg Endurance Test in sec	V_T in ml	IRV in ml	ERV in ml	VC in ml	FVC in ml	FEV_1 in ml	FEV_1 in %	PEFR L/min700	MEP mmHg	CPFI	VO2 Max ml/kg/min
38	15	M	162	45	23	73	63	1.46	18	22	82	112	60	83.33	34	30	500	700	400	2100	2250	2225	99	700	70	59.5	73.0
39	15	M	170	50	24	79	67	1.58	16.66	18	76	122	60	84	29	59	400	1150	1550	3000	3100	2900	93.5	500	114	52.8	71.8
40	15	M	156	35	20	69	61	1.28	15.55	22	84	110	80	88.66	33	32	400	600	600	1700	1700	1650	99	400	104	54.3	71.8
41	14	M	155	40	22	71	63	1.34	20	22	68	108	80	76.66	32	30	350	600	1000	2100	1900	1850	97	500	100	60.5	67.6
42	15	M	159	38	20	71	63	1.32	19	16	76	118	68	76	26	33	550	1900	750	850	2050	2000	97.5	500	74	62.5	73.3
43	15	M	171	45	22	76	65	1.52	15	16	76	112	72	93	39	39	500	550	1000	2350	1500	1300	87	500	100	53.5	71.0
44	15	M	161	40	21	72	57	1.38	16	18	80	112	80	82	38	40	350	700	550	2100	2250	2100	93	500	104	61.9	64.3
45	15	M	165	49	22	75	68	1.54	20	18	88	130	90	85.33	40	35	450	900	1100	2300	2650	2450	93	550	80	45.7	72.7
46	15	M	162	47	23	81	66	1.48	19	18	78	130	70	90	37	20	400	1300	1500	2600	2850	2550	89	700	98	45.2	58.4
47	14	M	156	42	21	73	63	1.36	17	18	74	118	70	86	38	53	600	800	800	2000	2000	1900	95	420	102	55.1	59.2
48	15	M	161	45	22	78	62	1.44	18	22	82	110	70	83	32	19	450	700	800	2300	2300	2150	93.4	500	150	53.5	68.5
49	15	M	165	48	22	80	69	1.52	19	26	86	130	70	90	32	32	650	800	900	2300	2500	2250	90	400	70	58.5	68.5
50	15	M	155	36	19	67	56	1.28	18	16	84	110	84	92	36	42	400	850	500	1900	2050	1850	90	450	130	44.1	69.3
51	14	M	147	33	18	64	55	1.28	17	24	84	116	70	86	30	36	350	650	700	1600	1600	1500	93.7	400	80	48.7	60.1
52	15	M	163	41	20	71	62	1.4	17	20	88	116	70	86	46	42	350	750	1000	1400	1475	1400	95	500	80	52.8	60.1
53	15	M	159	42	22	70	60	1.42	21	24	80	120	88	98.66	48	46	400	600	600	1800	1850	1800	97	440	90	53.1	68.5
54	15	M	158	47	23	78	68	1.46	19	18	76	130	76	94	65	48	500	1200	1000	2700	2850	2800	98	600	80	47.4	71.0
55	15	M	167	50	22	81	65	1.56	20	20	80	130	70	90	56	43	400	1150	900	2600	2750	2000	73	550	92	48.3	61.7
56	15	M	169	54	23	79	65	1.6	22	24	74	124	80	94.66	35	38	450	600	650	2000	2250	1950	87	700	140	53.5	64.3
57	15	M	162	51	24	76	63	1.56	19.92	18	84	110	62	78	30	34	350	1100	550	2300	2150	2000	93	500	88	55.5	69.3
58	15	M	162	48	22	73	65	1.5	19	20	68	112	78	89.33	29	29	400	750	600	2300	2225	2175	98	500	100	54.4	66.8
59	14	M	156	42	22	73	64	1.36	17	18	82	108	74	87.33	33	33	550	200	1100	1900	2000	1700	85	500	90	60.4	67.6
