"A COMPARATIVE STUDY OF DEVELOPMENT OF MOTOR ABILITIES IN NORMAL AND THAT IN DEAF AND DUMB CHILDREN FROM 8 TO 14 YEARS"

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DOCTOR OF PHILOSOPHY IN PHYSICAL EDUCATION

BY

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October, 2007

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CERTIFICATE

This is to certify that the work embodied in this thesis entitled, "A Comparative Study of the Development of Motor Abilities in Normal and that in Deaf and Dumb Children between 8 to 14 Years", has been carried out by Mr. Shatrunjay M. Kote. The work included in this thesis is original, unless stated otherwise and has not been submitted for other degree of Dr. Babasaheb Ambedkar Marathawada University or any other University. References made to the work of others have been cited in the text.

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Date: October 12th 2007.

DECLARATION

I hereby declare that the present work completed in the form of thesis entitled, "A Comparative Study of the Development of Motor Abilities in Normal and that in Deaf and Dumb Children between 8 to 14 Years", is an original work and has not been submitted, or published in any form for the fulfillment of any other degree or any other similar to this or any other university.

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CONTENT

INTRODUCTION

I.1 (A) - HISTORICAL BACKGROUND:

The modern age is an age of space, adventurism and technological gigantisms. Machines, which men built up for the purpose of adding comforts to his life, have become part and parcel of life. Biological discoveries have opened new casements of knowledge about human organism emphasizing that there has certainly been reduction in human physical efficiency since the time he started depending on machine. For man there is nothing more beautiful and valuable than his physique. The proper use of body is essentially necessary if humans wish to grow and develop to their optimal level. Today's education is not merely a vast sea of mental acrobatics but also a source of physical activity that leads to all round perfection of an individual. Modern thinkers in education, now a day, emphasize that the best individual is one who is physically fit, mentally sound and sharp, emotionally balanced and socially well adjusted and as a result the birth of physical education is witnessed. The broad objectives of physical education are physical development, motor development, mental development and social development.

According to the natural sciences it is believed that our solar system was created some 4600 million years ago[1]. A new milestone in the biological evolution was reached approximately 1500 million years ago when a unicellular organism with a nucleus, the eukaryote, developed[2]. Evolution stage probably began 700 million years ago[3]. For millions of years species remain unchanged in the fossil record, suddenly to be replaced by something that is substantially different but clearly related[4]. It may have been only 5 million or as many as 20 million years ago that the family tree of primate developed a branch the hominids, which finally resulted in *Homo sapiens,* the only surviving hominid. Not until about 4 million years ago do the African fossils reveal the presence of the hominid genus Australopithecus. The pelvis permitted an upright posture and bipedal gait with the arms free. There are archeological records of tools, pebble choppers, and small stones that are probably more than 3 million years old[5]. The general public is probably most familiar with Neanderthal man (*Homo Sapiens Neanderthaliensis*) who, from archeological findings, appears to have been well established some 200 000 years ago[6]. A human being living 50,000 years ago probably had the same potential for physical and intellectual performance, playing a piano or constructing a computer, as anyone living today. Therefore, from all indicators, *Homo sapiens* have remained biologically unchanged for at least 50,000 years. By 30,000 years ago, modern man has spread to nearly all parts of the world. It was not until some 10,000 years ago that the transition from a roaming hunter and food gatherer to a stationary farmer began[7].

To illustrate the evolutionary time-scale, let us compare 4600 million years that our planet has existed with a 460-km journey. Life began after the 100 km of the trip had been recovered. Another 200 km was required before the unicellular organism with a nucleus was born. Multi-cellular animals were living when we arrived at the 400 km mark. Evolutionary radiation of the mammalian stock began somewhere around the 453 km mark. The first hominid appeared approximately 6 km later. Australopithecus joined the 35 m journey 200 to 450 m from the end, and the Neanderthals disappeared about from the finish line. The cultivation of land and keeping of livestock occurred 1 m from man's present position. A 100 year-old person today has covered a distance of just 0.01 m or 10 mm of the 460 km journey[7].

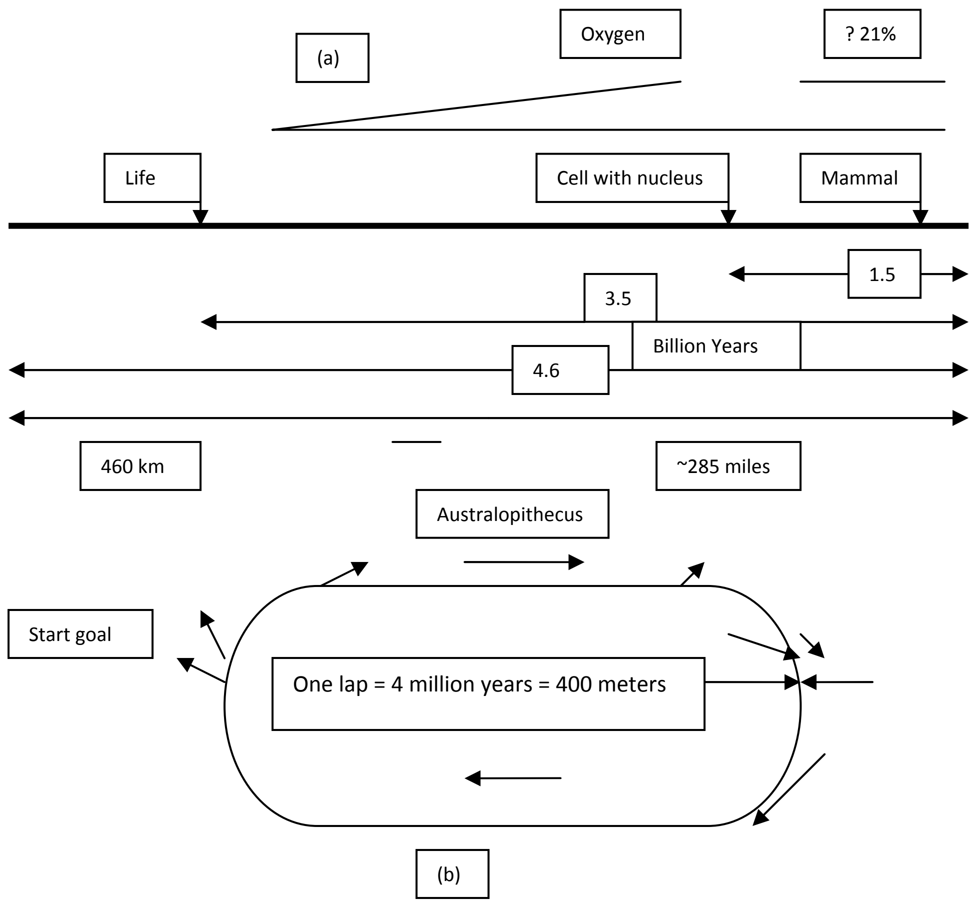

Figure I.1: (a) The history (approximately 4.6 billion years) of our planet is illustrated as proportional to a journey of 460km (285 miles). After some 300km (186 miles) we find a eukaryote-a cell with a nucleus. (b) The history of the hominids, starting with Australopithecus, covers the last 400m. Farming and agriculture started after 399m (10,000 years ago). Homo sapiens Neanderthaliensis died out at 3.5m (35,000 years ago). The 20th century covers the last 10mm[38].

The purpose of this brief summary has been to present an outline our genetic background. Many structures and functions are common to different species in the animal kingdom[8, 9].

For obvious reasons we do not know anything about athletic activities during the Stone Age. People probably liked games and plays, and they sang and danced. There is definite evidence in sculptures and paintings some 5000 years old that Egyptians exercised. There is an historical record of the ancient games beginning in Olympia in the Western Peloponnesus, Greece, in 776 BC. Thereafter, they were held at 4-year intervals, until AD 394 when they were abolished. The earlier Olympic programs consisted almost exclusively of exercises of the Spartan type, testing endurance and strength with a special view to war. Olympia became an expression of the Greek ideas that the body of man as well as his intellect and spirit has a glory, that the body and mind should alike be disciplined, and that it is by the harmonious discipline of both that men best honor Zeus[10].

Motor development objectives are concerned with making physical movements, useful with as little expenditure of energy as possible. The term motor is derived from the relationship of a nerve or nerve fiber to the one that connects the Central Nervous System with muscles through their convections the movements' results. Effective motor movement can only results if there is harmonious working of the muscular and the nervous system. It helps in keeping a greater distance between fatigue and peak performance. The activities that involve hanging, jumping, dodging, leaping, kicking, bending, throwing will enable a person to perform his daily work much effectively without reaching a point of wearing out, so quickly[11, 12].

Data obtained at the beginning of the century revealed that children, as they age, evidence various patterns of physical growth as well as skeletal maturity. These differences at times can cause rather dramatic changes in motor ability and in athletic performance. This type of investigation was stimulated by the use of X-rays to determine skeletal maturity, a practice expanded during the time between the two Worlds Wars, and manifested in the publication of various atlases of maturation.

More recent evidence suggests that marked ethnic differences exist in motor development at birth and during the first year or two of life. In general, it has been a consistent finding that infants from the so-called pre-industrial societies exhibit precocious motor development, when compared to similar indices obtained from children born within the more advanced industrialized societies.

The words maturation and development usually refer to various kinds of qualitative changes in the infants, children, and young adolescent. These changes mean that the organism is becoming more complex, differentiated as to function, and able to perform increasingly complex tasks. Growth, on the other hand, refers to less subtle, more measurable quantitative changes in the child. For this reason, human growth has been the subject of many of the earlier studies of those interested in the manner in which children grow and change. The norms that have emerged from these studies are not always helpful because of the small number of children who have been measured, or perhaps because of the relatively limited sample in terms of sex and ethnic and / or socioeconomic background.

For the most part, the growth rate of the average infant is extremely rapid during the first year and a half of life. One obtains a very different picture of physical growth when one looks at an individual child compared to simple linear plotting of studies in which large numbers of children have been measured. The individual child is a product of the genes of the parents and of their parents, and of subtle "genetic programming" which is just now beginning to be studied. Various other factors, including the opportunity to play and encouragement by parents in physical efforts, add further complexity to the “picture” of growth. A single child may, for example, evidence the relatively steady growth rate typical of the charts emanating from group studies. He or she may evidence relatively rapid early growth in childhood and a later “leveling off” still another pattern of growth may include a slow start, followed by a marked change in late childhood. An even more complicated pattern may include changes in size that show stops and starts during the period of time from the fifth year to puberty.

Historically and contemporarily, large number of terms has been used to represent physical fitness and motor performance ability of human beings[13].

Multiple performance traits: Interest in multiple performance traits began in two distinct waves. Motor ability and athletic ability tests were initiated in the early part of this century, while physical fitness and motor fitness tests are primarily products of the past 50 years[14].

Motor Ability: Athletic ability- along with the emphasis in cardiovascular testing that began at about 1900, interest also developed in athletic or motor ability testing. Early tests involved fundamental movements such as running, jumping, and throwing and were intended to test such factors as speed, power, agility, strength, and endurance. Although not identical, motor educability and motor capacity tests falls within this measurement area[14].

Athletic (motor) ability was first tested by the Turners (normal school of gymnastics) who, in 1894, developed test items to compare athletic performance of students. In 1902, Dudley Sergeant, because of his belief that strength tests did not measure endurance and speed, developed a battery of simple exercise to be performed for 30 minutes. Those who completed the test battery were considered athletically fit. Shortly thereafter, Dr. George Meylan of Columbia University developed comprehensive tests of running, jumping, vaulting and climbing that were later used at many universities for grading and classification. Motor ability tests were utilized in the public schools before universities and in the first decade of the twentieth century these tests were given in the New York City, Cleveland, Baltimore and Cincinnati. In 1913, the forerunner to the present National Recreation and Parks Association (NRPA), the Playground and Recreation Association of America, published the Athletic Badge Test, which included track and field tests as well as rope climbing and vaulting standards for boys and girls were developed and used in public schools throughout the nation[14].

In 1912, Sigma Delta Psi, the national athletic honorary fraternity for men, was founded at Indiana University. A series of minimum standards in several types of athletic events had to be met for membership into the national fraternity. These tests are currently administered by intramural personnel at most universities. Tests developed at other universities soon followed; the university of California classification test and another constructed at the University of Oregon are two examples. Until the 1920’s the majority of tests were for men or boys only. Garfield at Bernard developed the first motor ability test for women in 1925. Later, similar tests for women were developed at Oregon and Wellesley[14].

Under the supervision of J.H. Mc Gurdy, the Chairman of the National Committee on Motor Ability test in 1924, general ability tests were developed for football, soccer, field hockey, basketball and tennis. About the same time, new statistical techniques became available and allowed the development of scientifically constructed tests that had better validity and reliability. In the following years, new and better tests were devised. In 1927, David K. Brace of Texas developed his motor ability test, revised in 1931, by C. H. Mc Cloy of Iowa. Mc Cloy's revision is now called the Iowa Brace test and is considered a test of motor educability. In 1929; Frederick W. Cozens developed the test of General Athletic Ability, which has been widely used. From 1930 until 1960, general motor ability tests for students of various educational statuses were developed. However, since 1960 there has been little use of such tests[14].

Physical Fitness - Motor Fitness: The terms physical fitness and motor fitness are not synonymous. In essence, motor fitness is a limited phase of general motor ability. Motor fitness, however, is more general than physical fitness. The meaning and relationship of these terms is aptly explained by Clarke, "Physical fitness elements are muscular strength, muscular endurance and circulatory endurance. Muscular power, agility, speed, and flexibility are added to compose motor fitness; than, kinesthetic arm-eye, foot-eye coordination are needed for general motor ability"[15].

Fitness measurement and evaluation has always been done. The ancient Greek philosopher, Socrates, is responsible for the well-known phrase "a sound mind in a sound body". The sound body implies physical fitness[14].

Fitness tests in the United States are recent occurrences, although hints of fitness testing appeared in the Turnvereins of the East and Midwest during the nineteenth century. Fitness became a national issue during World War I because many inductees could not pass their physicals. The Physical Fitness Index (P.F.I.), published by Frederick R. Rogers in 1925, was the first modern physical fitness test. Actually Rogers' PFI tests muscular strength, muscular endurance, and lung capacity, which are only three of several components that comprise physical fitness. Motor Fitness tests were developed initially during World War II, again when emphasis was placed on the fitness of military men. Almost all branches of the armed services developed fitness tests with norms. Examples are the Army Physical Efficiency Test and the Navy Standard Physical Fitness Test. A number of other motor or physical fitness tests were created during the war years for college and school groups. In 1943, Karl Book Walter developed a motor fitness test for college men. Variations for high school boys (1944), girls (1944) and elementary school children (1948) soon followed. The latter adaptations were used in Indiana. In 1945 the National selection on Women's Athletics (now NAGWS) of the AAHPER proposed a motor fitness test for high school girls that were widely used for years[14].

In 1947, B.E. Phillips published the JCR (jump, chin, 10-yard shuttle run) Test in the research quarterly, which proved to be popular. In the same year T.K. Cureton of Illinois published a fourteen and an eighteen item motor fitness test. Subsequently, a seven item test, which is more administratively feasible, was developed[14].

In 1954, about a decade after the end of World War II, the nation received starting news regarding the relative fitness of its youth. Kraus and Hirsch land (1954) examined

4458 students from the eastern United States and 3157 Swiss, Austrian, and Italian children on six tests of minimum muscular fitness popularly known as the Kraus-Weber tests. The tests were designed to indicate the level of strength and flexibility for certain key muscle groups and were graded on a pass-fail basis. Results revealed that 57.9 % of U. S. children and only 8.7 % of European children failed one or more test items. Although the scoring and validity of the Kraus-Weber test were later questioned, they rekindled interest in fitness development and testing.

A direct result of the Kraus-Weber tests was the establishment of the president's council on youth fitness in 1956 under President Eisenhower. The AAHPER (American Alliance for Health Physical Education and Recreation) appointed a special committee, chaired by the late Paul Hun sicker of the University of Michigan that developed the AAHPER Youth Fitness Tests in 1957. Revisions of the test have been published in 1965 and 1975. It is undoubtedly the most idle used fitness test in United States. The AAHPER Youth Fitness Test has been officially adopted by the president's council on physical Fitness and Sports. The President's Physical Fitness Award has been established as a motivational technique and is distributed to all boys and girls who achieve the 85th percentile or better on all the tests. The test manual is available from AAHPER in Washington D. C. (1976). The AAHPER Youth Fitness Test is currently under revision. The items on the new revision will emphasize health-related fitness. The four items will include: Sit-up test; sit-and-reach flexibility test; a test of cardio respiratory function (9 minute or 1 mile run); and body composition measures (skin folds)[14].

Many other physical or motor fitness tests have been developed, for example, by universities, States and Armed services[14].

A major consideration of most modern fitness tests has been to test as simply, easily and economically as possible. Modern instrumentation and innovations such as Cooper's The New Aerobics (1970) have made fitness and fitness testing remain in the forefront of measurement in physical education programs. Such innovations as adult and family fitness programs with prescribed exercises have added to the body of knowledge in the areas of physical and motor fitness as well as cardiovascular fitness testing.

A comprehensive list of components of motor ability for performance of various physical activities (including sports) include muscular strength, muscular endurance, muscular power, cardiovascular endurance (alternatively also known as cardiopulmonary endurance), agility, speed, balance, flexibility, reaction time, coordination (eye-foot coordination, eye-hand coordination, whole-body coordination). In addition, traits like simple motor response, reflexes, sensory input and awareness of space and tempo (characteristic speed and rhythm of movement) are also considered important in motor performance- ability especially during the early years of body development. Keeping in view the above mentioned variable components of motor performance, hundreds of motor performance ability tests have been constructed by many investigators belonging to military organization, sports organizations, university departments and government departments (Mc Cloy, 1946; Larson, 1946; Fleishman, 1946; Barrow & Mc Gee, 1964; Mc Collum & Mc Corkle, 1971; Texas commission, 1973; Clarke & Clarke, 1987; Fox et. al, 1993). Some of these tests measure muscular strength, endurance, power, agility, coordination etc; some measure motor educability (learning) i.e., ones capacity to learn new motor skills, while some other tests attempt to measure motor capacity (one's hereditary potential of motor performance at adulthood or after training).

I.1 (B) - GENETIC BACKGROUND:

At the end of the first year of age, children usually begin to walk. Their motor behavior undergoes marked changed during this time and as they enter the second year they begin to show a number of variations in locomotor activities: they will usually begin to jump, to run and to hop. At the same time they show the beginnings of skills that will later be developed to high levels in childhood and adolescence. During the second year, they begin to handle play equipment and balls if they are made available[17].

During the third and fourth years, they will usually begin to manifest social interactions at play and variety of individual differences modifies the manner in which they move. The obese child of nursery school age performs in a different manner from his thinner peer[18]. Children begin to evidence differences due to the play experiences to which they are exposed, and several observers have noted both subtle and obvious differences in the manner in which boys and girls appear to move and to perform skills[19].

During this period, children will begin to display various asymmetries in manner in which they move. Hand preferences become apparent, ear and eye preferences are also measurable. The child prefers to hop on one foot consistently and in other ways establish movement characteristics that tend to persist into childhood and adulthood[20, 21, 22, 23].

Towards the end of the first five years, movements will become more integrated. They may begin to jump with their arms and to throw with the proper weight shift. By the end of the fifth year additional movement capacities will emerge, although they cannot hop rhythmically very well, skipping is not mastered until another year or more passes and abilities to throw accurately and to catch small balls both remain relatively under developed.

Children from 6 to 12 years of age improve to a marked degree in ability to move and to manipulate their environments. Although during this period obvious growth changes occur, the rates of growth begin to subside as children reach their sixth year and do not continue at the rapidity that characterized the first five years of life[17].

More important than growth and body weight changes in the modification of performance during this period of childhood are a number of experiences and situations in which motor skill is demanded. The boys form teams and the girls begin to interact socially in more individualistic games and as both groups each adolescent, they learn to dance.

The motor development of children has been studied from several standpoints by various investigators. Some have come to prefer a single test and have traced the manner in which children improve in its execution as a function of age. Other scholars have devised more competencies of children. The Johnson test, containing tumbling as well as locomotor sub skills, is typical of this kind of tests[24]. Vickers and associates have modified the scoring of the Brace Test, a stunt- type test, for use in the evaluation of children[25]. The Lincoln Oseretzsky is another battery of test, developed for the evaluation of children; it contains an even greater variety of both fine and goes motor skills to measure[26].

Several factors, which vary in importance depending on the characteristics of the sport, must be considered. Exercise has been demonstrated to be extremely important for normal growth and development of children. The most recent addition to the care team for the handicapped child has been the physical educator, sports coach, or dance teacher with specific skills and an interest in sports and fitness programs for the handicapped.

Hearing and Communication: Until recently, it was believed that all babies were born deaf and that after birth they gradually learned how to listen. However, research has indicated that the ears develop at a gestational age of approximately 4 months and that the fetus is capable of listening to sounds within the womb. Consequently a child is born with a functional hearing system. After birth the baby is capable of hearing and discriminating a variety of sounds although he has a preference for speech sounds which facilitates the natural acquisition of language. The quality of the newborns hearing ability changes and ranges from being able to identify his mother's voice among numerous female voices, to being able to discriminate intonation patterns and interpret friendly versus unfriendly voices. The infants hearing progresses from listening to auditory input in general to being able to listen to finer auditory detail. At approximately ten months of age the infant is able to respond appropriately to a variety of speech commands. At age 12 months the infant starts using single words which he expands to form two word sentences by the age of 2 years. Although the child is born with the ability to acquire language it is paramount that he is repeatedly exposed to and experiences sound, in the absence of which, language acquisition will not develop. During the first 4 years of his life the child is very receptive to the sounds of language. If during this stage the child was not exposed to or did not experience sound it is highly unlikely that he will acquire language skills. Initially the child's experiences with sound form the foundation of the language learning process. Meaning is attached to the sound experience as the child is exposed to language by hearing the speaker and in so doing develops an innate concept of language, which is stored in the brain. The child uses this innate language ability to speak, read and write. Hearing facilitates listening which in turn is a pre-requisite for the acquisition of spoken language. When the child becomes a speaker the hearing system serves to monitor his voice and language use[51].

Types of hearing loss:

(1) Conductive hearing loss: Loss of sound sensitivity as a result of abnormalities of the external and middle ear. The conduction of the sound by means of air conduction through the external or middle ear mechanism is weakened by an abnormality. The conduction of sound by means of bone conduction is not affected.

(2) Sensory-Neural hearing loss: Loss of sound sensitivity as a result of abnormalities in the inner ear (e.g. cochlea) or nerve pathways (e.g. eighth nerve).

(3) Mixed hearing loss: Loss of sound sensitivity as a result of abnormalities in both the conductive and sensory-neural mechanisms.

Causes of hearing loss: Hugo, 1987 lists the following as possible causes of hearing loss:

(1) Congenital: The majority of people have the ability to hear. This ability is a generic trait. Some people do not have this trait. Instead, they have a trait for deafness or hearing impairment. The cause of deafness may be traced to either parent. Congenital hearing impairment is transmitted either by ordinary, paired chromosomes (Autosomal) or by the sex chromosomes (x-linked). (a) Autosomal dominant inheritance: In this condition there is at least one dominant gene for hearing loss in one of the ordinary chromosomes. Possession of a single dominant gene is enough to cause the trait. A hearing impaired parent in this instance will have one normal gene and one gene for hearing loss and will transmit either a gene for hearing loss or a gene for normal hearing to his child. Typically for each pregnancy the chances for the child to have the trait are about 50%. Males and females are equally affected. The trait is carried vertically from one generation to the next. (b) Autosomal recessive inheritance: In recessive hearing impairment the gene for hearing loss is recessive to the gene for normal hearing. Parents of children with Autosomal inheritance usually have normal hearing. Parents of children with Autosomal inheritance usually have one gene for normal hearing and one gene for hearing loss. If both parents are carriers the probability is only 25% that the child will receive the defective gene from each parent and exhibit a hearing loss. (c) X-linked inheritance: X-linked inheritance is a special type of recessive inheritance. In its most common form, the mother carries the gene for x-linked hearing loss on one of her chromosomes. Because x-linked traits are often recessive the matching gene on the x-chromosome usually allows for normal hearing. The mother would have normal hearing but each son would have a 50% possibility of inheritance of a hearing loss. Each daughter has a 50% chance of inheriting the affected chromosome if the mother is a carrier. She also has a 50% chance of being a carrier of the x-linked trait. In other words she is capable of transmitting the trait to her sons. An affected male will transmit the x-linked trait for hearing loss to all his daughters, making them carriers, but to none of his sons, since he can contribute only y-chromosomes to them.

(2) Acquired: The first 28 days of fetal life form a crucial time of very rapid fetal growth and development during which more than 70% of long term neurological handicaps originate. A significant portion of these handicaps appear to begin with fetal infection acquired during pregnancy or in the period immediately before or after birth. (a) Pre-natal: Fetal infection occurs by one of the following routes: Trans-placental passage of virus. Extension of the birth canal with infection of the membranes. Direct contact or contamination during the birth process: Rubella, Cytomegalovirus, Kernicterus, Rh incompatibility. (b) Peri-natal: Prematurity, Anoxia, Birth injury. (c) Post natal: Meningitis, Measles, Mumps, Other viral infections including Chicken Pox, Ototoxity, Otitis media.

(3) Trauma: head injury, noise induced.

Implications of a hearing loss: The ear is the primary sensory channel through which speech and language skills are normally acquired. Hearing loss in an infant or young child is associated with a broad spectrum of problems:

(1) Effects on speech development: Speech is a complex signal, with most of the speech information carried in the frequency range between 400 – 3000 Hz[39, 40, 41]. In order to perceive speech adequately the frequencies between 800 –2000 Hz should be audible[42]. The process of speech perception is primarily an auditory one and limited in the child with a profound hearing impairment. Speech sounds usually occur in continuous speech. This complicates the speech perception process and necessitates the utilization of a variety of skills to adequately perceive the speech signal[42, 43, 44, 45, 46, 47, 48]. Firstly the child needs to detect the presence or absence of the speech signal. Both voicing and vowel information is confined to the lower frequency regions (100 Hz to 250 Hz). This suggests that most hearing impaired children will be able to detect the speech signal since individuals with profound hearing loss tend to have better hearing in the lower frequencies[40, 49]. Detection therefore involves a very limited analysis of the acoustic cues present in the speech signal. Secondly adequate speech perception depends on the ability to discriminate between speech signals of different temporal and spectral cues[43]. If the profoundly hearing impaired child has better hearing sensitivity in the lower frequencies it is predicted that he will be able to differentiate between speech signals differing in duration and stress, for example mono-syllabic vs. multi-syllabic words and spondees vs. trochees, as the supra segmental aspects of speech are provided in the lower frequencies. The availability of spectral cues is usually limited in a profoundly hearing impaired child. Therefore phonemes dependent largely on audibility of the second and third formants (high frequencies) may not be easily discriminated, for example, the vowels ‘i’ and ‘u’ have similar F1 and F2 formants but different third formants[40, 41]. The vowels ‘i’ and ‘u’ are therefore only distinguishable if the individual is able to hear the formant transitions of the first three formants[42, 29, 47, 41]. Thirdly the normal hearing child is able to perceive speech because he is capable of identifying specific phonemes by attaching a linguistic label to what was heard[43]. This skill is often difficult for a profoundly hearing impaired child to acquire as it is dependent on the correct perception of spectral cues in the speech signal. This information is often reduced in a profoundly hearing impaired child who has little if any residual hearing in the high frequencies[49]. Integration of the above mentioned skills, as well as adequate attention and memory, facilitate the total comprehension of the oral message. As the hearing impaired child receives only inadequate acoustic information which may be distorted[39]. He is primarily dependent on linguistic information available in the spoken message comprehension. Good speech perception skills are not only a pre-requisite for comprehension of a spoken message but are also essential for the development of good speech production skills[50]. The normal hearing infant utilizes the above mentioned skills for adequate perception of the speech signal. He then attempts to imitate the sound and is able to monitor his own productions. In this way he is able to modify his speech production continually and gradually develop intelligible speech[42, 47]. The profoundly hearing impaired child’s speech perception of the oral message is, however, restricted, in addition his auditory feedback mechanism is impaired or absent. This results in an inability to monitor his self speech production. Consequently the acquisition of speech production skills, particularly segmental aspects and to a lesser extent supra-segmental aspects is very difficult.

I.2 - EMERGENCE OF THE PROBLEM:

Growth and development is a lifelong process. Each and every aspect of human being is subject to the process of growth and development. In sports we consider physical and physiological aspects, psychological and social aspects and motor development aspects. Motor development is the most important aspect of growth and development for sports and physical education. It covers the development of motor abilities, sports skills, tactical efficiencies, motor performance and motor behavior.

Here the researcher wants to consider single aspect and i.e., motor abilities. Physical fitness or condition is the sum total of five motor abilities; namely strength, speed, endurance, flexibility and coordinative abilities. These five motor abilities and their complex form are the basic prerequisites for human motor actions. In this study the investigation is made on the comparative development of motor abilities among normal and that in deaf and dumb children between 8 to 14 years' age group. The researcher is in pursuit to find out if any specific compensatory qualities are found among the physically challenged children, which will be beneficial for the development of sports performance in certain age group, also the trainability of motor abilities which is the performance prerequisite.

"Sound education is the art of helping human beings of all ages to grow and develop to a fuller stature of mind, body and spirit, and to live well in their world" –L. Arnaud Reid

Physical education has an important part to play in helping children develop in stature of mind and spirit as well as body; children with 'special needs' may be helped to 'live well in their world' even if that world is more limited than that of their more fortunate peers.

It is of course true to say that every child has the same basic needs – food and shelter, affection, security, self-respect and acceptance. Every child 'needs' to be recognized as a person in his own right, yet some children come into the school system with considerable deprivations, and in this sense they have very special needs which must be satisfied if they are to develop their full potential as adults. Some children are deprived by the very love their parents have for them, for many physically challenged children are overprotected, and their development thus is limited because they are denied with opportunities to explore their environment. Most children find joy in movement; parents and child together delight in the child's first steps; older children enjoy rolling, climbing and sliding. Unfortunately many children do not experience the thrill of physical challenge because their locomotive powers are severely limited, because they have impaired sensory perception or because their home circumstances restrict physical play. Some, who are free to play with other children, suffer the frustration of exclusion from childhood games.

Whatever the educational situation, it is to give children the joys and excitement of physical activity and play in some form. This natural childhood activity should be used to give physically challenged children as much opportunity as possible for independence and for acceptance by other children.

Some physical educationalists think that the highly structured, teacher-directed types of program advocated by Kephart[27] and his followers cannot be considered part of physical education since they are concerned with training rather than with educating. Yet this type of work has greatly enriched the lives of many physically challenged children. If a child's difficulties in coordination are so pronounced that he cannot benefit from the more usual forms of physical education or if a child's learning difficulties are very severe then a teacher-directed program of perceptual motor training may be essential. Most children requiring special education, except the most severely mentally handicapped, want to take part in physical activities recognizably similar to those enjoyed by society at large- swimming, football, athletics, dancing, canoeing and so on. However, physical educationalists should not hold too narrow a view of their subject; nor should teachers with limited training in the subject fall into the trap of embracing a particular 'system' either because it is so highly structured or because it appears delightfully open-ended. No system holds all the answers. The wise teacher will attempt over a period of time to give his pupils a balanced program involving traditional activities (or at least a selection of the most appropriate), movement exploration, creative and aesthetic experiences and individually planned programs of sensory motor training. Each approach has something special to offer and a teacher can weight his program to satisfy the needs of the moment.

Body- mind relationship: The idea that physical well-being and motor skill has impact upon other aspects of life and adds to the quality of life is not new. The Latin tag 'mens sana in corpore sano' has been the watchword of others besides professional physical educationalists. The Greeks emphasized the importance of balance and harmony of mind and body. Socrates stated 'It is a matter of common knowledge that grave mistakes can often be traced to bad health.' But from time to time since the fifth century BC there has been the notion that one can educate the mind of man and ignore his body. This idea persists today in the teaching of educational philosophers such as R.S. Peter and his followers, who appear to think of man as an intellectual being without a body and perhaps without a soul. None the less twentieth-century doctors are very aware of the psychosomatic unity of man and acknowledge not only that the body may influence the mind but that the mind can have tremendous upon the body.

The Deaf child: The deaf child hearing impairment is often a result of sensor neural deficits caused through cochlear damage[16]. Equilibrium deficits with a concomitant loss of balance and coordination may compound the athlete's disability if there has been damage to the semicircular canals or vestibular apparatus. However, the greatest limitation which deaf athletes usually confront is their inability to communicate effectively with other individuals. This inability can be overcome by the use sign language and other methods of visual cueing. Deaf athletes can also compensate for their hearing loss by maximizing their visual abilities through training powers of observation and peripheral vision. Acquisition of these skills enables most deaf persons to participate in almost any athletic or fitness activity.

Games and Individual Sport: In these activities, the ideas of combining, cooperating, giving way, preserving and contributing as an individual to a group are all socially based, and can profitably be absorbed by deaf children on their own or in company with their hearing peers. In games there should be no problem beyond the possibility of delayed response to signals. One must be prepared for occasions when a child in a football game, unaware of the whistle, goes on triumphantly and cheerfully to shoot an inappropriate goal, but the problem is easily remedied if tolerance and a sense of humor are brought into play. In individual sports and athletic events, physically able deaf children can, of course, excel. A few adaptations are necessary. Starting signals should be visible as well as audible. In swimming it is important in the early stages for the teacher to remain alert to potential danger. Hearing-aids are out of the question, and water often blurs vision. Similarly, deaf children cannot easily be talked up a mock rock-climb, though they can be taught to observe prearranged signals and to look for instruction. The general principle of teaching children to be alert to visual signals if they are likely to be out of touch with audible ones holds in all training in sport and team games, and the overall principle of equipping children to be finally independent and self-reliant, holds in all aspects of physical education.

The potential ability of hearing-impaired children to take part in physical education programs is far more important than their disabilities and shortcomings. The children themselves need to recognize and come to terms with their disabilities so that they can use their own judgment to decide what they are capable of and why. The choice is finally theirs.

It is an unrewarding practice to fragment the curriculum at any level into separate subjects; the education of the child as a whole person must be constantly borne in mind. All aspects of learning should relate to children's needs and must therefore be inter-related. If the underlying aim of education is recognized to be the development of satisfactory personalities, communication must also be recognized as the keystone in any educational program. It has many aspects and can take many forms. Non-verbal communication in physical education cannot only advance verbal communication, but can contribute to the growth of the child as a person. The possibilities of developing more satisfactory social personalities in deaf children by this means are only just beginning to be recognized. It is a field in which exploration and controlled experiment is likely to be most rewarding.

The origin of organized competitive sport for the disabled is directly related to the rehabilitation of Second World War veterans with spinal cord injuries. There are earlier examples of outstanding disabled athletes and of sport organization for the disabled[28].

Considering the equal stature and right of exposure in sports participation; the need for the research in understanding the performance prerequisite: motor abilities development of the normal and the deaf-dumb children has emerged.

I.3 - STATEMENT OF THE PROBLEM:

"A comparative study of the development of motor abilities in normal and that in deaf-dumb children from 8 to 14 years"

I.4 – NEED OF THE STUDY:

As the population of the normal mass is comparatively more to that of deaf-dumb resulting the opportunities designed are more for normal mass. But at the same time their is a society always struggling to uplift the physically challenged and trying to give them the best and equal opportunities so that the handicapped ability should not be the hurdle in normal and natural unfolding of an individual.

Considering the inability, which has the opportunity to be converted into compensatory ability for excelling in the sports arena the researcher, felt high need to evaluate the development of motor ability among deaf-dumb and compare with the normal, which is a performance prerequisite.

I.5 – OBJECTIVES OF THE STUDY:

1. To find out the developments taking in motor abilities among normal children and that of deaf-dumb at particular age group.
2. To asses the developments taking in motor abilities among normal and deaf-dumb children at various age groups.
3. To analyze the developments taking in motor abilities among normal and deaf-dumb children; both boys and girls in various age groups.
4. To study the developments of motor abilities in boys and girls (normal and deaf-dumb) between 8 to 14 years.
5. To compare the rate of development of motor abilities in boys and girls (normal and deaf-dumb) between 8 to 14 years.
6. To understand if any higher or compensatory ability among deaf-dumb children is noticed when compared to the normal children.
7. To understand various parameters of motor ability in certain age group of certain physical abnormality.
8. To observe and evaluate if some established training methodology is applicable and useful for physically challenged children.
9. To understand scientific base for methods of training physically challenged children.
10. To understand how the society would help its weak counterpart.

I.6 – SIGNIFICANCE OF THE RESEARCH:

1. The study may reveal the physical and mental problems of deaf-dumb children.
2. The study may also profound a training methodology and loading procedure in motor training for physically challenged children in specific age group.
3. Results may prove helpful to establish motor ability training system for normal as well as deaf-dumb children in specific age group.
4. Results may also be helpful to enhance sports terminology communication skills with physically challenged children.
5. Evaluation of development of motor abilities may fetch platform for establishing training methodology for enhancing performance in specific sports.
6. The comparison of development of motor abilities will give clear picture of the positive and negative aspects of the motor abilities, which in turn ensure the proper training.

I.7 – HYPOTHESIS:

H-01: According to the researcher, there may be some compensatory physical and mental abilities with physically challenged children.

H-02: The study may establish a concrete relationship and differences in the development of motor abilities between 8 years to 14 years of normal and that of deaf and dumb children.

H-03: The study will also help the sports society to consider the physically challenged community on equal and valuable stature.

H-04: The researcher hypothesize that though being deaf-dumb the children do not show considerable differences in the development of motor abilities to that in normal children.

H-05: There is no significant difference in the growth of height between normal and deaf-dumb (boys / girls) from 8 to 14 years of age.

H-06: There is no significant difference in the growth of weight between normal and deaf-dumb (boys / girls) from 8 to 14 years of age.

H-07: There is no significant difference in the development of acceleration ability (Speed) between normal and deaf-dumb (boys / girls) from 8 to 14 years of age.

H-08: There is no significant difference in the development of locomotion ability (Speed) between normal and deaf-dumb (boys / girls) from 8 to 14 years of age.

H-09: There is no significant difference in the development of upper extremity explosive strength between normal and deaf-dumb (boys / girls) from 8 to 14 years of age.

H-10: There is no significant difference in the development of abdomen strength between normal and deaf-dumb (boys / girls) from 8 to 14 years of age.

H-11: There is no significant difference in the development of lower extremity explosive strength between normal and deaf-dumb (boys / girls) from 8 to 14 years of age.

H-12: There is no significant difference in the development of metabolic rate (Endurance) between normal and deaf-dumb (boys / girls) from 8 to 14 years of age.

H-13: There is no significant difference in the development of maximum oxygen uptake capacity VO_2 max (Endurance) between normal and deaf-dumb (boys / girls) from 8 to 14 years of age.

H-14: There is no significant difference in the development of shoulder flexibility between normal and deaf-dumb (boys / girls) from 8 to 14 years of age.

H-15: There is no significant difference in the development of trunk flexibility between normal and deaf-dumb (boys / girls) from 8 to 14 years of age.

H-16: There is no significant difference in the development of hip joint flexibility between normal and deaf-dumb (boys / girls) from 8 to 14 years of age.

H-17: There is no significant difference in the development of agility between normal and deaf-dumb (boys / girls) from 8 to 14 years of age.

H-18: There is no significant difference in the development of balancing ability (Coordinative ability) between normal and deaf-dumb (boys / girls) from 8 to 14 years of age.

H-19: There is no significant difference in the development of reaction ability (Coordinative ability) between normal and deaf-dumb (boys / girls) from 8 to 14 years of age.

I.8 – DELIMITATIONS:

1. The study is delimited to both boys and girls.
2. The study is further delimited to the age group between 8 to 14 years.
3. The study is delimited to only deaf-dumb (boys and girls) category in physically challenged children.
4. The study is delimited to the standard motor ability tests applicable for specific age groups and sex.
5. The study is further delimited to the school going children in both normal and deaf-dumb.

I.9 – LIMITATIONS:

1. Diet and rest of the children was a limitation.
2. Involvement of students during motor ability test was a limitation.
3. Physical, mental, weather, school, house and surrounding conditions were a limitation.
4. Organization of the tests was adjusted with the concerned school's time tables.

I.10 - DEFINITION OF THE TERMS:

'DEVELOPMENT':

Development is a process of qualitative transformation, which brings about progressive changes towards maturity and functional improvement in the organism of human being.

Development is the maturation of organ systems; the acquisition of skills, the ability to stand the stresses and strain of environment.

Development is the action of developing or the state of being developed[29].

Development is a new stage in a changing situation[29].

Development is the act or an instance of developing; the process of being developed[30].

Development is a stage of growth or advancement[30].

Development is evolution, growth, evolvement, maturation, unfolding, increase, expansion, enlargement, increment, advance, progress, improvement[30].

Development expresses the interrelation between growth and maturation in relation to the passage of time. The concept of development also includes the social, emotional, intellectual and motor realms of the child. The main focus is on change over time to facilitate the increase in functional capacity and competence[32].

