Chapter I

INTRODUCTION

The need of physical education and sports programmes in schools has been realized by our government, educationists and administrators. There has been a worldwide awakening in this regard. The new approach to education aims at the development of child through movement activities. A child shows better responses while learning through movements. This is primarily due to the fact that from birth until infancy much of the learning takes place through movements. Physical activities, therefore, become the basis of growth and development. In fact in Great Britain the words 'kindergarten' and 'primary education' are synonym to movement education. It further becomes necessary that programmes of physical activities is to be continued beyond primary school through to the child's active growth period.

In the process of growth and development the physiological functioning of the child gets consolidated and his motor abilities reach to new levels. However, some
kind of overlapping has been indicated by the research findings that there is no direct linear relationship between physical and physiological maturity and chronological age. There may be slow period of growth, spurt and stage of levelling off. The purpose of physical education programmes is to help the child in its optimal development in all aspects namely mental, physical and social. In physical development, the organic fitness is one essential aspect which aims at the development of qualities like strength, speed, power, cardio-vascular endurance etc. Although growth and development follow a general pattern, yet there are wide variations and differences within this pattern. While growth is generally viewed as increase in height, weight and size, development has to do more with functioning of body systems. Therefore, growth represents an increase in mass, while development indicates an organization of the mass with respect to its functioning abilities. They may go on simultaneously, but may also proceed independent to each other.

Growth is a continuous process which moves with an urgency from deep inner sources. One may well ask how the relatively helpless, unskilled, uncontrolled infant finally
reaches the stage of maturity to meet the tests of life. The answer is that, he does it by an orderly sequence of acquisitions. He grows because of strong impulse to grow which is inherent, the products of inheritance, enhanced or modified by experience.¹

The term growth, therefore, refers to the increase caused by the biological processes in which the child becomes bigger in size, in volume, and heavier in weight. Starting its life almost from invisible dot, the human organism grows to be more than five feet in height and more than 150 pounds in weight. Growth indicates the enlargement of cells, fibers and muscles, elongation of the skeleton and increase in the general volume of body parts and organ systems. Growth is educational in nature to a great extent, i.e. the perceptible changes in one's structure and form; it is quantitative in the sense that it can be measured in inches, points and dynes; marked structural changes are noticed as the organism travels further in time. Similarly the heart grows, becomes bigger and

also undergoes qualitative transformation when it becomes capable of pumping out more blood and thus stand the rigours of exercises.\(^2\)

The sequences of growth do not move along in time at a steady pace. Maturity indicators do not appear at regular intervals. There are periods of decelerated growth. Studies of growth have shown that, there are four such distinct periods, two characterised by slow growth and two by rapid growth. After a rapid growth at the pre-natal period, the growth of the child becomes slow till he reaches the age of puberty. Throughout the adolescent period the rate of growth will be once again rapid till it reaches the adult stage.\(^3\)

The young school child is entering upon a developmental period in which growth will proceed much more slowly than was the case during pre-school years. The organism settles down, as it were, to the task of perfecting specific areas and functions rather than achieving spectacular gain


in growth as a whole. At school entrance the child's larger muscles are better developed than his smaller muscles. His eyes are not yet fully mature, and he has a tendency to be farsighted. His heart is growing rapidly. His first permanent teeth, the six year moles are beginning to erupt. All these facts about growth are significant for the teacher whose special task is to help the child to develop the skills and understanding which he needs for wholesome realization and acceptance by society in which he is growing up.

The developmental changes among most children follow a broad sequential pattern. Each child however proceeds at his own rate and at any age shows his own unique pattern within the larger one. His progress depends on the interaction of inner potentials and external conditions. This means that the teacher should not think in terms of the average child or of standard performance. Instead, he should provide activities through which each child may try, in his own way, to realize his own powers to the optimal levels. Each child is recognized by the teacher when he improves, even though he may be rather clumsy. Thus, the
teacher should consider each child's growth pattern, not attempting to hold or mould to an age-grade norms.  