60	15	M	173	54	22	78	66	1.68	18	20	78	110	70	83.33	32	32	600	1000	450	1600	2300	2050	89	420	84	51.3	75.2
61	15	M	173	54	21	79	72	1.68	18	14	76	116	80	92	26	26	500	1050	950	1400	2800	2300	82	525	88	51.0	67.6
62	15	M	163	41	20	67	61	1.4	17	20	92	120	68	85	39	39	500	800	600	1800	2000	1950	98	550	80	50.6	65.9
63	14	M	160	42	21	75	63	1.4	19	14	76	124	70	87	38	25	600	1200	1900	2700	2600	2550	98	500	80	54.7	64.3
64	15	M	150	36	21	68	63	1.28	18	20	82	110	80	90	40	30	450	750	750	2550	1900	1725	91	500	90	52.0	69.3
65	15	M	157	35	21	69	59	1.28	18	20	82	130	78	95	37	39	500	1250	800	1950	2250	2000	98	600	90	50	65.9
66	14	M	167	50	20	79	61	1.56	20	18	80	122	68	83	35	40	500	1100	950	2050	2125	2075	98	600	124	54.3	60.9
67	14	M	171	55	23	90	73	1.66	18	20	72	118	60	76	32	40	400	1000	1000	2300	2400	2300	95.8	700	90	59.0	69.3
68	15	M	151	40	19	74	65	1.36	20	20	72	92	64	70	32	30	500	750	600	1900	1850	1800	97	500	80	58.1	75.2
59	15	M	171	64	26	86	73	1.76	21	20	72	94	78	83	36	42	600	1100	550	2100	2100	2000	95	700	90	50.3	73.5
70	14	M	164	50	22	74	67	1.54	18.51	20	84	94	62	72	30	20	500	700	400	2400	2100	2000	95	500	80	54.3	61.7
71	14	M	154	32	17	64	56	1.2	16	20	82	92	62	72	52	35	400	1000	1000	2000	2150	2100	98	600	90	53.9	71.0
72	14	M	163	51	21	77	63	1.54	20	16	80	110	64	75	60	48	400	1200	800	2550	2300	2200	96	550	90	48.7	68.5
73	15	M	165	50	20	75	61	1.52	20	19	64	118	64	82	60	46	500	1200	750	1800	2450	2225	91	500	90	60.9	61.8
74	14	M	158	44	17	67	59	1.4	22	18	100	110	66	77	45	23	650	1000	1050	2250	3100	2600	84	400	90	46.3	76.0

Annexure-4a Group I – Residential School children (Sainik School)

Master chart (Anthropometric, Physiological, Physical fitness, And Pulmonary Function Parameters in Group I 12-16 years)

Sl. No	Age in Yrs	Sex	Ht in cms	Wt in kgs	MAC in cms	CC in cms	AC in cms	BSA Sqm	BMIKg/m^2	RR cycles/min	PR bpm	SBP mmHg	DBP mmHg	MAP mmHg	BHT in sec	40mmHg Endurance Test in sec	V_T in ml	IRV in ml	ERV in ml	VC in ml	FVC in ml	FEV_1 in ml	FEV_1 in %	PEFR L/min	MEP mmHg	CPFI	VO2 Max ml/kg/min
75	15	M	159	44	21	76	63	1.42	22	20	90	92	72	78	30	25	500	1200	650	2100	2300	1950	85	600	80	47.7	56.7
76	15	M	151	42	21	71	61	1.32	21	24	84	100	68	78	29	45	600	700	800	2400	2000	1800	90	675	90	55.9	65.1
77	14	M	164	44	19	64	55	1.46	16.9	22	78	98	84	87.6	33	15	550	1250	1050	1850	2250	2300	90	490	80	52.4	71.0
78	15	M	156	43	19	69	58	1.42	21	18	92	102	70	80	32	40	400	1050	750	2100	2050	2000	98	450	110	57.7	67.6