Development is a broader concept than growth and maturation. Malina prefer to view it in the context of the development of competence in a variety of interrelated domains during childhood and youth, that is, social competence, intellectual and/or cognitive competence, motor competence, and so on[36].

'GROWTH':

Growth is a process anatomical in nature involves structural changes and quantitative to measure.

Growth refers to quantitative change in the size of the body, for example 'height'[32]. Body segment length and proportions are also direct expressions of the growth process.

Growth refers to measurable changes in body size, for example, height, weight, fatness[36].

'MATURATION':

Maturation is the natural unfolding of the potential with inherent in the human being, is time bound and speaks interaction of self and environment, characterized by progressive differentiation, is organ specific, manifested by progressive refinement and progressive specialization[32].

Maturation refers to qualitative system changes, both structure and function in nature, in the organism's progress toward maturity, for example, change in cartilage to bone in the skeleton[32]. The process of maturation implies changes in the cumulative motor, physical, perceptual, cognitive, social/ psychological capacities of the individual.

Maturation refers to the child's biological clock that marks progress toward the mature state. It is viewed most often in terms of skeletal and sexual maturation and the timing of the adolescent growth spurt… (It) refers to potential or a limit implies genotypic control, and the result is genetic-environment interaction[36].

'MOTOR ABILITIES':

The abilities that are responsible for human motor actions are called motor abilities. Strength, speed, endurance, flexibility and coordinative abilities are the five motor abilities and their sum total builds physical fitness or condition. These five motor abilities and their complex form are the basic prerequisites for human motor actions[33].

Motor ability: may be defined as one's present innate and acquired ability to perform motor skills of a general and fundamental nature excluding specialized sports skills. In other words it is synonymous with general motor ability[13].

Motor fitness: Although the term is most often used synonymously with physical fitness by the coaches but it is very important for the physical education students to understand the basic difference between physical fitness and motor fitness. Physical fitness is used to denote only the five basic fitness components (muscular strength muscular endurance, cardiovascular endurance, freedom from obesity and flexibility), whereas motor fitness is more comprehensive term which included all the ten fitness components including additional five motor performance components (power, speed, agility, balance and reaction time), important mainly for success in sports. In other words, motor fitness refers to the efficiency of basic movements in addition to the physical fitness.

General motor ability: It may be defined as motor fitness including neuro-muscular coordination abilities or motor control by eye-hand coordination, eye-foot coordination and whole body movement coordination. Sometimes general motor ability is also defined as one's inherent potentials to perform vigorous motor (muscular) activities with best speed, agility, power, balance, coordination and quick reaction time. Thus, when we use the term general motor ability, we are talking about basic motor fitness and general body coordination skills needed in various sports, athletics and gymnastics activities. Hence, the distinction between physical fitness and general sports skills should be made clear to the students. They must know that a student with poor skill can be physically fit while students who may excel in a sport's skill, say, throwing may not be physically quite fit.

Sports specific motor ability (sports skills): It may be defined as general motor ability plus excellence in specific sports skills in the game of one's specialization. Thus, sports specific motor ability is the culmination of all fitness, skill ability, motor control and motor educability testing. Ideally, if a person possesses good sports specific and general motor ability, it means that this individual is not only physically fit, but also possesses good motor control and body coordination in addition to excelling in the specific skills of his/her game of specialization.

General motor ability: (a) Components of physical fitness: (i) Muscular strength: maximum contraction power of the muscles is known as muscular strength. The muscular strength is usually measured with respect of individual group of muscles acting together. Muscular strength is tested with the help of dynamometers and/ or tensiometers which measure the amount of force exerted in a single effort by a particular group of muscles.

(ii) Muscular endurance: the duration, for which the muscle groups may perform, work maximally is known as muscular endurance. Muscular endurance, depending upon the category of muscular contraction, is also divided in two types. The endurance of isometric muscle (when tenseness of muscle changes without changing the metric length of muscle) is usually referred to as isometric endurance while the working ability (in duration) of isotonic muscles (when same tone tenseness is maintained by changing the length of muscles is called the isotonic muscular endurance).

(iii) Cardiovascular endurance (cardiopulmonary or circulatory respiratory endurance): The ability to perform muscular work at sub-maximal level by moderate contraction for a long time is known as cardiovascular endurance. The direct testing of cardio-pulmonary endurance is made by measuring one's aerobic power or maximum oxygen uptake while indirectly it is measured with the help of long duration activities like long / middle distance running, cycling or swimming.

(iv) Proper body composition (freedom from obesity): Obesity refers to the excess accumulation of fat in the body which is related to many health problems like coronary heart disease, high blood pressure, diabetes, respiratory problems etc. Freedom from obesity is measured by finding body fat content with respect to one's body weight.

(v) Flexibility: The range of movement in a joint or sequence of joints is known as flexibility.

(b) Additional five components of motor performance included in motor fitness: (i) Muscular power: ability to release maximum muscular force in and explosive manner in the shortest duration is known as muscular power.

(ii) Agility: The speed with which an individual may change his body positions or fastness in changing directions while moving is known as agility.

(iii) Speed: The rapidity of muscle movement or the rate of change of body movements is known as muscular speed. Literally speed is measured by dividing distance by time in short runs. However, in sports, time of sprint of 50 yards dash itself is considered as a measure of one's speed instead of covering it in meters per second it is recorded as seconds per 50 yard or 30 meters etc.

(iv) Balance: The ability to hold body positions in comparatively less stable positions is known as body balance. Balance is of two types: static balance and dynamic balance. Static balance may be defined as the ability of the body to maintain body in a static position for example, stork stand position balance or standing on one foot. Dynamic balance may be defined as the ability of the body to maintain the position of the body while moving over a lesser stable surface or over less broad surface, for example, moving over a rope, leaping from stone to stone, moving over a beam etc.

(v) Reaction time: The interval between presentation of stimulus and the first response is called reaction time. In other words, it is the time taken in responding to a visual or auditory stimulus. It may also be divided into two categories- visual reaction time and auditory reaction time. Visual reaction time is the interval between a visual signal and its response, for example switching off / on a button on a visual stimulus. Auditory reaction time is the internal between an auditory signal and its response.

(c) Three additional components of motor coordination included in general motor ability. Motor coordination: The harmonious interplay of muscles either with some sensory organ or with another muscle group is known as coordination. However, all muscles work in coordination with one another as well as in coordination with eye. Hence motor coordination is divided into the following three components.

(i) Hand-eye coordination: One's ability of harmonious interplay of hand and arm muscles with visual stimuli is known as hand-eye coordination.

(ii) Foot-eye coordination: One's ability of harmonious interplay of foot and leg muscles with visual stimuli is known as foot-eye coordination.

(iii) Whole body coordination: One's ability of harmonious interplay of all body muscles with one another is known as whole body coordination.

(d) Additional components included in sports specific skill testing:

(i) Motor educability: Physical educators often observe that some individuals learn skills more readily than others. Different individuals have different inherent aptitude for motor learning in somewhat the same way as individuals have different aptitude for mental learning. Motor educability may be defined as "the ease and thoroughness with which one learns motor movements", motor educability is a psycho-physiological variable.

(ii) Perceptual-motor learning: It refers to one's ability to receive, interpret and react properly to a multitude of stimuli which are acting not only from outside but also from within. The response to perceptual abilities in the form of movements and motor learning has become a new dimension of learning. Perception may be defined as "the total pattern arising from many sensations and resulting in a meaning which is more than the sum of its parts" (Cratty, 1964)[13].

General Motor Ability Test Batteries: (1) Barrow Motor Ability Test (men)- standing long jump, softball throw for distance, zigzag run, wall pass using basketball, six pound medicine ball put, 60 yard dash, (indoor battery). (2) Cozens General Athletic Test (men) - Baseball throw for distance, football punt for distance, bar snap (parallel bars), standing long jump, dips (parallel bars), dodging run, and quarter-mile run. (3) Scott Motor Ability Test (women) - Basketball throw for distance four-second dash, wall pass using basketball, standing long jump, obstacle run. (4) Newton Motor Ability Test - Standing long jump, hurdle run, scrambles (agility run). (5) Larson Motor Ability Test (men) - Indoor battery - Chins (pull-ups), vertical jump, dips, dodging run, and bar snap. Outdoor battery- Chins (pull-ups), bar snap, vertical jump, baseball throw for distance. (6) Latchaw Motor Achievement Test (elementary children) - Basketball wall pass, volleyball wall volley, vertical jump, standing long jump, shuttle run, soccer wall volley, softball repeated throws[14].

Motor capacity: It has been generally defined as "an individual's overall capacity which is indicative of his / her potential or hereditary capacity to perform motor activities (feats)". According to McCloy and Young (1984) motor capacity consists of four basic elements namely size and maturity; motor educability; power; agility and coordination. However, the term motor capacity is not currently in much use[13].

Psycho-motor ability: The term psycho-motor ability is synonymous with neuro-muscular ability and relates to one's general sports skill ability. Psycho-motor ability may be defined as one's present ability / status of neuro-muscular components of motor performance namely, balance, agility, coordination, speed and flexibility[13].

'NORMAL CHILD':

Normal: Typical; usual; healthy; according to the rule or standard[34].

If a child is found to be disease free, exhibits proper growth and development according to the age in its physical, mental and social health and status, then he / she may be defined as a normal child.

The importance of knowledge of normal development: A thorough knowledge of the normal should be just as much the basis of the study of children as is physiology and anatomy for medicine in general. It is an essential basis for the study of the abnormal and disease. The researcher believe that all concerned with the care and management of children should not only know the normal, but should be thoroughly conversant with the very common normal variations, which do not amount to disease and just as important, should try to understand the reasons for those variations.

'DEAF AND DUMB':

Deafness: There are so many conditions, which are associated with deafness that figures for the mean IQ of deaf children and meaningless. Unilateral hearing loss probably causes few, if any, educational problems[35].

Deaf is unable to hear; hearing indistinctly; hard of hearing[34].

Deafness is the loss of ability to hear without designation of the degree of loss or the cause. For the sake of clarity the otologist usually prefers terms with clearer definitions. The terms related are acusis, hearing, threshold shift, hypoacusis, anacusis, dysacusis, auditory agnosia, presbyacusis, and diplacusis[34].

Deaf: Sign language with the hands, as used by deaf and dumb people[31].

Deaf: Wholly or partially unable to hear[29].

Dumb: is mute; speechless; unable to speak[34].

Dumb: speechless because shy, embarrassed, or astonished[31].

Dumb: Unable to speak; lacking the power to speech[29].

Speech: Speech is important in the assessment of retarded children. The intelligence is perhaps the most important determinant of precocity in speech, since it affects both the ability to mimic and to understand the meaning of verbal symbols- Ausubel. Earliness of onset of speech is one of the most striking developmental characteristics of intellectually gifted children- Terman[35].

'8 YEARS TO 14 YEARS' (CHRONOLOGICAL AGE):

Chronological age is the number or years and days elapsed since birth[37].

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CHAPTER – II
REVIEW OF RELATED LITERATURE:

Research in the field of physical education and sports is vast and moreover with the emphasis is on the development of performance in competition and achievement levels. The required mental and physical qualities for enhancing the performance in sports are many, but to quote, the basic prerequisite are motor abilities in which many researches' are carried out. The researcher has gone through the related literature from various sources and tried to quote the maximum in relation to the studies carried out with motor abilities from birth till adolescent. Much of the literature is in relation to the development of normal children when compared to the physically challenged, specifically deaf-dumb.

Sue Watson in her research quotes that children with multiple disabilities will have a combination of various disabilities that may include: speech, physical mobility, learning, mental retardation (referred to as cognitive disabilities in Wisconsin), visual, hearing, brain injury and possibly others. Along with multiple disabilities, they can also exhibit sensory losses and behavior and or social problems. Children with multiple disabilities —also referred to as multiple exceptionalities—will vary in severity and characteristics. These students may exhibit weakness in auditory processing and have speech limitations. Physical mobility will often be an area of need. These students may have difficulty attaining and remembering skills and or transferring these skills from one situation to another. Support is usually needed beyond the confines of the classroom. There are many educational implications for these students. Most importantly, these identified children are to be given the same rights as non-identified school age children including screening, evaluation and an appropriate program and services. *Early intervention is necessary— as soon as the child begins school. • Involvement of the appropriate professionals, i.e., occupational therapists, speech / language therapists, physical therapists, etc. • A team approach at the school level involving an external agency / community liaison who meet on a regular basis is essential. • The physical arrangement of the classroom will need to best accommodate this child. Consideration of special equipment and assistive technology is essential. • Integration among their peers is important to assist these students with social development. It's important to integrate multiple disabled children as much as is possible. Research does indicate that when these students attend their community school and participate in the same activities as their peers, their social skills develop and are enhanced. (Sometimes these students are placed full-time in a regular classroom with support; however, in the majority of cases, these students are placed in a developmental skills type of classroom with some integration.) • Ensuring that all students demonstrate respect for the multiple disabled students becomes a teacher responsibility and needs to be taken[1].

Lecia Barker says that deficits in vocabulary have a negative impact on literacy and interpersonal interaction for deaf children. As part of an evaluation, an outcomes assessment was conducted to determine the effectiveness of a computer-based vocabulary tutor in an elementary auditory / oral program. Participants were 19 children, 16 profoundly deaf and 3 hearing. The vocabulary tutor displays line drawings or photographs of the words to be learned while a computer-generated avatar of a "talking head” provides synthesized audiovisual speech driven from text. The computer system also generates printed words corresponding to the imaged items. Through audiovisual reception, children memorized up to 218 new words for everyday household items. After 4 weeks, their receptive vocabulary was tested, using the avatar to speak the name of each item. Most of the students retained more than half of the new words. The freely available vocabulary tutor, whose characteristics can be tailored to individual need, can provide a language-intensive, independent learning environment to supplement classroom teaching in content areas[2].

Portman suggests providing opportunities to refine a variety of movement patterns involving coordination, balance, and gymnastics movement patterns. Help children make the transition from the general movement phase to the specific gymnastics movement patterns. Provide many opportunities for practice, encouragement and selective instruction. Sprinting should begin at 7-8 years of age, before the nervous system reaches complete maturation and is still “malleable”. Since growth is steady and gradual, training loads can be increased accordingly, playing close attention to signs of overload (i.e., injuries, discomfort, and difficulty keeping up). Systematic speed training is possible as long as sufficient recovery periods are allowed, in order to avoid fatigue and most importantly to avoid an increase in lactic acid (therefore avoid training speed-endurance at this stage). For example, carry the gymnast through a handspring and then have him or her train the parts. Ligaments, tendons and muscles are becoming stronger, but are not able to withstand heavy external loading. During the first part of the stage, training should be more general and varied, whereas in the latter part of it, training should become more specific and focused on different areas of the body. Note that local muscular endurance training should not be totally ignored during childhood, particularly in the reinforcement of muscular weaknesses, and in the maintenance of posture. The cardio-respiratory system continues its development. A six-year-old, will on average, have a heartbeat of 105 beats per minute at rest. Girls will average 95 beats per minute. Under exertion, the heartbeat can reach a value of 210-215 beats per minute. Highly trained children have an anaerobic threshold value ranging at 75-85% of their VO_2 max. Training at lower levels of the anaerobic threshold, which allows aerobic endurance training, does not set any problems for children. Normal play activities, including collective sports constitute and excellent form of aerobic endurance training. Emphasize on physical, aesthetic, kinesthetic and technical preparation. Between 10-14 years of age, adolescents experience another increase in speed and they can integrate the factors that determine it. Ensure that young athletes meet their nutritional needs, according to the growth period they are in and the frequency and intensity of training they are subjected to. For the child, anaerobic alactic endurance training, which solicits the complex ATP-PC, should involve activities requiring effort and repetition that do not exceed 8-10 seconds. Between 7-10 years of age, there is a sharp increase in a child’s speed of action. The capacity for speed increases to reach its peak at approximately 10 years of age. Subsequently, it is the speed of reaction that improves. Girls being their adolescent growth spurt when they are about 9 years old (plus or minus a year) which lasts for 2 to 3 years[3].

The findings of Gallahue and Tihanyi put forth that the body is growing at a slow but steady rate. Body parts become more functional, enabling children of 0 to 6 years of age group function at increasingly sophisticated levels in the performance of movement skills. Fundamental movement abilities (walking, running, jumping, throwing, catching, striking, bouncing, hopping, galloping, skipping, climbing) should be well defined by the beginning of this stage. Stability abilities are static and dynamic. Climbing and hanging activities are very helpful in developing the upper torso. Specialized movement skills begin to be developed and refined toward the end of this stage. Begin to stress accuracy, form and skill. Children's interest in sports is beginning to develop strongly during this stage. The size of the skull remains nearly the same until approximately the end of the stage (10 years of age), where the head broadens and lengthens. The body begins to lengthen out. It gains 5.1 to 7.6 centimeters (2 to 3 inches) and 1.4 to 2.7 kilograms (3 to 6 pounds) annually. Larger muscles groups are more developed than smaller ones. Children aged 6-9 years prefer activities involving the whole body. Motor control, coordination and balance are improving[4].

Developmental trends in reaction time have been studied for many years. Even before the turn of the century, J.A. Gilbert found that reaction time in children decreases with age, while choice reaction time (reaction to one of more than one possible stimulus), decreases faster than does simple reaction time. Gilbert, like numerous researchers to follow, also found that the variability of children's responses will diminish as they get older[5].

The present study considers the reasons for teaching sign language to mentally handicapped people and evaluates its success by examining both specific studies and some of the underlying psychological principles. This is followed by a linguistic appraisal of three sign language systems taught in the UK, with a particular examination of the Makaton Vocabulary. The experiment which follows is an attempt to measure the relative effects of three different approaches to intervention on the communicative abilities of three groups of institutionalized mentally handicapped subjects. The results of the one group receiving Makaton Vocabulary (sign language) intervention are then considered in greater detail. The results of the studies of sign acquisition and use are considered to be of particular interest for further research and possible improvements in teaching approaches[6].

One-hand-use, seen in a variety of human ancestors, therefore would not seem to be evidence of advances in neurological development, as Delacato's theory states. In child development, several visual process mature early, prior to the emergence of accurate motor attributes[7].

Groves in one of his experimental program of dance was taken with adolescent girls from three different special schools, at least one of which had a high proportion of girls who fell into this category. The program was based on the belief that lessons in dance would be attractive to adolescent girls, that it was possible to structure dance so that there would be little opportunity for failure, and that if particular attention was given to partner and group work this would lead to improved relations within the group. The schools used in this study varied greatly: one had many children with physical handicaps; one had a high proportion of children from broken homes; one had a very high proportion of children who were borderline severely retarded. The program followed with each group was similar[8].

The role of attention, self-control, and impulse control of motor acts has been given increased attention by researchers. Some of the positive outcomes derived from perceptual-development programs may have stemmed from the fact that a hyperactive child was required or encouraged to do something longer than he or she had ever done anything before. Measures of motor impulses control (“How slowly can you draw a line?”) have been found to be at least moderate predictors of school success and IQ. More research and attention to these relationships should make clearer the manner in which attention contributes to motor proficiency. It should also shed light on the manner in which the practice of various kinds of motor tasks may contribute to better attention, which in turn can lead to more efficient academic and emotional effort at home and in the classroom. The subtle relationships between speech and movement, of interest to Luria as well as to Bruner, contain facets that could keep researchers busy for years. The manner in which sub vocalizations provide an intellectual control or base for voluntary movements, for example, warrants further attention. Moreover, the way in which the child learns to sequence movements of the total body as well as of the speech apparatus. This provides numerous interesting problems both for the practitioner and for the research scholar[9].

A group of educationally retarded boys was taken for twelve weeks of judo instruction. Davis and Byrd tested the boys by means of the California Test of Personality, the Wide-Range Achievement Test and the AAHPER Special Fitness Test (i.e., a test specifically intended for use with handicapped children). Subjecting the results to statistical analysis they found that there were significant changes in total adjustment and in some measures of fitness. One particular case was of special interest. He was completely withdrawn, spoke to no one, showed no emotion and was completely uninterested in life. Before the end of the twelve-week program this boy was assisting the slower learners at judo and was at the end of the experimental period elected captain of the judo team. Davis suggests that “these gains were attributed in part to breaking the well-established repeated failure pattern”[10].

Recent data indicate that with consistent and sophisticated teaching, some kinds of motor competencies may be accelerated during early childhood. In a 1974 study, Werner for example, demonstrated that by exposing groups of children 3 to 5 years of age to what he termed “guided instruction” of motor skills, significant improvement could be elicited work on a balance board test, together with kicking practice and jumping activities accompanied by ball bouncing work, did elicit significant improvement after an eight-week period. The control group was permitted a more free-choice play situation and exhibited not parallel improvement in the tested skills. This and other studies indicated that significant improvements in skills may be possible after the first 18 months of life with special tutoring; before that time, improvement in basic behaviors involving walking, stair climbing, and the like may be less likely to be changed via teaching[11].

Freedman in his thorough review of these same differences, points out that some motor precocity on the part of babies evaluated in Northern Nigeria (from among the Hausas) may reflect centuries of child rearing practices, rather than race. In this particular tribe, the infants are placed immediately after birth on the backs of their mothers, thus necessitating early head control. Further, continuing to outline what he terms “selective forces," freedman points out that it is possible to locate Caucasian groups (the Punjabis of Northern India) whose infants are motorically superior when compared to norms contained on various developmental schedules. Thus, more important than race may be the duration of the "lying in" period imposed on the infant group being studied. Children from Caucasian groups in the U.S. and from studies of Oriental populations, perhaps because of a longer "lying in" period during which they spend extended time in cribs, may be less gifted at birth with regard to control of their bodies, as compared to children who are immediately made mobile on the backs of their parents[12].

In 1973, Constantini and colleagues completed an interesting study which looked at the ability of a child to accelerate movement and to inhibit movement when asked to do so. Their subjects ranged in age from 4 to 9 years of age. They found that 'both' the ability to inhibit movement and to significantly increase movement speed was often moderately related. The ability to move faster or slower was achieved better by older children in the study. In a 1973 study carried out in Cratty's laboratory, found a significant change in a "draw slowly" measure of impulse control between the ages of 5 and 8 years, in contrast to the findings reported above by Bucky et al[13].

Various events after birth can give rise to motor ineptitude. These include traumatic events such as a fall, injuries resulting from child abuse, as well as the inhalation of noxious fumes, lead poisoning, and drug infections (accompanied by high temperatures), or more subtle behavioral signs. In a study by Rosenblatt, for example, it was found that conditions including hypersensitivity to room light, poor muscle tone, and / or differences in muscle tone between the lower the upper parts of the body at birth are likely to mean developmental problems persisting through the fourth year. In this investigation, potential high risk babies were followed for a seven-year period, during which pediatric, speech-language and psychological evaluations were carried out at the fourth, eight and twelfth months, as well as the third, fourth, and seventh years[14].

It is probable that within a group of children evidencing coordination problems of the larger muscle groups, a larger percentage than would be found in a motorically normal group will evidence speech (articulation) problems. The same is true when evaluating self-control groups of children with motor problems then to display distractible hyperactive behavior or hypoactive (lethargic) behavior more than will a group of motorically "sound" children. At the same time, numerous awkward children are well controlled and many clumsy children free of speech-articulation problems while verbal IQ is not highly associated with motor problems, it is often found that the awkward child (due to his or her inability to perform important printing skills) will not do well in the first grade or two of school, and thus will be spuriously labeled as evidencing "learning disabilities". Further complicating the problem is the fact that when testing a group of clumsy children, the various scores obtained will many times not be highly correlated. In a study some colleagues and Cratty completed in 1973, for example, low, insignificant correlations were found when testing over 400 children between tests of balance, agility, self-control, copying geometric figures, fitness, and throwing[15].

The Cheshire Education Committee's report on retarded children (1973) stated that: By the time they reach the secondary school, children of low intelligence are generally of poorer physical development and are less physically able than the more intelligent. Some dull children have excellent coordination but the majority suffers from lack of contrast in range and quality of movement and a proneness to accidents because of this clumsiness[16].

Gulliford found a connection between difficulties over body and space awareness and reversal problems in language. The investigations of Lunt and others indicated a clear relationship between poor progress in reading and difficulties in rhythm as well as in space awareness[17].

Some studies show that children who are academically retarded are also retarded in a wide range of physical skills. Rarick and Dobbins have all indicated that amongst retarded children the greater the mental retardation the poorer the level of physical skill. The work of Rarick and Dobbins showed that educationally mentally retarded children were as a group very much poorer than intellectually able children of the same age and sex in motor tasks requiring elements of muscular strength and power, gross and fine motor control, flexibility and balance. However, they also found that in all tests some of the retarded children scored well above the mean for normal children. Teachers working with remedial children in mainstream education will know from observation that this is true. One physical educationalist working in a large streamed comprehensive school has said: “The lowest streams show a much wider spread of ability than the A streams”. These girls range from the highly gifted to the painfully slow[18].

Children from 6 to 12 years of age improve to a marked degree in ability to move and to manipulate their environments. Although during this period obvious growth changes occur, the rates of growth begin to subside as children reach their sixth year and do not continue at the rapidity that characterized the first five years of life. More important than growth and body weight changes in the modification of performance during this period of childhood are a number of experiences and situations in which motor skill is demanded[19].

Among infants in industrialized societies, acceleration in psychomotor development has been noted in studies among black infants in the United States, as well as among Japanese-American infants in homes that stressed acceleration. Kibbutz infants reared in a system of “caretakers” also seem to show enhanced psychomotor development. On the other hand, traditionally reared youngsters in Japan, who often are restrained in their movements via restrictive clothing, often are less able motorically than infants in other industrialized societies. The sharpest decline in motor development according to the survey by Werner is suffered by infants in urban slums, who while evidencing acceleration at birth, quickly decline in ability, probably because of inadequate nutrition[20].

In a study, based upon the observations of over 700 children over a seventeen-year period, Emma Pikler adds further data to the controversy concerning whether or not various kinds of early environmental conditions will elicit marked changes in motor development. The head of the National Methodological Institute for infant care and education in Budapest, Pikler presents data which indicated that young infants left relatively unrestricted by clothing, and without constant adult intervention, tend to progress developmentally in a manner parallel to children who receive constant parental stimulation. Indeed, she inferred that somehow the too-interested adult may interfere with the progress of the maturing child[21].

Cratty have tested over 2000 awkward children. Questions almost always on the lips of parents during interviews following such evaluations are “can you make any changes? How long will it take?” As has been pointed out movement programs to change academic competencies (unless the movements are accompanied by thought and by academic content itself- i.e., sight, reading) are not likely to succeed in their objectives. There are investigations whose findings have suggested that engaging in motor development programs can elicit improvement in movement competencies including both fine and gross motor control, as well as increased attention span and improved social relationships, with peer groups and authority figures[22].

Even in a school where academic distinction was deemed more important than athletic prowess, Symes found that clumsy boys were rejected not only in games but in other situations also. He suggested that even a slight motor impairment could interfere with both learning and personality development. Obviously the more serious the impairment the more difficult acceptance by one’s peers. Children who are mentally retarded have even more difficulties in play. Not only, as we shall see, are they likely to have problems of coordination, but they may not understand the rules of play[23].

Instead of noting that some children have difficulty in catching a ball or in jumping or skipping, but not doing anything about it because of the pressure to provide adequate reading and spelling attainment, we may do well to develop the basic neuro-muscular skills first[24].

There is plenty of evidence that motor skills can be improved. Bundschuh et al. showed that much the same technique could be used with both moderately and severely handicapped pupils. He took fourteen severely retarded and twenty-six moderately retarded young people aged 5 to 19 years. After twenty daily swimming lessons involving carefully selected drills taught on a one-to-one basis together with some free play, 90% of the class could swim at least six feet, compared with only three who could swim this far before the program began. Not only did all the moderately retarded learn to swim: over 10% went from being non-swimmers to being able to swim over seventy-five feet! The studies which follow show that not only can skills be taught and fitness improved but also that when this happens it has an effect upon other aspects of the personality[25].

Surwillo in work published in 1964 and 1971, postulates that neurological maturation marked by difference in information processing produces faster reaction time in older children. He employed evaluation of electro-encephalitic output of children, collected along with reaction time measures, to gain evidence in support of this theory. He found that as maturation takes place, changes in brain-wave function in general parallel improvement in reaction time, and also that by artificially speeding up or slowing down certain brain waves in children via visual stimulation, he could alter reaction times[26].

In an Israeli study dance was used with children whose ability was limited by a difficult environment. The research, reported by Friedman-Witthower, involved two groups of nine- and ten-year-old from ‘culturally deprived’ homes. The groups were carefully matched to produce an experimental group which had four lessons of ‘movement’ and dance a week for two years and a control group which had no special dance program. The members of the experimental group were reported as showing a marked rise in IQ, in body and space awareness and in their relationship with others. Friedman-Witthower declared: Well-guided movement education helps to overcome developmental blocks, influences positively certain character-qualities, leads, apart from better motor performance, to better scholastic achievement and is fundamentally important in the rehabilitation of culturally deprived children[27].

Other aspects of the physical education curriculum have been shown to bring about similar changes in social adjustment. In one program Goodwin compared the effects of two different approaches. One group of educationally retarded children was taken for group-oriented activities of a traditional nature while a matched group had an individualized program of movement exploration. Each group had 30 minutes a day five days a week for ten weeks. Goodwin found that both groups had improved scores in tests of physical fitness, intelligence and social maturity. He found however that the group following a traditional program made greater gains in physical fitness tests while those following the movement exploration program had higher gains in the IQ test. This is as one might expect since the pupil was asked to make his own decisions and to work out problems in the movement exploration program, but could not spend as much time in active performance as was allowed in the more directed program[28].

In most recent studies, parent stature and the growth and performance status of children has been studied by Garn as well as by Malina. Unfortunately, the findings are somewhat mixed. In the 1970 Malina study, for example, parents were classified into three groups: tall, medium, and short. A parent sized trend was noted for girls but not for boys in the strength-related items, but no consistent pattern when parent-size groups of boys were examined. In the study, however, there was a slight tendency for the offspring of tall parents to perform better at jumping and throwing. It is obvious that additional work employing more exact measures of parental size and body builds and performance task capacities of their children is needed. These and other studies indicate that there are more important influences on many types of motor performance than body build, and then the indirect influence of the body builds of parents. Nutritional intake, climate, early child-rearing practices, as well as parental attitudes, are only some of the variables being studied during the 1970s[29].

There has been a proliferation of research dealing with biochemical changes in children as a function of age, and with individual differences in the muscular makeup of children and youth. The work dealing with muscle fiber type, such as that by Bernard and Edgerton, for example, may tell us rather early in life whether a child is suited for either strength or endurance activities. Other chemical parameters of the child’s makeup may also afford helpful guidelines when devising remedial programs, as well as activities intended to improve the normal child. Investigations of development by research teams consisting of psychologists, biochemists, orthopedists, and biomechanicists should prove more than helpful[30].

A variety of factors in addition to physique are operative in the formation of early motor abilities. Further complicating the discovery of physique- performance relationships is the fact that some kinds of physical performance require certain bodily capacities different from the characteristics that may be helpful in performing another kind of task. Most studies, for example, indicate that the presence of more than average amounts of subcutaneous fat is not helpful in tasks requiring strength and fitness. Likewise, a lean, muscular child free of excess bodily fat is at an obvious advantage when required to project his or her body in various ways[31].

An increased number of studies have been done whose data are in surprisingly close agreement concerning the existence of racial and ethnic differences in the motor abilities of young children and infants. Ascertaining the causes of these differences, however, seems to be the job of scholars within the years that lie ahead. More than one investigation has produced data which indicate that young black children in the United States evidence motor abilities in various ways superior to those elicited from their white play companions. Hutsinger, for example, found that the black children he surveyed could run significantly faster than his white subjects. Van Alstyne and Osborn also discovered that the black children they studied were able to replicate a rhythmic beat with more facility than could the white children tested. In an unpublished study by Robert Bonds this same precocity of the black child was uncovered. The 5-year old black children were able to throw farther, run faster, and evidence stronger hand-grips than were both the white-angle and Chicano children exposed to his test battery. In this same study, superiority in balance ability was also seen among the black children evaluated[32].

The measurement of reaction time in young children has not been studied in any large range of tasks. The information that is available indicates that in simple reaction-time problems, the reaction time of a 5-year olds is twice as long as is found at adulthood. At the same time, there is marked improvement of about 43 percent from the ages of 3 to 5 years of age. These findings indicated that a large amount of the motor ineptitude apparent in young children may be caused by inability rapidly to start a movement itself. For example, as whiting points out, if a 5-year-old is expected to catch a ball traveling only 15 feet per second from a distance of 10 feet, he must initiate his response as soon as the ball has left the throwers hand[33].

The girls proved to be slightly superior to the boys in static kind of balance task; boys could on the average maintain their balance with arms folded for about three seconds, and girls were able to perform the task for about two seconds longer[34].

Ismail has reported a moderate correlation between balance scores, IQ, and school achievement measures. Bryant J. Cratty has also obtained similar correlations in a study conducted in the laboratory. In studies B.J. Cratty have carried out employing a series of tests of static balance, similar age trends have been noted. These tests have been made increasingly difficult but requiring the children to fold their arms across the chest and close their eyes to earn a higher score, and then to perform in the same manner on the non-preferred foot[35].

Bruner, in recent attempts to somehow untangle the thicket of neonatal behavior, has drawn from research supplied by the anthropologists and linguists as well as developmental psychologists. Of initial importance Jerome Bruner believes, is the realization that infant behavior has evolved from action patterns seen in related primate species. He also suggests that human uniqueness manifests itself in several ways: in the rich substitution of symbols (speech- language) for things, ideas and actions as well as in more complex ways than can be managed by the clumsier primate. One should consider not only what the human infant is developing towards, but what he has developed from in order to construct a comprehensive mosaic of the complexities of immature motor, linguistic and intellectual behaviors. He has explained Speech Tool Use and Early Motor Control: Speech is seen by Bruner as an important classification of skilled behavior. Moreover, it is a method of sustaining the child's behavior as he begins to reach, grasp, and manipulate objects. Thus, Bruner seems to conceive of speech as a kind of tool, which when used properly aids the child to sustain attention and gain precision in necessary motor tasks[36].

Bayley, who published a longitudinal study of 54 individuals from birth to 36 years of age, has found that an infant's abilities can be factored into six separate attributes by the age of 5 months: visual following, social responsiveness, perceptual interest, manual dexterities, vocalizations, and object relations. Furthermore, she found that only the quality of a child's early vocalizations correlate with later IQ, whereas, boy babies who are active and rapid before 15 months of age tend to have IQs lower than those of calmer, less active infants. The early motor responsiveness of girls, according to Bayley, was not correlated in any way with IQ. Not until a child is about 8 years of age was it possible to predict IQ in later childhood and early adolescence with any degree of accuracy. Thus, Kephart's assertion that the quality of early motor abilities is predictive of and influences later intellectual development is at odds with the findings from a number of research studies[37].

By the age of 5 years, however, many children gain the necessary endurance, balance, and strength to enable them to hop for some distance at a reasonably rapid speed. Most can hop 50 feet in about 10.5 seconds. Sex differences are also seen in this type of hopping task, with the girls excelling the boys. They will usually traverse 50 feet, hopping on one foot about 3.4 seconds faster than the boys, and at the same time more than 80 percent of the girls exposed to this task by researchers have completed 50 feet successfully, whereas only from 62 to 69 percent of the boys have been able to do so[38].

A testing program in which factor analytic techniques have been employed was carried out by Ismail at Purdue. Although his primary intent seemed to be the identification of relationships between mental and motor tests, his findings also reveal much about the factors that contribute to motor ability in children. In previous studies among educationally impaired children Ismail found that different domains of intellectual and motor attributes emerged[39].

A number of approaches have been made in comparison of mental and motor performance measures. One type of study is generally a predictive one. These investigations, summarized by Bloom and others, have involved comparing mental and motor scores at various points within a child's lifetime, usually in attempting to determine whether early motor indices are in any way predictive of later intellectual development, still another approach has been to produce correlative data between mental, academic, and motor attributes using children of various types[40].

One of the more extensive studies was that carried out by Rarick and Broadhead. This American study examined the role of physical education in the modification of the motor, intellectual, social and emotional behavior of 275 educationally retarded and 206 brain-damaged children of primary-school age. One control group followed a special art program; two groups followed special physical activity programs and one group, also acting as a control, followed its normal program. The children were all taken for their special activity by their own class teacher for one period every school day for twenty weeks. Rarick and Broadhead reported that children participating in both the specially prepared experimental programs showed statistically significant improvement in scores of motor, intellectual and emotional development compared with the control group. In other words, the special art program produced the same sort of all-round improvement as did the physical education program. The important aspect was, as Oliver pointed out in his Packwood experiment, the promotion of feeling of achievement and success. The children taking part in Rarick and Brodhead's physical education programs showed, as one would expect, greater improvement in motor performance than did the children in the other groups. A Particularly interesting finding was that the girls did not show improvement in behavior to anything like the same extent as the boys[41].

Oliver and Keog showed that even amongst educationally subnormal children there is a significant relationship between physical abilities, social acceptance and behavior patterns. Many physically awkward children are withdrawn and have difficulty in relating to others; some rejected at play become defensive or aggressive[42].

Ismail and Gruber carried out an intensive study of fifth and sixth graders in USA. They used forty-two different items to measure motor and intellectual abilities. Their findings showed that while physical growth was not significantly related to intelligence, coordination and rhythm were significantly and positively related to academic achievement. They also found that strength, speed and accuracy of aim, though virtually unrelated to intelligence, did show some relation to academic progress[43].

Espenschade states that generally, the wirier baby will walk earlier than the more obese baby. Girls will usually walk before boys. At times children will be seen to walk on tiptoes when they are first gaining an upright walking posture however, it is not common to see this modification until the middle of the second year. The walking rhythms of children of approximately two years of age have been measured, and they generally assume a pattern of about 170 steps per minute, with the steps about half the length of those seen in adults[44].

Evidence of the relationship between physical and social development: The relationship between physical ineptness and emotional disturbance was shown in a study carried out in Glasgow and reported by Stott. Delinquent youths were shown to have significantly poorer motor coordination than comparable non-delinquents. This could be another illustration of the impact of a disturbed mind upon the body. Equally it could be an illustration of the effect of clumsiness upon mental health[45].

The Delacto method has been much maligned by the medical profession and others, although it has received praise in the popular press. Delacto's theory is based on a view of neural function which suggests that specific "layers" of the brain mediate discrete motor functions. Moreover, Delacto believes that training in specific locomotor tasks will positively influence various brain centers (the midbrain, pons, medulla, and cortex). This in turn helps positively influence other perceptual and cognitive functions that are thought to belong exclusively to these brain centers[46].

A longitudinal analysis of strength and motor development of the children was carried out by H. Harrison Clarke and his students at the University of Oregon. The subjects have been from the Medford city schools in Oregon. During this time, much of data have been collected, and the interactions of a number of variables, including skeletal maturation and motor abilities, have been studied and compared. One portion of this larger study was devoted to assessing strength changes in boys from 7 to 9 years of age. The findings from this analysis have important implications for programs of physical education and for the study of muscle strength in children. Overall it has been found that there are only low to moderate correlations between strength measures obtained in various parts of the body. Elbow flexion strength correlated only from +.3 to +.5 to measures of trunk extension strength. Furthermore, it was found that as children mature the increase in muscle strength in various portions of the body proceeds at uneven rates. Shoulder flexion strength was found to accelerate to the age of 8; back lift strength improved through early childhood and then tended to become less pronounced at 12 years of age; and ankle flexion strength continued to improve regularly at all ages in childhood[47].

General activity level in children was investigated by Scarr in a recent study. She first suggested that tendencies to activity in children might be divided into several sub-categories, including measures of reaction time, number of activities engaged in during a specific time interval, number of active games chosen by children, as well as measures of anxiety and patience. Because she found that the pairs of measures collected from identical twins were more highly correlated than the scores made by fraternal twins. Scarr concluded that "activity level" and tendencies for vigorous action" are largely inherited[48].

Using skeletal age, Falkner suggested that six different patterns of maturation may be identified in children. These include: (1) An average child who will closely approximate the mean curve for height and weight at started ages. (2) Early maturing children who are tall in childhood only because they are more mature than the average; they will not become unusually tall adults. (3) Early maturing children who are also genetically taller than average from early childhood. They mature rapidly and remain taller than average throughout their lives. (4) Late maturing children who are short in childhood, but who later evidence reasonable growth. They will not remain unusually small in adulthood. (5) Late maturing children who are genetically short and who remain short adults. (6) An "indefinite group" whose members must often be exposed to medical evaluation; they may be children whose adolescent growth "spurt" starts unusually early, by the eighth or ninth year, or their growth may evidence unusually delay and be the cause for parental and medical concern[49].

A study by Walters, for example, presents evidence that the child who engages in prolonged and vigorous pre-birth movements can be counted upon to be advanced motorically during the first few years of life[50].

One of the conclusions Piaget drew from watching his children grow was the conviction that thought sprang from actions, and not from other sources such as language. Perhaps frustrated by his work with abnormal children, during which he attempted to assess them via verbal behaviors, he came to look upon the concrete manipulations of objects via the child's motor abilities as important clues to the quality of emerging intelligent behavior. Several concepts shaped by Piaget at this time are reflected in his writings on movement-intellectual relationships[51].