During early years, both physical pre-requisite and the neuro-muscular pattern upon which future skill will be based form gradually. This process is continuous one, which lasts throughout maturation and into adult life. During early childhood, losses in some of the physical status pre-requisites, usually occur due to inactivity, this influences the growth patterns. In later life skills decline, losses occur in balance, agility and coordination, and the body becomes increasingly inefficient. As requirements differ at each period, physical education practices must also differ. Scientifically, valid physical education implies that the achievement of individual and group practice is sought more actively at the time when achievement potential is optimum. Therefore, as near perfect synchronisation is achieved between the growth and developmental cycle of the individual and the specific activities which must effectively accelerate these processes at any given time.  

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5 Ibid., p. 78.
In physical education, the level of physical maturity and development may have more to do with determining what to teach than it does in any other subject matter area. Eventhough several research studies have been undertaken to find out at what stage the children are to be segregated according to their ages for participating in physical education activities. The dominance of different components of physical and motor fitness is not uniform in various activities, and games and sports. There are certain activities in which speed is a dominating factor; in some sports strength dominates; whereas in a large number of activities endurance is more important. Therefore, after assessing the variations among components of motor fitness of children the teacher of physical education will be in a better position to group the children according to their ages for effective participation in physical education activities.

When the child reaches the stage of adolescence a growth spurt, accompanied by hormonal fluctuations, serves to change body shape and size and to alter performance potential. These changes tend to affect the individual's
feeling about himself, which, in turn affect performance. 6

The body proportions of a six year old approximate more nearly those of the adult than those of a new born child. He is better than twice as tall as he was at birth and five or six times as heavy; his body surface area is three times as great as when he was born. His body and limbs have grown so much rapidly than his head that is no longer "top heavy", his head is now only about one-eighth as long as his body.

The increase in height and weight during the childhood is not at a steady rate. The rate of weight gain continues at nearly twice the rate of height gain. The longer limbs grow faster in proportion than does the length of the stem. This child when healthy and vigorous, is typically graceful and swift in movement, self-assured in games requiring physical skill and competent in the management of big muscle activities. 7


The Medford Boys' study over many years has produced considerable concrete evidences to show that elementary and junior high school boys participating more actively in athletics are superior to their peers in maturity, body size, muscular strength, endurance and power. There is similar evidence of girls. The significant indication; here is that the decisions whether boys and girls are physically ready for such participation should be determined by factors other than age or grade in school. 8

The available evidence, however, does not indicate any conclusive findings as to whether motor performance and physiological maturity at different ages are the results of only chronological age or there is a cause and effect relationship between participation in physical education programmes and motor performance and physiological maturity. This study is an attempt to find out the variations in motor performance and physiological functioning as the boys progress in age.

Statement of the Problem

The purpose of the study was to cross-sectionally examine the development and modification of selected physiological variables of school boys ten through seventeen years of age, and also to investigate the relationship of these physiological variables to the motor performance components agewise across various ages employed in this study.

The secondary purpose of the study was to compare motor performance components of boys ten through seventeen years of age.

Delimitations

1. Taking into consideration the resources available, time factor and convenience of availability of student population, the study was delimited to two schools of Gwalior city, namely, Miss Hill Higher Secondary School and J.C. Mills Higher Secondary School.

2. The study was further delimited to the male students of classes six to twelve which cover the age range as employed in this study and only those students who actually fell
in the selected age groups were finally selected agewise for the purpose of this study.

3. The study was confined to the following physiological variables and motor performance components:

**Physiological Variables**

i) Pulse Rate (Heart Rate)

ii) Blood Pressure (Pulse Pressure)

iii) Forced Ventilatory Capacity

iv) Breath Holding Capacity

v) Body Composition (Percentage of Fat).

**Motor Performance Components**

i) Speed

ii) Strength

iii) Power

iv) Agility

v) Balance

vi) Cardio-Respiratory Endurance.