79	14	M	149	35	18	64	53	1.22	18	18	72	94	64	74	26	19	300	1050	1200	2000	2250	2000	89	400	80	60	71.8
80	14	M	165	54	21	77	67	1.6	22	18	68	122	60	80.66	39	30	450	1000	1100	2150	2800	2500	89	675	80	55.1	74.4
81	15	M	150	35	18	69	57	1.22	17	18	78	98	84	87.66	38	45	400	700	1050	2050	1750	1700	97	400	80	46.3	67.5
82	14	M	169	45	18	68	58	1.5	15	18	80	92	80	84	47	35	450	750	750	2300	1750	1700	94	440	70	72.1	60.1
83	15	M	154	40	19	71	59	1.34	20	23	90	110	70	83.33	37	30	500	1350	1350	2450	2500	1850	74	500	80	51.0	81.1
84	15	M	157	40	18	66	55	1.34	20	17	74	106	72	83.33	35	32	450	850	550	2450	1700	1600	94	540	70	50.3	67.6
85	15	M	168	53	23	76	62	1.6	18	18	96	112	74	86.66	48	38	500	350	800	1900	1600	1500	93	700	88	51.4	60.8
86	15	M	159	44	19	73	62	1.4	18	18	120	106	76	86	32	57	650	1000	1100	2500	2225	2100	94	500	70	47.7	67.6
87	14	M	151	34	19	67	57	1.22	17	18	70	96	60	72	36	35	400	1500	1050	2000	2500	2400	96	500	100	62.2	63.4
88	14	M	149	36	19	66	56	1.24	18	18	86	102	60	74	30	30	300	400	650	2300	2075	1800	87	400	100	52.4	75.2
89	15	M	155	42	19	70	59	1.38	21	22	68	98	62	74	46	38	500	600	1150	2900	1850	1300	70	500	90	55.9	68.5
90	14	M	152	35	19	63	54	1.22	17	18	78	112	90	97.33	48	35	650	1400	800	1750	2500	2400	96	500	90	60	70.2
91	14	M	154	41	19	63	55	1.34	20	18	88	92	60	70	43	29	600	750	650	1700	1700	1550	91	400	70	49.3	72.7
92	14	M	173	50	23	82	68	1.62	17	16	64	102	62	75	30	40	500	1300	950	2600	2600	2550	98	550	90	81.9	63.5
93	14	M	171	45	22	76	64	1.5	15	18	82	120	90	100	29	52	500	700	900	1800	1950	1900	97	600	90	47.7	72.8
94	15	M	142	35	20	73	38	1.2	18	18	78	94	60	71	33	42	500	950	1000	1600	2500	2400	96	450	80	55.1	64.3
95	14	M	176	60	26	90	72	1.74	20	16	62	124	74	90.6	32	41	400	1400	650	1850	2000	1600	80	450	120	60.5	71.0
96	15	M	166	42	20	69	59	1.42	16.8	18	82	122	76	91.33	26	36	600	1400	650	2500	2200	1100	86.3	400	80	40.1	75.2
97	14	M	172	52	21	76	70	1.64	17.3	16	78	118	76	90	39	41	550	1350	600	2000	2250	2200	97.7	350	100	41.4	56.7
98	14	M	157	45	21	68	63	1.34	17.4	14	80	112	80	90.66	38	32	400	1400	450	1750	1800	1600	88.8	400	100	45.2	59.3
99	15	M	159	46	20	72	60	1.4	18.14	20	80	118	76	90	40	40	300	650	250	850	1050	900	85.71	500	90	55.14	67.65
100	14	M	158	40	23	74	63	1.36	16	20	76	122	78	92.6	37	30	400	600	300	900	1500	1300	87	450	100	58.13	73.01

Annexure-4b Group- II - Non- Residential School children (Banjra high school)

Master chart (Anthropometric, Physiological, Physical fitness, And Pulmonary Function Parameters in Group I 12-16 years)