When beam-walking tests are utilized, it is usually found that most 6-year-olds can walk a beam that is 2 inches wide, but may fail to walk a beam that is only 1 inch wide. The scores obtained from these tasks are the distance walked (before falling) on a beam of a given width and / or the number of steps taken prior to loosing balance. Static balance measures are usually the number of seconds the child is able to posture in a specified position. Surveys carried out on changes in the ability to balance during the elementary school years generally indicate that the attribute matures slightly earlier in the life of child than do some other attributes, such as strength and endurance, and that there are usually two or more significant improvements in mean balance scores evidenced during childhood. Typical of the trends in the data between the ages of 6 and 12 years are the scores graphed from the work carried out by seashore. In general, sex differences are not usually marked; however, Keogh and other have demonstrated that girls between 7 and 9 years of age are so often superior to boys in dynamic balance abilities. When trends in the scores from balance studies are considered separately by sex, it is sometimes seen that boys tend to improve most between the ages of 7 and 9 years and again by age 10. Girls, on the other hand, often evidence more marked improvement between the ages of 6 and 7 years and later between the ages of 10 and 11 years[52].

By the age of 6, normal children can run well, and evidence well-coordinated arm and leg actions. They can jump vertically and horizontally reasonably well with takeoffs of 2 feet. Sometimes their jumping is accompanied by arm action; sometimes this arm action is absent. In addition to simple forward and lateral movements, 6-year-old children are beginning to experiment with numerous variations of locomotor patterns; they can skip, and some can hop rhythmically from one foot to the other foot while in place. Various tests of 'speed' of locomotor function have been given to children during the elementary school years. Running speed has been measured by several researchers, as has the speed at which children can hop a specified distance. Vertical Jump: A frequently used test with an older child and with an adolescent requires that the child first stand flat-footed and reach above his head with his hands, and then see how far above that height he can touch when he jumps. Successful performance is probably dependent on leg power and on proper jumping mechanics. It is seen that boys excel girls in this type of vigorous movement after the age of 7 years. At 7 years, both female and male children can jump about 7 inches in the air straight upward, following that age, sex differences are apparent. There is about a 1 inch mean difference in this attribute between boys and girls. Girls are seen to improve most between the ages of 9 and 10 years, and boys' mean improvement is more marked between the ages of 7 and 8 years. The boys improved about 66% and the girls during this same range evidenced improvement of about 50%[53].

The effect of additional physical education programs in the education of handicapped children: In order to test the all-round physical fitness of slow learners before and after an extended period of daily physical education lessons, both Stein (1965) and Solomon and Prangle (1967) employed the AAHPER (American Association of Health, Physical Education and Recreation) youth fitness test. Both studies showed that with 'blocked' periods of teaching, educationally mentally retarded (i.e., ESN (M)) boys can attain the same fitness levels as their normal peers. Solomon and Prangle re-tested their group after a six week interval and found that the gains in physical fitness had been retained even though the intensive program had been discontinued. Of course if the boys had not later continued to exercise, in a relatively short period of time their fitness levels would have dropped[54].

Studies summarized by Bloom have pointed out the difficulty of predicting later intelligence by evaluating the perceptual-motor attributes of young children[55].

At times the studies have shown remarkable advancement in motor development among infants in pre-industrial societies. For example, observations of samples of infants in Uganda and in the Congo revealed sensory motor development at birth which equaled that of European babies and those in the United States at 3 to 4 months of age. Moreover, these same infants revealed a lack of tonicity (restricting reflexes) at birth, which in turn seemed to prepare them earlier for the acquisitions of voluntary motor skills. Seemed to prepare them earlier for the acquisition of voluntary motor skills. Additionally, electroencephalographic evaluations of newborn. African babies revealed greater maturity of the central nervous system. Finally, even premature babies of low birth weight in Africa and Latin America showed adequate motor development when compared with children from industrialized societies[56].

Differences in findings among the various studies, in both the United States and overseas, however, suggest that more careful attention be given to patterns of child rearing as well as to the nutritional status of both parent and child, in order to more clearly ascertain the reasons for the differences. Additionally, measurable structural differences between the black and white children, measured in the fetal state by Schultz in 1926, were similar to the differences seen in adults of both races. That is, the black child seems to possess longer forearms and a shorter trunk, than white counterparts. These differences, when coupled with others, may exert a considerable influence on the mechanics of running and throwing, as well as on other motor tasks and sports skills. Similarly, the precocity of the skeleton of the black child at birth, repeatedly verified by investigators such as Seale, Kelly and Reynolds and Masse and Hunt, which is reflected not only in heavier, denser bones, but in an earlier appearance of the ossification centers in the fetus, could have significant effects on the physical performance capacities of the black child[57].

Running Speed: As with the simple measures of leg power in children, boys excel girls' between the ages of 6 and 12 years. Comparisons of data collected from the various studies, however, are difficult because of the differences in distances run and the ways in which subjects were started. Agility Runs: The data indicate that boys improve substantially until between the ages of 8 and 9 years, at which time mean performance increases becomes less marked. Girls, on the other hand, improve a great deal between the ages of 6 and 7 years, with smaller yearly increases after this time. The boys in most of the studies are from 0.3 seconds to 0.7 seconds faster when running 30-yard than are girls of similar age. The available evidence suggests that boys during elementary school years are slightly superior to girls in tests of running speed and when running is evaluated in various agility run tests. The performances of children in these tasks evidence a regular increase with age, with the greatest improvement occurring between the beginning and the end of the age range under study[58].

In general the same linear relationship is seen between age and strength improvement in both boys and girls, with the boy's superior by about 2 lb at each age. It is difficult to determine whether the sex differences are caused by differences in hand size, by cultural variables concerning the emphasis on physical performance by boys, or by qualitative differences in muscle strength as revealed in the investigation by Rarick and Thompson dealing with leg muscle efficiency in children. The investigations that conclusively demonstrate hormonal differences reflected in measures of blood chemistry and existing between boys and girls undergo marked changes between the ages of 6 and 12 years. The average scores of the boys double during these years, and those of the girls increase by more than 2.5 times[59].

These low and nonproductive correlations, however, do not indicate any causal relationship between some components of intelligence and balance, and probably simple reflect some slight common influence of ocular control on both academic functioning and balance ability. Goetizinger obtained no correlation between measures of dynamic balance using the Heath rail-walking test and IQ scores obtained from the draw-a-person test[60].

A comparison of physical abilities of fathers and sons that B.J. CRATTY carried out some years ago, utilizing data collected at the same time in their lives by the same testers and on the same facilities, demonstrated the decreasing capacities of the sons. Other investigations have produced data which indicate that the size and strength of the present generation are significantly different from those of the previous generations[61].

The importance of developing of the full the physical potential of those gifted in this field, though they may be educationally retarded, is self-evident. But what of those who are far below the norm? It is hoped to show here that even these children can be helped, and that such help is of far-reaching importance to their future lives. Even more valuable perhaps is attention to the physical needs of handicapped children for later intellectual development is well established in the work of Piaget, Kephart and others. Kephart has said: 'Motor patterns are the foundation for more complex learning, because motor patterns provide the basis for meaningful orientation. Newell C. Kephart was a clinical psychologist who, in several books, a series of 19 one-hour films, and several articles, has outlined a theory proposing that motor learning is the basis of all learning. Proceeding from this basic premise, he outlined motor activities that he contended would positively influence academic readiness, school achievement, and reading[62].

Scott et al., as well as Williams and Scott, suggest that more permissive child rearing among lower social classes could be one of the more important reasons for differences in motor abilities between black and white youngsters. Others have reported similar advancement in gross motor attributes among African children and for black children in Jamaica. These and other investigations, however, have generally found that early advancement in motor development tended to disappear as the populations they surveyed passed their second birthday. By that age, the possible positive influences of breast feeding and frequent maternal handling may have worn off, while the effects of less than adequate nutrition may have begun to exert an influence on these children[63].

In a recent factor analysis of motor performance in children by Rarick and Dobbins, the scores on forty-seven tests were analyzed, using 145 boys and girls. In general, the factors which emerged were relatively similar in the two sexes, and not as numerous as found in similar studies by Fleishman et al. using older subjects. Six factors accounted for the major portion of the variance in both sexes: (1) Strength- power- body size, combining measures of height, weight, grip, and limb strength. (2) Gross limb coordination (including measures of throwing, running and crawling). (3) Fine visual-motor coordination, including tests of manipulation, tapping and the like. (4) Fat, or dead weight, composed primarily of measures of skin fold thickness in various parts of the body in addition to body weight. (5) Balance, including both static and dynamic (moving) balance. (6) Leg power and coordination, including a 35-yard dash and a 150-yard run[64].

In addition to employing locomotor tasks in which the child is not required to cover a great deal of space, experimenters has used tasks involving running speed and agility measures requiring changes of direction while running. It is probable that the two types of running tests measure separate attributes in children of elementary school age. Carpenter has found, for example, that running speed tests scores cluster in a factor separate from those of strength scores and ball-handling scores[65].

Cumbee also has found that tests evaluating quick changes of direction while running are independent of other measures of motor performance in children including measures obtained from children while running a straight course[66].

Flexibility: Hupprich and Sigerseth, for example, found that flexibility of girls was due to specific factors because low inter-correlations were obtained between the various scores, indicating a range of joint motion. The experimenters' findings revealed that, contrary to the common hypothesis, as girls grow older they do not always evidence decrease in flexibility. Although decreases in measures reflecting flexibility of the knees, the thighs, and the shoulder joints were recorded, the scores obtained suggested that girls may have increased trunk flexibility, wrist flexion, and leg abduction[67].

Hilderth, found it less likely that children will use their left hands when performing tasks in which they are likely to incur social censure[68].

Carpenter investigated various measures of speed in children and found that again three separate factors were isolated. Running speed tests were related but were independent of tests in which strength was evaluated. Hand-eye coordination was again contributed to by the scores in tasks involving ball handling. In this investigation

Carpenter found that improvement in the measures obtained was evidenced as children grew older, but that when correlations between age and ability were computed, they were moderate to low[69].

Metheny and later Keogh have surveyed which, generally points to the following conclusions: Little difference is usually found when the pressures exerted by the right and left hands are compared. Slight sex differences are usually found, with boys superior to girls in early childhood and with girls often catching up to boys in late childhood. The data from a study by Keogh illustrate the usual trend found when the grip strength of children of both sexes within this age range is surveyed. No significant differences between the left and right grip strength scores were found in this investigation, although the mean left grip score was on the average a pound less than was the same measure collected with the right hand[70].

Aileen Carpenter, using the Johnson test together with other measures, evaluated the abilities of 530 children and found that three separate factors emerged. These included general agility factors specific to the items on the Johnson test, strength factor to which the grip strength scores contributed, and a hand-eye coordination factor, evaluated by reference to tests of marble manipulation, ball bouncing, and the like[71].

The child will employ the two feet takeoff at about two years of age, and initially this will be accompanied by a retraction of the arms to the rear rather than by the more efficient arm swing forward seen in older children. Guttridege has found that approximately 42% of preschool children can jump well by the age of 3 years and that approximately 72% may be considered reasonably skillful jumpers by four and half[72].

Fifty percent of the 3-year-old children tested by Bailey in 1935 were able to walk a distance of 10 feet on a 1-inch wide line without falling off. It is not until nearly 4 years of age, however, that children are able to walk a circular line, according to Wellman[73].

A study by Bayley revealed that measures of stockiness (based on height / weight ratios) were not predictive of motor ability test scores from 3 to 36 months of age. At the same time, this same study found that children with proportionally longer legs tended to have slightly better scores in motor ability test[74].

Minerva selected one from each group (identical twins and fraternal twins) and gave them a six month period of motor training involving a variety of tasks, including the ones initially tested (jumping over a cord, throwing accuracy at about 3 feet distance, and ball-rolling accuracy) for. Minerva concluded that the more complex tasks are modifiable through training, but the more basic locomotor functions are not[75].

Three primary theories have been used to explain the decrease of reaction time as function of maturity. These include one proposed by Luria in 1932 suggesting that reaction time is slower in young children because general excitation produced by the stimulus spreads not only to the motor system, but also to other parts of the brain, causing somewhat diffuse responses which interfere with the appropriate response. As children grow older, this diffusion, or general excitation, becomes less likely to occur. The suggestion that a ‘functional barrier’ built up in older children results in a more efficient response to a given stimulus. A second theory proposed by Rogers Elliot emphasizes the role of attention as a regulator of reaction time. He believes that young children are less likely to be playing close attention to the stimuli, and thus are less ready to respond, as contrasted to older children[76].

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CHAPTER – III

METHODOLOGY

III.1 – SAMPLE:

The samples of this study are randomly selected form different schools with their date of birth lying between 1993 and 1999 in normal (boys and girls) and deaf-dumb subjects (boys and girls). The selected age groups of the subjects were from 8 to 14 years. In each group 30 subjects were selected initially with a margin of ±5. All the selected subjects were non-sportsman staying either in school hostels or at their residence to ensure the untrained development in motor abilities. In all, 840 subjects were tested initially and the same 840 subjects were tested finally after one academic year (10 months). The tests were conducted for two days for four hours approximately on each group of 30 subjects. In all, 700 subjects were considered for obtaining the difference between growth and development and are evaluated by subtracting the initial test score from the final test score. Every subject was allotted with a code and a separate self contained form for test results. The tests were selected in the aspects of growth and development. In growth, height and weight is evaluated and in development of motor abilities the researcher has selected the standard tests in speed, strength, endurance, flexibility, coordinative abilities and their complex forms for evaluation. The tests were administered individually under standard conditions applicable for specific tests and the time period required between two tests is amply considered.

Table No. III.1: Coding procedure and colors adopted for the samples.

S. NO.	CODE	25 SUBJECTS	COLOUR	REMARKS
1	101NB-08 TO 125NB-08	101-125	YELLOW	101 TO 300
2	126NB-09 TO 150NB-09	126-150	YELLOW	
3	151NB-10 TO 175NB-10	151-175	YELLOW	
4	176NB-11 TO 200NB-11	176-200	YELLOW	
5	201NB-12 TO 225NB-12	201-225	YELLOW	
6	226NB-13 TO 250NB-13	226-250	YELLOW	
7	251NB-14 TO 275NB-14	251-275	YELLOW	
S. NO.	**CODE**	**25 SUBJECTS**	**COLOUR**	**REMARKS**
8	301NG-08 TO 325NG-08	301-325	GREEN	301 TO 500
9	326NG-09 TO 350NG-09	326-350	GREEN	
10	351NG-10 TO 375NG-10	351-375	GREEN	
11	376NG-11 TO 400NG-11	376-400	GREEN	
12	401NG-12 TO 425NG-12	401-425	GREEN	
13	426NG-13 TO 450NG-13	426-450	GREEN	
14	451NG-14 TO 475NG-14	451-475	GREEN	
S. NO.	**CODE**	**25 SUBJECTS**	**COLOUR**	**REMARKS**
15	501DDB-08 TO 525DDB-08	501-525	BLUE	501 TO 700
16	526DDB-09 TO 550DDB-09	526-550	BLUE	
17	551DDB-10 TO 575DDB-10	551-575	BLUE	
18	576DDB-11 TO 600DDB-11	576-600	BLUE	

19	601DDB-12 TO 625DDB-12	601-625	BLUE	
20	626DDB-13 TO 650DDB-13	626-650	BLUE	
21	651DDB-14 TO 675DDB-14	651-675	BLUE	
S. NO.	**CODE**	**25 SUBJECTS**	**COLOUR**	**REMARKS**
22	701DDG-08 TO 725DDG-08	701-725	PINK	701 TO 900
23	726DDG-09 TO 750DDG-09	726-750	PINK	
24	751DDG-10 TO 775DDG-10	751-775	PINK	
25	776DDG-11 TO 800DDG-11	776-800	PINK	
26	801DDG-12 TO 825DDG-12	801-825	PINK	
27	826DDG-13 TO 850DDG-13	826-850	PINK	
28	851DDG-14 TO 875DDG-14	851-875	PINK	

NOTE:

NB = NORMAL BOYS
NG = NORMAL GIRLS
DDB = DEAF-DUMB BOYS
DDG = DEAF-DUMB GIRLS
8, 9, 10, 11, 12, 13, 14 = AGE GROUPS

III.2 – VARIABLES:

DEPENDENT VARIABLES:

1. Performance of Normal boys.
2. Performance of Deaf-dumb boys.
3. Performance Normal girls.
4. Performance Deaf-dumb girls.

INTERWEAVING VARIABLES:

1. Sex: Boys and Girls.
2. Age: 8 to 14 years.
3. Criteria: Non sportsman.
4. Times: Initial and Final

INDEPENDENT VARIABLES:

GROWTH:

1. Height.
2. Weight.

DEVELOPMENT OF MOTOR ABILITIES:

3. Acceleration ability.
4. Locomotion ability.
5. Upper extremity explosive strength.
6. Abdomen explosive strength.
7. Lower extremity explosive strength.
8. Metabolic rate.
9. Maximum oxygen uptake capacity (VO_2 max).

10. Shoulder flexibility.
11. Trunk flexibility.
12. Hip joint flexibility.
13. Reaction ability.
14. Balancing ability.
15. Agility.

DEFINITION OF THE GROWTH AND DEVELOPMENT FACTORS:

1. **Height:** Height is the total vertical length of an individual from the point vertex to the ground (Centimeters).

2. **Weight:** Weight is the complete mass of an individual standing on the weighing scale with optimum clothing (Kilograms).

3. **Acceleration ability:** It is the ability to achieve high speed of locomotion from a stationary position or from a slow moving position. Acceleration ability depends to great extent on explosive strength, technique and movement frequency (Seconds).

4. **Locomotion ability:** It is the ability to maintain maximum sped of locomotion for maximum possible duration or distance. Locomotion ability depends to a great extent on mobility of the nervous system which allows for high movement frequency (Seconds).

5. **Upper extremity explosive strength:** It can be defined as the ability to overcome resistance with high speed with upper extremity (Meters).

6. **Abdomen explosive strength:** It is the ability to perform contraction of abdomen muscles to overcome resistance with high speed against time (Numbers).

7. **Lower extremity explosive strength:** It can be defined as the ability to overcome resistance with high speed with lower extremity (Centimeters).

8. **Metabolic rate:** MET is the energy unit – and indicates the aerobic fitness level. At rest it is 1 MET and during exercise it should be able to reach between 10 to 20 METS i.e., 10 to 20 times of resting level.

9. **Maximum oxygen uptake capacity (VO_2 max):** The aerobic capacity is measured by the maximum amount of oxygen which can be consumed by the working muscles in one minute (VO_2 max). When VO_2 max is divided by the body weight of the sportsmen then we get the relative VO_2 max i.e., the amount of oxygen consumed per kilogram of body weight per minute (Milliliters).
10. **Shoulder flexibility:** Shoulder flexibility can be defined as the ability to execute movements with greater amplitude or range at shoulder joint (Inches).

11. **Trunk flexibility:** Trunk flexibility can be defined as the ability to execute movements with greater amplitude or range at trunk joint (Centimeters).

12. **Hip joint flexibility:** Hip joint flexibility can be defined as the ability to execute movements with greater amplitude or range at hip joint (Inches).

13. **Reaction ability:** It is the ability to react quickly and effectively to a signal (Seconds).

14. **Balancing ability:** It is the ability to maintain balance during whole body movements and to regain balance quickly after the balance disturbing movements (Seconds).

15. **Agility:** Agility is the ability of an individual to change the direction with speed (Seconds).

III.3 - TOOLS AND MEANS:

There are lot of motor ability tests or means and tools. Lists of the items of several of the most used motor tests, and indicates the types of items included in such tests: General Motor Ability test Batteries-

(1) Barrow Motor Ability Test (men) - standing long jump, softball throw for distance, zigzag run, wall pass using basketball, six pound medicine ball put, 60 yard dash, (indoor battery).

(2) Cozens General Athletic Test (men) - Baseball throw for distance, football punt for distance, bar snap (parallel bars), standing long jump, dips (parallel bars), dodging run, and quarter-mile run.

(3) Scott Motor Ability Test (women) - Basketball throw for distance four-second dash, wall pass using basketball, standing long jump, obstacle run.

(4) Newton Motor Ability Test - standing long jump, hurdle run, scrambles (agility run).

(5) Larson Motor Ability Test (men) - Indoor battery - Chins (pull-ups), vertical jump, dips, dodging run, and bar snap. Outdoor battery - Chins (pull-ups), bar snap, vertical jump, baseball throw for distance.

(6) Latchaw Motor Achievement Test (elementary children) - basketball wall pass, volleyball wall volley, vertical jump, standing long jump, shuttle run, soccer wall volley, softball repeated throws.

All these motor abilities test batteries deal with specific age, sex or category and the coefficients of the reliability and validity are not stable and vary in wide range if applied in the present study. These motor ability tests are useful to distinguish specific groups of children, and it is difficult to separate the individuals according to their categories.

So these motor ability test batteries are not useful to study the comparison of the development of motor abilities in normal (boys and girls) and deaf-dumb (boys and girls) for present study. Hence research scholar used some of the selected motor ability tests which are applicable to the selected age group and samples and are universally accepted and established standard tests for assessing development of motor abilities.

MEANS USED

1. **Personal data bank:** It is used to collect the information of an individual. Personal data bank consists of the following aspect: Full name, name and address of the school, date of birth and age, gender, deaf-dumb/ normal, diet (vegetarian/ mix), sportsman / non-sportsman, physical maturity, height and weight.

2. **Motor ability tests:**

- Fifty yard dash for Acceleration ability:
- 30 meters flying start for Locomotion ability.
- Medicine ball put for Upper extremity explosive strength.
- Sit-ups for Abdomen explosive strength.
- Standing vertical jump for Lower extremity explosive strength.
- 20 meters shuttle run (Canadian fit test) for Metabolic rate.
- 20 meters shuttle run (Canadian fit test) for Maximum oxygen uptake capacity (VO_2 max).
- Shoulder rotation test for Shoulder flexibility.
- Forward bend and reach for Trunk flexibility.
- Side split test for Hip joint flexibility.
- Nelson's hand reaction test for Reaction ability.
- Storks stand for Static balancing ability.
- 6 X 10 meters shuttle run for Agility.

III.4 – PROCEDURE:

The subjects were selected from different schools in normal category (boys and girls) and deaf-dumb schools (boys and girls). In all 15 testes were selected for evaluating the growth and development of motor abilities of the subjects between 8 to 14 years. To have the difference of data for assessing the development it was decided to organize the test on 840 subjects; 30 in each group; 28 groups in all and the same subjects to be evaluated after a gap of one academic year. The subjects were tested initially for their growth and development in motor abilities from 02nd January 2006 to 15th March 2006 and the second test on the same subjects was organized from 01st November 2006 to 15th January 2007 for evaluating the natural motor development (which is untrained). While organizing the tests the following things are observed strictly for objectivity, reliability and validity of the findings:

1. The sequence of tests will not cultivate fatigue in the subjects.
2. The condition of the subject before undergoing / performing the test is normal and motivated.
3. No exertion in daily activities.
4. Proper and comfortable kit while performing the test.
5. Condition of the surface and other physical equipment required for test.

6. Sufficient time was allotted for warming-up exercises.
7. Obtained information of diet and recovery the day before from the subject.
8. Instructions regarding the performance of the specific tests are passed before the test.

In each group 30 subjects were tested in 15 variables in growth and development of motor abilities, 4 hours were allotted in two days dividing 2 hours on each day. The sequence of the tests was so organized as to avoid fatigue, which was as follows:

Day one- Warming up for 15 minutes, 50 yard dash, Medicine ball put, Shoulder rotation test, Stork stand, Standing vertical jump, Forward bend and reach, 6X10 meters shuttle run, Cooling down 10 minutes, Height, Weight.

Day two- Warming up for 15 minutes, 30 meters flying start, Side split test, Sit-ups, Nelson's hand reaction test, 20M shuttle run (Canadian fit test), Cooling down 10 minutes.

<u>DAY ONE:</u>

(1) 50-YARD DASH: It is advised that two subjects run at the same time. Both start from a standing position. The command to go the starter drops his arm so that the timer at the finish line can start the timing. The subjects run as fast as possible across the finish line. The elapsed time from the starting signal until the runner crosses the finish line is measured to the nearest tenth of a second.

(2) MEDICINE BALL PUT: From a sitting position in a straight back chair, the performer holds the ball in both hands with the ball drawn back against the chest and just under the chin. He then pushes the ball upward and outward for maximum distance. The rope is placed around the performer's chest and held tight to the rear by a partner in order to eliminate rocking action during the push. The performer's effort should be primarily with the arms. The distance of the best of three trials measure to the nearest meter is recorded as a score. One practice trial may be taken before scoring.

(3) SHOULDER ROTATION TEST: (A) Grasp one end of the rope with your left hand and grasp the rope with your right hand in a like manner a few inches away. (B) Extend both arms to full length in front of your chest and rotate the rope over your head. As you meet resistance in rotating your shoulders, you must let the rope slide within the grip of your right hand so that the arms can spread and allow you to lower the rope until it is resting across your back. (C) Keeping your arms locked, rotate to the starting position and measure the number of inches of rope between the thumbs to your hands. The least amount of distance indicated a better level of performance (D) Secure the maximum shoulder width across the back from deltoid to deltoid with the flexomeasure. Your shoulder width is subtracted from the total inches of the best scores of three trials.

(4) STORK STAND: From a stand on the foot of the dominant leg, place the other foot on the inside of the supporting knee and place the hands on the hips. Upon a given signal, raise the heel from the floor and maintain the balance as long as possible without moving the ball of the foot from its initial position or letting the heel touch the floor. The score is the greatest number of seconds counted between the time the heel is raised and the balance is lost on three trials with the preferred foot. Only the highest score is recorded.

(5) STANDING VERTICAL JUMP: The performer should stand with one side towards a wall, heels together, and hold a 1 inch piece of chalk in the hand nearest to the wall. Keeping the heels together, on the floor, he should reach upward as high as possible and make a mark on the wall. The performer then jumps as high as possible and makes another mark at the height of his jump. The number of inches between the reach and the jump marks measured to the nearest half inch is the score. Three to five trials are allowed and the best trial is recorded as the score.

(6) FORWARD BEND AND REACH: (A) Line up the 15 inch mark of the yardstick with a line on the floor and tape the ends of the stick to the floor so that the flexomeasure case (window side) is face down. (B) Sit down and line up your heels with the near edge of the 15 inch mark and slide your seat back beyond the zero end of the yardstick. (C) Have a partner stand and brace his or her toes against your heels. Also, have and assistant on each side to hold your knees in a locked position as you prepare to stretch. (D) With heels not more than 5 inches apart, slowly stretch forward, while pushing the flexomeasure case as far down the stick as possible with the fingertips of both hands. Take your reading at the near edge of the flexomeasure case. The best of three trials measured to the nearest quarter of a centimeter is the test score.

(7) 6 X 10 METERS SHUTTLE RUN: The subject stands behind the starting line. On getting g starting signal 'go' he runs faster, goes nearest to the other line and touches it with the one hand turns and comes back to starting line, touches it with hand, turns and repeats it for a total of 5 times and 6^{th} time runs over as fast as possible. The time taken by the performer to complete the course of 6 x 10 meters to the nearest $1/10^{th}$ of a second is recorded as score of the test. Only one chance is given. Participants are not allowed to use spikes and the area should be firm and non-slippery.

(8) HEIGHT: The subject is made to stand touching the back to the marking on the wall and a scale is put at the vertex (maximum point of the head of an individual).

(9) WEIGHT: Weight is taken by making the subject stand on the weighing scale with optimum clothes and without excess ornaments or accessories on the body.

DAY TWO:

(1) 30 METERS FLYING START: The performer stands behind the line F and accelerates, and cross the line B with maximum possible speed. The time keeper stands on point C and when the runner comes in line with the flag A and E, he starts the watch and when the torso of runner comes in line B and D he stops the watch. The time is then noted down from the watch.

(2) SIDE SPLIT TEST: (a) from a stand, extend the legs apart from side to side until your crouch is as near to the floor as possible. (b) As you lower, an assistant should be positioned behind you with the zero end of the yardstick on the floor. (c) When you reach your lowest point, the case is raised upward until the ruler guide rests under your crotch. The reading to the nearest quarter of an inch is taken in the case window at the lower (C-D) line. (d)The best score of three trials is recorded as the performance score.

(3) SIT-UPS: From a lying position on the back, the performer flexes his knees over the yardstick while sliding his heels as close to his seat as possible. The yardstick should be held tightly under the knees until the performer is instructed to slowly slide this feet forward. At the point where the yardstick drops on the mat, the tester marks the heel line and seat line to indicate how far the feet should remain from the seat during the bent-knee sit-up exercise. The performer should interlace the fingers behind the neck and perform sit-ups alternating a left elbow touch of the inside right knee and right elbow touch of the inside left knee. The exercise should be repeated as many times as possible. The total number of repetition is recorded for the score. However, repetitions should not be counted when fingertips do not maintain contact behind the head, when the knees are not touched, or when the pupil pushes off the floor with the elbow.

(4) NELSON'S HAND REACTION TEST: The subject sits with this forearm and hand resting comfortably on the table (or desk chair). The tips of the thumb and the index finger are held in already to pinch position about 3 or 4 inches beyond the edge of the table. The upper edge of the thumb and index finger should be in a horizontal position. The tester holds the stick timer near the top, letting it hand between the subject's thumb and index finger. The base line should be even with the upper surface of the subject's thumb. The subject is directed to look at the concentration zone (which is a black shaded zone between the 0.120 and 0.130 lines) and is told to react by catching the stick (by pinching the thumb and index finger together) when it is released. The subject should not look at the tester's hand; nor is he allowed to move his hand up or down while attempting to catch the falling stick. Twenty trials are given. Each drop is preceded by a preparatory command of "ready". When the subject catches the timer, the score is read just above the upper edge of the thumb. The five slowest and five fastest trials are discarded, and an average of the middle ten is recorded, as the score. Numbers on the timer represent thousandths of a second. Scores may be recorded to the nearest 5/1000 of a second.

(5) 20 METERS SHUTTLE RUNS (CANADIAN FIT TEST): (A) It is suitable for either sex, individuals between the age of 6 and 60 in a medically fit condition. (B) The test includes a period of warm up. (C) Maximal effort is required only at the end of the test. (D) The test as such involves jogging and running at progressively increasing pace, over a 20 meters course for as long as possible. The pace is given by the audio cassette. At every sound heard, you must have reached one of the 20 meters lines and upon hearing the sound, you should pivot and reverse your direction and run at the set pace to the opposite line in time for the next audio signal. This way you run till your maximum capacity is reached. If twice in a row you can't reach within 2 strides of the line, you have reached your max capacity and so remember the last number announced on the cassette player. This is your stage level and equates this with your score from the score sheet attached – to know your VO_2 max as per your age.

III. 5 - COLLECTION OF DATA:

The subjects were selected from different schools in normal category (boys and girls) and deaf-dumb schools (boys and girls). In all 15 testes were selected for evaluating the growth and development of motor abilities of the subjects between 8 to 14 years. To have the difference of data for assessing the development it was decided to organize the test on 840 subjects; 30 in each group; 28 groups in all and the same subjects to be evaluated after a gap of one academic year. The subjects were tested initially for their growth and development in motor abilities from 02nd January 2006 to 15th March 2006 and the second test on the same subjects was organized from 01st November 2006 to 15th January 2007 for evaluating the natural motor development (which is untrained). Much of the samples were collected from the regions of Maharashtra and Andhra Pradesh. The scores are then entered individually in the forms provided accordingly. For identification of variables different colors are used: Normal boys- yellow; Normal girls- green; Deaf-dumb boys- blue; Deaf-dumb girls- pink.

III.6 – STATISTICAL METHODS:

To analyze the collected data the scores are arranged according to the comparison and in sequential order so as to find out the statistical values. The following statistical variables are selected for comparing, analyzing and interpretation of numerical values and basing on which the findings are discussed.

Mean is computed by adding all the scores and then dividing by the number of scores involved. The mean is used in the study to measure the average in growth and development.

Standard Deviation is computed in the study for the measures of variability. Standard deviation reflected the magnitude of the deviations of the scores from their mean.

Correlation is computed in the study to find out the relationship of one variable to another and also to determine the validity, reliability, and objectivity of the tests.

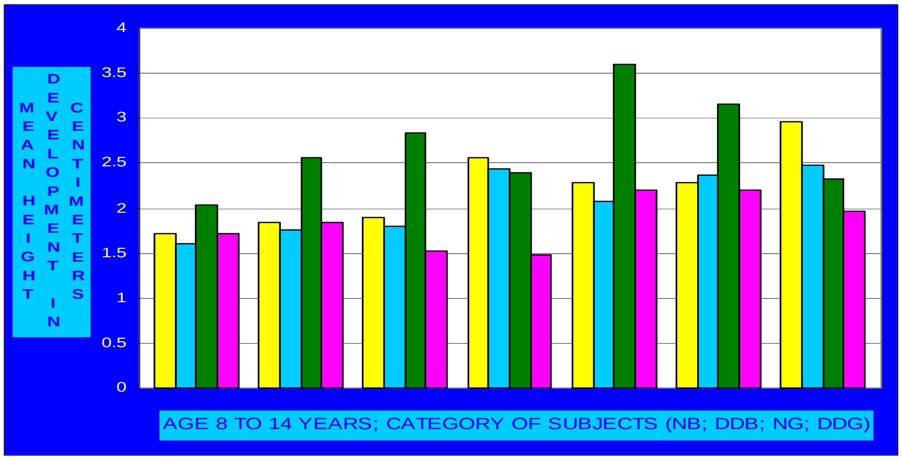
For testing the null hypothesis for the difference between various sample means the t-Test is used at significance of .05 levels.

For testing the null hypothesis for the difference between sample means, the F-Test is used and also to evaluate the significance of the difference.

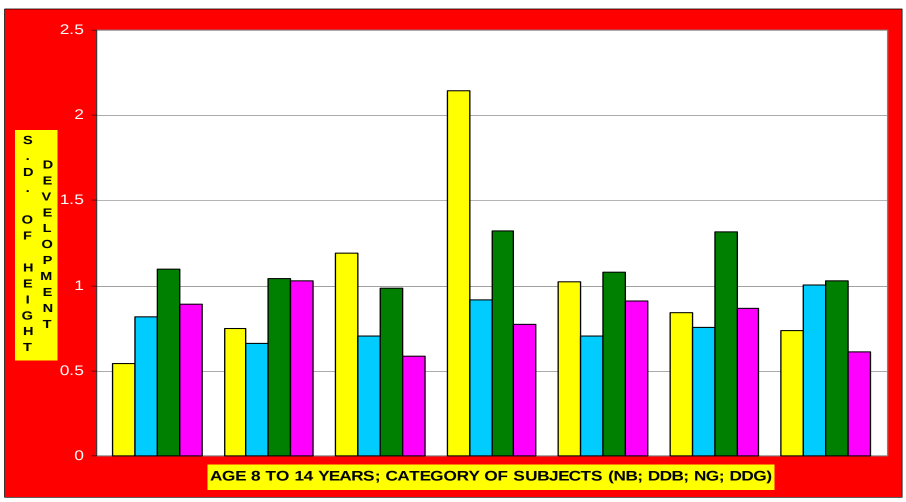
The obtained values of the mean, standard deviation, correlation, t-Test, and F-Test are given in the tables below followed by the graphical representation. The graphs and tables interpretation is evaluated sequentially in the growth and development along with the comparison of normal boys to deaf-dumb boys and normal girls to deaf-dumb girls.