**Limitations**

1. The best technique to study the comparative effect at various ages is an investigation of such changes
employing longitudinal approach, but this technique requires a fairly long period of time of about eight to ten years. Keeping in view the statutory requirements of completing and submitting the work within a specific period of time necessitated a cross-sectional approach which is also a fairly acceptable technique for studying comparative effect across various ages. The overlappings that must have occurred as a result of the use of this technique, due to sampling error was recognized as the main limitation of the study.

2. It was ascertained from school records that the students studying in these two schools represent the cross-section of the society. The only criterion for this study was monthly income of the parents. But since subjects were purely selected at random agewise unequal representation of different income groups in the sample could not be ruled out because stratified random sampling could not be employed for income overlappings. This might have affected the results in some way, and as such was considered another limitation of the study.

3. All efforts were made by the research scholar to motivate the children to put their optimum performance
in the various test items, but there were no objective measures available to make sure that each child has performed to his optimum while undergoing the tests. This was identified as another limitation of the study.

**Definition and Explanation of Terms**

**Cross-Sectional Study**

In order to study differences in a given variable or variables inconsonence with progress in age one has to employ a single sample and then study it from month to month or year to year as the case may be observed changes for a given period of time. Such a method possesses methodical difficulties besides impinging upon the factors of cost and economy of time.

A cross-sectional study is a alternative method, certainly with recognized limitations, which employs simultaneous samples for given ages in order to study changes in given set of variables assuming that each sample of age is a representative of the preceding or following age group.
Physiological Variables

Physiological variables refer to those physiological functions of different systems of the body which are liable to vary across age or as a result of exercise etc. The selected physiological variables examined across age in this study have been defined/explained below:

Pulse Rate

Ross and Wilson\(^9\) have defined pulse rate as a wave of distension and elongation that is felt in an artery wall due to the contraction of the left ventricle forcing blood into the already full aorta. When the aorta is distended a wave passes the walls of the arteries and can be felt at any point where an artery can be pressed gently against the bone.

In this study pulse rate has been defined as the number of pulse waves per minute felt at the radial artery.

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Blood Pressure

Blood pressure is the lateral pressure exerted by blood on the vessel walls while flowing through it.\(^{10}\)

Blood pressure is the force with which the blood distends the walls of the vessels and with which, it would escape if the vessel were cut.\(^{11}\)

Ross and Wilson\(^{12}\) define blood pressure as the force or pressure which the blood exerts on the walls of the blood vessels in which is obtained. When the left ventricle contracts and pushes the blood into aorta, the pressure pushed is known as systolic blood pressure and when complete cardiac diastolic occurs and the heart is resting with no ejection of blood, the pressure within the blood vessels is termed as the diastolic pressure.

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\(^{12}\) Ross and Wilson, *Foundation of Anatomy and Physiology*, p.150.
The difference between the systolic and the diastolic pressure at any moment is called the pulse pressure, which has been considered in this study.

**Forced Ventilatory Capacity**

Forced ventilatory capacity also called the peak flow rate, is the maximum rate of air flow that could be expired out forcefully after a deepest - possible inspiration. This is measured by Peak Flow Meter and expressed in liter/minute.

**Breath Holding Capacity**

The breath holding capacity refers to the duration of holding breath after full inspiration till expiration impulse overtakes i.e. maximum time of holding the breath after full inspiration.

**Body Composition**

Body composition refers to the structural determinants of fat and non-fat proportions as possessed by an individual. That means body composition help to understand the ratio fo fat and non-fat tissues present in the
body which is directly an indicator of an individual functional efficiency with respect to the overall body capacity. Body composition is assessed by normally two methods, direct and indirect method. In the direct method, body density is measured by under water weighing and making corrections for the residual air. Under the indirect method, assessment of body fat is made by skinfold caliper measurement and then applied certain corrections to assess lean body mass.

For the purpose of this study, body composition is estimated from the skinfold measurements of biceps, triceps, sub-scapular and supra-illiac was employed, which was converted into fat percentage on the basis of Durnin and Rehman's\textsuperscript{13} guidelines.