Sl. No	Age in Yrs	Sex	Ht in cms	Wt in kgs	MAC in cms	CC in cms	AC in cms	BSA Sqm	BMIKg/m^2	RR cycles/min	PR bpm	SBP mmHg	DBP mmHg	MAP mmHg	BHT in sec	40mmHg Endurance Test in sec	V_T in ml	IRV in ml	ERV in ml	VC in ml	FVC in ml	FEV_1 in ml	FEV_1 in %	PEFR L/min	MEP mmHg	CPFI	VO2 Max ml/kg/min
1.	14	M	134	26	17	58	56	1	15	20	80	108	68	81	22	18	400	300	200	1200	1400	1300	90	300	70	44.11	57.57
2.	14	M	148	42	20	66	53	1.3	18	20	80	118	76	90	22	47	500	1300	650	2250	2250	2200	97.77	350	80	48.07	59.25
3.	14	M	146	41	20	60	59	1.28	20.9	22	80	106	64	78	23	32	450	1200	450	2200	1900	1850	97.36	450	80	46.29	59.25
4.	14	M	146	38	18	58	49	1.22	17.8	18	76	112	78	87.3	16	30	450	1500	450	2250	2250	2200	97.77	450	100	41.43	55.89
5.	17	M	143	42	20	62	51	1.28	21	22	76	112	68	83	18	29	400	1400	600	2500	2200	2150	97.7	300	70	45.45	58.41
6.	16	M	149	36	18	65	59	1.2	18	24	80	90	60	70	35	33	400	1400	450	2400	1950	1850	94.87	210	70	48.07	59.25
7.	14	M	159	40	19.5	65	60	1.36	16.12	20	80	110	60	70.66	15	32	500	500	600	2000	2000	1750	83.33	250	60	46.01	55.89
8.	14	M	150	37	19	66	61	1.24	16.44	16	80	100	60	70.33	30	26	400	550	300	1300	2050	1300	64.41	600	80	40.10	39.93
9.	14	M	147	40	19.5	71	63	1.26	18.51	20	80	110	60	76.66	42	39	600	1150	300	1700	2200	2050	93.18	270	40	40.98	50.01
10.	14	M	145	27	17	62	52	1.08	12.85	22	96	100	60	73.33	40	38	350	500	600	1500	1650	1600	96.96	290	60	52.08	65.97
11.	13	M	143	35	19	67	59	1.18	17.15	22	82	100	60	73.33	15	40	400	500	400	1300	1350	1300	96.29	350	40	39.89	51.69
12.	14	M	153	35	18	63	52	1.24	14.95	16	82	108	68	81.33	15	30	500	900	600	2200	2200	2000	90.90	300	70	51.02	65.97
13.	14	M	155	41	19	71	68	1.34	17.06	18	84	108	58	74.66	30	42	500	750	450	1750	1900	1600	84.21	370	50	38.46	44.97
14.	15	M	170	49	21	74	65	1.56	16.95	18	88	120	78	92	22	40	500	750	400	1800	1900	1500	63.16	400	40	42.13	52.53
15.	14	M	153	37	19	69	58	1.28	15.81	18	84	108	68	81.33	15	15	500	950	550	1850	2100	1750	83.33	300	40	43.60	54.21
16.	14	M	143	44	18	62	52	1.3	21.56	18	84	110	66	80.6	22	15	500	1200	550	1700	2000	1700	85	400	80	44.11	55.89
17.	13	M	155	41	20	69	63	1.36	18	22	84	102	64	76	10	30	400	1400	400	1500	1900	1650	86.84	500	90	43.60	54.21
18.	14	M	156	41	19	68	62	1.36	16.87	22	78	122	90	100.6	35	22	300	500	500	1200	1300	1100	84.61	500	100	43.37	52.53
19.	14	M	139	32	18	62	60	1.12	16.56	20	92	110	70	83.33	38	15	450	700	200	1300	1500	1150	76.66	450	48	46.87	59.25
20.	15	M	158	40	19	71	67	1.36	16.02	18	76	118	72	88	34	15	500	700	550	1800	2000	1400	70	350	80	47.77	57.57