Graph No. III.1 (a), (b), (c): GRAPHICAL REPRESENTATION OF THE COMPARISON OF THE GROWTH OF HEIGHT OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 TO 14 YEARS

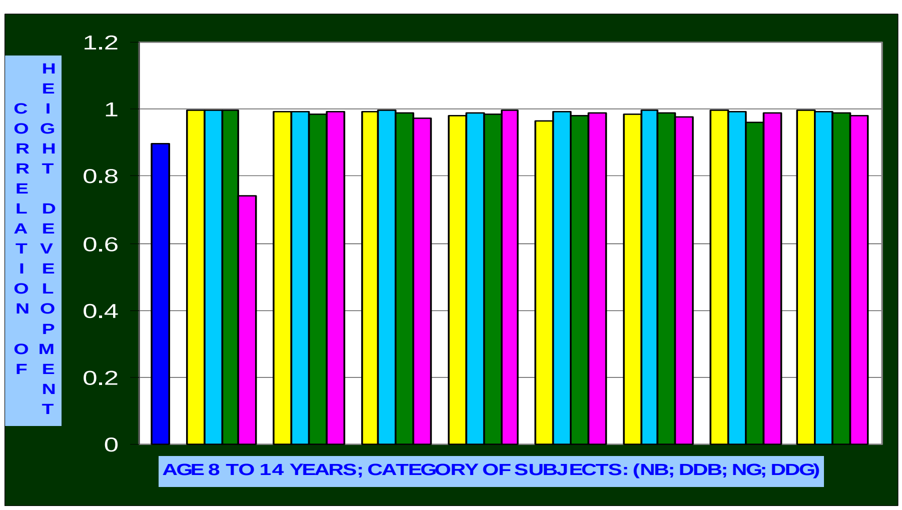
(a) MEAN



(b) STANDARD DEVIATION

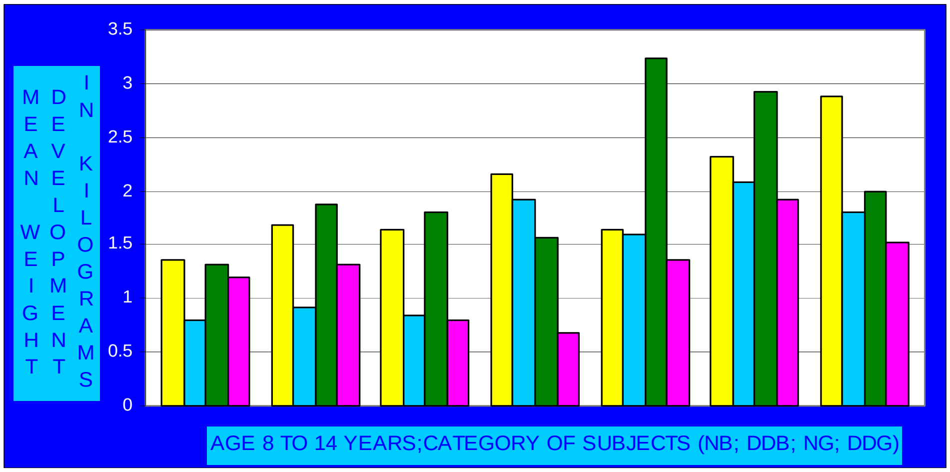


(c) CORRELATION

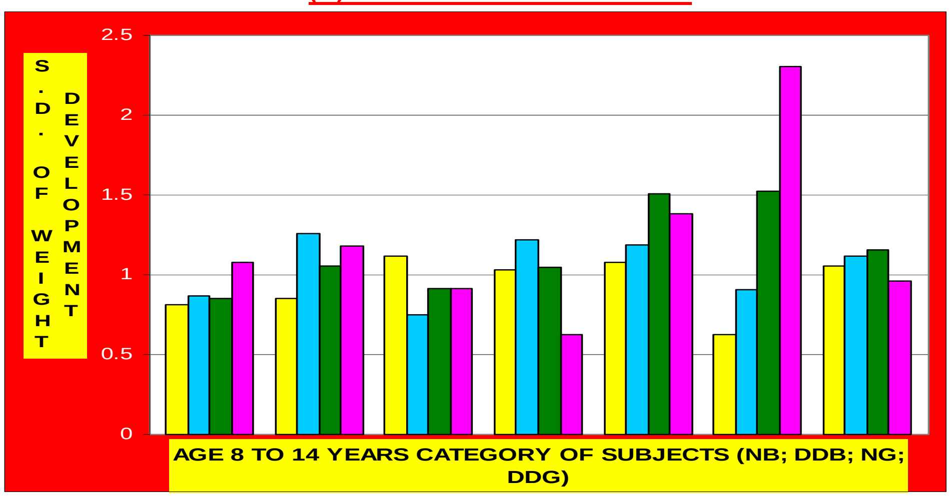


Graph No. III.2 (a), (b), (c): GRAPHICAL REPRESENTATION OF THE COMPARISON OF THE GROWTH OF WEIGHT OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 TO 14 YEARS (WEIGHING SCALE)

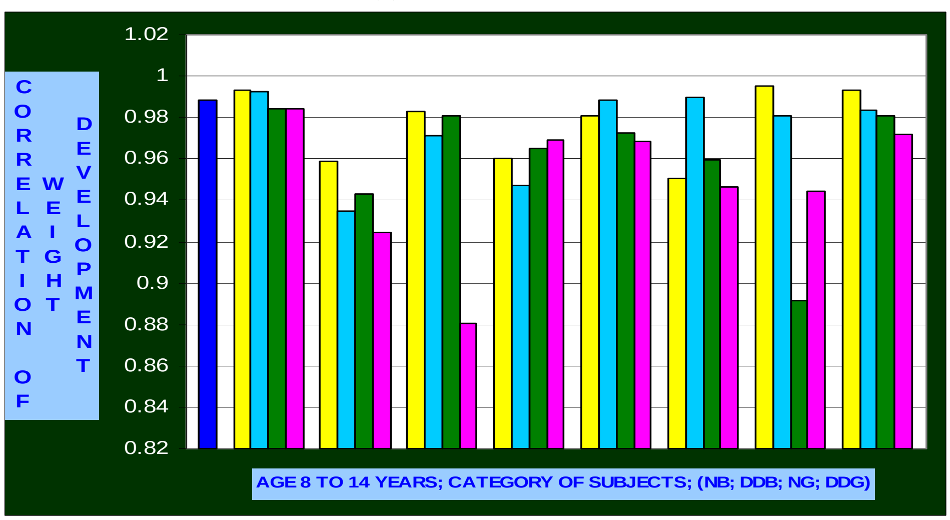
(a) MEAN



(b) STANDARD DEVIATION

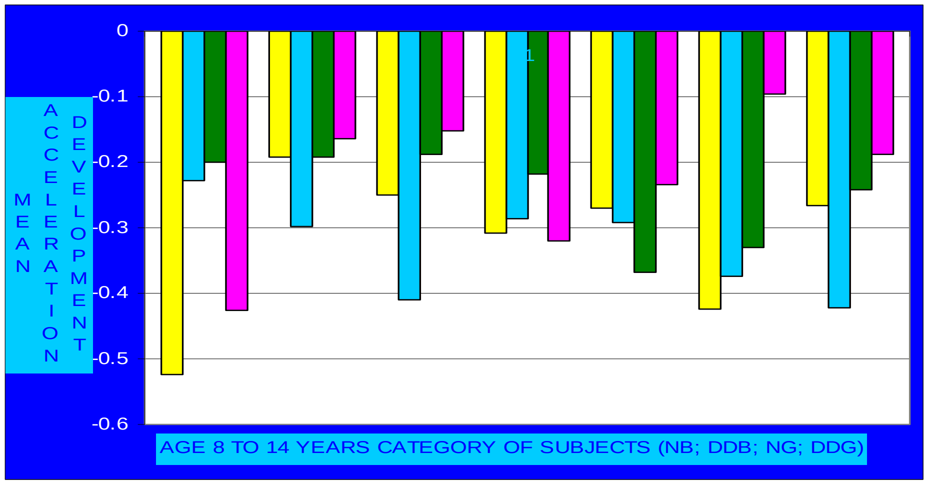


(c) CORRELATION

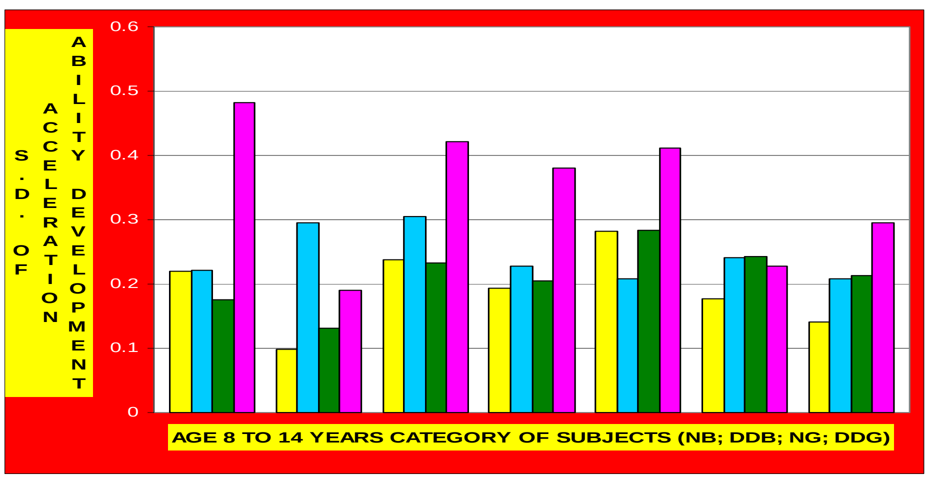


Graph No. III. 3 (a), (b), (c): GRAPHICAL REPRESENTATION OF THE COMPARISON OF THE DEVELOPMENT OF ACCELERATION (SPEED) OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 TO 14 YEARS (50 YARD DASH)

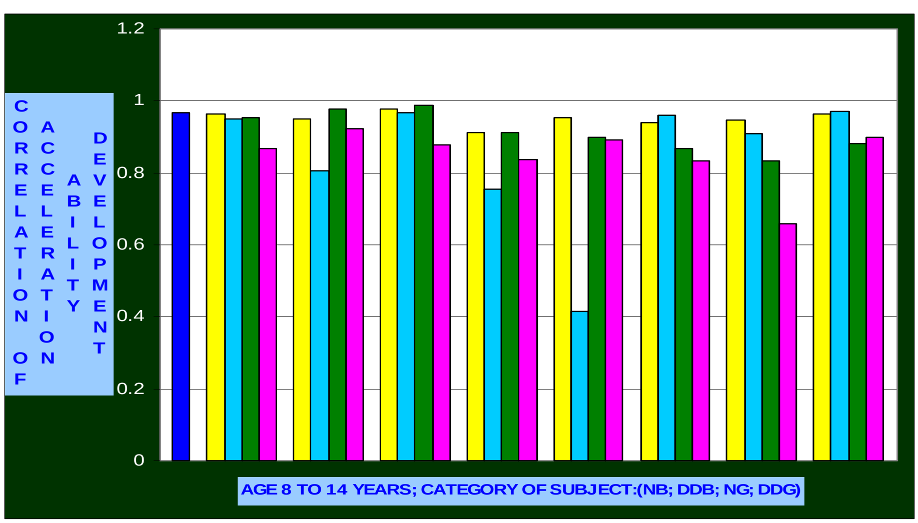
(a) MEAN



(b) STANDARD DEVIATION

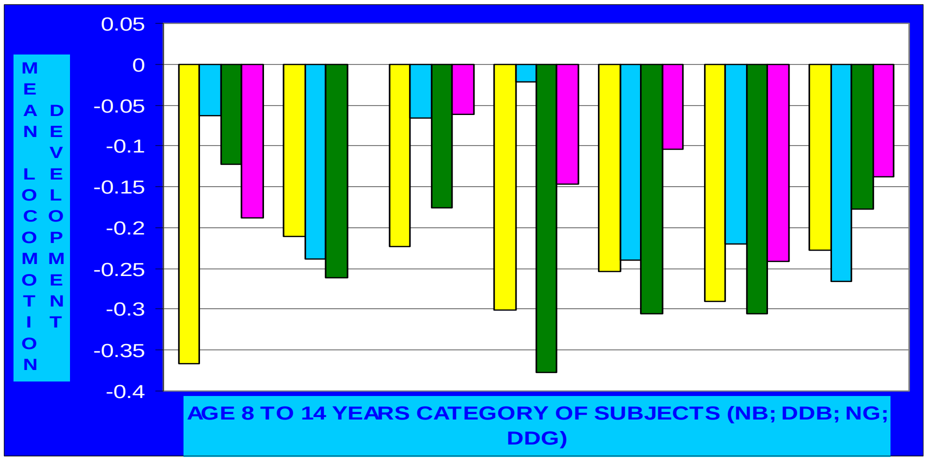


(c) CORRELATION

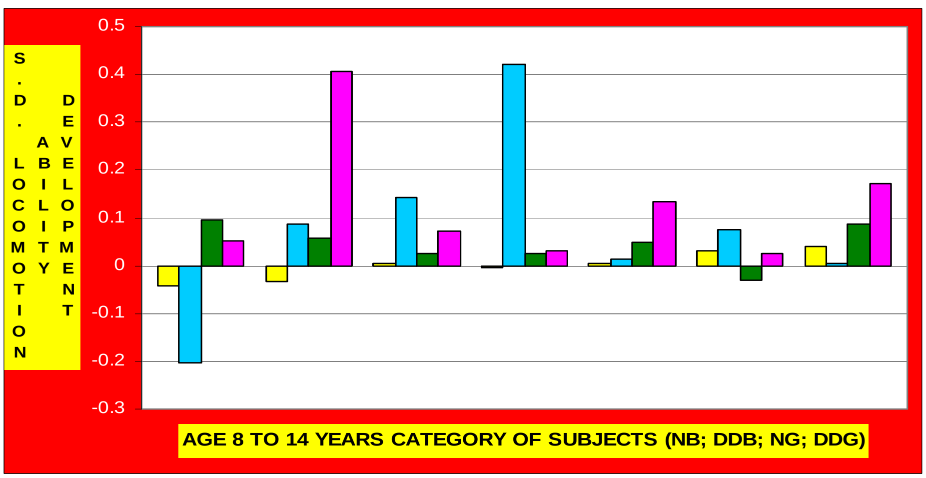


Graph No. III.4 (a), (b), (c): GRAPHICAL REPRESENTATION OF THE COMPARISON OF THE DEVELOPMENT OF LOCOMOTION ABILITY (SPEED) OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 TO 14 YEARS (30METERS FLYING START)

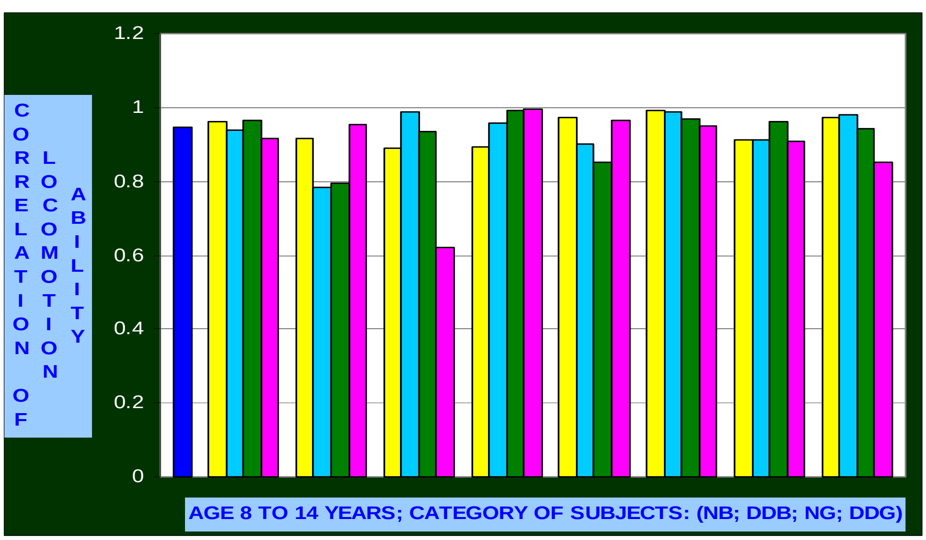
(a) MEAN



(b) STANDARD DEVIATION

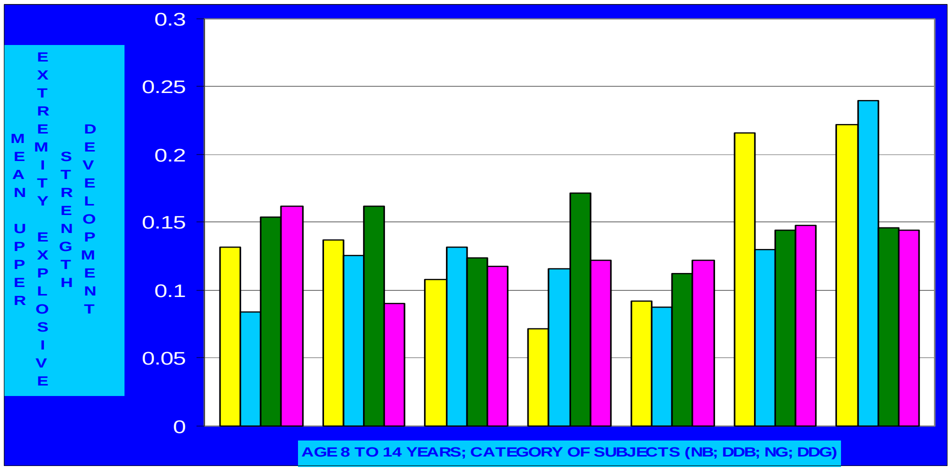


(c) CORRELATION

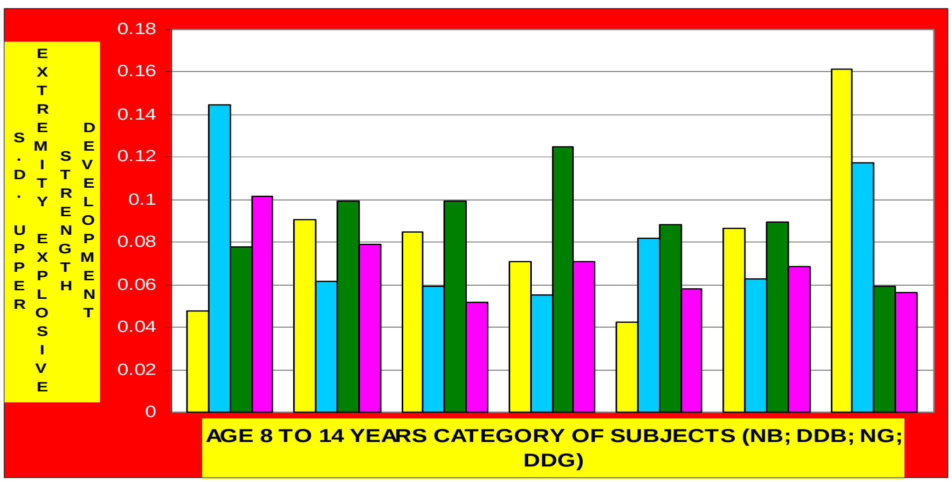


Graph No. III.5 (a), (b), (c): <u>GRAPHICAL REPRESENTATION OF THE COMPARISON OF THE DEVELOPMENT OF UPPER EXTREMITIES EXPLOSIVE STRENGTH OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 TO 14 YEARS (MEDICINE BALL THROW)</u>

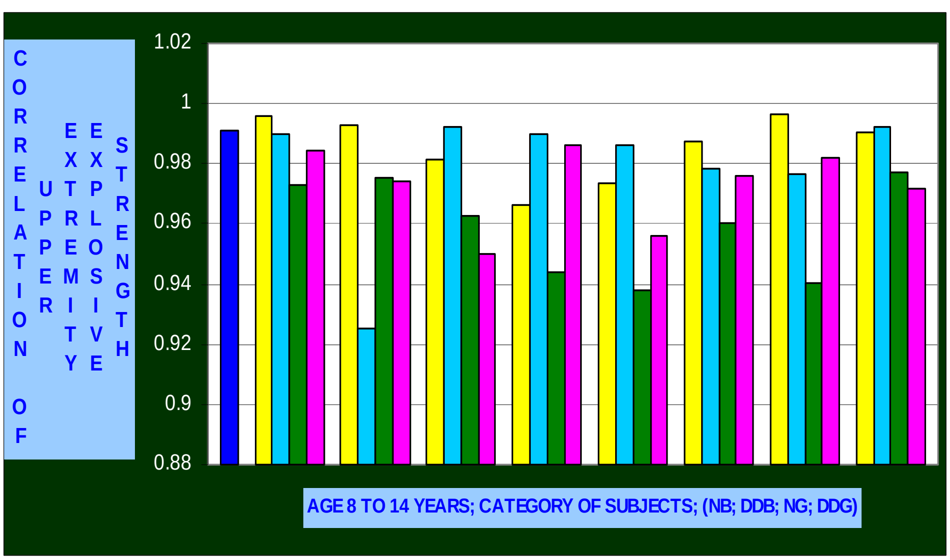
(a) MEAN



(b) STANDARD DEVIATION

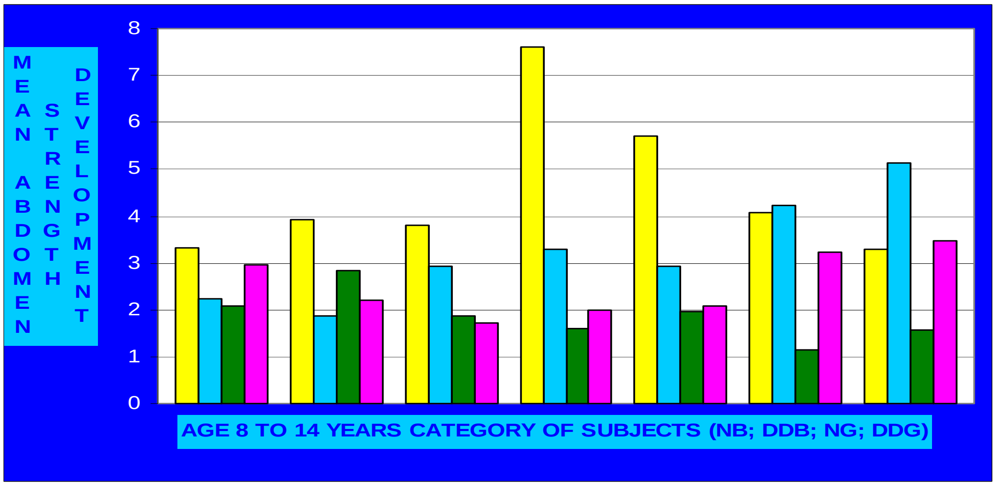


(c) CORRELATION

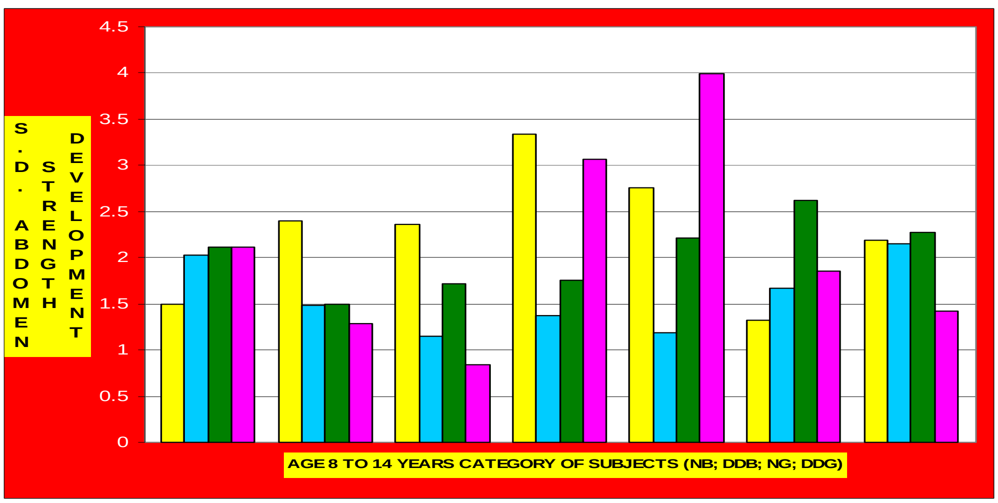


Graph No. III.6 (a), (b), (c): GRAPHICAL REPRESENTATION OF THE COMPARISON OF THE DEVELOPMENT OF ABDOMEN EXPLOSIVE STRENGTH OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 TO 14 YEARS (SIT-UPS)

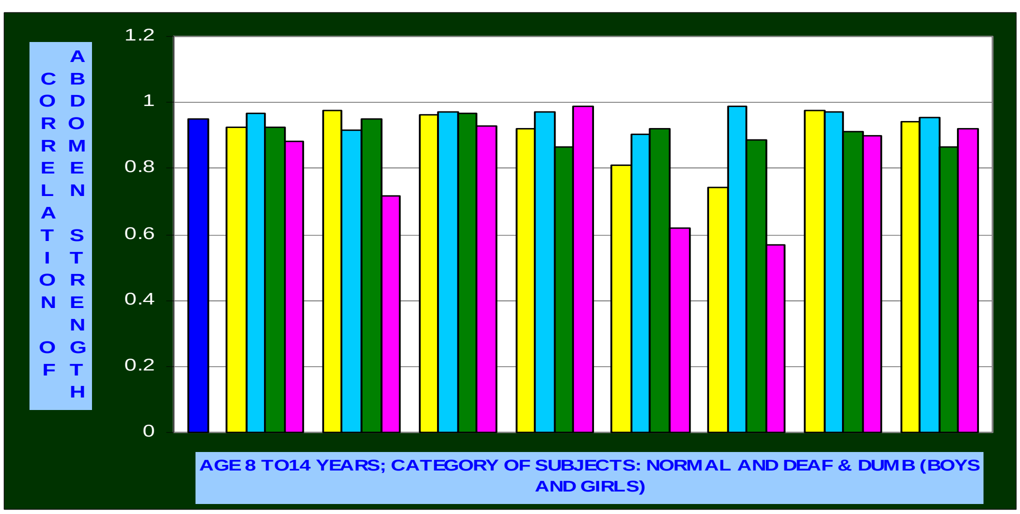
(a) MEAN



(b) STANDARD DEVIATION

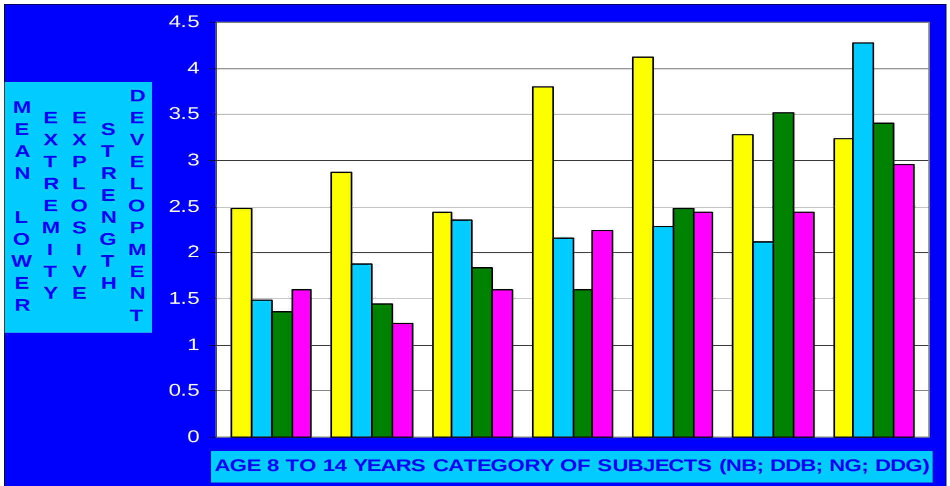


(c) CORRELATION

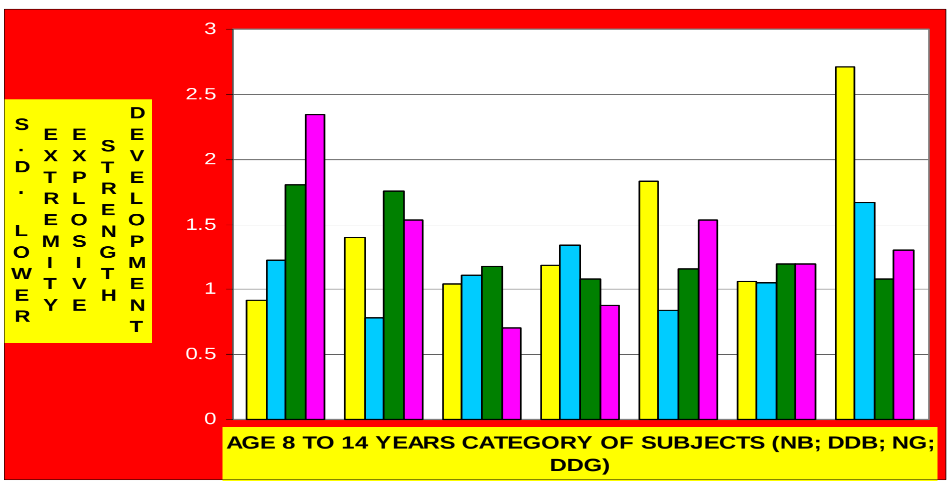


Graph No. III. 7 (a), (b), (c): GRAPHICAL REPRESENTATION OF THE COMPARISON OF THE DEVELOPMENT OF LOWER EXTREMITIES EXPLOSIVE STRENGTH OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 TO 14 YEARS (STANDING VERTICAL JUMP)

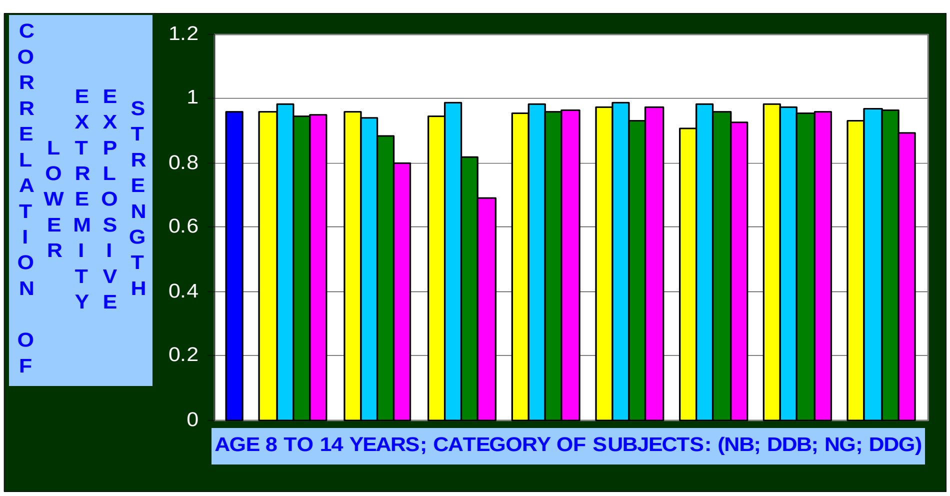
(a) MEAN



(b) STANDARD DEVIATION

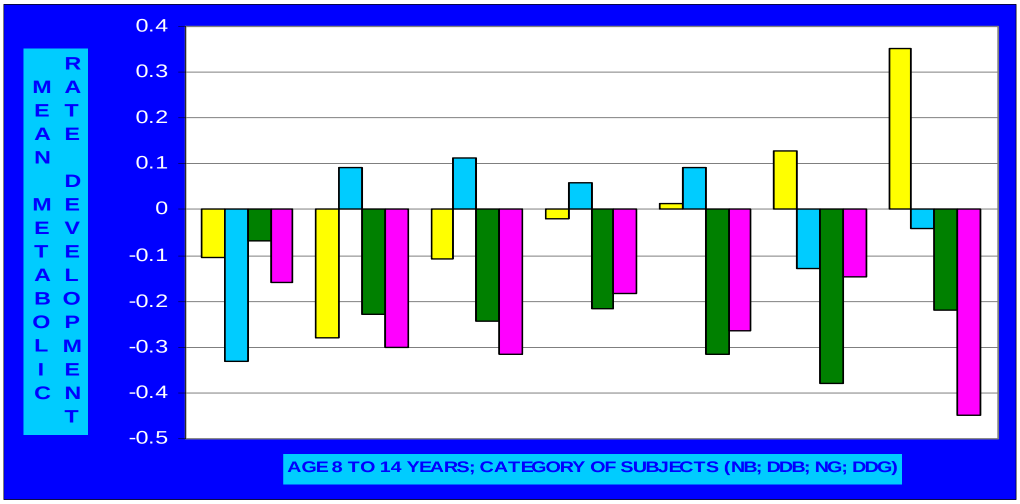


(c) CORRELATION

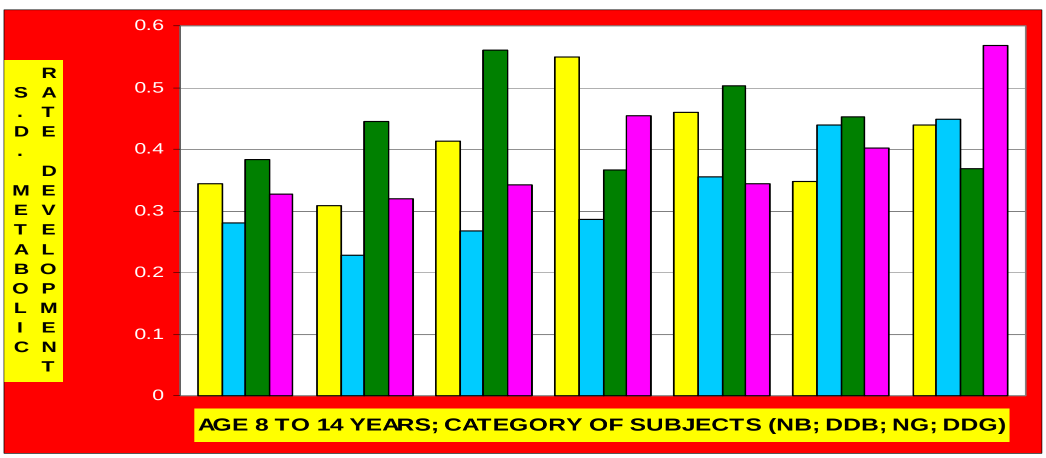


Graph No. III. 8 (a), (b), (c): GRAPHICAL REPRESENTATION OF THE COMPARISON OF THE DEVELOPMENT OF METABOLIC EQUIVALENT (ENDURANCE) OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 TO 14 YEARS (20 METERS SHUTTLE RUN – CANADIAN FIT TEST)

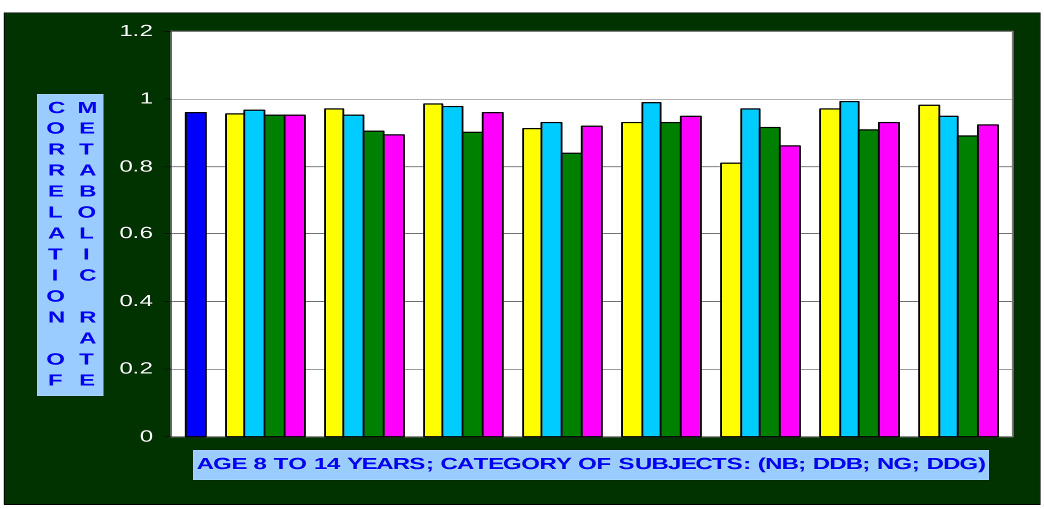
(a) MEAN



(b) STANDARD DEVIATION

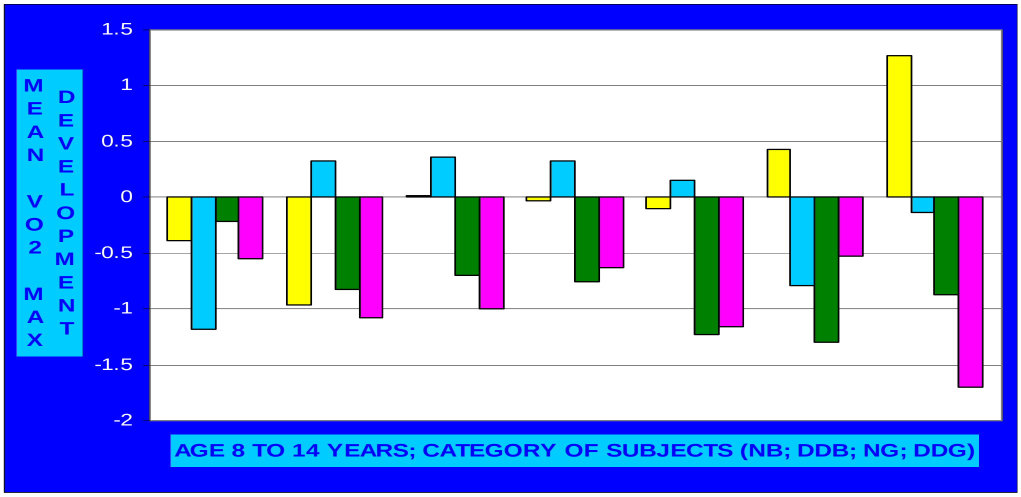


(c) CORRELATION

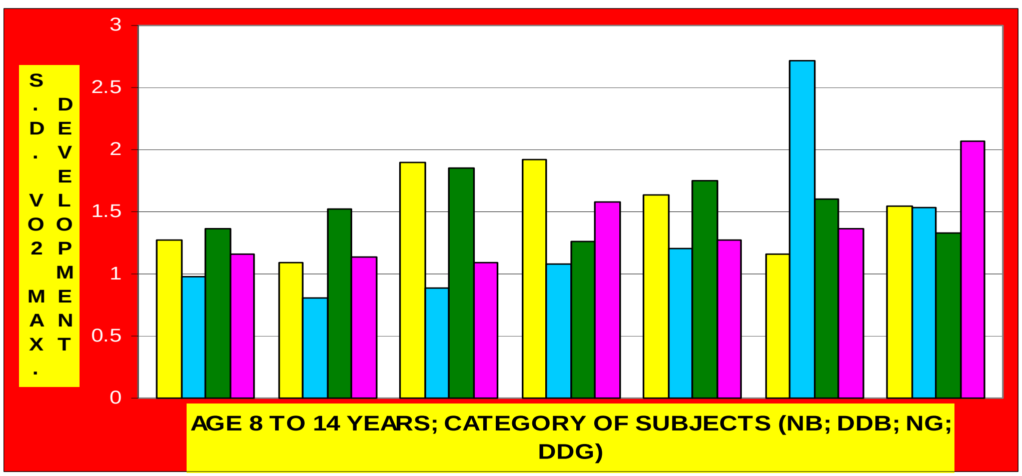


Graph No. III. 9 (a), (b), (c): GRAPHICAL REPRESENTATION OF THE COMPARISON OF THE DEVELOPMENT OF MAXIMUM OXYGEN UPTAKE CAPACITY – VO_2 MAX. (ENDURANCE) OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 TO 14 YEARS (20 METERS SHUTTLE RUN – CANADIAN FIT TEST)

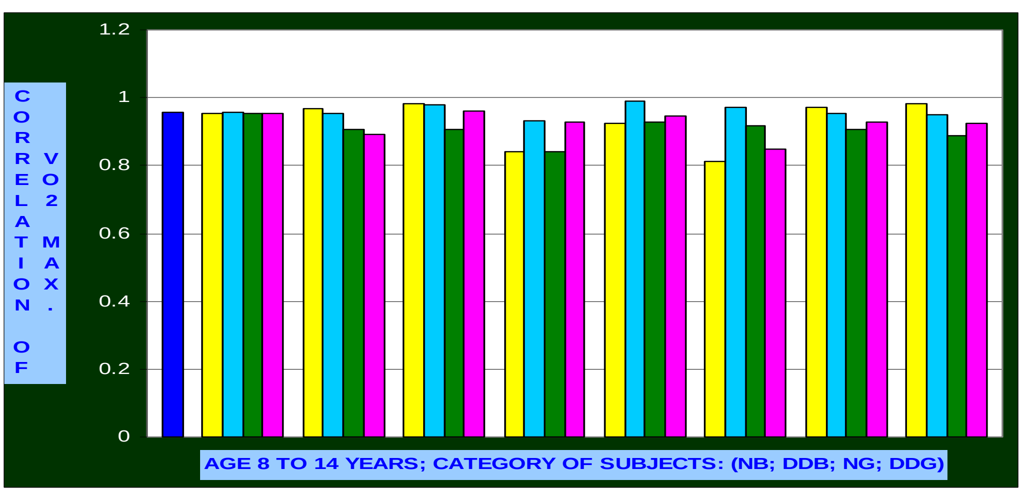
(a) MEAN



(b) STANDARD DEVIATION

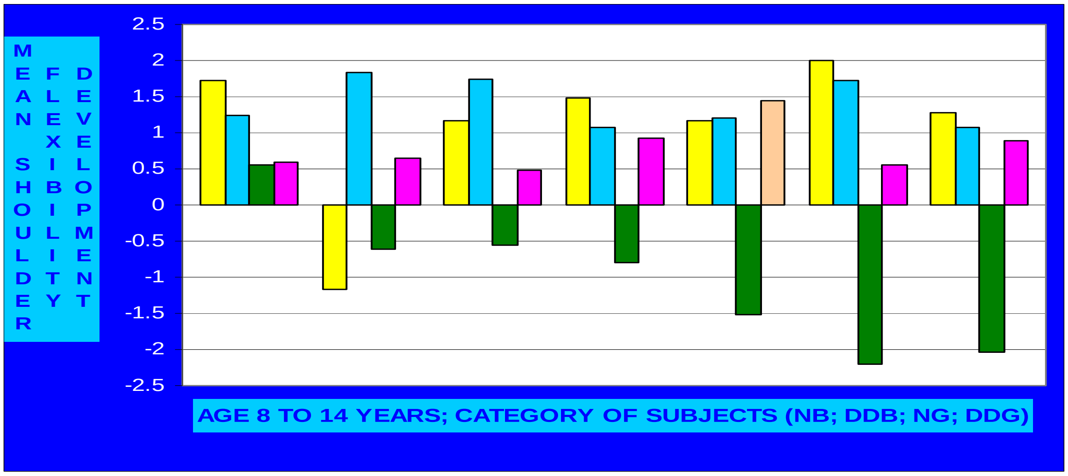


(c) CORRELATION

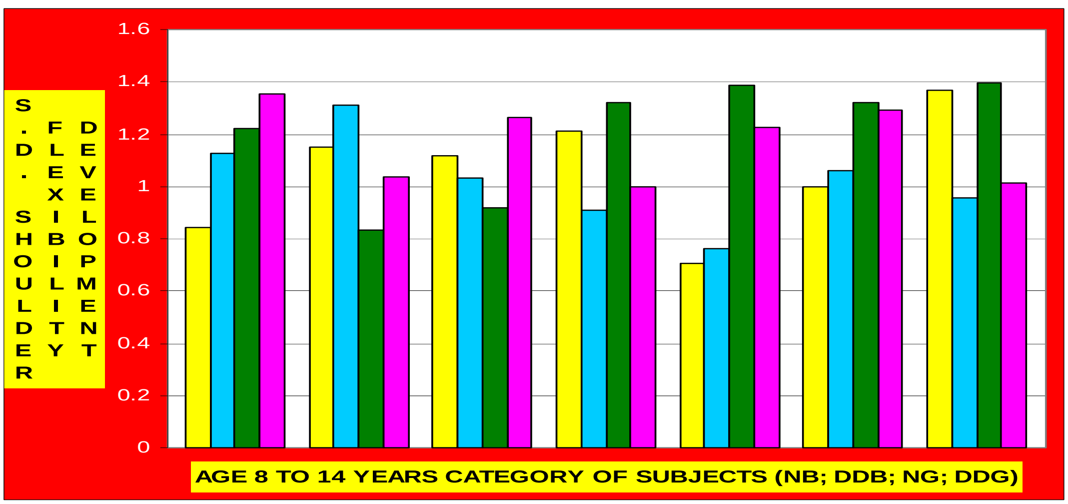


Graph No. III. 10 (a), (b), (c): GRAPHICAL REPRESENTATION OF THE COMPARISON OF THE DEVELOPMENT OF SHOULDER FLEXIBILITY OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 TO 14 YEARS (SHOULDER ROTATION TEST)