Motor Performance Components

Motor performance components refer to those components which are essential for efficient functioning in the

psycho-motor domain. These components are performance oriented and are dependent upon functioning of different systems of the body in an integrated manner. The motor performance components considered in this study have been defined/explained below:

**Speed**

It can also be defined as "rapidity with which successive movements of same kind can be performed."\(^{14}\)

According to Barrow and McGee\(^{15}\), it is the capacity of the individual to perform successive movements of the same pattern at the fast rate.

For the purpose of this study the term speed refers to the time performance of completing a task i.e. the shortest time taken to run a distance of fifty meters.

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Strength

Strength can be defined as the contractive power of muscles attained by a single maximum effort.\textsuperscript{16}

Muscle strength refers to the contraction power of the muscles. The amount of force, particular muscle group can be apply in a single maximum effort.\textsuperscript{17}

For the purpose of this study strength can be defined as the contractive ability of muscle or group of muscles to perform action repeatedly such as push ups, pull ups etc.

Power

Power is the combination of speed and strength and may be defined as the ability to release maximum force in a shortest possible time.\textsuperscript{18}


\textsuperscript{17}Clarke, \textit{Physical Fitness Research Digest}, p.2.

\textsuperscript{18}Phillips and Hornak, \textit{Measurement and Evaluation in Physical Education}, p.225.
For the purpose of this study power is exertion of maximum muscular force in a shortest possible time to accomplish a specific task as standing broad jump, composed by both strength and speed.

Agility

Agility is defined as the ability of the body or parts of the body to change directions rapidly and accurately.\textsuperscript{19}

It is the ability to change both rapidly and accurately the position or direction of the body through large range of movement.\textsuperscript{20}

For the purpose of this study agility is the speed of changing body position and direction as measured by 4 x 10 meter shuttle run.

Balance

Balance may be defined as the ability to maintain body position, whereas dynamic balance measure the ability

\textsuperscript{19}Barrow and McGee, \textit{A Practical Approach to Measurement in Physical Education}, p.113.

to maintain balance while in motion.\textsuperscript{21}

Barrow and McGee\textsuperscript{22} defined dynamic balance as one's ability to move from one point or space to another and maintain equilibrium.

For the purpose of this study balance is the ability to maintain equilibrium for shorter period on a particular spot while body is in motion as measured by modified Bass Dynamic Balance Test.

**Cardio-Respiratory Endurance**

Cardio-respiratory endurance is the ability to continue or persist in strenuous task involving, large muscle groups for long period of time.\textsuperscript{23}

Cardio-respiratory endurance is characterised by moderate contractions of large-muscle groups for relatively long periods of time, during which maximal adjustments

\begin{enumerate}
\item \textsuperscript{21}Phillips and Hornak, *Measurement and Evaluation in Physical Education*, p.244.
\item \textsuperscript{22}Barrow and McGee, *A Practical Approach to Measurement in Physical Education*, p.114.
\end{enumerate}
of the cardio-respiratory system are necessary.

Significance of the Study

One of the objectives of physical education is to develop organic vigour and physical fitness. In other words, physical education programmes aim at the development of efficient physiological functions and also sound motor qualities. The physiological functions of the body and motor qualities develop among children at different stages at different rates. They are complementary in nature i.e. a specific level of physiological maturity may be required to perform a particular motor task. It is however difficult to say which causes the other. Hence it is not easy to establish a cause-effect relationship. Nevertheless, it is necessary to understand at the first instance the nature of physiological development among children at various stages of development along with the development of motor qualities. The thorough understanding of this process only can help physical education teachers to work-out programmes most suited to the needs of the children and thus help them to activate the process of physiological and motor maturity. The present study will therefore, be of significance in the following ways:

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24 Clarke, Physical Fitness Research Digest, p.2.
1. Physical education teachers and others concerned would be able to understand general pattern of physiological changes at various stages of development among Indian school children.

2. Findings of this study would be of help to physical education teachers and others concerned in understanding the relationship between physiological changes and motor development at each stage of development across different ages employed in this study.

3. The results of the study would be of significance in developing and working out suitable programmes of physical activities which will be helpful in activating favourable physiological changes and motor development among children.