21.	14	M	135	27	17	61	56	1.04	14.83	18	80	110	68	82	47	12	500	400	350	1300	1050	900	85.71	300	40	47.77	58.41
22.	14	M	153	38	18	68	60	1.3	17	20	76	110	72	84	32	18	500	850	700	2100	2300	1800	78.26	350	80	46.29	57.57
23.	15	M	153	36	18	63	59	1.36	16	20	92	110	68	82	30	17	550	650	200	1400	1550	1350	87.09	300	60	40.76	52.53
24.	15	M	149	33	19	65	55	1.2	14.86	22	86	116	68	84	29	15	450	650	500	1700	1900	1700	89.47	400	70	39.28	52.53
25.	15	M	160	44	19	67	63	1.42	17.98	22	78	118	80	92.66	33	10	500	1000	750	2200	2300	2200	95.65	500	80	45.45	55.89
26.	15	M	163	46	18	65	60	1.38	15.06	22	76	122	80	94	32	10	450	1100	750	1950	2100	1750	83.33	500	80	46.29	56.73
27.	14	M	154	38	18	67	60	1.3	17	22	80	112	70	84	26	16	400	600	500	2100	1500	1300	86.66	350	70	45.73	59.25
28.	15	M	155	45	20	70	58	1.4	18.73	20	88	110	70	83.33	39	10	550	750	650	1700	2200	1900	86.66	500	80	46.01	60.93
29.	14	M	151	42	21	70	66	1.32	18.42	22	86	110	70	93.33	38	25	500	1200	650	2050	2200	1100	50	400	120	44.11	55.89
30.	15	M	152	38	20	65	60	1.28	16.52	20	76	110	66	76.66	40	20	500	1450	700	2200	2300	2150	93.47	375	120	40.32	55.89
31.	14	M	150	46	23	70	61	1.36	20	20	84	118	76	90	37	26	450	1400	1100	2800	3100	2700	87.09	450	90	46.87	57.57
32.	15	M	158	46	22	71	63	1.42	18.42	16	76	118	72	87.33	35	15	400	1300	650	2400	2500	2250	90	700	80	50.33	58.41
33.	14	M	152	36	20	65	54	1.24	15.65	22	88	104	64	77.33	32	11	400	700	550	1650	1850	1500	81.08	290	40	35.71	42.45
34.	14	M	149	37	20	63	59	1.24	16.66	18	80	118	68	84.66	42	20	500	1000	300	1850	1800	1600	88.88	400	110	45.18	55.89
35.	13	M	136	30	78	61	55	1.1	16.21	16	76	110	68	82.0	36	47	450	900	200	1400	1400	1000	71..42	500	110	46.29	60.93
36.	14	M	151	44	21	71	65	1.36	20	16	80	118	80	92	42	32	550	950	800	2200	2500	1950	78	400	90	44.37	58.41
37.	16	M	170	81	30	95	90	1.92	28.02	18	88	118	82	94	46	30	450	1600	550	2850	2900	2100	72.41	500	120	38.65	44.13

Annexure-4b Group- II - Non- Residential School children (Banjra high school)
Master chart (Anthropometric, Physiological, Physical fitness, And Pulmonary Function Parameters in Group I 12-16 years)

Sl. No	Age in Yrs	Sex	Ht in cms	Wt in kgs	MAC in cms	CC in cms	AC in cms	BSA Sqm	BMIKg/m^2	RR cycles/min	PR bpm	SBP mmHg	DBP mmHg	MAP mmHg	BHT in sec	40mmHg Endurance Test in sec	V_T in ml	IRV in ml	ERV in ml	VC in ml	FVC in ml	FEV_1 in ml	FEV_1 in %	PEFR L/min	MEP mmHg	CPFI	VO2 Max ml/kg/min