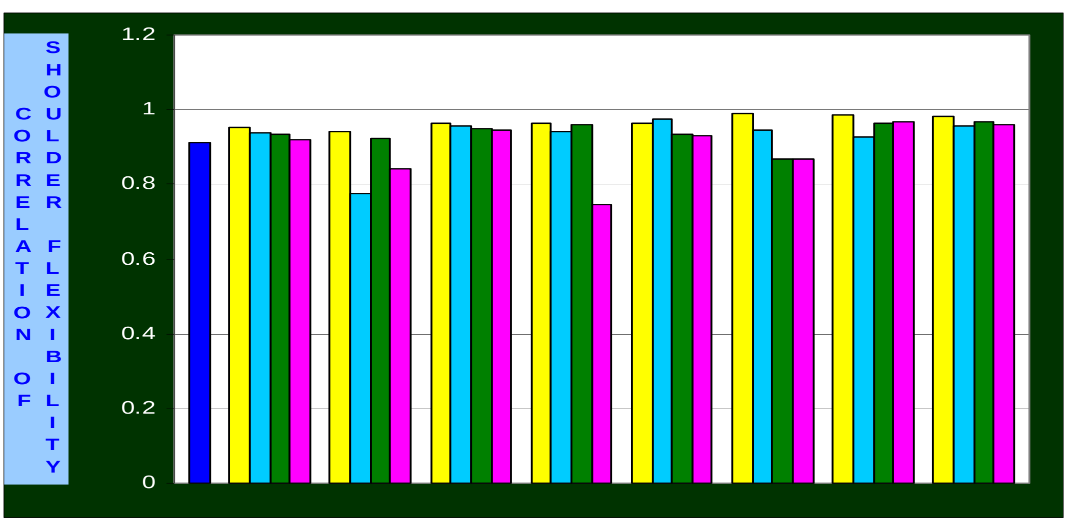
(a) MEAN



(b) STANDANDARD DEVIATION

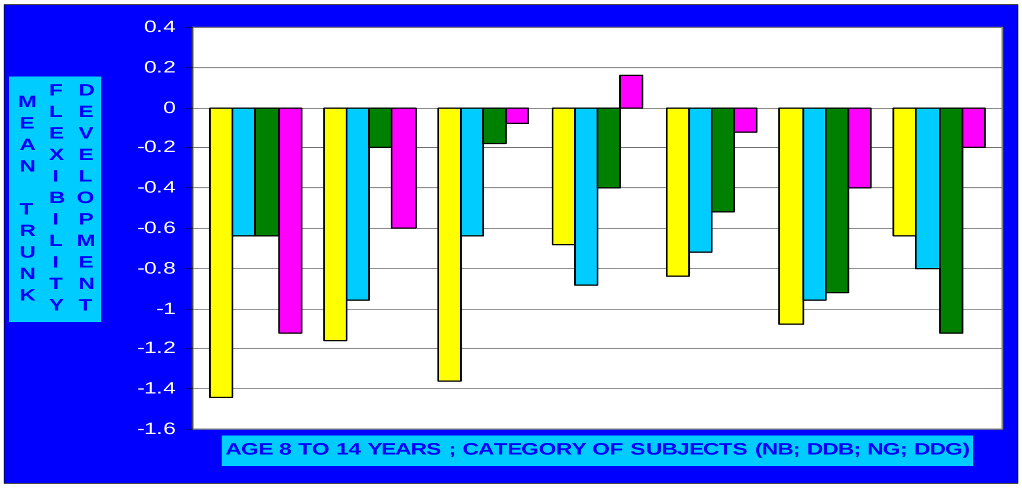


(c) CORRELATION

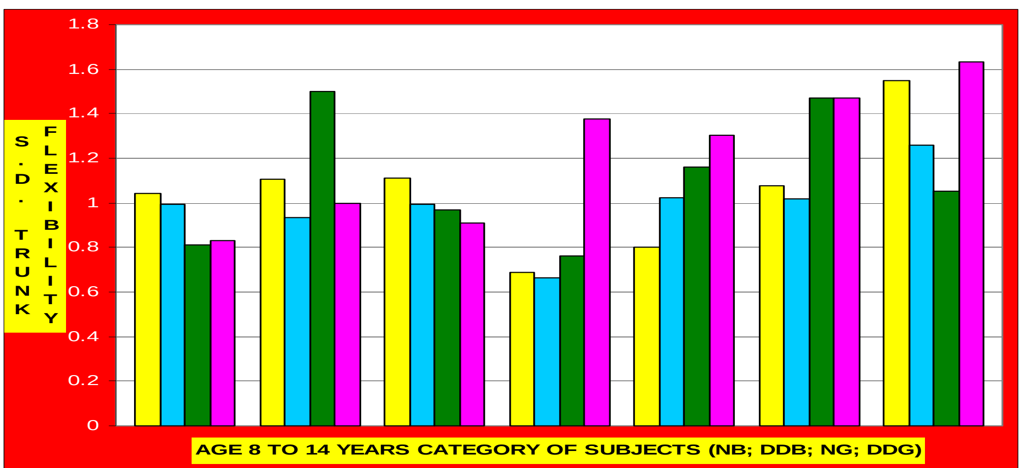


Graph No. III.11 (a), (b), (c): GRAPHICAL REPRESENTATION OF THE COMPARISON OF THE DEVELOPMENT OF TRUNK FLEXIBILITY OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 TO 14 YEARS (FORWARD BEND AND REACH)

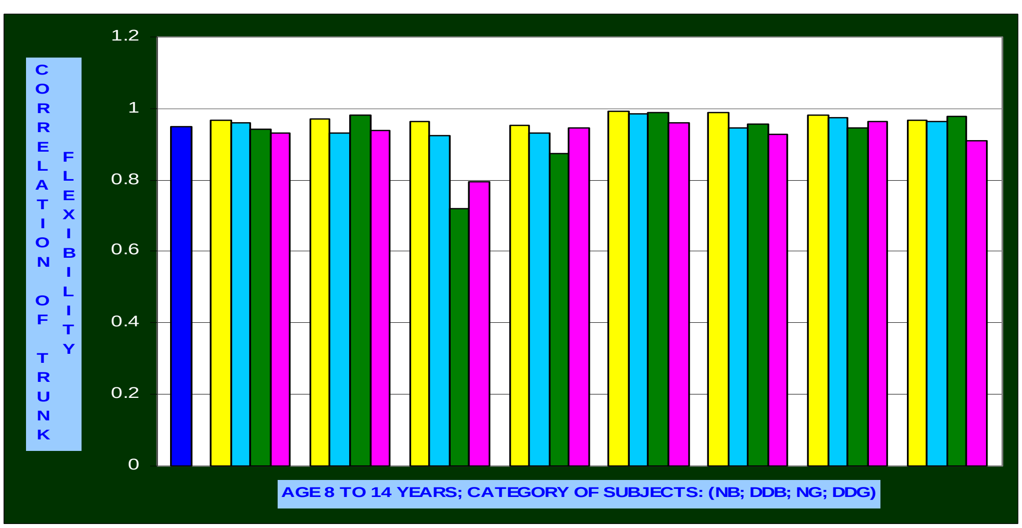
(a) MEAN



(b) STANDARD DEVIATION

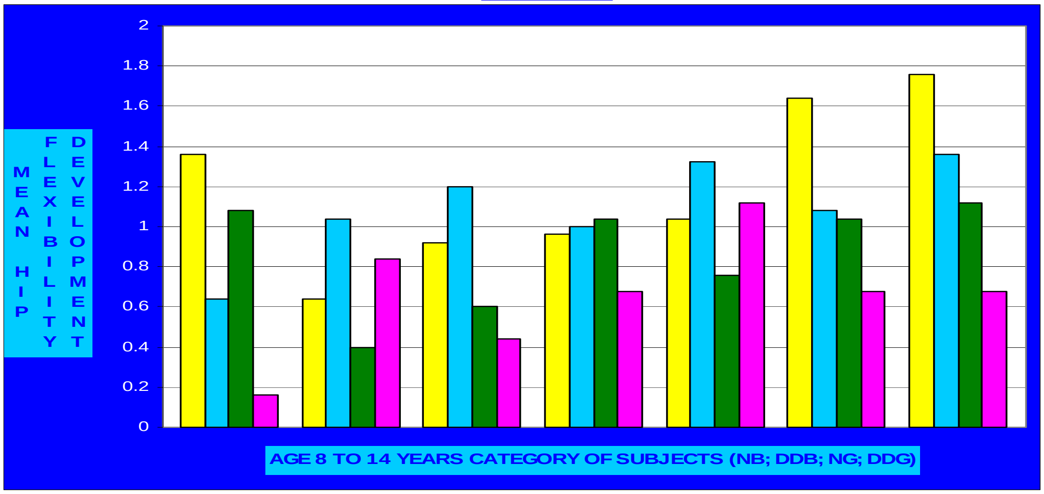


(c) CORRELATION

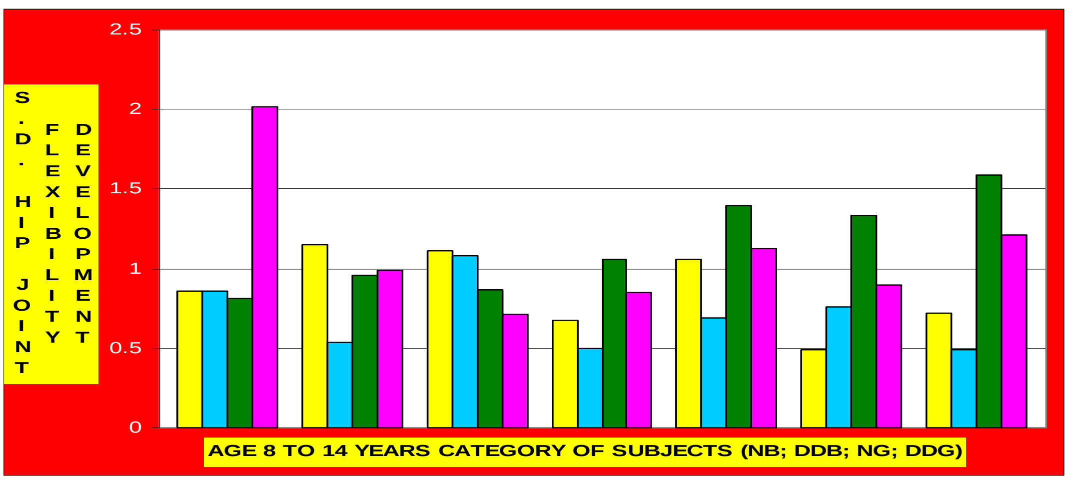


Graph No. III. 12 (a), (b), (c): GRAPHICAL REPRESENTATION OF THE COMPARISON OF THE DEVELOPMENT OF HIP JOINT FLEXIBILITY OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 TO 14 YEARS (SIDE SPLIT TEST)

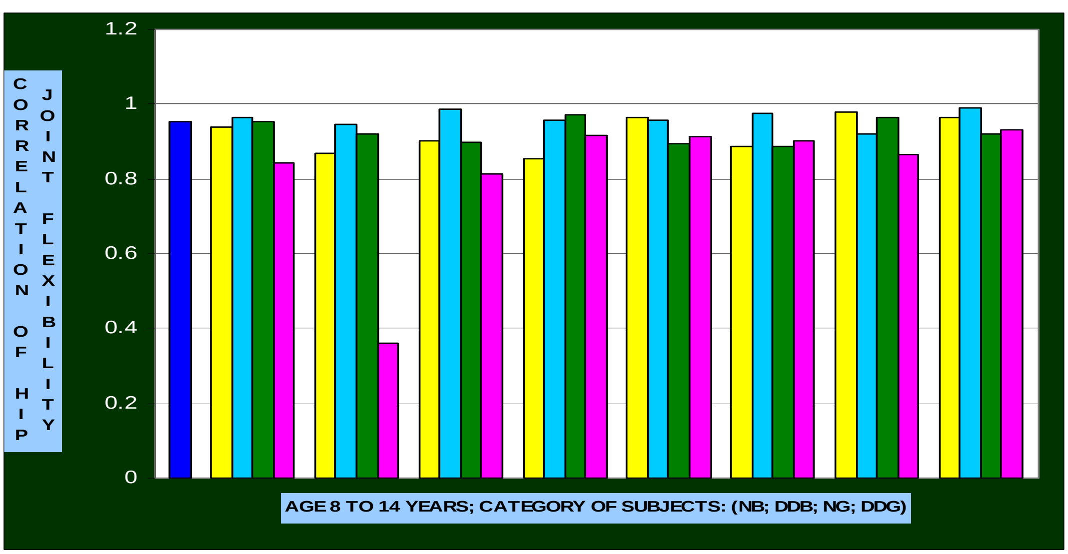
(a) MEAN



(b) STANDARD DEVIATION

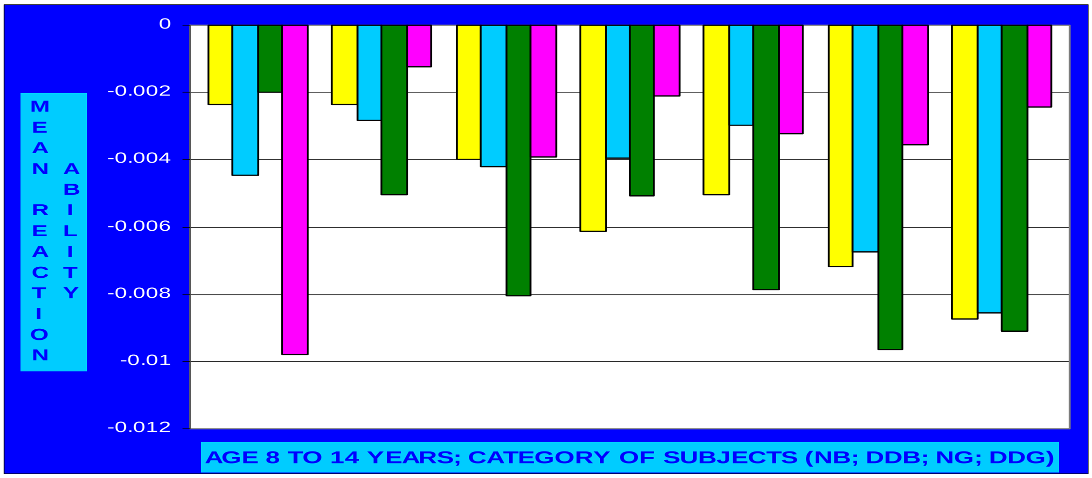


(c) CORRELATION

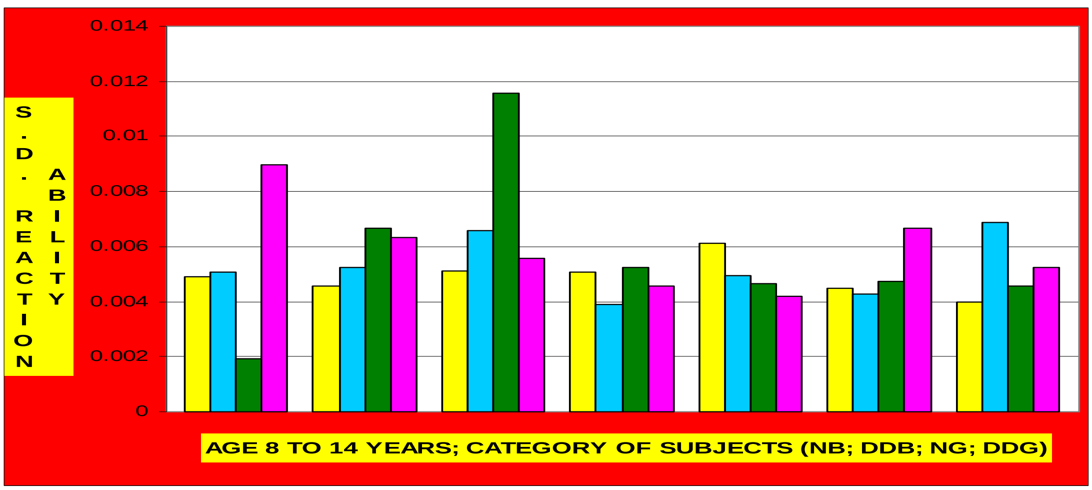


Graph No. III. 13 (a), (b), (c): GRAPHICAL REPRESENTATION OF THE COMPARISON OF THE DEVELOPMENT OF REACTION ABILITY (COORDINATIVE ABILITY) OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 TO 14 YEARS (NELSON'S HAND REACTION TEST)

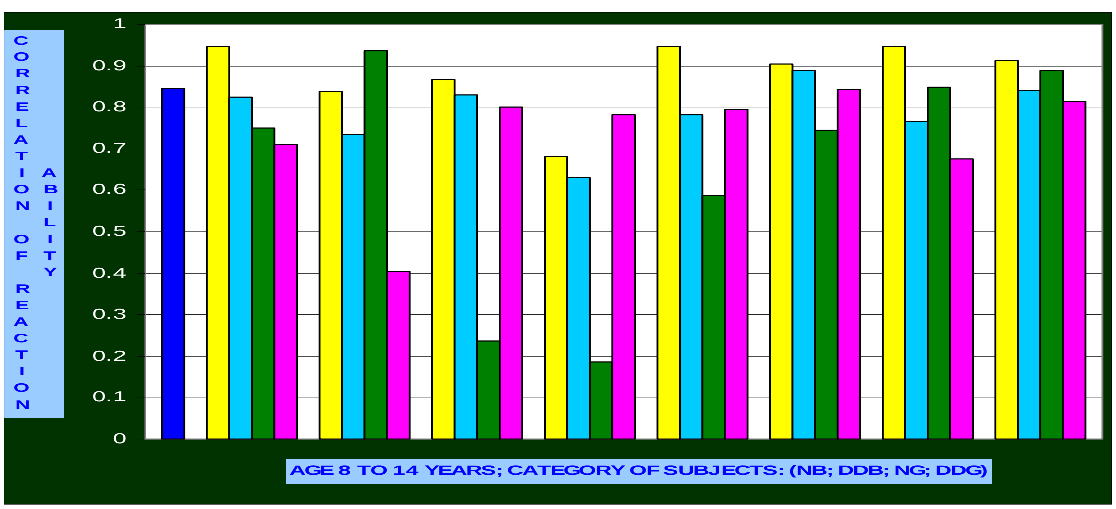
(a) MEAN



(b) STANDARD DEVIATION

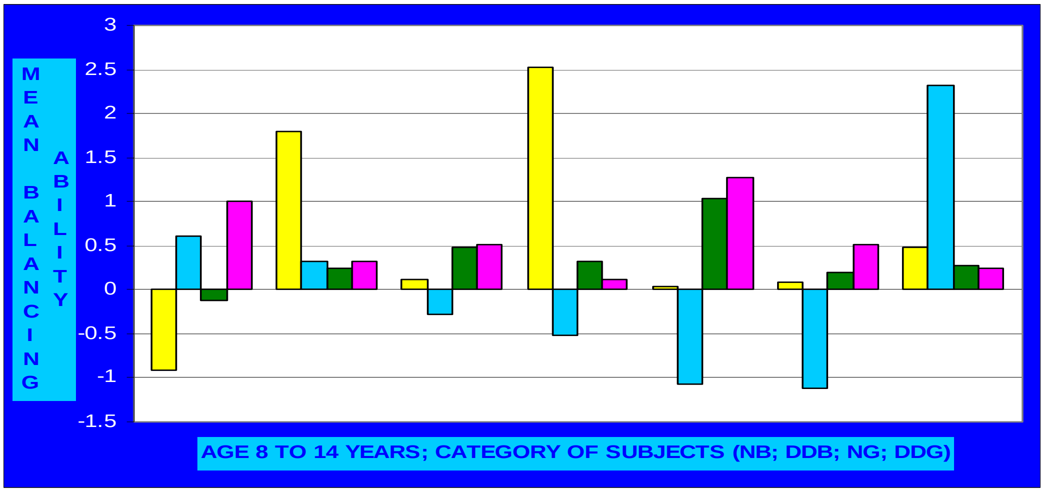


(c) CORRELATION

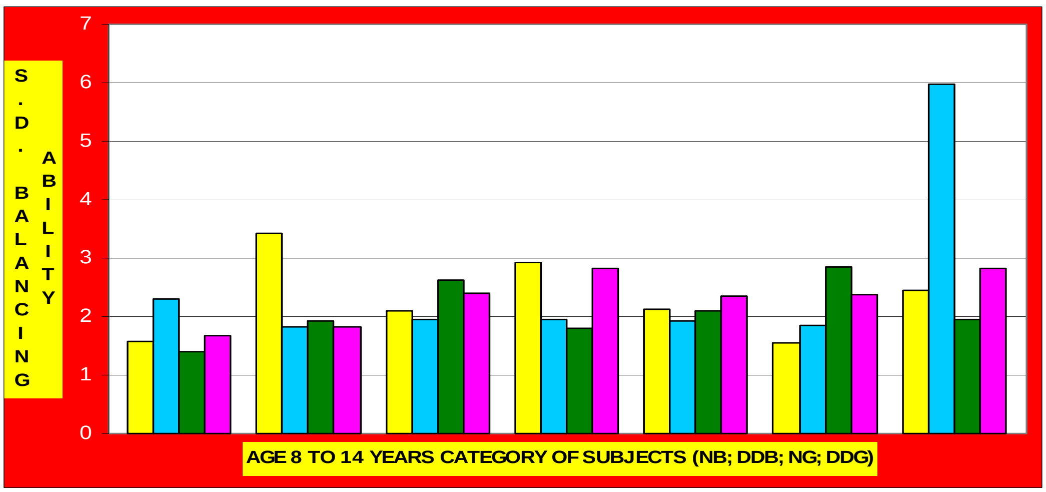


Graph No. III. 14 (a), (b), (c): GRAPHICAL REPRESENTATION OF THE COMPARISON OF THE DEVELOPMENT OF BALANCING ABILITY (COORDINATIVE ABILITY) OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 TO 14 YEARS (STORK STAND TEST)

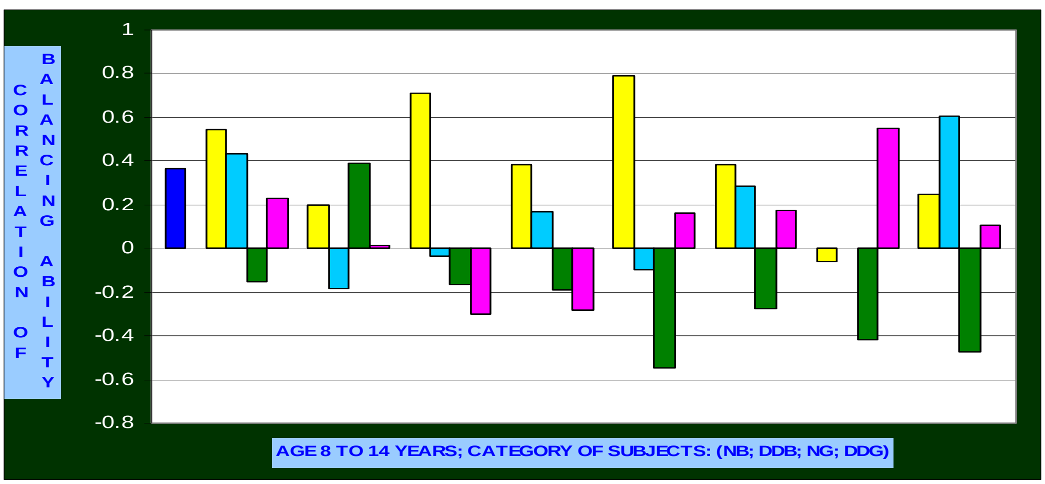
(a) MEAN



(b) STANDARD DEVIATION

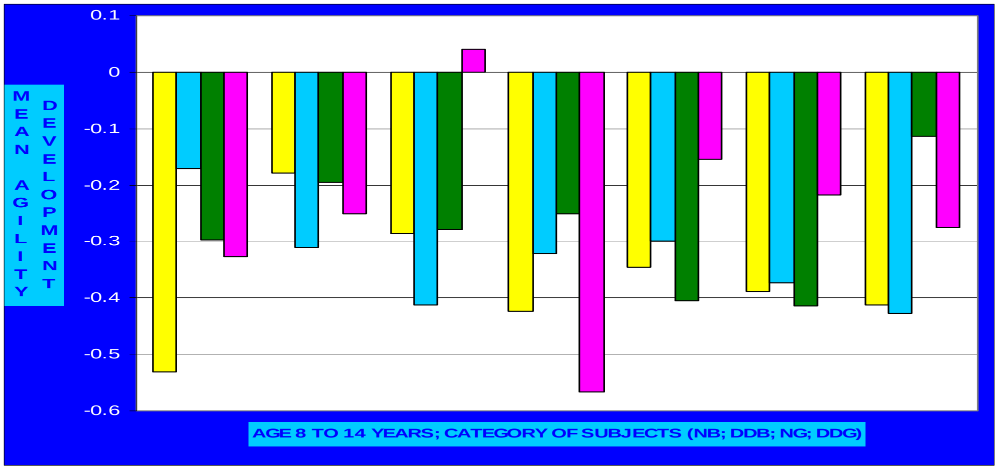


(c) CORRELATION

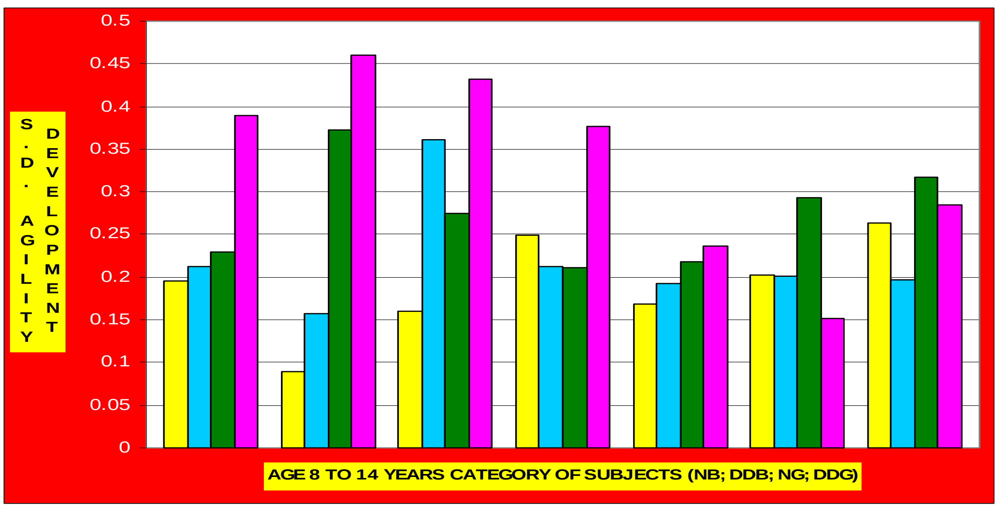


Graph No. III. 15 (a), (b), (c): GRAPHICAL REPRESENTATION OF THE COMPARISON OF THE DEVELOPMENT OF AGILITY (COORDINATIVE ABILITY) OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 TO 14 YEARS (6 X 10 METERS SHUTTLE RUN)

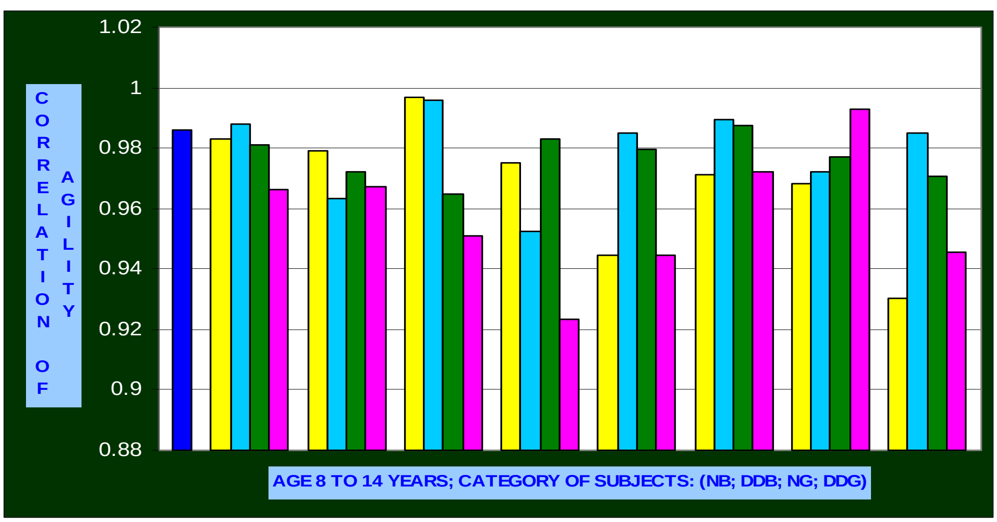
(a) MEAN



(b) STANDARD DEVIATION



(c) CORRELATION



CHAPTER – IV

RESULTS AND DISCUSSIONS

IV.1 - RESULTS:

RESULTS OF THE COMPARISON OF THE GROWTH OF HEIGHT OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 YEARS TO 14 YEARS:

Normal boys:

1. The maximum mean of growth of height in normal boys was found at the age of 14th year, which is 2.96cms and the minimum at 8th year, which is 1.72cms. The average mean growth of height in normal boys between 8 to 14 years is found to be 2.22cms.
2. The standard deviation in growth of height in normal boys is found maximum at the age of 11th year, which is 2.14 and minimum at the age of 8th year, which is 0.54. The average standard deviation of growth of height in normal boys between 8 to 14 years is found to be 1.02.
3. The correlation of growth of height in normal boys between 8 years to 14 years of age groups is found as high as 0.97.

Deaf-dumb boys:

1. The maximum mean of growth of height in deaf-dumb boys was found at the age of 14th year, which is 2.48cms and the minimum at 8th year, which is 1.60cms. The average mean growth of height in deaf-dumb boys between 8 to 14 years is found to be 2.07cms.
2. The standard deviation of growth of height in deaf-dumb boys is found maximum at the age of 14th year, which is 1.00 and minimum at the age of 9th year, which is 0.66. The average standard deviation of growth of height in deaf-dumb boys between 8 to 14 years is found to be 0.79.
3. The correlation of growth of height in deaf-dumb boys between 8 to 14 years of age groups is found as high as 0.98.

Normal girls:

1. The maximum mean of growth of height in normal girls was found at the age of 12th year, which is 3.6cms and the minimum at 8th year, which is 2.04cms. The average mean growth of height in normal girls between 8 to 14 years is found to be 2.70cms.
2. The standard deviation of growth of height in normal girls is found maximum at the age of 11th year, which is 1.32 and minimum at the age of 10th year, which is 0.98. The average standard deviation of growth of height in normal girls between 8 to 14 years is found to be 1.12.
3. The correlation of growth of height in normal girls between 8 to 14 years of age groups is found as high as 0.97.

Deaf-dumb girls:

1. The maximum mean of growth of height in deaf-dumb girls was found at the age of 12th and 13th year, which is 2.2cms and the minimum at 11th year, which is 1.48cms. The average mean growth of height in deaf-dumb girls between 8 to 14 years is found to be 1.85cms.
2. The standard deviation of growth of height in deaf-dumb girls is found maximum at the age of 9th year, which is 1.02 and minimum at the age of 10th year, which is 0.58. The average standard deviation of growth of height in deaf-dumb girls between 8 to 14 years is found to be 0.80.
3. The correlation of growth of height in deaf-dumb girls between 8 to 14 years of age groups is found as high as 0.98.

COMPARISON OF BOYS (Normal and deaf-dumb):

The average mean of growth of height of normal boys between 8 to 14 years is 2.22cms, which is more than 2.07cms of the deaf-dumb boys between 8 to 14years. The difference of mean of growth of height between normal boys and the deaf-dumb boys between 8 to 14 years is 0.15cms, which is insignificant. The maximum mean of growth of height in normal boys and that in the deaf-dumb boys it is found at the age of 14th year, which is 2.96cms and 2.48cms respectively.

Table No. IV.1: evaluation of significance of growth in height in normal and deaf-dumb (boys) by using t-test and F-test.

BOYS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NB & DDB	0.271	0.049	Insignificant
09 NB & DDB	0.345	0.569	insignificant
10 NB & DDB	0.359	0.013	insignificant
11 NB & DDB	0.134	0.717	insignificant
12 NB & DDB	0.211	0.072	Insignificant
13 NB & DDB	0.362	0.604	insignificant
14 NB & DDB	0.029	0.132	insignificant

* Significant at 0.05 level

COMPARISON OF GIRLS (Normal and deaf-dumb):

The average mean of growth of height of normal girls between 8 to 14 years is 2.70cms, which is more than 1.85cms of the deaf-dumb girls between 8 to 14 years. The difference of mean of growth of height between normal girls and the deaf-dumb girls between 8 to 14 years is 0.85cms, which is insignificant. The maximum mean of growth of height in normal girls and that in the deaf-dumb girls it is found at the age of 12th year, which is 3.6cms and 2.2cms respectively.

Table No. IV.2: evaluation of significance of growth in height in normal and deaf-dumb (girls) by using t-test and F-test.

GIRLS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NG & DDG	0.131	0.311	Insignificant
09 NG & DDG	0.008	0.939	Insignificant

10 NG & DDG	0.29	0.013	Insignificant
11 NG & DDG	0.002	0.010	insignificant
12 NG & DDG	0.47	0.415	Insignificant
13 NG & DDG	0.001	0.046	Insignificant
14 NG & DDG	0.069	0.013	insignificant

* Significant at 0.05 level.

RESULTS OF THE COMPARISON OF THE GROWTH OF WEIGHT OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 YEARS TO 14 YEARS (WEIGHING SCALE):

Normal boys:

1. The maximum mean of growth of body weight in normal boys was found at the age of 14th year, which is 2.88kg and the minimum at 8th year, which is 1.36kg. The average mean of growth of weight in normal boys between 8 to 14 years is found to be 1.95kg.
2. The standard deviation of growth of weight in normal boys is found maximum at the age of 10th year, which is 1.11 and minimum at the age of 13th year, which is 0.62. The average standard deviation of growth of weight in normal boys between 8 to 14 years is found to be 0.93.
3. The correlation of growth of weight in normal boys between 8 to 14 years of age groups is found as high as 0.97.

Deaf-dumb boys:

1. The maximum mean of growth of weight in deaf-dumb boys was found at the age of 13th year, which is 2.08kg and the minimum at 8th year, which is 0.80kg. The average mean of growth of weight in deaf-dumb boys between 8 to 14 years is found to be 1.42kg.
2. The standard deviation of growth of weight in deaf-dumb boys is found maximum at the age of 9th year, which is 1.25 and minimum at the age of 10th year, which is 0.74. The average standard deviation of growth of weight in deaf-dumb boys between 8 to 14 years is found to be 1.03.
3. The correlation of growth of weight in deaf-dumb boys between 8 to 14 years of age groups is found as high as 0.96.

Normal girls:

1. The maximum mean of growth of weight in normal girls was found at the age of 12th year, which is 3.24kg and the minimum at 8th year, which is 1.32kg. The average mean of growth of weight in normal girls between 8 to 14 years is found to be 2.10kg.
2. The standard deviation of growth of weight in normal girls is found maximum at the age of 13th year, which is 1.52 and minimum at the age of 8th year, which is 0.85. The average standard deviation of growth of weight in normal girls between 8 to 14 years is found to be 1.02.
3. The correlation of growth of weight in normal girls between 8 to 14 years of age groups is found as high as 0.95.

Deaf-dumb girls:

The maximum mean of growth of weight in deaf-dumb girls was found at the age of 13th year, which is 1.92kg and the minimum at 11th year, which is 0.68kg. The average mean of growth of weight in deaf-dumb girls between 8 to 14 years is found to be 1.25kg.

1. The standard deviation of growth of weight in deaf-dumb girls is found maximum at the age of 13th year, which is 2.30 and minimum at the age of 11th year, which is 0.62. The average standard deviation of growth of weight in deaf-dumb girls between 8 to 14 years is found to be 1.20.
2. The correlation of growth of weight in deaf-dumb girls between 8 to 14 years of age groups is found as high as 0.94.

COMPARISON OF BOYS (Normal and deaf-dumb):

The average mean of growth of weight of normal boys between 8 to 14 years is 1.95kg, which is more than 1.42kg of the deaf-dumb boys between 8 to 14 years. The difference of mean of growth of weight between normal boys and the deaf-dumb boys between 8 to 14 years is 0.53kg, which is insignificant. The maximum mean of growth of weight in normal boys is found at 14th year, which is 2.88kg and that in the deaf-dumb boys it is found at the age of 13th year, which is 2.08kg.

Table No. IV.3: evaluation of significance of growth in weight in normal and deaf-dumb (boys) by using t-test and F-test.

BOYS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NB & DDB	0.011	0.747	Insignificant
09 NB & DDB	0.007	0.063	Insignificant
10 NB & DDB	0.002	0.055	Insignificant
11 NB & DDB	0.228	0.402	insignificant
12 NB & DDB	0.450	0.623	Insignificant
13 NB & DDB	0.141	0.074	Insignificant
14 NB & DDB	0.0004	0.773	insignificant

* Significant at 0.05 level.

COMPARISON OF GIRLS (Normal and deaf-dumb):

The average mean of growth of weight of normal girls between 8 to 14 years is 2.10kg, which is more than 1.25kg of the deaf-dumb girls between 8 to 14 years. The difference of mean of growth of weight between normal girls and the deaf-dumb girls between 8 to 14 years is 0.85kg, which is insignificant. The maximum mean of growth of weight in normal girls is found at 12th year, which is 3.24kg and that in the deaf-dumb girls it is found at the age of 13th year, which is 1.92kg.

Table No. IV.4: evaluation of significance of growth in weight in normal and deaf-dumb (girls) by using t-test and F-test.

GIRLS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NG & DDG	0.332	0.253	Insignificant
09 NG & DDG	0.041	0.581	Insignificant

10 NG & DDG	0.0001	0.999	Insignificant
11 NG & DDG	0.0003	0.015	insignificant
12 NG & DDG	0.1501	0.670	Insignificant
13 NG & DDG	0.038	0.047	Insignificant
14 NG & DDG	0.058	0.379	insignificant

* Significant at 0.05 level.

RESULTS OF THE COMPARISON OF THE DEVELOPMENT OF ACCELERATION (SPEED) OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 YEARS TO 14 YEARS (50 YARD DASH):

Normal boys:

1. The maximum mean of development of acceleration ability in normal boys was found at the age of 8th year, which is -0.52sec and the minimum at 9th year, which is -0.19sec. The average mean of development of acceleration ability in normal boys between 8 to 14 years is found to be -0.31sec.
2. The standard deviation of development of acceleration ability in normal boys is found maximum at the age of 12th year, which is 0.28 and minimum at the age of 9th year, which is 0.09. The average standard deviation of development of acceleration ability in normal boys between 8 to 14 years is found to be 0.18.
3. The correlation of development of acceleration ability in normal boys between 8 years to 14 years of age groups is found as high as 0.94.

Deaf-dumb boys:

1. The maximum mean of development of acceleration ability in deaf-dumb boys was found at the age of 14th year, which is -0.42sec and the minimum at 8th year, which is -0.22sec. The average mean of development of acceleration ability in deaf-dumb boys between 8 to 14 years is found to be -0.32sec.
2. The standard deviation of development of acceleration ability in deaf-dumb boys is found maximum at the age of 10th year, which is 0.30 and minimum at the age of 12th year, which is 0.20 The average standard deviation of development of acceleration ability in deaf-dumb boys between 8 to 14 years is found to be 0.23.
3. The correlation of development of acceleration ability in deaf-dumb boys between 8 to 14 years of age groups is found as high as 0.82.

Normal girls:

1. The maximum mean of development of acceleration ability in normal girls was found at the age of 12th year, which is -0.36sec and the minimum at 10th year, which is -0.18sec. The average mean of development of acceleration ability in normal girls between 8 to 14 years is found to be -0.24sec.
2. The standard deviation of development of acceleration ability in normal girls is found maximum at the age of 12th year, which is 0.28 and minimum at the age of 9th year, which is 0.13. The average standard deviation of development of acceleration ability in normal girls between 8 to 14 years is found to be 0.20.
3. The correlation of development of acceleration ability in normal girls between 8 to 14 years of age groups is found as high as 0.90.

Deaf-dumb girls:

1. The maximum mean of development of acceleration ability in deaf-dumb girls was found at the age of 8th year, which is -0.42sec and the minimum at 13th years, which is 0.09sec. The average mean of development of acceleration ability in deaf-dumb girls between 8 to 14 years is found to be -.22sec.
2. The standard deviation of development of acceleration ability in deaf-dumb girls is found maximum at the age of 8th year, which is 0.48 and minimum at the age of 9th year, which is 0.19. The average standard deviation of development of acceleration ability in deaf-dumb girls between 8 to 14 years is found to be 0.34.
3. The correlation of development of acceleration ability in deaf-dumb girls between 8 to 14 years of age groups is found as high as 0.84.

COMPARISON OF BOYS (Normal and deaf-dumb):

The average mean of development of acceleration ability of normal boys between 8 to 14 years is -0.31sec, which is more than -0.32sec of the deaf-dumb boys between 8 to 14 years. The difference of mean of development of acceleration ability between normal boys and the deaf-dumb boys between 8 to 14 years is -0.01sec, which is insignificant. The maximum mean of development of acceleration ability in normal boys is found at the age of 8th year, which is -0.52sec and that in the deaf-dumb boys it is at the age of 14th year, which is -0.42sec.

Table No. IV.5: evaluation of significance of development in acceleration ability in normal and deaf-dumb (boys) by using t-test and F-test.

BOYS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NB & DDB	0.103	0.968	Insignificant
09 NB & DDB	0.048	0.79	Insignificant
10 NB & DDB	0.022	0.220	Insignificant
11 NB & DDB	0.357	0.424	insignificant
12 NB & DDB	0.377	0.141	Insignificant
13 NB & DDB	0.205	0.132	Insignificant
14 NB & DDB	0.001	0.063	insignificant

* Significant at 0.05 level

COMPARISON OF GIRLS (Normal and deaf-dumb):

The average mean of development of acceleration ability of normal girls between 8 to 14 years is -0.24, which is less than -0.22sec of the deaf-dumb girls between 8 to 14 years. The difference of mean of development of acceleration ability between normal girls and the deaf-dumb girls between 8 to 14 years is -0.02sec, which is insignificant. The maximum mean of development of acceleration ability in normal girls is found at the age of 12th year, which is -0.36sec and that in the deaf-dumb girls it is at the age of 8th year, which is -0.42sec.

Table No. IV.6: evaluation of significance of development in acceleration ability in normal and deaf-dumb (girls) by using t-test and F-test.