38	14	M	140	31	19	62	56	1.1	15.81	22	78	100	66	77.33	48	29	400	500	300	1400	1500	1450	96.66	300	30	44.11	54.21
39	15	M	149	33	18	59	51	1.16	14.86	20	72	106	60	75.3	43	33	400	850	400	1500	1450	1300	89.65	350	70	53.57	65.97
40	14	M	170	50	21	74	62	1.58	17.30	18	80	122	80	94	38	32	600	1050	300	1600	1500	1000	66.66	450	90	44.11	55.89
41	16	M	148	37	19	67	58	1.22	16.89	18	76	122	68	86	34	26	650	850	400	1650	1850	1700	91.89	500	100	45.73	57.57
42	14	M	154	36	19	66	50	1.26	15.18	18	80	112	68	82.66	17	39	500	500	350	1400	1400	1200	85.71	300	70	46.29	58.41
43	14	M	161	42	21	73	64	1.4	16.21	18	82	118	76	90	12	38	500	950	850	2400	2600	2500	96.15	600	80	44.11	55.89
44	14	M	154	46	20	64	63	1.4	19.40	18	82	118	76	90	14	40	450	450	450	1850	2200	1900	86.36	500	80	46.58	59.25
45	13	M	150	35	17	63	56	1.22	15.55	22	88	110	70	83.33	35	10	500	650	550	1400	1600	1500	93.75	500	80	43.60	54.21
46	16	M	150	50	22	71	63	1.4	22.22	20	84	122	80	94	38	12	500	1200	800	2300	2200	2100	95.45	400	60	43.10	55.89
47	13	M	148	32	17	65	53	1.16	14.61	20	84	108	70	82.66	34	11	450	1000	450	1600	1950	1500	76.92	310	100	37.68	40.77
48	14	M	162	46	22	74	68	1.46	17.55	16	76	120	76	90.66	47	10	600	1100	800	2100	2250	1900	84.44	400	60	48.07	60.93
49	14	M	150	33	17	62	53	1.18	15	22	96	114	68	83.33	32	47	500	900	550	1700	1950	1650	84.61	300	25	34.88	33.21
50	14	M	150	46	21	70	63	1.36	20	18	80	100	60	73.33	30	32	400	1100	300	1800	1700	1600	94.11	300	40	37.5	44.97
51	13	M	151	40	19	65	55	1.28	18	20	90	110	50	70	29	30	400	600	250	1200	1200	1150	95.83	210	45	42.61	52.53
52	15	M	153	41	20	66	60	1.34	17.52	18	76	110	68	82	33	29	500	1000	300	1950	1900	1600	84.21	450	70	50.33	58.41
53	13	M	154	45	21	73	96	1.4	20	24	104	104	82	89.33	32	33	400	850	300	1300	1950	1900	97.43	450	40	35.73	35.54
54	15	M	151	42	18	69	61	1.32	21	18	84	92	70	76.66	26	32	600	700	550	1650	2150	1950	90.69	420	50	55.55	64.29
55	15	M	157	37	19	70	59	1.3	15.01	20	100	108	70	82.66	39	26	450	800	300	1500	1900	1700	89.47	500	50	47.02	58.33
56	14	M	150	36	20	69	56	1.22	16	18	78	118	70	86	38	39	400	600	500	1750	1950	1900	97.43	500	50	44.64	58.41
57	13	M	146	31	18	65	54	1.14	14.55	20	88	102	64	76.66	40	38	300	800	700	1550	1850	1750	94.59	500	100	55.89	43.10
58	14	M	161	56	24	81	67	1.56	21.62	18	76	116	68	84	37	40	400	700	300	1300	1550	1500	96.77	400	90	46.87	60.93
59	16	M	143	65	27	90	88	1.52	31.86	24	76	128	80	96	35	10	375	400	500	1300	1300	1150	88.46	500	140	43.60	55.89
60	13	M	149	41	19	70	60	1.28	18.46	18	72	110	68	82	32	10	400	1100	250	1800	2100	1600	76.19	500	60	48.10	61.03
61	14	M	143	32	19	61	56	1.16	15.68	24	86	106	60	75.33	42	10	400	600	300	1200	1500	1350	90	400	60	47.16	60.93
62	13	M	143	36	21	67	61	1.2	17.64	20	84	108	70	82.66	36	16	400	900	400	1700	1600	950	60	350	80	44.11	55.89
63	15	M	144	50	22	80	80	1.38	15.68	18	84	108	70	82	42	15	400	1400	750	2650	2900	2100	72.41	300	80	47.46	57.57
64	14	M	155	42	19	67	57	1.34	17.64	20	68	106	70	82	46	18	450	1200	700	1900	2000	1500	75	400	90	51.36	57.55
65	14	M	138	40	19	56	48	1.24	25	20	72	110	78	89	48	18	550	400	600	1700	1800	1400	77.77	400	80	46.29	57.57
66	14	M	146	29	18	62	54	1.1	17.48	18	80	98	60	72.66	43	10	400	750	550	1400	1200	1000	83.33	250	40	50.50	65.13
67	14	M	150	45	21.5	74	69	1.34	20	22	80	102	60	74	38	22	450	1200	700	2000	2300	1450	63.04	350	80	48.07	54.21
68	14	M	150	47	22	73	62	1.38	13.61	22	70	122	76	91.33	34	8	500	1050	400	1850	2250	1900	84.44	350	70	48.70	63.45
59	15	M	152	45	21	71	67	1.4	20	12	72	116	76	89.33	10	10	500	750	1200	2200	2400	1900	79.16	300	40	42.37	55.89
70	14	M	139	36	19	66	56	1.2	20.88	20	84	116	68	84	16	15	500	650	650	1700	1700	1550	91.17	450	120	43.60	57.57
71	14	M	156	45	21	70	64	1.42	19.56	22	84	108	68	81.33	15	40	600	700	450	2200	1900	1700	89.47	500	70	43.35	55.89
72	13	M	152	34	18	61	50	1.2	18.65	20	84	106	68	74.66	18	26	400	400	500	1400	1100	900	81.8	500	120	42.13	52.53
73	14	M	150	41	17	69	63	1.3	18.58	18	72	112	68	82.66	18	44	600	700	400	1800	1150	1050	91.3	300	60	60.48	71.01
74	14	M	148	33	17	62	53	1.18	14.78	18	82	106	70	82	10	47	400	300	400	1000	1500	1000	66.67	300	60	34.09	35.73

Annexure-4b Group- II - Non- Residential School children (Banjra high school)

Master chart (Anthropometric, Physiological, Physical fitness, And Pulmonary Function Parameters in Group I 12-16 years)

Sl. No	Age in Yrs	Sex	Ht in cms	Wt in kgs	MAC in cms	CC in cms	AC in cms	BSA Sqm	BMIKg/m^2	RR cycles/min	PR bpm	SBP mmHg	DBP mmHg	MAP mmHg	BHT in sec	40mmHg Endurance Test in sec	V_T in ml	IRV in ml	ERV in ml	VC in ml	FVC in ml	FEV_1 in ml	FEV_1 in %	PEFR L/min	MEP mmHg	CPFI	VO2 Max ml/kg/min
75	14	M	149	35	17	65	55	1.2	13.66	20	72	112	68	82.6	22	32	600	400	400	1500	1700	1300	76.4	350	80	52.08	64.29
76	14	M	156	42	21	73	65	1.38	15.06	18	82	116	82	93.3	21	30	400	550	550	1750	2100	1650	78.5	350	60	45.18	55.89
77	14	M	149	38	17	62	53	1.26	15.76	20	82	106	70	82	10	29	400	750	200	1550	1500	1000	66.6	400	60	43.85	54.31