GIRLS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NG & DDG	0.015	0.516	Insignificant
09 NG & DDG	0.279	0.074	Insignificant
10 NG & DDG	0.361	0.005	Insignificant
11 NG & DDG	0.124	0.003	insignificant
12 NG & DDG	0.094	0.071	Insignificant
13 NG & DDG	0.0004	0.753	Insignificant
14 NG & DDG	0.234	0.114	insignificant

* Significant at 0.05 level

RESULTS OF THE COMPARISON OF THE DEVELOPMENT OF LOCOMOTION ABILITY (SPEED) OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 YEARS TO 14 YEARS (30METERS FLYING START):

Normal boys:

1. The maximum mean of development of locomotion ability in normal boys was found at the age of 8th year, which is -.036sec and the minimum at 9th year, which is -0.21sec. The average mean of development of locomotion ability in normal boys between 8 to 14 years is found to be -0.26sec.
2. The standard deviation of development of locomotion ability in normal boys is found maximum at the age of 8th year, which is -0.041 and minimum at the age of 11th year, which is -0.002. The average standard deviation of development of locomotion ability in normal boys between 8 to 14 years is found to be 0.0002.
3. The correlation of development of locomotion ability in normal boys between 8 years to 14 years of age groups is found as high as 0.93.

Deaf-dumb boys:

1. The maximum mean of development of locomotion ability in deaf-dumb boys was found at the age of 14th year, which is -0.26sec and the minimum at 11th year, which is -0.02sec. The average mean of development of locomotion ability in deaf-dumb boys between 8 to 14 years is found to be -0.015sec.
2. The standard deviation of development of locomotion ability in deaf-dumb boys is found maximum at the age of 11th year, which is 0.42 and minimum at the age of 14th year, which is 0.004. The average standard deviation of development of locomotion ability in deaf-dumb boys between 8 to 14 years is found to be 0.07.
3. The correlation of development of locomotion ability in deaf-dumb boys between 8 to 14 years of age groups is found as high as 0.92.

Normal girls:

1. The maximum mean of development of locomotion ability in normal girls was found at the age of 11th year, which is -0.37sec and the minimum at 8th year, which is -0.12sec. The average mean of development of locomotion ability in normal girls between 8 to 14 years is found to be -0.24sec.

2. The standard deviation of development of locomotion ability in normal girls is found maximum at the age of 8th year, which is 0.095 and minimum at the age of 13th year, which is -0.029. The average standard deviation of development of locomotion ability in normal girls between 8 to 14 years is found to be 0.043.
3. The correlation of development of locomotion ability in normal girls between 8 to 14 years of age groups is found as high as 0.91.

Deaf-dumb girls:

1. The maximum mean of development of locomotion ability in deaf-dumb girls was found at the age of 13th year, which is -0.24sec and the minimum at 9th years, which is -0.0004sec. The average mean of development of locomotion ability in deaf-dumb girls between 8 to 14 years is found to be -0.12sec.
2. The standard deviation of development of locomotion ability in deaf-dumb girls is found maximum at the age of 9th year, which is 0.40 and minimum at the age of 13th year, which is 0.023. The average standard deviation of development of locomotion ability in deaf-dumb girls between 8 to 14 years is found to be 0.12.
3. The correlation of development of locomotion ability in deaf-dumb girls between 8 to 14 years of age groups is found as high as 0.88.

COMPARISON OF BOYS (Normal and deaf-dumb):

The average mean of development of locomotion ability of normal boys between 8 to 14 years is -0.26sec, which is less than -0.15sec of the deaf-dumb boys between 8 to 14 years. The difference of mean of development of locomotion ability between normal boys and the deaf-dumb boys between 8 to 14 years is -0.11sec, which is insignificant. The maximum mean of development of locomotion ability in normal boys is found at the age of 8th year, which is -0.36sec and that in the deaf-dumb boys it is at the age of 14th year, which is -0.26sec.

Table No. IV.7: evaluation of significance of development in locomotion ability in normal and deaf-dumb (boys) by using t-test and F-test.

BOYS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NB & DDB	0.253	0.016	Insignificant
09 NB & DDB	0.305	0.126	Insignificant
10 NB & DDB	0.012	0.296	Insignificant
11 NB & DDB	0.157	0.664	insignificant
12 NB & DDB	0.302	0.479	Insignificant
13 NB & DDB	0.103	0.009	Insignificant
14 NB & DDB	0.109	0.914	insignificant

* Significant at 0.05 level

COMPARISON OF GIRLS (Normal and deaf-dumb):

The average mean of development of locomotion ability of normal girls between 8 to 14 years is -0.24sec, which is more than -0.12sec of the deaf-dumb girls between 8 to 14 years. The difference of mean of development of locomotion ability between normal girls and that in the deaf-dumb girls is -0.12sec, which is insignificant. The maximum mean of development of locomotion ability in normal girls is found at the age of 11th year, which is -0.37sec and that in the deaf-dumb girls it is at the age of 13th year, which is -0.24sec.

Table No. IV.8: evaluation of significance of development in locomotion ability in normal and deaf-dumb (girls) by using t-test and F-test.

GIRLS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NG & DDG	0.119	0.300	Insignificant
09 NG & DDG	0.027	0.320	Insignificant
10 NG & DDG	0.755	0.010	Insignificant
11 NG & DDG	0.1606	0.253	insignificant
12 NG & DDG	0.0008	0.162	Insignificant
13 NG & DDG	0.063	0.923	Insignificant
14 NG & DDG	0.283	0.168	insignificant

* Significant at 0.05 level

RESULTS OF THE COMPARISON OF THE DEVELOPMENT OF UPPER EXTREMITIES EXPLOSIVE STRENGTH OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 YEARS TO 14 YEARS (MEDICINE BALL THROW):

Normal boys:

1. The maximum mean of development of upper extremity explosive strength in normal boys was found at the age of 14th year, which is 0.22mts and the minimum at 11th year, which is 0.07mts. The average mean of development of upper extremity explosive strength in normal boys between 8 to 14 years is found to be 0.13mts.
2. The standard deviation of development of upper extremity explosive strength in normal boys is found maximum at the age of 14th year, which is 0.16 and minimum at the age of 12th year, which is 0.042. The average standard deviation of development of upper extremity explosive strength in normal boys between 8 to 14 years is found to be 0.08.
3. The correlation of development of upper extremity explosive strength in normal boys between 8 years to 14 years of age groups is found as high as 0.98.

Deaf-dumb boys:

1. The maximum mean of development of upper extremity explosive strength in deaf-dumb boys was found at the age of 14th year, which is 0.24mts and the minimum at 8th year, which is 0.08mts. The average mean of development of upper extremity explosive strength in deaf-dumb boys between 8 to 14 years is found to be 0.13mts.
2. The standard deviation of development of upper extremity explosive strength in deaf-dumb boys is found maximum at the age of 8th year, which is 0.14 and minimum at the age of 11th year, which is 0.055. The average standard deviation of development of upper extremity explosive strength in deaf-dumb boys between 8 to 14 years is found to be 0.07.
3. The correlation of development of upper extremity explosive strength in deaf-dumb boys between 8 to 14 years of age groups is found as high as 0.97.

Normal girls:

1. The maximum mean of development of upper extremity explosive strength in normal girls was found at the age of 11th year, which is 0.17mts and the minimum at 12th year, which is 0.11mts. The average mean of development of upper extremity explosive strength in normal girls between 8 to 14 years is found to be 0.14mts.
2. The standard deviation of development of upper extremity explosive strength in normal girls is found maximum at the age of 11th year, which is 0.12 and minimum at the age of 14th year, which is 0.05. The average standard deviation of development of upper extremity explosive strength in normal girls between 8 to 14 years is found to be 0.08.
3. The correlation of development of upper extremity explosive strength in normal girls between 8 to 14 years of age groups is found as high as 0.95.

Deaf-dumb girls:

1. The maximum mean of development of upper extremity explosive strength in deaf-dumb girls was found at the age of 8th year, which is 0.16mts and the minimum at 9th years, which is 0.09mts. The average mean of development of upper extremity explosive strength in deaf-dumb girls between 8 to 14 years is found to be 0.12mts.
2. The standard deviation of development of upper extremity explosive strength in deaf-dumb girls is found maximum at the age of 8th year, which is 0.10 and minimum at the age of 10th year, which is 0.051. The average standard deviation of development of upper extremity explosive strength in deaf-dumb girls between 8 to 14 years is found to be 0.06.
3. The correlation of development of upper extremity explosive strength in deaf-dumb girls between 8 to 14 years of age groups is found as high as 0.96.

COMPARISON OF BOYS (Normal and deaf-dumb):

The average mean of development of upper extremity explosive strength of normal boys between 8 to 14 years is 0.13mts, which is equal to 0.13mts of the deaf-dumb boys between 8 to 14 years. The difference of mean of development of upper extremity explosive strength between normal boys and that in the deaf-dumb boys is 0.00mts, which is insignificant. The maximum mean of development of upper extremity explosive strength in normal boys is found at the age of 14th year, which is 0.22mts and that in the deaf-dumb boys it is at the age of 14th year, which is 0.24mts.

Table No. IV.9: evaluation of significance of development in upper extremity explosive strength in normal and deaf-dumb (boys) by using t-test and F-test.

BOYS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NB & DDB	0.061	0.707	Insignificant
09 NB & DDB	0.299	0.064	Insignificant
10 NB & DDB	0.126	0.084	Insignificant
11 NB & DDB	0.009	0.235	insignificant
12 NB & DDB	0.414	0.0020	Insignificant
13 NB & DDB	0.995	0.129	Insignificant
14 NB & DDB	0.326	0.124	insignificant

* Significant at 0.05 level

COMPARISON OF GIRLS (Normal and deaf-dumb):

The average mean of development of upper extremity explosive strength of normal girls between 8 to 14 years is 0.14mts, which is more than 0.12mts of the deaf-dumb girls between 8 to 14 years. The difference of mean of development of upper extremity explosive strength between normal girls and that in the deaf-dumb girls is 0.02mts, which is insignificant. The maximum mean of development of upper extremity explosive strength in normal girls is found at the age of 11th year, which is 0.17mts and that in the deaf-dumb girls it is at the age of 8th year, which is 0.16mts.

Table No. IV.10: evaluation of significance of development in upper extremity explosive strength in normal and deaf-dumb (girls) by using t-test and F-test.

GIRLS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NG & DDG	0.377	0.198	Insignificant
09 NG & DDG	0.0033	0.272	Insignificant
10 NG & DDG	0.160	0.315	Insignificant
11 NG & DDG	0.044	0.007	insignificant
12 NG & DDG	0.318	0.044	Insignificant
13 NG & DDG	0.429	0.198	Insignificant
14 NG & DDG	0.451	0.809	insignificant

* Significant at 0.05 level.

RESULTS OF THE COMPARISON OF THE DEVELOPMENT OF ABDOMEN STRENGTH OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 YEARS TO 14 YEARS (SIT-UPS):

Normal boys:

1. The maximum mean of development of abdomen explosive strength in normal boys was found at the age of 11th year, which is 7.6 and the minimum at 14th year, which is 3.28. The average mean of development of abdomen explosive strength in normal boys between 8 to 14 years is found to be 4.53.
2. The standard deviation of development of abdomen explosive strength in normal boys is found maximum at the age of 11th year, which is 3.34 and minimum at the age of 13th year, which is 1.32. The average standard deviation of development of abdomen explosive strength in normal boys between 8 to 14 years is found to be 2.20.
3. The correlation of development of abdomen explosive strength in normal boys between 8 years to 14 years of age groups is found as high as 0.90.

Deaf-dumb boys:

1. The maximum mean of development of abdomen explosive strength in deaf-dumb boys was found at the age of 14th year, which is 5.12 and the minimum at 9th year, which is 1.88. The average mean of development of abdomen explosive strength in deaf-dumb boys between 8 to 14 years is found to be 3.22.
2. The standard deviation of development of abdomen explosive strength in deaf-dumb boys is found maximum at the age of 14th year, which is 2.14 and minimum

at the age of 10th year, which is 1.15. The average standard deviation of development of abdomen explosive strength in deaf-dumb boys between 8 to 14 years is found to be 1.57.

3. The correlation of development of abdomen explosive strength in deaf-dumb boys between 8 to 14 years of age groups is found as high as 0.94.

Normal girls:

1. The maximum mean of development of abdomen explosive strength in normal girls was found at the age of 9th year, which is 2.84 and the minimum at 13th year, which is 1.16. The average mean of development of abdomen explosive strength in normal girls between 8 to 14 years is found to be 1.86.
2. The standard deviation of development of abdomen explosive strength in normal girls is found maximum at the age of 13th year, which is 2.62 and minimum at the age of 9th year, which is 1.49. The average standard deviation of development of abdomen explosive strength in normal girls between 8 to 14 years is found to be 2.02.
3. The correlation of development of abdomen explosive strength in normal girls between 8 to 14 years of age groups is found as high as 0.90.

Deaf-dumb girls:

1. The maximum mean of development of abdomen explosive strength in deaf-dumb girls was found at the age of 14th year, which is 3.48 and the minimum at 10th years, which is 1.72. The average mean of development of abdomen explosive strength in deaf-dumb girls between 8 to 14 years is found to be 2.52.
2. The standard deviation of development of abdomen explosive strength in deaf-dumb girls is found maximum at the age of 12th year, which is 3.98 and minimum at the age of 10th year, which is 0.84. The average standard deviation of development of abdomen explosive strength in deaf-dumb girls between 8 to 14 years is found to be 2.07.
3. The correlation of development of abdomen explosive strength in deaf-dumb girls between 8 to 14 years of age groups is found as high as 0.79.

COMPARISON OF BOYS (Normal and deaf-dumb):

The average mean of development of abdomen explosive strength of normal boys between 8 to 14 years is 4.53, which is more to 3.22 that of the deaf-dumb boys between 8 to 14 years. The difference of mean of development of abdomen explosive strength between normal boys and that in the deaf-dumb boys is 1.31, which is insignificant. The maximum mean of development of abdomen explosive strength in normal boys is found at the age of 11th year, which is 7.60 and that in the deaf-dumb boys it is at the age of 14th year, which is 5.12.

Table No. IV.11: evaluation of significance of development in abdomen strength in normal and deaf-dumb (boys) by using t-test and F-test.

BOYS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NB & DDB	0.018	0.140	Insignificant
09 NB & DDB	0.0003	0.021	Insignificant

10 NB & DDB	0.050	0.0008	Insignificant
11 NB & DDB	0.137	0.445	insignificant
12 NB & DDB	0.125	0.0001	Insignificant
13 NB & DDB	0.354	0.262	Insignificant
14 NB & DDB	0.002	0.924	insignificant

* Significant at 0.05 level

COMPARISON OF GIRLS (Normal and deaf-dumb):

The average mean of development of abdomen explosive strength of normal girls between 8 to 14 years is 1.86, which is less than 2.52 of the deaf-dumb girls between 8 to 14 years. The difference of mean of development of abdomen explosive strength between normal girls and that in the deaf-dumb girls is 0.66, which is insignificant. The maximum mean of development of abdomen explosive strength in normal girls is found at the age of 9th year, which is 2.84 and that in the deaf-dumb girls it is at the age of 14th year, which is 3.48.

Table No. IV.12: evaluation of significance of development in abdomen strength in normal and deaf-dumb (girls) by using t-test and F-test.

GIRLS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NG & DDG	0.073	0.984	Insignificant
09 NG & DDG	0.055	0.485	Insignificant
10 NG & DDG	0.338	0.0009	Insignificant
11 NG & DDG	0.287	0.008	insignificant
12 NG & DDG	0.447	0.005	Insignificant
13 NG & DDG	0.001	0.095	Insignificant
14 NG & DDG	0.0003	0.024	insignificant

* Significant at 0.05 level.

RESULTS OF THE COMPARISON OF THE DEVELOPMENT OF LOWER EXTREMITIES EXPLOSIVE STRENGTH OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 YEARS TO 14 YEARS (STANDING VERTICAL JUMP):

Normal boys:

1. The maximum mean of development of lower extremities explosive strength in normal boys was found at the age of 12th year, which is 4.12cms and the minimum at 14th year, which is 3.24cms. The average mean of development of lower extremities explosive strength in normal boys between 8 to 14 years is found to be 3.17cms.
2. The standard deviation of development of lower extremities explosive strength in normal boys is found maximum at the age of 14th year, which is 2.17 and minimum at the age of 8th year, which is 0.91. The average standard deviation of development of lower extremities explosive strength in normal boys between 8 to 14 years is found to be 1.44.

3. The correlation of development of lower extremities explosive strength in normal boys between 8 years to 14 years of age groups is found as high as 0.94.

Deaf-dumb boys:

1. The maximum mean of development of lower extremities explosive strength in deaf-dumb boys was found at the age of 14th year, which is 4.28cms and the minimum at 8th year, which is 1.48cms. The average mean of development of lower extremities explosive strength in deaf-dumb boys between 8 to 14 years is found to be 2.36cms.
2. The standard deviation of development of lower extremities explosive strength in deaf-dumb boys is found maximum at the age of 14th year, which is 1.67 and minimum at the age of 9th year, which is 0.78. The average standard deviation of development of lower extremities explosive strength in deaf-dumb boys between 8 to 14 years is found to be 1.14.
3. The correlation of development of lower extremities explosive strength in deaf-dumb boys between 8 to 14 years of age groups is found as high as 0.97.

Normal girls:

1. The maximum mean of development of lower extremities explosive strength in normal girls was found at the age of 13th year, which is 3.52cms and the minimum at 8th year, which is 1.36cms. The average mean of development of lower extremities explosive strength in normal girls between 8 to 14 years is found to be 2.23cms.
2. The standard deviation of development of lower extremities explosive strength in normal girls is found maximum at the age of 8th year, which is 1.80 and minimum at the age of 11th year, which is 1.08. The average standard deviation of development of lower extremities explosive strength in normal girls between 8 to 14 years is found to be 1.31.
3. The correlation of development of lower extremities explosive strength in normal girls between 8 to 14 years of age groups is found as high as 0.92.

Deaf-dumb girls:

1. The maximum mean of development of lower extremities explosive strength in deaf-dumb girls was found at the age of 14th year, which is 2.96cms and the minimum at 9th years, which is 1.24cms. The average mean of development of lower extremities explosive strength in deaf-dumb girls between 8 to 14 years is found to be 2.07cms.
2. The standard deviation of development of lower extremities explosive strength in deaf-dumb girls is found maximum at the age of 8th year, which is 2.07 and minimum at the age of 8th year, which is 2.34. The average standard deviation of development of lower extremities explosive strength in deaf-dumb girls between 8 to 14 years is found to be 1.35.
3. The correlation of development of lower extremities explosive strength in deaf-dumb girls between 8 to 14 years of age groups is found as high as 0.88.

COMPARISON OF BOYS (Normal and deaf-dumb):

The average mean of development of lower extremities explosive strength of normal boys between 8 to 14 years is 3.17cms, which is more to 2.36cms that of the deaf-dumb boys between 8 to 14 years. The difference of mean of development of lower extremities explosive strength between normal boys and that in the deaf-dumb boys is

0.81cms, which is insignificant. The maximum mean of development of lower extremities explosive strength in normal boys is found at the age of 12th year, which is 4.12cms and that in the deaf-dumb boys it is at the age of 14th year, which is 4.28cms.

Table No. IV.13: evaluation of significance of development in lower extremity explosive strength in normal and deaf-dumb (boys) by using t-test and F-test.

BOYS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NB & DDB	0.0010	0.160	Insignificant
09 NB & DDB	0.001	0.006	Insignificant
10 NB & DDB	0.397	0.754	Insignificant
11 NB & DDB	0.175	0.556	insignificant
12 NB & DDB	0.175	0.0003	Insignificant
13 NB & DDB	0.0001	0.971	Insignificant
14 NB & DDB	0.054	0.021	insignificant

* Significant at 0.05 level.

COMPARISON OF GIRLS (Normal and deaf-dumb):

The average mean of development of lower extremities explosive strength of normal girls between 8 to 14 years is 2.23cms, which is more than 2.07cms of the deaf-dumb girls between 8 to 14 years. The difference of mean of development of lower extremities explosive strength between normal girls and that in the deaf-dumb girls is 0.16cms, which is insignificant. The maximum mean of development of lower extremities explosive strength in normal girls is found at the age of 13th year, which is 3.52cms and that in the deaf-dumb girls it is at the age of 14th year, which is 2.96cms.

Table No. IV.14: evaluation of significance of development of lower extremity explosive strength in normal and deaf-dumb (girls) by using t-test and F-test.

GIRLS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NG & DDG	0.343	0.202	Insignificant
09 NG & DDG	0.335	0.511	Insignificant
10 NG & DDG	0.193	0.015	Insignificant
11 NG & DDG	0.012	0.320	insignificant
12 NG & DDG	0.458	0.181	Insignificant
13 NG & DDG	0.001	0.995	Insignificant
14 NG & DDG	0.100	0.357	insignificant

* Significant at 0.05 level.

RESULTS AND DISCUSSIONS OF THE COMPARISON OF THE DEVELOPMENT OF METABOLIC RATE (ENDURANCE) OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 YEARS TO 14 YEARS (20 METERS SHUTTLE RUN – CANADIAN FIT TEST):

Normal boys:

1. The maximum mean of development of metabolic rate in normal boys was found at the age of 14th year, which is 0.352 and the minimum at 12th year, which is 0.012. The average mean of development of metabolic rate normal boys between 8 to 14 years is found to be -0.001.
2. The standard deviation of development of metabolic rate in normal boys is found maximum at the age of 11th year, which is 0.54 and minimum at the age of 9th year, which is 0.03. The average standard deviation of development of metabolic rate in normal boys between 8 to 14 years is found to be 0.40.
3. The correlation of development of metabolic rate in normal boys between 8 years to 14 years of age groups is found as high as 0.93.

Deaf-dumb boys:

1. The maximum mean of development of metabolic rate in deaf-dumb boys was found at the age of 8th year, which is -0.332 and the minimum at 14th year, which is -0.04. The average mean of development of metabolic rate in deaf-dumb boys between 8 to 14 years is found to be -0.06.
2. The standard deviation of development of metabolic rate in deaf-dumb boys is found maximum at the age of 14th year, which is 0.44 and minimum at the age of 9th year, which is 0.22. The average standard deviation of development of metabolic rate in deaf-dumb boys between 8 to 14 years is found to be 0.32.
3. The correlation of development of metabolic rate in deaf-dumb boys between 8 to 14 years of age groups is found as high as 0.96.

Normal girls:

1. The maximum mean of development of metabolic rate in normal girls was found at the age of 13th year, which is -0.38 and the minimum at 8th year, which is -0.068. The average mean of development of metabolic rate in normal girls between 8 to 14 years is found to be -0.238.
2. The standard deviation of development of metabolic rate in normal girls is found maximum at the age of 10th year, which is 0.55 and minimum at the age of 11th year, which is 0.365. The average standard deviation of development of metabolic rate in normal girls between 8 to 14 years is found to be 0.43.
3. The correlation of development of metabolic rate in normal girls between 8 to 14 years of age groups is found as high as 0.89.

Deaf-dumb girls:

1. The maximum mean of development of metabolic rate in deaf-dumb girls was found at the age of 14th year, which is -0.448 and the minimum at 13th years, which is -0.148. The average mean of development of metabolic rate in deaf-dumb girls between 8 to 14 years is found to be -0.26.
2. The standard deviation of development of metabolic rate in deaf-dumb girls is found maximum at the age of 14th year, which is 0.56 and minimum at the age of 9th year, which is 0.31. The average standard deviation of development of metabolic rate in deaf-dumb girls between 8 to 14 years is found to be 0.38.
3. The correlation of development of metabolic rate in deaf-dumb girls between 8 to 14 years of age groups is found as high as 0.91.

COMPARISON OF BOYS (Normal and deaf-dumb):

The average mean of development of metabolic rate of normal boys between 8 to 14 years is -0.001, which is less to -0.06 that of the deaf-dumb boys between 8 to 14 years. The difference of mean of development of metabolic rate between normal boys and that in the deaf-dumb boys is -0.059, which is insignificant. The maximum mean of development of metabolic rate in normal boys is found at the age of 14th year, which is 0.35 and that in the deaf-dumb boys it is at the age of 8th year, which is -0.33.

Table No. IV.15: evaluation of significance of development of metabolic rate in normal and deaf-dumb (boys) by using t-test and F-test.

BOYS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NB & DDB	0.006	0.319	Insignificant
09 NB & DDB	0.656	0.141	Insignificant
10 NB & DDB	0.014	0.036	Insignificant
11 NB & DDB	0.260	0.002	insignificant
12 NB & DDB	0.247	0.208	Insignificant
13 NB & DDB	0.013	0.255	Insignificant
14 NB & DDB	0.0015	0.911	insignificant

* Significant at 0.05 level.

COMPARISON OF GIRLS (Normal and deaf-dumb):

The average mean of development of metabolic rate of normal girls between 8 to 14 years is -0.23, which is more to -0.26 of the deaf-dumb girls between 8 to 14 years. The difference of mean of development of metabolic rate between normal girls and that in the deaf-dumb girls is -0.03, which is insignificant. The maximum mean of development of metabolic rate in normal girls is found at the age of 13th year, which is -0.38 and that in the deaf-dumb girls it is at the age of 14th year, which is -0.44.

Table No. IV.16: evaluation of significance of development of metabolic rate in normal and deaf-dumb (girls) by using t-test and F-test.

GIRLS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NG & DDG	0.182	0.454	Insignificant
09 NG & DDG	0.256	0.109	Insignificant
10 NG & DDG	0.292	0.019	Insignificant
11 NG & DDG	0.392	0.300	insignificant
12 NG & DDG	0.335	0.068	Insignificant
13 NG & DDG	0.030	0.572	Insignificant
14 NG & DDG	0.049	0.037	insignificant

* Significant at 0.05 level.

RESULTS OF THE COMPARISON OF THE DEVELOPMENT OF MAXIMUM OXYGEN UPTAKE CAPACITY – VO_2 MAX (ENDURANCE) OF BOYS AND

GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 YEARS TO 14 YEARS (20 METERS SHUTTLE RUN – CANADIAN FIT TEST):

Normal boys:

1. The maximum mean of development of maximum oxygen uptake capacity – VO_2 max in normal boys was found at the age of 14th year, which is 1.272 and the minimum at 10th year, which is 0.012. The average mean of development of maximum oxygen uptake capacity – VO_2 max normal boy between 8 to 14 years is found to be -.33.
2. The standard deviation of development of maximum oxygen uptake capacity – VO_2 max in normal boys is found maximum at the age of 11th year, which is 1.91 and minimum at the age of 9th year, which is 1.08. The average standard deviation of development of maximum oxygen uptake capacity – VO_2 max in normal boys between 8 to 14 years is found to be 1.48.
3. The correlation of development of maximum oxygen uptake capacity – VO_2 max in normal boys between 8 years to 14 years of age groups is found as high as 0.92.

Deaf-dumb boys:

1. The maximum mean of development of maximum oxygen uptake capacity – VO_2 max in deaf-dumb boys was found at the age of 8th year, which is -0.388 and the minimum at 12th year, which is 0.148. The average mean of development of maximum oxygen uptake capacity – VO_2 max in deaf-dumb boys between 8 to 14 years is found to be -0.13.
2. The standard deviation of development of maximum oxygen uptake capacity – VO_2 max in deaf-dumb boys is found maximum at the age of 13th year, which is 2.72 and minimum at the age of 9th year, which is 0.80. The average standard deviation of development of maximum oxygen uptake capacity – VO_2 max in deaf-dumb boys between 8 to 14 years is found to be 1.03.
3. The correlation of development of maximum oxygen uptake capacity – VO_2 max in deaf-dumb boys between 8 to 14 years of age groups is found as high as 0.95.

Normal girls:

1. The maximum mean of development of maximum oxygen uptake capacity – VO_2 max in normal girls was found at the age of 13th year, which is -1.3 and the minimum at 8th year, which is -0.21. The average mean of development of maximum oxygen uptake capacity – VO_2 max in normal girls between 8 to 14 years is found to be -0.84.
2. The standard deviation of development of maximum oxygen uptake capacity – VO_2 max in normal girls is found maximum at the age of 10th year, which is 1.85 and minimum at the age of 11th year, which is 1.25. The average standard deviation of development of maximum oxygen uptake capacity – VO_2 max in normal girls between 8 to 14 years is found to be 1.52.
3. The correlation of development of maximum oxygen uptake capacity – VO_2 max in normal girls between 8 to 14 years of age groups is found as high as 0.89.

Deaf-dumb girls:

1. The maximum mean of development of maximum oxygen uptake capacity – VO_2 max in deaf-dumb girls was found at the age of 14th year, which is -1.7 and the minimum at 13th years, which is -0.52. The average mean of development of maximum oxygen

uptake capacity – VO_2 max in deaf-dumb girls between 8 to 14 years is found to be -0.94.

2. The standard deviation of development of maximum oxygen uptake capacity – VO_2 max in deaf-dumb girls is found maximum at the age of 14th year, which is 2.06 and minimum at the age of 10th year, which is 1.09. The average standard deviation of development of maximum oxygen uptake capacity – VO_2 max in deaf-dumb girls between 8 to 14 years is found to be 1.37.
3. The correlation of development of maximum oxygen uptake capacity – VO_2 max in deaf-dumb girls between 8 to 14 years of age groups is found as high as 0.90.

COMPARISON OF BOYS (Normal and deaf-dumb):

The average mean of development of maximum oxygen uptake capacity – VO_2 max of normal boys between 8 to 14 years is -0.33, which is less to -0.13 that of the deaf-dumb boys between 8 to 14 years. The difference of mean of development of maximum oxygen uptake capacity – VO_2 max between normal boys and that in the deaf-dumb boys is -0.20, which is insignificant. The maximum mean of development of maximum oxygen uptake capacity – VO_2 max in normal boys is found at the age of 14th year, which is 1.272 and that in the deaf-dumb boys it is at the age of 8th year, which is -0.388.

Table No. IV.17: evaluation of significance of development of VO_2 max in normal and deaf-dumb (boys) by using t-test and F-test.

BOYS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NB & DDB	0.0083	0.213	Insignificant
09 NB & DDB	0.886	0.147	Insignificant
10 NB & DDB	0.205	0.00040	Insignificant
11 NB & DDB	0.211	0.0071	insignificant
12 NB & DDB	0.268	0.133	Insignificant
13 NB & DDB	0.021	0.905	Insignificant
14 NB & DDB	0.0011	0.968	insignificant

* Significant at 0.05 level.

COMPARISON OF GIRLS (Normal and deaf-dumb):

The average mean of development of maximum oxygen uptake capacity – VO_2 max of normal girls between 8 to 14 years is -0.84, which is more than -0.94 of the deaf-dumb girls between 8 to 14 years. The difference of mean of development of 'maximum oxygen uptake capacity' – VO_2 max between normal girls and that in the deaf-dumb girls is -0.10, which is insignificant. The maximum mean of development of 'maximum oxygen uptake capacity' – VO_2 max in normal girls is found at the age of 13th year, which is -1.3 and that in the deaf-dumb girls it is at the age of 14th year, which is -1.7.

Table No. IV.18: evaluation of significance of development of VO_2 max in normal and deaf-dumb (girls) by using t-test and F-test.

GIRLS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NG & DDG	0.179	0.447	Insignificant

09 NG & DDG	0.254	0.160	Insignificant
10 NG & DDG	0.244	0.012	Insignificant
11 NG & DDG	0.380	0.261	insignificant
12 NG & DDG	0.441	0.126	Insignificant
13 NG & DDG	0.035	0.418	Insignificant
14 NG & DDG	0.049	0.034	insignificant

* Significant at 0.05 level.

RESULTS OF THE COMPARISON OF THE DEVELOPMENT OF SHOULDER FLEXIBILITY OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 YEARS TO 14 YEARS (SHOULDER ROTATION TEST):

Normal boys:

1. The maximum mean of development of shoulder flexibility in normal boys was found at the age of 13th year, which is 2.00 and the minimum at 10^{th} & 12th year, which is 1.16. The average mean of development of shoulder flexibility normal boys between 8 to 14 years is found to be 1.09.
2. The standard deviation of development of shoulder flexibility in normal boys is found maximum at the age of 14th year, which is 1.36 and minimum at the age of 12th year, which is 0.70. The average standard deviation of development of shoulder flexibility in normal boys between 8 to 14 years is found to be 1.04.
3. The correlation of development of shoulder flexibility in normal boys between 8 years to 14 years of age groups is found as high as 0.96.

Deaf-dumb boys:

1. The maximum mean of development of shoulder flexibility in deaf-dumb boys was found at the age of 9th year, which is 1.84 and the minimum at 11^{th} & 14^{th} year, which is 1.08. The average mean of development of shoulder flexibility in deaf-dumb boys between 8 to 14 years is found to be 1.41.
2. The standard deviation of development of shoulder flexibility in deaf-dumb boys is found maximum at the age of 9th year, which is 1.31 and minimum at the age of 12th year, which is 0.76. The average standard deviation of development of shoulder flexibility in deaf-dumb boys between 8 to 14 years is found to be 1.018.
3. The correlation of development of shoulder flexibility in deaf-dumb boys between 8 to 14 years of age groups is found as high as 0.92.

Normal girls:

1. The maximum mean of development of shoulder flexibility in normal girls was found at the age of 13th year, which is -2.2 and the minimum at 8th year, which is 0.56. The average mean of development of shoulder flexibility in normal girls between 8 to 14 years is found to be -1.02.
2. The standard deviation of development of shoulder flexibility in normal girls is found maximum at the age of 14th year, which is 1.39 and minimum at the age of 9th year, which is 0.83. The average standard deviation of development of shoulder flexibility in normal girls between 8 to 14 years is found to be 1.19.

3. The correlation of development of shoulder flexibility in normal girls between 8 to 14 years of age groups is found as high as 0.93.

Deaf-dumb girls:

1. The maximum mean of development of shoulder flexibility in deaf-dumb girls was found at the age of 12th year, which is 1.44 and the minimum at 10th years, which is 0.48. The average mean of development of shoulder flexibility in deaf-dumb girls between 8 to 14 years is found to be 0.788.
2. The standard deviation of development of shoulder flexibility in deaf-dumb girls is found maximum at the age of 8th year, which is 1.35 and minimum at the age of 11th year, which is 0.99. The average standard deviation of development of shoulder flexibility in deaf-dumb girls between 8 to 14 years is found to be 1.16.
3. The correlation of development of shoulder flexibility in deaf-dumb girls between 8 to 14 years of age groups is found as high as 0.88.

COMPARISON OF BOYS (Normal and deaf-dumb):

The average mean of development of shoulder flexibility of normal boys between 8 to 14 years is 1.09, which is less to 1.41 that of the deaf-dumb boys between 8 to 14 years. The difference of mean of development of shoulder flexibility between normal boys and that in the deaf-dumb boys is 0.32, which is insignificant. The maximum mean of development of shoulder flexibility in normal boys is found at the age of 13th year, which is 2.00 and that in the deaf-dumb boys it is at the age of 9th year, which is 1.84.

Table No. IV.19: evaluation of significance of development of shoulder flexibility in normal and deaf-dumb (boys) by using t-test and F-test.

BOYS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NB & DDB	0.047	0.159	Insignificant
09 NB & DDB	0.141	0.527	Insignificant
10 NB & DDB	0.031	0.706	Insignificant
11 NB & DDB	0.096	0.166	insignificant
12 NB & DDB	0.424	0.687	Insignificant
13 NB & DDB	0.170	0.772	Insignificant
14 NB & DDB	0.275	0.082	insignificant

* Significant at 0.05 level.

COMPARISON OF GIRLS (Normal and deaf-dumb):

The average mean of development of shoulder flexibility of normal girls between 8 to 14 years is -1.02, which is more than 0.788 of the deaf-dumb girls between 8 to 14 years. The difference of mean of development of shoulder flexibility between normal girls and that in the deaf-dumb girls is -0.23, which is insignificant. The maximum mean of development of shoulder flexibility in normal girls is found at the age of 13th year, which is -2.2 and that in the deaf-dumb girls it is at the age of 12th year, which is 1.44.

Table No. IV.20: evaluation of significance of development of shoulder flexibility in normal and deaf-dumb (girls) by using t-test and F-test.

GIRLS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NG & DDG	0.456	0.610	Insignificant
09 NG & DDG	0.385	0.458	Insignificant
10 NG & DDG	0.0008	0.123	Insignificant
11 NG & DDG	0.206	0.172	insignificant
12 NG & DDG	0.110	0.551	Insignificant
13 NG & DDG	0.730	0.913	Insignificant
14 NG & DDG	0.221	0.121	insignificant

* Significant at 0.05 level.

RESULTS OF THE COMPARISON OF THE DEVELOPMENT OF TRUNK FLEXIBILITY OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 YEARS TO 14 YEARS (FORWARD BEND AND REACH):

Normal boys:

1. The maximum mean of development of trunk flexibility in normal boys was found at the age of 8th year, which is -1.44 and the minimum at 14th year, which is -0.64. The average mean of development of trunk flexibility normal boys between 8 to 14 years is found to be -1.02.
2. The standard deviation of development of trunk flexibility in normal boys is found maximum at the age of 14th year, which is 1.55 and minimum at the age of 11th year, which is 0.69. The average standard deviation of development of trunk flexibility in normal boys between 8 to 14 years is found to be 1.05.
3. The correlation of development of trunk flexibility in normal boys between 8 years to 14 years of age groups is found as high as 0.97.

Deaf-dumb boys:

1. The maximum mean of development of trunk flexibility in deaf-dumb boys was found at the age of 9th & 13th year, which is -0.96 and the minimum at 8th & 10th year, which is -0.64. The average mean of development of trunk flexibility in deaf-dumb boys between 8 to 14 years is found to be -0.80.
2. The standard deviation of development of trunk flexibility in deaf-dumb boys is found maximum at the age of 14th year, which is 1.25 and minimum at the age of 11th year, which is 0.66. The average standard deviation of development of trunk flexibility in deaf-dumb boys between 8 to 14 years is found to be 0.97.
3. The correlation of development of trunk flexibility in deaf-dumb boys between 8 to 14 years of age groups is found as high as 0.94.

Normal girls:

1. The maximum mean of development of trunk flexibility in normal girls was found at the age of 14th year, which is -1.12 and the minimum at 10th year, which is -0.18. The average mean of development of trunk flexibility in normal girls between 8 to 14 years is found to be -0.56.
2. The standard deviation of development of trunk flexibility in normal girls is found maximum at the age of 9th year, which is 1.5 and minimum at the age of 11th year,

which is 0.76. The average standard deviation of development of trunk flexibility in normal girls between 8 to 14 years is found to be 1.09.

3. The correlation of development of trunk flexibility in normal girls between 8 to 14 years of age groups is found as high as 0.91.

Deaf-dumb girls:

1. The maximum mean of development of trunk flexibility in deaf-dumb girls was found at the age of 8th year, which is -1.12 and the minimum at 10th years, which is -0.08. The average mean of development of trunk flexibility in deaf-dumb girls between 8 to 14 years is found to be -0.13.
2. The standard deviation of development of trunk flexibility in deaf-dumb girls is found maximum at the age of 14th year, which is 1.63 and minimum at the age of 8th year, which is 0.83. The average standard deviation of development of trunk flexibility in deaf-dumb girls between 8 to 14 years is found to be 1.2.
3. The correlation of development of trunk flexibility in deaf-dumb girls between 8 to 14 years of age groups is found as high as 0.91.

COMPARISON OF BOYS (Normal and deaf-dumb):

The average mean of development of trunk flexibility of normal boys between 8 to 14 years is -1.02, which is more to -0.80 that of the deaf-dumb boys between 8 to 14 years. The difference of mean of development of trunk flexibility between normal boys and that in the deaf-dumb boys is -0.22, which is insignificant. The maximum mean of development of trunk flexibility in normal boys is found at the age of 8th year, which is -1.44 and that in the deaf-dumb boys it is at the age of 9 &13th year, which is -0.64.

Table No. IV.21: evaluation of significance of development of trunk flexibility in normal and deaf-dumb (boys) by using t-test and F-test.

BOYS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NB & DDB	0.003	0.815	Insignificant
09 NB & DDB	0.246	0.415	Insignificant
10 NB & DDB	0.009	0.585	Insignificant
11 NB & DDB	0.151	0.860	insignificant
12 NB & DDB	0.322	0.238	Insignificant
13 NB & DDB	0.343	0.791	Insignificant
14 NB & DDB	0.345	0.311	insignificant

* Significant at 0.05 level.

COMPARISON OF GIRLS (Normal and deaf-dumb):

The average mean of development of trunk flexibility of normal girls between 8 to 14 years is -0.56, which is more than -0.13 of the deaf-dumb girls between 8 to 14 years. The difference of mean of development of trunk flexibility between normal girls and that in the deaf-dumb girls is -0.39, which is insignificant. The maximum mean of development of trunk flexibility in normal girls is found at the age of 14th year, which is -1.12 and that in the deaf-dumb girls it is at the age of 8th year, which is -1.12.

Table No. IV.22: evaluation of significance of development of trunk flexibility in normal and deaf-dumb (girls) by using t-test and F-test.

GIRLS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NG & DDG	0.02	0.895	Insignificant
09 NG & DDG	0.136	0.052	Insignificant
10 NG & DDG	0.35	0.765	Insignificant
11 NG & DDG	0.040	0.005	insignificant
12 NG & DDG	0.128	0.575	Insignificant
13 NG & DDG	0.108	0.994	Insignificant
14 NG & DDG	0.011	0.036	insignificant

* Significant at 0.05 level.

RESULTS OF THE COMPARISON OF THE DEVELOPMENT OF HIP JOINT FLEXIBILITY OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 YEARS TO 14 YEARS (SIDE SPLIT TEST):

Normal boys:

1. The maximum mean of development of hip joint flexibility in normal boys was found at the age of 14th year, which is 1.76 and the minimum at 9th year, which is 0.64. The average mean of development of hip joint flexibility normal boys between 8 to 14 years is found to be 1.18.
2. The standard deviation of development of hip joint flexibility in normal boys is found maximum at the age of 9th year, which is 1.15 and minimum at the age of 13th year, which is 0.48. The average standard deviation of development of hip joint flexibility in normal boys between 8 to 14 years is found to be 0.86.
3. The correlation of development of hip joint flexibility in normal boys between 8 years to 14 years of age groups is found as high as 0.91.

Deaf-dumb boys:

1. The maximum mean of development of hip joint flexibility in deaf-dumb boys was found at the age of 14th year, which is 1.36 and the minimum at 8th year, which is 0.64. The average mean of development of hip joint flexibility in deaf-dumb boys between 8 to 14 years is found to be 1.09.
2. The standard deviation of development of hip joint flexibility in deaf-dumb boys is found maximum at the age of 10th year, which is 1.08 and minimum at the age of 14th year, which is 0.48. The average standard deviation of development of hip joint flexibility in deaf-dumb boys between 8 to 14 years is found to be 0.69.
3. The correlation of development of hip joint flexibility in deaf-dumb boys between 8 to 14 years of age groups is found as high as 0.95.

Normal girls:

1. The maximum mean of development of hip joint flexibility in normal girls was found at the age of 14th year, which is 1.12 and the minimum at 10th year, which is 0.60.

The average mean of development of hip joint flexibility in normal girls between 8 to 14 years is found to be 0.86.
2. The standard deviation of development of hip joint flexibility in normal girls is found maximum at the age of 14th year, which is 1.58 and minimum at the age of 8th year, which is 0.81. The average standard deviation of development of hip joint flexibility in normal girls between 8 to 14 years is found to be 1.13.
3. The correlation of development of hip joint flexibility in normal girls between 8 to 14 years of age groups is found as high as 0.91.

Deaf-dumb girls:

1. The maximum mean of development of hip joint flexibility in deaf-dumb girls was found at the age of 12th year, which is 1.12 and the minimum at 8th years, which is 0.16. The average mean of development of hip joint flexibility in deaf-dumb girls between 8 to 14 years is found to be 0.65.
2. The standard deviation of development of hip joint flexibility in deaf-dumb girls is found maximum at the age of 8th year, which is 2.01 and minimum at the age of 10th year, which is 0.71. The average standard deviation of development of hip joint flexibility in deaf-dumb girls between 8 to 14 years is found to be 1.11.
3. The correlation of development of hip joint flexibility in deaf-dumb girls between 8 to 14 years of age groups is found as high as 0.81.

COMPARISON OF BOYS (Normal and deaf-dumb):

The average mean of development of hip joint flexibility of normal boys between 8 to 14 years is 1.18, which is more to 1.09 that of the deaf-dumb boys between 8 to 14 years. The difference of mean of development of hip joint flexibility between normal boys and that in the deaf-dumb boys is 0.09, which is insignificant. The maximum mean of development of hip joint flexibility in normal boys is found at the age of 14th year, which is 1.76 and that in the deaf-dumb boys it is at the age of 14th year, which is 1.36.

Table No. IV.23: evaluation of significance of development of hip joint flexibility in normal and deaf-dumb (boys) by using t-test and F-test.

BOYS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NB & DDB	0.002	0.999	Insignificant
09 NB & DDB	0.060	0.0004	Insignificant
10 NB & DDB	0.185	0.877	Insignificant
11 NB & DDB	0.406	0.147	insignificant
12 NB & DDB	0.136	0.040	Insignificant
13 NB & DDB	0.001	0.036	Insignificant
14 NB & DDB	0.013	0.061	insignificant

* Significant at 0.05 level.

COMPARISON OF GIRLS (Normal and deaf-dumb):

The average mean of development of hip joint flexibility of normal girls between 8 to 14 years is 0.86, which is more than 0.65 of the deaf-dumb girls between 8 to 14 years. The difference of mean of development of hip joint flexibility between normal girls and that in the deaf-dumb girls is 0.21, which is insignificant. The maximum mean of development of hip joint flexibility in normal girls is found at the age of 14th year, which is 1.12 and that in the deaf-dumb girls it is at the age of 12th year, which is 1.12.

Table No. IV.24: evaluation of significance of development of hip joint flexibility in normal and deaf-dumb (girls) by using t-test and F-test.

GIRLS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NG & DDG	0.019	0.335	Insignificant
09 NG & DDG	0.058	0.884	Insignificant
10 NG & DDG	0.239	0.343	Insignificant
11 NG & DDG	0.095	0.292	insignificant
12 NG & DDG	0.160	0.312	Insignificant
13 NG & DDG	0.134	0.057	Insignificant
14 NG & DDG	0.138	0.195	insignificant

* Significant at 0.05 level.

RESULTS OF THE COMPARISON OF THE DEVELOPMENT OF REACTION ABILITY (COORDINATIVE ABILITY) OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 TO 14 YEARS (NELSON'S HAND REACTION TEST):

Normal boys:

1. The maximum mean of development of reaction ability in normal boys was found at the age of 14th year, which is -0.008 sec and the minimum at 9th year, which is -0.002. The average mean of development of reaction ability normal boys between 8 to 14 years is found to be -0.004 sec.
2. The standard deviation of development of reaction ability in normal boys is found maximum at the age of 12th year, which is 0.006 and minimum at the age of 14th year, which is 0.003. The average standard deviation of development of reaction ability in normal boys between 8 to 14 years is found to be 0.004.
3. The correlation of development of reaction ability in normal boys between 8 years to 14 years of age groups is found as high as 0.86.

Deaf-dumb boys:

1. The maximum mean of development of reaction ability in deaf-dumb boys was found at the age of 14th year, which is -0.008 sec and the minimum at 9th year, which is -0.002. The average mean of development of reaction ability in deaf-dumb boys between 8 to 14 years is found to be -0.004 sec.
2. The standard deviation of development of reaction ability in deaf-dumb boys is found maximum at the age of 14th year, which is 0.006 and minimum at the age of 11th year, which is 0.003. The average standard deviation of development of reaction ability in deaf-dumb boys between 8 to 14 years is found to be 0.004.
3. The correlation of development of reaction ability in deaf-dumb boys between 8 to 14 years of age groups is found as high as 0.77.

Normal girls:

1. The maximum mean of development of reaction ability in normal girls was found at the age of 13th year, which is -0.009 sec and the minimum at 8th year, which is -0.001. The average mean of development of reaction ability in normal girls between 8 to 14 years is found to be -0.006 sec.
2. The standard deviation of development of reaction ability in normal girls is found maximum at the age of 10th year, which is 0.011 and minimum at the age of 8th year, which is 0.001. The average standard deviation of development of reaction ability in normal girls between 8 to 14 years is found to be 0.005.
3. The correlation of development of reaction ability in normal girls between 8 to 14 years of age groups is found as high as 0.62.

Deaf-dumb girls:

1. The maximum mean of development of reaction ability in deaf-dumb girls was found at the age of 8th year, which is -0.009 sec and the minimum at 9th years, which is -0.001. The average mean of development of reaction ability in deaf-dumb girls between 8 to 14 years is found to be -0.003 sec.
2. The standard deviation of development of reaction ability in deaf-dumb girls is found maximum at the age of 8th year, which is 0.008 and minimum at the age of 12th year, which is 0.004. The average standard deviation of development of reaction ability in deaf-dumb girls between 8 to 14 years is found to be 0.005.
3. The correlation of development of reaction ability in deaf-dumb girls between 8 to 14 years of age groups is found as high as 0.72.

COMPARISON OF BOYS (Normal and deaf-dumb):

The average mean of development of reaction ability of normal boys between 8 to 14 years is -0.004 sec, which is equal to -0.004 sec that of the deaf-dumb boys between 8 to 14 years. The difference of mean of development of reaction ability between normal boys and that in the deaf-dumb boys is 0.00 sec, which is totally insignificant. The maximum mean of development of reaction ability in normal boys is found at the age of 14th year, which is -.008 sec and that in the deaf-dumb boys it is at the age of 14th year, which is -0.008 sec.

Table No. IV.25: evaluation of significance of development in reaction ability in normal and deaf-dumb (boys) by using t-test and F-test.

BOYS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NB & DDB	0.072	0.889	Insignificant
09 NB & DDB	0.369	0.500	Insignificant
10 NB & DDB	0.451	0.230	Insignificant
11 NB & DDB	0.048	0.194	insignificant
12 NB & DDB	0.098	0.301	Insignificant
13 NB & DDB	0.368	0.833	Insignificant
14 NB & DDB	0.455	0.009	insignificant

* Significant at 0.05 level.

COMPARISON OF GIRLS (Normal and deaf-dumb):

The average mean of development of reaction ability of normal girls between 8 to 14 years is -0.006, which is more than -0.003 sec of the deaf-dumb girls between 8 to 14 years. The difference of mean of development of reaction ability between normal girls and that in the deaf-dumb girls is -0.003 sec, which is insignificant. The maximum mean of development of reaction ability in normal girls is found at the age of 13th year, which is -0.009 sec and that in the deaf-dumb girls it is at the age of 8th year, which is -0.009 sec.

Table No. IV.26: evaluation of significance of development of reaction ability in normal and deaf-dumb (girls) by using t-test and F-test.

GIRLS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NG & DDG	0.475	0.871	Insignificant
09 NG & DDG	0.021	0.800	Insignificant
10 NG & DDG	0.057	0.0006	Insignificant
11 NG & DDG	0.019	0.494	insignificant
12 NG & DDG	0.0002	0.629	Insignificant
13 NG & DDG	0.0002	0.106	Insignificant
14 NG & DDG	0.7306	0.513	insignificant

* Significant at 0.05 level.

RESULTS OF THE COMPARISON OF THE DEVELOPMENT OF BALANCING ABILITY (COORDINATIVE ABILITY) OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 YEARS TO 14 YEARS (STORK STAND TEST):

Normal boys:

1. The maximum mean of development of balancing ability in normal boys was found at the age of 11th year, which is 2.52 sec and the minimum at 12th year, which is 0.04 sec. The average mean of development of balancing ability normal boys between 8 to 14 years is found to be 0.58 sec.
2. The standard deviation of development of balancing ability in normal boys is found maximum at the age of 9th year, which is 3.41 and minimum at the age of 13th year, which is 1.55. The average standard deviation of development of balancing ability in normal boys between 8 to 14 years is found to be 2.30.
3. The correlation of development of balancing ability in normal boys between 8 years to 14 years of age groups is found as low as 0.37.

Deaf-dumb boys:

1. The maximum mean of development of balancing ability in deaf-dumb boys was found at the age of 14th year, which is 2.32 sec and the minimum at 10th year, which is -0.28 sec. The average mean of development of balancing ability in deaf-dumb boys between 8 to 14 years is found to be 0.03 sec.
2. The standard deviation of development of balancing ability in deaf-dumb boys is found maximum at the age of 14th year, which is 5.98 and minimum at the age of 9th year, which is 1.81. The average standard deviation of development of balancing ability in deaf-dumb boys between 8 to 14 years is found to be 2.53.

3. The correlation of development of balancing ability in deaf-dumb boys between 8 to 14 years of age groups is found as low as 0.10.

Normal girls:

1. The maximum mean of development of balancing ability in normal girls was found at the age of 12th year, which is 1.04 sec and the minimum at 8th year, which is -0.12 sec. The average mean of development of balancing ability in normal girls between 8 to 14 years is found to be 0.34 sec.
2. The standard deviation of development of balancing ability in normal girls is found maximum at the age of 13th year, which is 2.84 and minimum at the age of 8th year, which is 1.39. The average standard deviation of development of balancing ability in normal girls between 8 to 14 years is found to be 2.08.
3. The correlation of development of balancing ability in normal girls between 8 to 14 years of age groups is found as low as -0.23.

Deaf-dumb girls:

1. The maximum mean of development of balancing ability in deaf-dumb girls was found at the age of 12th year, which is 1.28 sec and the minimum at 11th years, which is 0.12 sec. The average mean of development of balancing ability in deaf-dumb girls between 8 to 14 years is found to be 0.57 sec.
2. The standard deviation of development of balancing ability in deaf-dumb girls is found maximum at the age of 11 & 14th year, which is 2.83 and minimum at the age of 8th year, which is 1.68. The average standard deviation of development of balancing ability in deaf-dumb girls between 8 to 14 years is found to be 2.32.
3. The correlation of development of balancing ability in deaf-dumb girls between 8 to 14 years of age groups is found as low as 0.06.

COMPARISON OF BOYS (Normal and deaf-dumb):

The average mean of development of balancing ability of normal boys between 8 to 14 years is 0.58 sec, which is more to 0.03 sec that of the deaf-dumb boys between 8 to 14 years. The difference of mean of development of balancing ability between normal boys and that in the deaf-dumb boys is 0.55 sec, which is insignificant. The maximum mean of development of balancing ability in normal boys is found at the age of 11th year, which is 2.52 and that in the deaf-dumb boys it is at the age of 14th year, which is 2.32 sec.

Table No. IV.27: evaluation of significance of development of balancing ability in normal and deaf-dumb (boys) by using t-test and F-test.

BOYS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NB & DDB	0.004	0.068	Insignificant
09 NB & DDB	0.030	0.003	Insignificant
10 NB & DDB	0.243	0.735	Insignificant
11 NB & DDB	0.365	0.050	insignificant
12 NB & DDB	0.028	0.601	Insignificant
13 NB & DDB	0.008	0.388	Insignificant
14 NB & DDB	0.080	0.445	insignificant

* Significant at 0.05 level.

COMPARISON OF GIRLS (Normal and deaf-dumb):

The average mean of development of balancing ability of normal girls between 8 to 14 years is 0.34 sec, which is less than 0.57 sec of the deaf-dumb girls between 8 to 14 years. The difference of mean of development of balancing ability between normal girls and that in the deaf-dumb girls is 0.23 sec, which is insignificant. The maximum mean of development of balancing ability in normal girls is found at the age of 12th year, which is 1.04 and that in the deaf-dumb girls it is at the age of 12th year, which is 1.28 sec.

Table No. IV.28: evaluation of significance of development of balancing ability in normal and deaf-dumb (girls) by using t-test and F-test.

GIRLS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NG & DDG	0.006	0.362	Insignificant
09 NG & DDG	0.440	0.792	Insignificant
10 NG & DDG	0.477	0.676	Insignificant
11 NG & DDG	0.383	0.029	insignificant
12 NG & DDG	0.353	0.597	Insignificant
13 NG & DDG	0.334	0.392	Insignificant
14 NG & DDG	0.476	0.072	insignificant

* Significant at 0.05 level.

RESULTS OF THE COMPARISON OF THE DEVELOPMENT OF AGILITY COORDINATIVE ABILITY) OF BOYS AND GIRLS (NORMAL AND DEAF-DUMB) BETWEEN 8 YEARS TO 14 YEARS (6 X 10 METERS SHUTTLE RUN):

Normal boys:

1. The maximum mean of development of agility in normal boys was found at the age of 8th year, which is -0.53 sec and the minimum at 9th year, which is -0.17 sec. The average mean of development of agility normal boys between 8 to 14 years is found to be -0.36 sec.
2. The standard deviation of development of agility in normal boys is found maximum at the age of 14th year, which is 0.26 and minimum at the age of 9th year, which is 0.08. The average standard deviation of development of agility in normal boys between 8 to 14 years is found to be 0.18.
3. The correlation of development of agility in normal boys between 8 years to 14 years of age groups is found as high as 0.96.

Deaf-dumb boys:

1. The maximum mean of development of agility in deaf-dumb boys was found at the age of 14th year, which is -0.42 sec and the minimum at 8th year, which is -0.17 sec. The average mean of development of agility in deaf-dumb boys between 8 to 14 years is found to be -0.32 sec.
2. The standard deviation of development of agility in deaf-dumb boys is found maximum at the age of 10th year, which is 0.36 and minimum at the age of 9th year,

which is 0.15. The average standard deviation of development of agility in deaf-dumb boys between 8 to 14 years is found to be 0.21.

3. The correlation of development of agility in deaf-dumb boys between 8 to 14 years of age groups is found as high as 0.97.

Normal girls:

1. The maximum mean of development of agility in normal girls was found at the age of 13th year, which is -0.41 sec and the minimum at 14th year, which is -0.11 sec. The average mean of development of agility in normal girls between 8 to 14 years is found to be -0.27 sec.
2. The standard deviation of development of agility in normal girls is found maximum at the age of 9th year, which is 0.37 and minimum at the age of 11th year, which is 0.21. The average standard deviation of development of agility in normal girls between 8 to 14 years is found to be 0.26.
3. The correlation of development of agility in normal girls between 8 to 14 years of age groups is found as high as 0.97.

Deaf-dumb girls:

1. The maximum mean of development of agility in deaf-dumb girls was found at the age of 11th year, which is -0.56 sec and the minimum at 10th years, which is 0.04 sec. The average mean of development of agility in deaf-dumb girls between 8 to 14 years is found to be -0.24 sec.
2. The standard deviation of development of agility in deaf-dumb girls is found maximum at the age of 9th year, which is 0.45 and minimum at the age of 13th year, which is 0.15. The average standard deviation of development of agility in deaf-dumb girls between 8 to 14 years is found to be 0.32.
3. The correlation of development of agility in deaf-dumb girls between 8 to 14 years of age groups is found as high as 0.95.

COMPARISON OF BOYS (Normal and deaf-dumb):

The average mean of development of agility of normal boys between 8 to 14 years is -0.36 sec, which is more to -0.32 sec that of the deaf-dumb boys between 8 to 14 years. The difference of mean of development of agility between normal boys and that in the deaf-dumb boys is -0.04 sec, which is insignificant. The maximum mean of development of agility in normal boys is found at the age of 8th year, which is -0.53 sec and that in the deaf-dumb boys it is at the age of 14th year, which is -0.42 sec.

Table No. IV.29: evaluation of significance of development of agility in normal and deaf-dumb (boys) by using t-test and F-test.

BOYS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NB & DDB	0.498	0.674	Insignificant
09 NB & DDB	0.0003	0.006	Insignificant
10 NB & DDB	0.058	0.0001	Insignificant
11 NB & DDB	0.062	0.429	insignificant
12 NB & DDB	0.182	0.526	Insignificant
13 NB & DDB	0.398	0.967	Insignificant
14 NB & DDB	0.420	0.158	insignificant

* Significant at 0.05 level.

COMPARISON OF GIRLS (Normal and deaf-dumb):

The average mean of development of agility of normal girls between 8 to 14 years is -0.27 sec, which is more than -0.24 sec of the deaf-dumb girls between 8 to 14 years. The difference of mean of development of agility between normal girls and that in the deaf-dumb girls is -0.03 sec, which is insignificant. The maximum mean of development of agility in normal girls is found at the age of 13th year, which is -0.41 sec and that in the deaf-dumb girls it is at the age of 11th year, which is -0.56 sec.

Table No. IV.30: evaluation of significance of development of agility in normal and deaf-dumb (girls) by using t-test and F-test.

GIRLS (NORMAL & DEAF-DUMB)	t-Test Results	F-Test Results	COMMENTS
08 NG & DDG	0.374	0.011	Insignificant
09 NG & DDG	0.321	0.309	Insignificant
10 NG & DDG	0.0014	0.030	Insignificant
11 NG & DDG	0.0003	0.006	insignificant
12 NG & DDG	0.00014	0.677	Insignificant
13 NG & DDG	0.002	0.0018	Insignificant
14 NG & DDG	0.032	0.598	insignificant

* Significant at 0.05 level.

IV.2 – DISCUSSIONS:

The changes in motor abilities from the ages of 8 to 14 years reveals that, although children of this age range do no change as rapidly as children from birth to 6 years of age, there is invariably a regular improvement, with the performance curves usually assuming a rough linear relationship to age. A variety of complex tasks are able to be mastered by older children within this age range. At the same time, their needs for activity may remain high and thus their basic capacities increases as a result of frequent and vigorous participation. A number of structural changes are evidenced during these years.

A gradual increase in height and weight is observed in both boys and girls (normal and deaf-dumb) form 8^{th} year to 14^{th} year. The height and weight spurt of boys is found in the 14^{th} year whereas it is observed in 12^{th} year in case of girls. The proportionate growth in weight with respect to height is observed in both sexes and variables. The difference of developmental changes in height and weight growth when compared between normal boys with deaf-dumb boys and normal girls with deaf-dumb girls is found insignificant when tested for significance by ‘t’ and ‘F’ tests at 0.05 levels.

The speed ability in which specifically the acceleration ability and locomotion ability is found increasing the most at 8^{th} year and gradually reducing the rate of development of speed till 10^{th} year and again increasing steadily till 14^{th} year in normal boys. The rate of development of speed is observed unsteady in case of deaf-dumb boys and girls. In case of normal girls the development of speed is steadily increasing and observed maximum at 11th and 12th years and again reducing slowly till 14th year of age. The difference of developmental changes in acceleration and locomotion ability, when compared between normal boys with deaf-dumb boys and normal girls with deaf-dumb girls is found insignificant when tested for significance by ‘t’ and ‘F’ tests at 0.05 levels.

In case of normal boys the development of strength in upper extremity is observed highest at the age of 14th whereas the abdominal strength at the age of 11th years and 12th years in lower extremity at 12th year. The development of hands, abdomen and leg strength is found at 14th year of age of deaf-dumb boys. The hands and legs strength development in normal girls is found to be steadily increasing from 8th to 14th year whereas the abdominal strength development is observed reducing. The deaf-dumb girls have good steady increase development in hand, abdomen and legs. The difference of developmental changes in upper extremity explosive strength, abdomen strength, and lower extremity explosive strength when compared between normal boys with deaf-dumb boys and normal girls with deaf-dumb girls is found insignificant when tested for significance by ‘t’ and ‘F’ tests at 0.05 levels.

The steady development in metabolic rate and VO_2 max is observed from negative to positive in normal boys till 14th years. An uneven distribution of development in metabolic rate and VO_2 max is observed in deaf-dumb boys and girls and normal girls. The reduction in metabolism and VO_2 max is observed after 11th till 14th year in normal and deaf-dumb girls. The difference of developmental changes in metabolic rate and VO_2 max when compared between normal boys with deaf-dumb boys and normal girls with deaf-dumb girls is found insignificant when tested for significance by ‘t’ and ‘F’ tests at 0.05 levels.

Flexibility in shoulder joint is found positively in normal boys, deaf-dumb boys and deaf-dumb girls, but it is found negative in normal girls. The trunk flexibility is found unevenly reducing at all age groups and in all variables as the age is advancing from 8th to 14th year. The development of hip joint flexibility is found maximum at 8th year and in 14th year in normal boys, deaf-dumb boys and girls. The difference of developmental changes in shoulder joint flexibility, trunk flexibility and hip joint flexibility, when compared between normal boys with deaf-dumb boys and normal girls with deaf-dumb girls is found insignificant when tested for significance by ‘t’ and ‘F’ tests at 0.05 levels.

The reaction ability of normal boys, girls and deaf-dumb boys, is found developed from 8th to 14th year sequentially. In deaf-dumb girls it is found maximum at the age of 8th year. The difference of developmental changes in reaction ability when compared between normal boys with deaf-dumb boys and normal girls with deaf-dumb girls is found insignificant when tested for significance by ‘t’ and ‘F’ tests at 0.05 levels.

Balancing ability has been evaluated as the most uncertain ability as if has found a very low correlation among the same subjects when tested initially and finally. But can be developed at higher age groups. The difference of developmental changes in balancing ability when compared between normal boys with deaf-dumb boys and normal girls with deaf-dumb girls is found insignificant when tested for significance by ‘t’ and ‘F’ tests at 0.05 levels.

The development in agility is found developing in all the age groups and in all the variables, but it is observed maximum at different ages in different variables. The difference of developmental changes in agility when compared between normal boys with deaf-dumb boys and normal girls with deaf-dumb girls is found insignificant when tested for significance by ‘t’ and ‘F’ tests at 0.05 levels.

CHAPTER – V

V.1 – SUMMARY:

Present study is an inspiration to do something for the physically challenged. The rationale behind the formation of hypothesis is that the blind have the capability of good listening and reproducing sharp alteration in either vocal or music in the similar way a deaf-dumb without any other physical ailment can do better in sports. It is always noticed that the physically challenged society have feeling of inferiority out of which an insecurity builds in their minds. To overcome the inferiority they dream high and try to adopt remarkable feats. The confidence level grows as society starts recognizing and appreciating it.

The need of these children is proper guidance, nurturing and exposure of optimum things at right time and age and the affection, understanding about their feelings. To excel in sports one is expected to have all the innate physical, physiological, psychological, sociological qualities not in normal, but in higher qualities. The idea of considering deaf-dumb subjects is that they possess all the qualities required to excel in sports except capability of listening which is of least importance for some specific sports.

Growth and development in any creature on earth is inevitable and is a life long process. In this study specific qualities in growth and development in motor abilities are considered which are pre-pubertal, pubertal and partly post-pubertal, where the physiological and psychological changes are observed tremendously. The comparison is made to show that the so called physically challenged (deaf-dumb) children are no way inferior to their normal counterpart. The special quality of attention and concentration can be used positively for enhancing sports performance.

The subjects were randomly selected from different schools. The motor abilities tests were administered twice with a gap of one academic year in the initial and final for noting the rate of growth and development at different age groups i.e., from 8 to 14 years in both boys and girls. The raw scores were then statistically analyzed and compared for interpretation. It was noticed that there is no significant difference in normal (boys and girls) and deaf-dumb (boys and girls).

Few similar studies were conducted at various geographical areas. Few difficulties on ground and with management of schools were faced by the researcher during the study. Based on the result of this study, a training methodology can be established for normal as well as deaf-dumb. The results of the study can be implemented for the alterations of psychological mind set like pessimism, inferiority, reactionary of deaf-dumb towards facing the complexities, reconstructing pessimism and developing confidence. The details of the purpose, objectives, significance, hypothesis, limitation, delimitations, required definitions, methodology, analysis, interpretation, conclusion, recommendations and suggestions are detailed logically.

In this research several facets of the motor development of children from 8 to 14 years are covered. Problems and procedures of testing are discussed. The inter-relationships between motor tests scores is explored, including a review of the findings of some factorial studies carried out within recent years. The manner in which motor proficiencies improve as children grow older is surveyed, including comparisons of the motor performance scores of both boys and girls.

V.2 - CONCLUSION:

The study of the scores elicited in tasks through which the motor proficiencies of boys and girls between the ages 8 and 14 years have been assessed led to the following generalization:

1. As children mature in these years, they usually evidence regular increases in the ability to do most motor tasks. With some expectations, there is usually a linear relationship between age and mean scores, reflecting improvement in reasonably complex tasks.
2. Boys are stronger than girls in overall strength. In most of the abilities the normal boys and girls are comparatively slightly ahead from their deaf-dumb counterpart.
3. Measures of flexibility in children are highly specific, and as children move from eight to fourteen years they may grow less flexible in hip joint regions and maximum flexible in shoulder joint.
4. Balancing ability seems to mature towards the fourteenth year in most children, but still no correlations between their own initial and final performance is observed.
5. Sex differences in throwing, running, and strength task seem to become greater as maturing.
6. Level of concentration while performing the tests is found higher in deaf-dumb children (girls and boys) as compared to normal children (girls and boys).
7. Deaf-dumb children constitute an insignificant percentage of populations of so-called normal children. The children admitted to the schools evidence motor abilities that are less than adequate; reflected in the inability to move well on the playground.
8. Some of these children, who are for the part boys and girls, are evidencing maturational lags which may disappear with time. In general, the early identification and remediation of these problems is more fruitful than assuring that children will outgrow motor ineptitude.
9. Deaf-dumb children evidence certain general problems, including rejection from parents and society resulting mental depression. At the same time, during testing, groups of normal and deaf-dumb children, it is often found that ineptitude in one type of skill will not necessarily predict in others.
10. It is observed that many agencies which are running deaf-dumb schools are not taking optimum care of the students in development of physical and motor abilities.

Early Childhood Stage- Up to Age 6 - Motor Maturation:

1. The period ranging from about two to seven years of age is the ideal time for children to master fundamental locomotor, manipulative and stability skills. These movement skills develop along a continuum of stages: (A) Initial stage (2-3 years of age) is characterized by crude, non-rhythmical, uncoordinated movements, in which major components of the mature pattern are missing. (B) Elementary stage (3-4 years of age) is characterized by an improvement of coordination and rhythm, children have greater control over their movements but they still appear awkward and lack fluidity. (C) Mature stage (can be attained in most fundamental movements by age 5 to 7) are

characterized by an integration of all component parts of a movement pattern into a well coordinated, mechanically correct, efficient act.

2. Successful achievement of early stages of skill development will permit the later acquisition of stable performances. The performance improves rapidly, which results from a considerable increase in muscle tissue mass and consequently in strength development.
3. The nervous system is developing rapidly. Neurons grow proportionally to the physical lengthening of the body. Myelin increases in both thickness and length and synapses also increase to improve communication between neurons. Myelination is largely completed by 6 years of age.
4. Brain growth goes through a spurt beginning at about mid-pregnancy and continuing till 4 years of age. Brain growth is about 75% complete by age 3 and nearly 90% by age 6.
5. Although gross motor control is developing rapidly, fine motor control is not fully established. Children (4 years of age) mostly depend on tactile-kinesthetic cues in motor performance. Body schema should be developed by six years of age.
6. The rate of growth in length (height) and weight is very rapid up to two years of age, followed by a reduced but continuous gain in both height and weight throughout childhood.
7. Changes in the relative sizes of different body parts occur during postnatal development. The normal growth pattern is nonlinear. The change in the ratio of head to body and limb length causes the body to be disproportional.
8. Strength as well as muscular endurance increases linearly with age until 13-14 years of age.
9. The training of endurance capacity that has, by far, the most influence on all the parameters determining the performance capacity of a child.
10. The ratio of muscle and tendon strength to bone length is lower in a child because increase in bone length precedes strength development. Thus, when the strength of a child's leg or arm muscles cannot meet the increased demands of acquired bone length, there is an increased risk of skeletal overuse injuries.
11. The cardio-respiratory system is developing. Maximal aerobic power (VO_2 Max) increases linearly until approximately 16 years of age in boys, 14 years in girls.
12. Anaerobic endurance can be trained at all ages as long as the training loads remain in the capacity limits of the child. Aerobic endurance is one of the most trainable physical qualities in children.
13. Training methods that favor long-lasting activities at constant speed are recommended for aerobic endurance training with children. Training should not surpass 45 minutes per day with 10 minutes of light recovery.
14. The assumption that young people are naturally flexible and do not need flexibility training is a misconception. However, individuals are more flexible in the pre-pubertal period than in post-puberty. An individual's flexibility decreases without training, even during childhood.

Pre-Pubertal Stage – Age 6 To 11 years: Motor Maturation:

1. The body is growing at a slow but steady rate. Body parts become more functional, enabling children of this age group to function at increasingly sophisticated levels in

the performance of movement skills. Motor control, coordination and balance are improving. Stability abilities are static and dynamic.

2. Specialized movement skills begin to be developed and refined toward the end of this stage. Children's interest in sports is beginning to develop strongly during this stage. Sprinting should begin at 7-8 years of age, before the nervous system reaches complete maturation and is still "malleable".
3. Between 7-10 years of age, there is a sharp increase in a child's speed of action. The capacity for speed increases to reach its peak at approximately 10 years of age. Subsequently, it is the speed of reaction that improves. Movement speed is easier to develop between 7 and 13 years of age, and one must take advantage of the more rapid growth periods.
4. The growth of the brain size is very slow. The size of the skull remains nearly the same until approximately the end of the stage (10 years of age), where the head broadens and lengthens. The body begins to lengthen out.
5. Larger muscles groups are more developed than smaller ones. Children aged 6-9 years prefer activities involving the whole body. Ligaments, tendons and muscles are becoming stronger, but are not able to withstand heavy external loading.
6. Children aged 10-12 years should be developing their muscular endurance. During the first part of the stage, training should be more general and varied, whereas in the latter part of it, training should become more specific and focused on different areas of the body. Note that local muscular endurance training should not be totally ignored during childhood, particularly in the reinforcement of muscular weaknesses, and in the maintenance of posture.
7. Girls begin their adolescent growth spurt when they are about 9 years old (plus or minus a year) which lasts for 2 to 3 years. Average players who are pre-selected to be late maturers may begin their adult growth spurt closer to 11 years of age. In growth spurts, the bones grow faster than the muscles, tendons, and ligaments around them, thus making the player tighter and more susceptible to tissue strains and pulls. Training appears not to accelerate or decelerate skeletal maturation.
8. The cardio-respiratory system continues its development. A six-year-old, will on average, have a heartbeat of 105 beats/ minute at rest. Girls will average 95 beats/ minute. Under exertion, the heartbeat can reach a value of 210-215 beats/ minute. VO_2 max increases until post-puberty. Highly trained children have an anaerobic threshold value ranging at 75-85% of their VO_2 max.
9. Training at lower levels of the anaerobic threshold, which allows aerobic endurance training, does not set any problems for children. Pre-pubescent children are not well equipped to withstand lactic acid and thus have a low ability to sustain high intensity sub-maximal exercise. Because they have proportionally less muscle mass than adults (30% against 45%), young children have lower capacity to produce anaerobic energy compared to the same mass of the adult muscle.
10. A child's basal metabolic rate can reach 20 to 30 times that of an adult's. As a result, the high level child-athlete needs to intake a substantial amount of proteins on a daily basis, as well as complex carbohydrates for energy metabolism.

Early Pubertal Stage- Age 11 to 13 years: Motor Maturation:

1. The schema of the body reaches maturity at 11-12 years of age, which means that both gross motor control and fine motor control are practically fully established.

Therefore, children are perfecting an increasing number of motor skills. Between 10-14 years of age, adolescents experience another increase in speed and they can integrate the factors that determine it.

2. GIRLS: On average, a girl's muscle mass increases until the age of 13. As muscle growth increases, there is corresponding increase in strength. Main increase in strength occurs during a few months following or even just before peak height. The awkwardness or lag in performance presumably involves problems with agility, balance, and coordination.
3. BOYS: Between the ages of 11-12 years, significant muscle growth takes place. This muscle development is shortly followed by strength gains. Approximately 30% of the weight of the average 12-year-old boy is made up of muscle tissue. Boys increase their strength by about 65% during puberty.
4. Early physical maturation among boys can enhance athletic ability, which often leads to increased status among peers, members of the opposite sex and adults. On the other hand, late matures sometimes fear that they may never develop further or grow tall. Children who grow slowly actually grow over a longer period of time, therefore usually end up to be taller than early maturing children.
5. Between 11-13 years of age, the anaerobic lactic system improves considerably, although it is still far from being close to that of an adult's.
6. During the early pubertal stage, it is still important not to involve young adolescents in training situations that provoke high levels of lactic acid (maximal repetitive loads). The aerobic endurance capacity of the athlete continues to improve gradually during this stage partly due to increased hemoglobin.
7. There is a reduction in joint flexibility during rapid growth since muscle tissue lengthens in response to increases in bone length. This may contribute to conditions favorable to overuse injury.

Late Pubertal Stage: Ages 12- 14 Years:

1. BOYS: During this stage, peak height velocity will be achieved. The growth in height tapers off at approximately age 14, with notable increases in height ending around age 16.
2. All boys will achieve peak height velocity during this maturation period regardless of their chronological age. The year before, during and the year after peak height velocity, linear growth is rapid. The end of this stage is characterized by the optimal time for muscle hypertrophy. Over 70% of boys reach peak strength development velocity between 0.15-1.5 years after peak height velocity.
3. During puberty, the capacity for strength increases rapidly with a male's sexual maturation. Early maturing boys are stronger at all ages than normal or slow maturing boys. Early maturing boys may reach peak height velocity before or by the age of 13 years and therefore experience acceleration in strength by about 14 years of age (within one year).
4. By contrast, slow maturing boys will have an age delayed peak height velocity well past 15 years of age. For these boys, strength acceleration will also be delayed beyond 16 years of age. Peak velocity for leg length occurs earlier than peak height velocity (approximately 60% of height increases). Whereas peak velocity for sitting height or trunk length, skeleton breadths and circumferences of the trunk and upper extremities occurs after that for stature.

5. The adolescent weight spurt includes principally gains in stature (skeletal tissue) and muscle mass. Fat mass is relatively stable at this time.
6. Early-maturing children tend to have greater average body weights and greater weight for stature than average- and late-maturing children, and tend therefore to be more mesomorphic.
7. Late-maturing boys tend to have relatively narrow hips and relatively broad shoulders, tend to be longer-legged, have a more linear physique and are more ectomorphically inclined.
8. The cardio-respiratory system approaches, and in some cases reaches, maturity (respiratory volume, vital capacity, maximum breathing capacity and aerobic capacity are increased). The adolescent spurt in VO_2 max begins, on the average, at about 13 years of age and reaches a peak at about 14 years of age.
9. The anaerobic lactic system is rapidly developing, following the male's sexual maturation. It is during puberty that anaerobic training begins to be most effective, although production of energy through the aerobic system is still more favorable.
10. Without training an individual's flexibility decreases even during childhood and adolescence.
11. GIRLS: During this stage, peak height velocity will be achieved. The growth in height tapers off at approximately age 14, with notable increases in height ending around age 16.
12. All girls will achieve peak height velocity during this maturation period regardless of their chronological age. The year before, during and the year after peak height velocity, linear growth is rapid. Main increase in strength occurs during a few months following or even just before peak height velocity. Between 12 and 15 years of age, muscle strength only reaches 60% of the adult strength.
13. The cardio-respiratory system approaches, and in some cases reaches, maturity (respiratory volume, vital capacity, maximum breathing capacity and aerobic capacity are increased). VO_2 max appears to reach a ceiling at about 14 years of age, showing little or no increase after this point.
14. The anaerobic lactic system is rapidly developing. It is during puberty that anaerobic training begins to be most effective, although production of energy through the aerobic system is still more favorable.
15. An individual's flexibility decreases without training, even during childhood and adolescence. Moreover, there is a greater loss of flexibility during growth spurt as a result of increased muscle-tendon tightness around the joints. This decreased flexibility causes most of the spinal problems in adolescence.

V.3 - RECOMMENDATIONS:

1. To successfully modify the motor behavior of both normal and physically challenged children, one should be aware of the complexities of human development and the numerous variables that modify the development.
2. Efforts should be made to delineate the manner in which individual differences in population of children may be affected. It is possible that the child from the higher-income home or from good background may benefit more from increased exposure to motor activities than the child from the lower income home. The child from lower-

income home may be improved more by exposure of verbal-linguistic tasks and exercises.

3. Increased attempts should be made to incorporate a number of sensory stimulations into programs for the profoundly retarded and physically challenged. Tactual, auditory, visual, and kinesthetic stimulation combined in the correct task to the correct degree may aid the severely retarded adult and child to react more appropriately to objects, situations, other stimuli.
4. Fitness is likely to improve and with it the opportunity to enjoy life more fully where activities are physically demanding; motivation is likely to be heightened where feedback is immediate and success obvious to both performer and those who watch; and a more active leisure life, more chance to enjoy life is likely where activities can be linked to those of the wider community. This gives a sample of the growing body of research which shows that physically challenged children do indeed have very special needs which can be at least partially satisfied by some or all of the wealth of activities which are included under the umbrella of physical education. Those responsible for educating handicapped children who ignore this aspect of education will be depriving many of their pupils of the opportunity ‘to grow and develop to a fuller stature and to live well in their world’.

Early Childhood Stage- Up to Age 6: Implication for the Children:

1. Provide ample opportunities for motor skills development in a variety of situations as these will play an important role in the child’s sport performance capacities in the future.
2. Make sure to use movements appropriate to the child’s maturity level, as some have not developed sufficient motor coordination and control successfully performs fundamental motor skills.
3. Make sure to make room for individual differences by individualizing instruction whenever possible.
4. Do not emphasize the standards / outcomes of performances. Provide a variety of motor experiences with an emphasis on kinesthetic experiences, e.g., “getting to know your body and its parts in space” as these motor experiences are of great value in helping youngsters to refine their neuromuscular control. Note that motor development is related to the rapid growth of the brain at early childhood stage. Focus should be laid on gross motor activities.
5. Simple explanations accompanied by body shaping activities (i.e., “manual guidance” etc.) are useful for learning during this stage. Emphasize body shapes by using images which allow the child to find the required position.
6. Combinations of fun forms of training should be used while at the same time introducing the acceptance of certain training rules. Rapid physical changes parallel rapid skill development, therefore continual skill development challenges (varied environment) need to be provided.
7. Note that, skill acquisition is not only the result of teaching but is also the result of environmental opportunity interacting with the maturing bodies. Provide activities that focus on using body positions that require control of body weight in a variety of postural positions.
8. As poor habits of posture are beginning, reinforce good posture with positive statements.