78	14	M	154	42	21	68	56	1.36	17.28	18	78	124	72	95.3	15	33	500	1400	700	1300	2650	2450	92.5	400	80	44.11	55.89
79	14	M	152	49	21	73	60	1.4	17.17	20	92	110	80	90	40	32	450	1300	550	1300	2200	2050	93.2	480	100	46.87	61,71
80	16	M	148	40	21	62	53	1.28	17.72	20	84	110	70	83.3	26	26	450	750	550	1800	1550	1150	74.2	350	80	42.13	55.89
81	15	M	145	26	16	58	49	1.02	21	24	100	100	50	66.6	44	39	350	400	400	1200	1200	1000	83.3	240	60	36.23	37.41
82	15	M	148	35	20	66	55	1.22	18.26	16	68	90	60	70	20	38	500	1050	850	1700	2650	2350	88.7	400	100	49.34	60.93
83	13	M	1154	37	20	67	55	1.28	13	22	88	112	68	82.6	32	40	400	650	750	2650	2150	1750	81.4	600	90	42.13	52.53
84	13	M	150	34	20	65	59	1.2	15.5	20	92	100	60	73.3	35	10	450	700	500	1900	1600	1400	87.5	380	70	47.46	62.61
85	15	M	148	36	19	66	53	1.24	15.6	18	84	108	68	81	38	17	300	1100	650	1700	2800	2100	75	400	70	45.73	57.57
86	15	M	140	28	17	59	50	1.02	15.11	20	80	100	70	80	34	19	450	800	650	1400	1700	1550	91.2	260	90	45.73	55.89
87	15	M	154	48	20	68	60	1.41	14.4	22	96	110	84	92.6	47	10	450	800	950	2000	2200	1800	81.8	390	100	37.5	49.13
88	13	M	144	35	18	62	54	1.18	14.28	18	76	100	60	73.3	32	16	450	550	500	1850	1600	1400	87.5	450	70	54.34	64.29
89	15	M	147	30	53	61	59	1.12	21	18	84	90	56	61.3	30	15	650	400	400	2200	900	800	88.8	300	80	37.31	43.29
90	14	M	148	31	18	61	52	1.14	16.90	16	96	104	68	88	29	18	400	1100	400	1700	1700	1400	82.4	500	60	39.47	44.13
91	13	M	141	30	17	59	50	1.1	13	22	76	90	60	70	33	18	550	650	400	2200	1000	900	90	410	60	38.86	47.97
92	14	M	154	47	21.5	74	65	1.4	14.15	24	88	124	70	88	32	10	450	950	550	1700	2400	2150	89.6	210	60	39.47	50.01
93	14	M	150	30	17	61	51	1.12	15	16	96	114	78	90	26	22	450	500	750	1450	1600	1250	78.1	230	50	35.71	45.81
94	14	M	149	34	18	62	53	1.18	21	18	92	90	60	70	39	8	400	950	500	2000	2250	1900	84.4	310	30	47.77	65.97
95	14	M	148	29	18	62	52	1.12	13	18	74	112	80	90.6	38	10	600	600	600	1500	1800	1650	91.7	290	100	38.87	45.81
96	14	M	142	30	16	60	58	1.1	17	20	86	90	60	73.3	40	15	500	1400	700	2600	1800	1600	89	280	60	47.16	59.79
97	14	M	162	47	23	74	68	1.46	13	14	96	120	70	86.6	37	40	300	1000	650	1600	2300	1600	69.6	500	50	39.26	53.37
98	14	M	155	50	21	67	65	1.46	14.88	16	96	116	76	89.3	35	26	500	550	550	350	1300	900	69.2	380	50	43.98	59.67
99	14	M	150	37	18	68	58	1.24	17.93	20	84	108	72	84	32	44	400	750	550	1900	2200	1950	88.6	260	75	43.10	48.33
100	14	M	149	34	18	66	15.31	1.2	34.75	18	72	122	76	91.3	42	20	550	600	650	1700	2100	1850	88.1	410	180	59.52	77.73