9. Be aware that varying limb lengths and weights may affect balance, momentum and potential speed in ballistic and dynamic skills.
10. Activities using muscular strength and endurance are important to enhance a child's level of fitness. These activities should be varied, be kept simple and enjoyable (i.e., running, bicycling, swinging on bars, lifting objects) and be monitored at all times. Keep the activities simple and monitor the growth as well as the effort level at all times. Monitor for recurring soreness by keeping log of complaints.
11. For the child, anaerobic endurance training, eliciting the ATP-PC complex, should involve activities requiring effort and repetition that do not exceed 8-10 seconds. An intense activity of maximal duration of 20 sec. (i.e., sprint) is good to train a child's anaerobic endurance. However, numerous repetitions of this effort level should be avoided particularly if recovery periods are too short. A maximum of 5-10 repetitions of 20-second sprints and 40 second recovery is recommended. Sports such as hockey and soccer for boys, swimming, bicycling and skating for girls are good activities for anaerobic and aerobic endurance training.
12. Introduce fun stretching and make it an integral part of regular training. Include movements that enhance body awareness (knowledge of the body parts, knowledge of what the parts can do and knowledge of how to make them do it), spatial awareness (knowledge of self-space, general space and restricted space), directional awareness, and temporal awareness. Focus on the different sensory modalities (i.e., sight, sound, touch) in the movement experiences, such as rhythmic exercises.
13. Introduce focusing exercises and relevant visual cue identification and monitoring. However, be aware that the eyes are generally not ready for close work for extended periods of time. Introduce fun focusing exercises and relevant cue identification and monitoring (i.e., associating words with actions, centering attention on an object).
14. Children should be engaged in object handling (ball) activities and games of obstacle agility races. They should generally engaged in activities that demand visual focus and recognition of imminent changes (direction, shape, size, height, width, etc.) in reference points.
15. Do not stress coordination in conjunction with speed and agility. Demonstrate games and skills by using figures / pictures.
16. Emphasize the development of directional extremes by incorporating them in playful activities. Use a variety of different objects during games and activities. Incorporate bilateral activities (skipping, galloping, hopping) after unilateral movements are fairly well established.
17. Provide regular stimulus for both sides and monitor use of hand and leg preference. Use analogies to explain games and activities. Include games that use analogies to movement patterns from nature, i.e., walk like an elephant.
18. Ensure that all activities are presented in a fun and playful context.
19. Use symbols in your teaching interventions. Assist children by pointing out the relevant stimuli in a task.
20. Provide cognitive / emotional challenges through relaxation, energizing, imagery and the use of other mental skills as they often help with the development of attention skills and control, which subsequently enhances self-confidence.
21. Ensure that instruction is not overly structured and formalized. It should be specific, simple and goal-directed. Activities should be presented in a fun and playful context.

Vary the conditions in which the children play games and practice skills in order to nurture their development of schemata.

22. Experimentation should occur in different environments. Children should be encouraged to initiate activities on their own. Reinforce for initiative / assertiveness. Teach “approach-success” versus “avoid-failure”.
23. Emphasize positive mindset, attitude and focus. Use a problem-solving approach that permits a variety of “correct” solutions by children. Individualizing instruction is a way of ensuring success.
24. Ensure the development of a positive self-concept, as it will establish a sense of security in the child.
25. Provide opportunities in which children can express their autonomy in a reasonable and proper manner (involve them in decision-making, let them choose some activities and work on their own with close supervision).
26. Be aware that children of early childhood age already understand what feelings and emotions are and may use emotion to manipulate adults in order to get what they want. Discuss basic human emotions (i.e., fear, anger, disgust / contempt, surprise, sadness, happiness, interest) and effective responses to them.
27. Provide cooperative activities in which children are able to interact with one another in positive ways. Encourage positive rivalries, fair play, and supportiveness. Emphasize sharing, respect and equal opportunities for everyone.

Pre-Pubertal Stage – Age 6 to 11 years: Initiation:

1. Fundamental movement abilities (walking, running, jumping, throwing, catching, striking, bouncing, hopping, galloping, skipping, climbing) should be well defined at the beginning of this stage.
2. Provide opportunities to refine a variety of movement patterns involving coordination and balance. Climbing and hanging activities are very helpful in developing the upper torso.
3. Help children make the transition from the general movement phase to the specific movement patterns. Begin to stress accuracy, form and skill. Provide many opportunities for practice, encouragement and selective instruction.
4. The training method that is most suitable for developing speed is one that involves repetitions (short distances, brief series of rapid movements, etc.). Systematic speed training is possible as long as sufficient recovery periods are allowed, in order to avoid fatigue and most importantly to avoid an increase in lactic acid (therefore avoid training speed endurance at this stage).
5. Since growth is steady and gradual, training loads can be increased accordingly, playing close attention to signs of overload (i.e., injuries, discomfort and difficulty keeping up).
6. Gross motor skills should be accentuated. Use whole-part-whole approach to learning individual joint actions as well as whole gross movement patterns. There should be a limited amount of weight lifting exercises. Use body weight to develop strength and involve children in some resistance work such as stretching with surgical tubing and calisthenics.
7. Close supervision of resistance activities mainly for technique and endurance are desirable.

8. Design practices to lessen impact forces by first using activities that require controlling body weight by ‘dropping into bent positions’ from straight positions without impact.
9. Follow-up on signs of discomfort, this may be overlooked by youngsters, who are motivated and focused on competing. Avoid repetitive heavy loading of the musculoskeletal system with external weights.
10. Activities and games that require short bursts of speed should be emphasized. Specific exercises focused on endurance, involving the arms, shoulders, abdominal and lower back muscle groups will initiate the future specificity demands of games. These activities can often be incorporated into games-specific games.
11. Girls should practice basic dance / ballet posture training, maintaining flexibility training (active and passive). Include daily flexibility training of all major joints of the body (i.e., hip and shoulder joints). Concentrate on good form. Teach the “stretch” and “relax” technique.
12. Ensure a proper warm-up and an active cool down. Emphasize and monitor post-workout stretching to facilitate recovery and develop / maintain flexibility when muscles are warm and responsive. Instruct children to focus on stretch sensations, which are to incorporate feeling in their stretching by imagining it getting longer.
13. Normal play activities, including collective sports constitute an excellent form of aerobic endurance training. Coaches should not expect children’s gains in aerobic capacity to be the same as those of older children/ adolescents.
14. For the child, anaerobic alactic endurance training, which solicits the complex ATP-PC, should involve activities requiring effort and repetition that do not exceed 8-10 seconds. An intense activity of a maximal duration of 20 seconds (i.e., sprint) is good to train a child’s anaerobic lactic endurance because very little lactic acid is produced. However, numerous, repetitive activities of this effort level should be avoided, particularly if recovery periods are too short, because this would increase the production of lactates.
15. Ensure that young athletes meet their nutritional needs, according to the growth period they are in the frequency and intensity of training they are subjected to.
16. Encourage child to integrate visual and kinesthetic information to perform techniques. Physically shape the movement in slow motion to allow a better perception of the movement patterns.
17. Continue involving activities that promote the development of coordination.
18. Even though hand preference is established, continue soliciting the use of both hands. Emphasize knowledge development of games by using appropriately timed instruction of an emphasis on rules, ethics, strategies and goals. Involve them in decision making.
19. Encourage them to think before they act.
20. A variety of inherently fun activities is crucial. Provide gymnastics games.
21. Make sure that your goals and their goals are visible and attainable. Address task / goal completion.
22. Tell them why mechanical principles work in practice. Ask questions to understand their knowledge of mechanics.
23. Help children develop strategies to identify relevant environmental cues and selectively direct their attention.

24. Relaxation should be introduced. Use games requiring imagination. Incorporate the use of music and rhythmic in activities, as they are enjoyable and are valuable in enhancing fundamental skills, creativity, and a basic understanding of music and rhythm components.
25. Avoid embarrassing activities, comments and put-downs. Use concrete examples at all times. Moments requiring conceptual understanding i.e., 'Do you know why you fell back?' should be provided by the end of the stage.
26. Development and application of mental skills should be emphasized as it is important for children to have mastery and confidence in these skills before increased perceptiveness and sensitivity of pre-adolescence hits.
27. Encourage children to plan and perform movement patterns and sequences. Allow individual solutions to movement problems.
28. Create an environment in which children can feel competent and in control of own actions. Make children feel accepted and valued as a human being.
29. During the elementary school years, a child's personality develops through apperception of accomplishment. The child needs to mix work (training) and play to achieve this.
30. Encourage children not only to 'produce' things but also to complete what they have initiated. Provide many opportunities for practice, encouragement and selective instruction. Provide cooperative games and activities that will enable children to discover one-self in relation to others and appreciate their personal capacities.
31. Give positive feedback for effort and continued practice, not just for mastery. Use of 'highlights' is essential for each training session.
32. Provide opportunities to demonstrate successfully learned skills and activities that stimulate positive emotions. Expose children to experiences involving greater amounts of responsibility to help promote self-reliance.
33. Give statements that cushion failure with success. Use positive feedback for effort, correct skills for effort and give positive encouragement for next trial. Give general constructive feedback. If adults do not provide ability-related information in a sensitive and encouraging way, children may interpret this feedback as an indication of low ability.
34. The feedback should also focus on one or two major points and avoid wordy details. For young athletes in this age group, the feedback should be task-oriented rather than outcome-oriented. Create mastery-motivational climates for children in learning situations.
35. Exercises for relaxing and imagery should be encouraged. Introduce periodic free activity / play periods of short duration, usually unrelated to previous tasks. Rational perspectives vs. irrational beliefs should be discussed.
36. Nurture the development of a positive self-concept as well as sportsmanship. Avoid developing problems of negative rivalries (animosity, jealousy and negative images).
37. Be aware that parents might often unintentionally trigger such problems. Smaller-group situations may be a good alternative for problems of egocentrism.
38. Sports provide great contexts for developing friendship patterns among children of this age. Gradually introduce children to group and team activities at the proper time. Respect for others must always be assured (i.e., taking turns on apparatus). Emphasize always giving one's best and finishing what one starts. Discuss such

topics as taking turns, fair play, cheating and sportsmanship to help children establish what is right or wrong.

Early Pubertal Stage: Age 11 to 13 years: Implication for the Children:

1. Emphasize on physical, aesthetic, kinesthetic and technical preparation.
2. Begin individualization of strength training, as it diminishes the risk of skeletal overuse injuries.
3. Provide specific strength and power training on gym simulators (progressive resistance and specificity). Plyometrics can become a more intricate part of training along with body weight exercises.
4. Young adolescents should proceed with caution and be closely supervised when using weight training to improve strength as they are susceptible to musculoskeletal injuries and also peer pressure, which can lead to games of trying to outperform one another. Be cautious with repetitive heavy loading of the musculoskeletal system.
5. There should be monthly recording of height and leg length (sitting height and standing height).
6. During the period of maximum growth, it is critical that an increased caloric intake, above what is required for activity and maintenance, be available to allow optimal growth.
7. Education about nutrition, obesity and weight control should be routinely provided to players.
8. As early as 10-11 years of age, introduce aerobic/ anaerobic interval workouts (progressive training impulses with recovery intervals) as they prevent boredom, improve focus, teach mental toughness and also upgrade the quality of training.
9. At low intensity training periods, training should be geared towards aerobic exercises, such as aerobic interval training e.g., running 400-800 meters with four minutes rest for three to five repetitions and other sub-threshold aerobic fitness sports.
10. Emphasize the importance of and provide opportunities to maintain flexibility. This may mean increase in time devoted to flexibility in order to maintain current level.
11. Reinforce training of body, spatial, directional and temporal awareness.
12. Good verbal instruction should complement to good demonstration skills.
13. Detailed feedback is possible and also necessary in a positive context. During intervention, cue important points to direct the athlete's attention to the most relevant aspects of the performance.
14. Responsibility for actions and self-monitoring of movements errors are to be encouraged. Continue problem solving and task completion strategies. There should be a regular, dynamic involvement in goal setting, reinforcement, progress assessment and efficient time management.
15. The development of a process versus an outcome focus should be discussed. Full relaxation / mental imagery sessions of good performances should be used.
16. Encourage athletes to select and become committed to their own realistic goals. Promote the use of arousal and rational emotive techniques. Promote positive thinking and positive self-talk.
17. Team participation can be used to enhance these values. Emphasize the creation of ethics of positive games subculture (i.e., we are gifted and different).
18. Promote independence, self-dependency and responsibility for competitive preparation. Promote the understanding of proper games effort. Hard work may

compensate for lower levels of ability. Try to promote ‘no excuses’, i.e., primarily an ‘internal locus of control’ attitude.

19. Advance maturity should not be mistaken for superior ability or skill competence. Criticism may be better accepted. Rationalization may occur for differing opinions of coaches and athletes. Get the athlete to start seeking the answers to difficulties first in him or herself.
20. Evaluate social factors and constraints as well as motivational climate in order to lead children to develop optimal achievement goal perspectives, whether they be mastery or competitive-oriented.
21. Monitor individual and group goal setting. Well structured modified competitive formats for challenges, success and monitoring are recommended. However, emphasis should still be on learning rather than winning. Setting short-term goals for local and regional competitions are also recommended.
22. Ensure that expectations are realistic for the social, psychological and physical maturity of the individual. Differences between actual competence and future competence can be rationally discussed.
23. Regularly point out subtle improvements/ developments. Encourage the athletes and provide specific indications of progress and / or potential. Create and highlight positive role models in the sport. Positive outlets should be provided for energetic social groups inside and outside of play arenas.
24. Promote the concept of ‘team’ and positive supportive rivalries otherwise it can lead to disappointment, doubt and insecurity.
25. Emphasis should be on good sportsmanship, respect and acceptance of individual differences. Reinforce caring about others. Regularly discuss understandable emotions.
26. Teach how to accept, respond, and channel energy and focus. This often creates attitudes and concerns regarding social relationships.
27. Care should be taken for providing appropriate role models and keep communication channels open.
28. Changes of body image during this period can also influence the motivation of athletes to perform, and the performance.
29. Ensure that effort is rewarded along with mastery. Allow a measure of independence and self-motivation.
30. Teach pre-adolescents that if they focus effectively and feel good, they will look great. If they worry about ‘how they look’, their focus and feelings clearly will be jeopardized.

Late Pubertal Stage – Age 12 to 14 Years: Implication for the Children:

1. Be aware of fluctuating skill characteristics and ‘weak’ performance.
2. Care must be taken to maintain relative strength and muscle balance.
3. Training of both agonist and antagonist muscle groups should be emphasized. Greatest strength gains should be expected during this period.
4. Introduce strength training for specific sports specific movement skills.
5. Increase the volume of speed-strength and endurance-strength training in the later years.

6. Counsel late matures to be patient and early matures to expect less relative success when others ‘catch-up’ to them. Because of differences in proportions, previously executed skills may become difficult.
7. Avoid frequent overloading of the wrists, especially during the early part of this stage.
8. Specific anaerobic lactic endurance training should be emphasized (moderately at the beginning) as significant gains in these functions are possible. A specific (anaerobic) or non-specific (aerobic-anaerobic) training program will allow the adolescent to sensibly increase his/her maximal anaerobic power.
9. Intensive interval training is possible in the latter part of this stage.
10. Suggest novelty / variety to help produce general cross-training effects and minimize boredom, exhaustion and overuse syndromes. Also encourage team workouts, the use of videos and music to promote enjoyment and training quality.
11. Maintain a high specificity of flexibility training, especially after a workout when the muscles are warm and responsive.
12. Emphasize active methods to develop isometric strength in stretched out positions.

V.4 - SUGGESTIONS:

1. Increased emphasis should be placed as research that attempts to delineate just what components of which program change what kinds of children in what ways. Incorporation of the motor development exercises will definitely enhance the mental ability controlled by emotionality. E.g. it has been suggested that failure to fixate on the printed page may stem from emotional stress. Thus, balance-beam walking or trampoline jumping (‘motor stresses’) while watching a point on a wall may habituate the child to fixate under stress, an improvement that may, in turn, positively transfer to the classroom.
2. The effects of motor activities leading to learning within populations of boys and girls should also be studied.
3. The intellectual functions of children with various levels of arousal, using divergent learning strategies and different IQ groups, should be studies as a function of various kinds of perceptual-motor training.
4. A well-designed testing program, accompanied by a comprehensive program to cover a wide variety of problems, is likely to elicit positive changes in children. However, changes are more likely if the children are relatively young and if their problems are not great. Changes are also more likely in measures of fitness and the like than in motor control.
5. Further it cannot be assumed that changes in test scores constitute some kind of subtle rearrangement; improvement may be due to the child’s discovering and employing more efficient strategies when executing a skill. More and more literature is appearing suggesting further research, organizing helpful remedial techniques and evaluation programs and offering other general and specific background information to those contemplating a program for children whose movement abilities are less than adequate.
6. Consideration of the samples from cities may establish: (1) Fit children should be afforded frequent and vigorous opportunities during the school day to exercise their

movement capacities and thus enable them to bring full attention and intellectual energy to academic work. (2) So called academic work, for some children, should be integrated with movement activities.

7. Numerous measurement problems have plagued scholar attempting to evaluate the motor abilities of children. Young children are extremely variable in the manner in which they decide to perform given skills, as they often have not developed efficient work methods. Thus a researcher may construct what he or she believes to be a consistent testing instrument and then find that the performance of children exposed to this testing instrument is extremely unreliable. The scores collected one day from a given group of children may be dissimilar to the scores collected on a second day on the same tests by the same children.
8. The problem of locating valid norms is also difficult groups of children of the same age tested by two different researchers in the same event, such as standing broad jump, will often obtain highly dissimilar average scores. At the same time, some of the work that has been done fails delineates testing procedures exactly. It is well known that if either instructions or conditions are varied slightly, children will often modify their performances to marked degrees. It is sometimes not clearly specified whether the children on whom the norms were based were tested individually or in groups.
9. It is suggested that the potentially strong children in motor abilities should be encouraged to participate in specific sports accordingly.
10. Few motor abilities development and activity oriented programs will enhance the supply of oxygen to the brain resulting in the increase in number of brain cells allowing the student to concentrate and enhance in schooling activity.
11. In the near future research in motor development will begin to focus even more on early perceptual as well as cognitive and emotional factors that will be predictive of superior motor performance later in life. Batteries composed of tests of physiological makeup, as well as of perceptual and visual activities, together with measures of muscular strength and motor accuracy, may be useful in this context. Additional factors could also be assessed, such as those evaluating various anthropometric parameters as well as surveys of parental attitudes about sport.
12. One of the more pressing needs is to better understand several aspects of motor learning in infants, children and youth. Despite numerous assertions attesting to the manner in which various skills may be taught to children, it remains unclear just how much may be formally taught to a child, and how much he or she acquires through imitative process. Various individual differences in learning strategies- differences that may vary from age to age and from sex to sex – have not been thoroughly looked at by scholars. Knowledge of this kind when translated into practical terms should help provide more meaningful services not only to the average child, but to children who may be either awkward or motorically ‘gifted’.
13. On reviewing the research literature dealing with the various aspects of the motor development of children, one cannot help and notice that a great many more people are anxious to write about children’s motor development. After reviewing the material that follows, some readers may be encouraged to formulate and carry out their own investigations into this interesting area of inquiry by confirming or rejecting the speculations through the collection of ‘hard’ data.

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13. WWW: http://www.ecrp.uiuc.edu/v2n2/saluja.html
14. WWW: http://www.epnet.com/citation.asp?tb=1&ug=dbs+0+1n+en%2dus+sid+972852E2%2D.html
15. WWW: http://www.geocities.com/babysigning/advantages.html.
16. WWW: http://www.geocities.com/babysigning/whysign.html
17. WWW: http://www.kidsource.com/kidsource/content/readiness_for_K.html
18. WWW: http://www.littlepeople.co.za/education_guide/article_01.html
19. WWW: http://www.suntimes.coza/2002/01/13/news/news05.asp.html
20. WWW: http://specialed.about.com/od/multipledisabilities/amultiple.htm 2006.
21. WWW: http://www.fairtest.org/facts/readiness.html 1982.

APPENDIX-I

"A COMPARATIVE STUDY OF THE DEVELOPMENT OF MOTOR ABILITIES IN NORMAL AND THAT IN DEAF AND DUMB CHILDREN FROM 8 YEARS TO 14 YEARS"

FULL NAME:
NAME AND ADDRESS OF THE SCHOOL:
DATE OF BIRTH AND AGE:
MALE ( ); FEMALE ( ).
DEAF AND DUMB/ DIFFERENTLY ABLE ( ); NORMAL ( ).
VEGETARIAN ( ); MIX ( ).
SPORTSMAN ( ); NON-SPORTSMAN ( ).
PHYSICALLY MATURED ( ); PHYSICALLY IMMATURED ( ).
HEIGHT:
SITTING HEIGHT:
WEIGHT:
DAY ONE
01) 50 YARD DASH (1):
02) NELSON HAND REACTION TEST (20): /; AVERAGE OF MIDDLE TEN:
03) SIT-UPS (BENT KNEES) (MAXIMUM): NUMBERS.
04) TRUNK AND NECK EXTENSION (3): / / ; TRUNK AND NECK LENGTH: INCH MINUS BEST LIFT: INCH; FINAL SCORE: INCH.
05) 600 YARD RUN (1): MINUTES AND SECONDS.
06) SIT, BEND AND REACH (3): / / /; BEST: INCH.
07) TWO HAND MEDICINE BALL PUT (3): / / /; BEST METERS.
08) SHOULDER ROTATION TEST (3): / / / ; BEST: INCHES MINUS SHOULDER WIDTH: INCH; FINAL: INCH.
DAY TWO
09) 30 METERS FLYING START (1): SECONDS.
10) SIDE SPLIT TEST (3): / / /; BEST: INCH.

11) STANDING VERTICAL JUMP (3): / / /; BEST: INCH.
12) NELSON SPEED OF MOVEMENT TEST (20): /; VERAGE OF MIDDLE TEN:
13) GRIP STRENGTH TEST (2 EACH): RIGHT: / . LEFT: / . BEST OF RIGHT HAND: ; BEST OF LEFT HAND: .
14) STORK STANDS (3): / / /; BEST: SECONDS.
15) 6X10 METERS SHUTTLE RUN (1): SECONDS.
16) ANGLE REPRODUCTION TEST (3): / / /; AVERAGE OF THREE:
DAY THREE
17) 20 METERS SHUTTLE RUN (1): LEVEL; KM/HR; - MET; VO_2 MAX.
18) CHIN-UPS (**BOYS**) (MAXIMUM NUMBER): FLEX ARM HANG (**GIRLS**) (MAXIMUM TIME):
19) NELSON FOOT REACTION TEST (20): / AVERAGE OF MIDDLE TEN:
20) SCAPULA SKIN FOLD (1):
21) CHEST SKIN FOLD (1):
22) TRICEPS SKIN FOLD (1):
23) ABDOMEN SKIN FOLD(1):
24) SUPRAILLIAC SKIN FOLD (1):
25) THIGH SKIN FOLD (1):
26) CALF SKIN FOLD(1):
27) HUMERUS BONE DIAMETER(1):
28) FEMUR BONE DIAMETER (1):
29) BICEPS MUSCLE GIRTH(1):
30) CALF MUSCLE GIRTH(1):
(Mr. Shatrunjay M. Kote) The Researcher   (Dr. Mohd. Sabir) The Research Guide   (Principal/ Headmaster) Signature and Stamp

APPENDIX-II

AII.1 - FIFTY YARD DASH

OBJECTIVE: To measure speed (acceleration).
AGE LEVEL: Ages six through seventeen.
SEX: Satisfactory for both boys and girls.
RELIABILITY: None reported.
OBJECTIVITY: None reported.
VALIDITY: Face validity is accepted.
EQUIPMENT: Two stopwatches or a watch with a split-second timer is needed. A suitable running area to allow the fifty-yard run plus extension for stopping is also required.
DIRECTIONS: It is advised that two subjects run at the same time. Both start from a standing position. The command to go the starter drops his arm so that the timer at the finish line can start the timing. The subjects run as fast as possible across the finish line.
SCORING: The elapsed time from the starting signal until the runner crosses the finish line is measured to the nearest tenth of a second.

Percentile	Sex	Age					
		6	7	8	9	10	11
99th	Boys	8.3	8.4	7.6	7.5	7.3	7.4
	Girls	9.2	8.6	8.0	7.7	7.7	7.5
90th	Boys	8.8	8.6	7.9	7.8	7.6	7.7
	Girls	9.4	8.9	8.4	8.0	7.8	7.6
80th	Boys	9.0	8.8	8.1	8.0	7.	7.9
	Girls	9.7	9.1	8.7	8.2	8.0	7.8
70th	Boys	9.3	9.1	8.4	8.1	8.0	8.1
	Girls	9.9	9.4	8.9	8.5	8.4	8.0
60th	Boys	9.4	9.2	8.6	8.3	8.2	8.3
	Girls	10.1	9.5	9.1	8.7	8.6	8.1
50th	Boys	9.5	9.5	8.7	8.4	8.3	8.4
	Girls	10.2	9.9	9.3	9.0	8.8	8.5
40th	Boys	9.5	9.7	9.0	8.7	8.5	8.6
	Girls	10.5	10.0	9.5	9.2	9.1	9.0
30th	Boys	9.9	10.1	9.2	8.9	8.7	8.8
	Girls	10.9	10.2	9.9	9.5	9.4	9.4
20th	Boys	10.6	10.5	9.7	9.4	9.0	9.4
	Girls	11.5	10.8	10.5	10.0	9.8	9.7
10th	Boys	12.5	12.3	12.6	11.4	10.5	9.8
	Girls	13.4	14.8	17.5	12.5	11.4	10.8
N	Boys	27	116	126	203	149	50
	Girls	31	101	113	100	82	32

Percentile	Girls								Percentile
	10	11	12	13	14	15	16	17	
100th	6.0	6.0	5.9	6.0	6.0	6.4	6.0	6.4	100th
95th	7.0	7.0	7.0	7.0	7.0	7.1	7.0	7.1	95th
90th	7.3	7.4	7.3	7.3	7.2	7.3	7.3	7.3	90th
85th	7.5	7.6	7.5	7.5	7.4	7.5	7.5	7.5	85th
80th	7.7	7.7	7.6	7.6	7.5	7.6	7.5	7.6	80th
75th	7.9	7.9	7.8	7.7	7.6	7.7	7.7	7.8	75th
70th	8.0	8.0	7.9	7.8	7.7	7.8	7.9	7.9	70th
65th	8.1	8.0	8.0	7.9	7.8	7.9	8.0	8.0	65th
60th	8.2	8.1	8.0	8.0	7.9	8.0	8.0	8.0	60th
55th	8.4	8.2	8.1	8.0	8.0	8.0	8.1	8.1	55th
50th	8.5	8.4	8.2	8.1	8.0	8.1	8.3	8.2	50th
45th	8.6	8.5	8.3	8.2	8.2	8.2	8.4	8.3	45th
40th	8.8	8.5	8.4	8.4	8.3	8.3	8.5	8.5	40th
35th	8.9	8.6	8.5	8.5	8.5	8.4	8.6	8.6	35th
30th	9.0	8.8	8.7	8.6	8.6	8.6	8.8	8.8	30th
25th	9.0	9.0	8.9	8.8	8.9	8.8	9.0	9.0	25th
20th	9.2	9.0	9.0	9.0	9.0	9.0	9.0	9.0	20th
15th	9.4	9.2	9.2	9.2	9.2	9.0	9.2	9.1	15th
10th	9.6	9.6	9.5	9.5	9.5	9.5	9.9	9.5	10th
5th	10.0	10.0	10.0	10.2	10.4	10.0	10.5	10.4	5th
0th	14.0	13.0	13.0	15.7	16.0	18.0	17.0	12.0	0th

Reference: Practical measurement for evaluation in physical education, Third edition- Barry L. Johnson and Jack K. Nelson, Published by S.S. Chhabra for Surjeet Publication India 1988 with permission from Burgess Publishing Company U.S.A.; Page number 250 and 251.

AII.2 - 30 METERS FLYING START (LOCOMOTION)

TEST AIM: To measure the maximum speed (locomotion).
EQUIPMENT: Stop watch (1/10th of a second) and six flag posts. 45 meters running strip, measuring tape.
MARKING: 45 meter distance is divided into two zones of 15 meters and the other of 30 meter say FA & B is of 15 meters and AB is of 30 meters. Take radius of 30 meters and mark an arc from point A. Mark another arc of 30 meters from point B and intersecting at point C. Join CA and extend to E and join CB and extend to D. Fix flags at all these six points A,B,C,D,E, & F.
PROCEDURE: The performer stands behind the line F and accelerates, and cross the line B with maximum possible speed.
SCORING: The time keeper stands on point C and when the runner comes in line with the flag A and E, he starts the watch and when the torso of runner comes in line B and D he stops the watch. The time is then noted down from the watch.

AGE	SATISFACTORY		GOOD		VERY GOOD	
	BOYS	GIRLS	BOYS	GIRLS	BOYS	GIRLS
8 years	5.3-4.8	5.6-5.2	4.7-4.5	5.1-4.7	4.4 & less	4.6 & less
9 years	5.1-4.7	5.4-4.9	4.6-4.3	4.8-4.5	4.2 & less	4.4 & less
10 years	4.9-4.5	5.2-4.8	4.4-4.1	4.7-4.3	4.0 & less	4.2 & less
11 years	4.8-4.5	4.9-4.6	4.3-3.9	4.5-4.2	3.8 & less	4.1 & less
12 years	4.7-4.3	4.8-4.5	4.2-3.8	4.4-4.0	3.7 & less	3.9 & less
13 years	4.2-4.0	4.4-4.2	3.9-3.6	4.1-3.9	3.5 & less	3.8 & less
14 years	4.1-3.8	4.2-4.0	3.7-3.4	3.9-3.7	3.3 & less	3.6 & less

Reference: prospectus of Andhra Pradesh sports school, Hakim pet, Secunderabad page no. 7 and Kreeda Prabodhini, Indian norms

AII.3 - TWO HAND MEDICINE BALL PUT (6 LBS)

OBJECTIVE: To measure the power of the arms and shoulder girdle.
AGE LEVEL: Ages twelve through college.
SEX: Satisfactory for boys and girls.
RELIABILITY: An 'r' of 0.81 was found for college girls, while 'r' of 0.84 was found for college boys.
OBJECTIVITY: Reported as high as 0.99 as found by Gene Ford, 1969.
VALIDITY: An 'r' of 0.77 was obtained by correlating distance scores with scores computed by power formula. However, angle of release was not figured in the correlation, although it is a definite limiting factor affecting the validity!
EQUIPMENT AND MATERIALS: A 6 pound medicine ball, marking material (chalk or tape), small rope, chair, and a tape measure are needed for this test.
DIRECTIONS: From a sitting position in a straight back chair, the performer holds the ball in both hands with the ball drawn back against the chest and just under the chin. He then pushes the ball upward and outward for maximum distance. The rope is placed around the performer's chest and held taut to the rear by a partner in order to eliminate rocking action during the push. The performer's effort should be primarily with the arms.
SCORING: The distance of the best of three trials measure to the nearest foot is recorded as a score. One practice trial may be taken before scoring.
ADDITIONAL POINTERS: (a) Each of three trials should be taken in succession. (b) Distance is measured form the forward edge of the chair to the point of contact of the ball with the floor.

COLLEGE MEN		COLLEGE WOMEN
SCORES	PERFORMANCE LEVEL	SCORES
26 and above	Advance	15 and above
22 to 25	Advance intermediate	13 to 14
14 to 21	Intermediate	8 to 12
10 to 12	Advance beginner	5 to 7
0 to 9	Beginner	0 to 4

Data is based on 100 score secured form physical education classes at Corpus Christi State University, Corpus Christi, TX. 1976.
Data is based on 65 scores secured from physical education classes at Corpus Christi State University, Corpus Christi, TX. 1976.
Medicine ball of 1 kg for up to 10 years, 2 kg for 11 years and above
Reference: Sports medicine centre, Pune, India.

AGE	BOYS			GIRLS		
	SATISFACTORY	GOOD	VERY GOOD	SATISFACTORY	GOOD	VERY GOOD
8 Years	2.26 to2.50	2.51 to 2.76	2.77 or more	1.80 to 2.13	2.14 to 2.47	2.48 or more
9 years	2.51 to 2.82	2.83 to 3.13	3.14 or more	2.02 to 2.40	2.42 to 2.80	2.81 or more
10 years	2.66 to 3.13	3.14 to 3.59	3.60 or more	2.21 to 2.69	2.70 to 3.18	3.19 or more
11 years	2.50 to 2.96	2.97 to 3.43	3.44 or more	2.41 to 2.84	2.85 to 3.29	3.30 or more
12 years	2.60 to 3.28	3.29 to 3.97	3.98 or more	2.51 to 2.94	2.95 to 3.39	3.40 or more
13 years	3.01 to 3.62	3.63 to 4.23	4.24 or more	2.56 to 3.02	3.03 to 3.49	3.50 or more

14 years	3.19 to 3.80	3.81 to 4.41	4.42 or more	2.61 to 3.09	3.10 to 3.59	3.60 or more

Reference: Practical measurement for evaluation in physical education, Third edition- Barry L. Johnson and Jack K. Nelson, Published by S.S. Chhabra for Surjeet Publication, India 1988 with permission form Burgess Publishing Company U.S.A.; Page number 208, 209

AII.4 - SIT-UPS (Bent Knees)

OBJECTIVES: To measure the endurance of the abdominal muscles.
AGE: Ages ten through college.
SEX: Satisfactory as a test for both boys and girls.
RELIABILITY: Has been reported as high as 0.94.
OBJECTIVITY: An ‘r’ of 0.98 was found for this test.
VALIDITY: Face validity was accepted for this test.
EQUIPMENT AND MATERIALS: The only equipment required is a mat and yardstick.
DIRECTIONS: From a lying position on the back, the performer flexes his knees over the yardstick while sliding his heels as close to his seat as possible. The yardstick should be held tightly under the knees until the performer is instructed to slowly slide this feet forward. At the point where the yardstick drops on the mat, the tester marks the heel line and seat line to indicate how far the feet should remain from the seat during the bent-knee sit-up exercise. The performer should interlace the fingers behind the neck and perform sit-ups alternating a left elbow touch of the inside right knee and right elbow touch of the inside left knee. The exercise should be repeated as many times as possible.
SCORING: The total number of repetition is recorded for the score. However, repetitions should not be counted when fingertips do not maintain contact behind the head, when the knees are not touched, or when the pupil pushes off the floor with the elbow.
ADDITIONAL POINTS: (a) The feet should rest flat on the floor and may be separated a few inches. (b) The back of the hands should touch the mat each time before curling to the sit-up position. (c) Taping the yardstick to the floor for the seat line helps the performer to maintain proper distance between seats 2 feet.
Raw score norms for sit-ups (bent knees):

College Men	Performance level	College Women
66 and above	Advanced	49 and above
53 to 65	Advance intermediate	37 to 48
34 to 52	Intermediate	21 to 36
25 to 33	Advanced beginner	13 to 20
0 to 24	Beginner	0 to 12

Reference: Practical measurement for evaluation in physical education, Third edition- Barry L. Johnson and Jack K. Nelson, Published by S.S. Chhabra for Surjeet Publication, India 1988 with permission form Burgess Publishing Company U.S.A.; Page number 120, 121, and 122.

AII.5 - STANDING VERTICAL JUMP (SARGENT CHALK JUMP)

OBJECTIVE: To measure explosive strength of the legs in jumping vertically upward.
AGE LEVEL: Satisfactory for ages nine through adulthood.
SEX: Satisfactory for both boys and girls.
RELIABILITY: Has been reported as high as 0.93.
OBJECTIVITY: An objectivity coefficient of 0.93 was obtained by Jack Clayton, 1969.
VALIDITY: A validity of 0.78 has been reported with the criterion of a sum of four track and field event scores.

EQUIPMENT AND MATERIALS: A yardstick, several pieces of chalk, and a smooth wall surface of at least 12 feet from the floor are required.
DIRECTIONS: The performer should stand with one side towards a wall, heels together, and hold a 1 inch piece of chalk in the hand nearest to the wall. Keeping the heels together, on the floor, he should reach upward as high as possible and make a mark on the wall. The performer then jumps as high as possible and makes another mark at the height of his jump.
SCORING: The number of inches between the reach and the jump marks measured to the nearest half inch is the score. Three to five trials are allowed and the best trial is recorded as the score.
ADDITIONAL POINTERS: (a) A double jump or a 'crow hop' should not be permitted upon take-off. (b) The chalk should not be extended any further than necessary beyond the fingertips to make the standing and jumping marks. (c) The reliability and validity of the test can be slightly improved if the performer practices the jump until it is correctly executed before being tested. (d) Body weight may be included to score in terms of foot-pounds.
*Vertical jump scoring table

GENDER AND AGE	100	90	80	70	60	50	40	30	20	10	0
Boys and Girls 9,10,11	16	15	14	12	11	10	9	7	4	2	0
Boys 12,13,14	20	18	17	16	14	13	11	9	5	2	0
Girls 12,13,14	16	15	14	13	12	11	10	8	4	2	0
Boys 15 to 17	25	24	23	21	19	16	12	8	5	2	0
Girls 15 to 17	17	16	15	14	13	11	8	6	3	2	0
Men 18 to 34	26	25	24	23	19	16	13	9	8	2	0
Women 18 to 34	14	13	13	12	10	8	6	4	2	1	0

Reference: Harold T. Friermood, 'volleyball skill contest for Olympic development' in United States Volleyball Rules and Reference guide of the U.S. Volleyball Association, Berne, Ind.: USVBA printer, 1967, pp 134-135.
*Raw scores are located in the chart in accordance with age and sex, and percentile scores are located across the top.
Reference: Sports Medicine Centre, Pune.

AGE	BOYS			GIRLS		
	SATIS-FACTORY	GOOD	VERY GOOD	SATIS-FACTORY	GOOD	VERY GOOD
8	30-32	33-35	36 & above	26-29	30-33	34 & above
9	33-35	36-38	39 & above	29-32	33-36	37 & above
10	36-38	39-41	42 & above	32-35	36-39	40 & above
11	39-41	42-44	45 & above	35-38	39-43	44 & above
12	42-45	46-50	51 & above	39-42	43-47	48 & above
13	44-47	48-53	54 & above	43-46	47-50	51 & above
14	46-50	51-56	57 & above	46-49	50-53	54 & above

AII.6 - 20 METERS SHUTTLE RUN (CANADIAN FIT TEST):

METHOD 1: This is a very simple test used and recognized internationally and introduced in India by the Sports Medicine Center. Just by means of a simple audio cassette and a tape recorder, one can determine the VO_2 max of an athlete and identify real talent with better VO_2 max capacity amongst many participants. Simplicity of this test facilitates many people to be tested in a very short time.

REQUIREMENTS: (i) A 20 meters area with markings as shown on the ground. (ii) A cassette player (iii) A 20 meters shuttle run audio cassette.

THE TEST – SALIENT FEATURES: (1) It is suitable for either sex, individuals between the age of 6 and 60 in a medically fit condition. (2) The test includes a period of warm up. (3) Maximal effort is required only at the end of the test. (4) The test as such involves jogging and running at progressively increasing pace, over a 20 meters course for as long as possible. The pace is given by the audio cassette. At every sound heard, you must have reached one of the 20 meters lines and upon hearing the sound, you should pivot and reverse your direction and run at the set pace to the opposite line in time for the next audio signal. This way you run till your maximum capacity is reached. If twice in a row you can't reach within 2 strides of the line, you have reached your max capacity and so remember the last number announced on the cassette player. This is your stage level and equates this with your score from the score sheet attached – to know your VO_2 max as per your age.

READING YOUR RUN SCORE FROM THE CHART GIVEN: (1) The chart/ score sheet has been worked out from age group of 7 onwards to 18 + (which includes adults of all ages) – which has been put on the horizontal axis of the chart. (2) The 1st column vertically downwards shows the number of stages/ minutes you have run. (3) The 2nd vertical column downwards shows your running speed in kilometers/ hour. (4) The columns thereafter are placed age groups wise and divided into two sub-sections vertically: (a) the first shows the METS – value (MET is the energy unit – and indicates the aerobic fitness level. At rest it is 1 MET and during exercise it should be able to reach between 10 to 20 METS i.e., 10 to 20 times your resting level). (b) The second sub-section shows the VO_2 in milliliter/ kilogram.

20 METERS SHUTTLE RUN (CANADIAN FIT TEST)

PREDICTION OF MET AND VO_2 MAX WITH FIT TEST

STAGE	VEL KM/H	AGE											
		7		8		9		10		11		12	
		MET	VO_2	MET	VO_2	MET	VO_2	MET	VO_2	MET	VO_2	MET	VO_2
1	8.5	12.9	45.0	12.3	43.0	11.7	41.1	11.2	39.1	10.6	37.2	10.1	35.2
2	9.0	13.5	47.1	12.9	45.2	12.4	43.4	11.9	41.5	11.3	39.6	10.8	37.8
3	9.5	14.1	49.3	13.6	47.5	13.1	45.7	12.5	43.9	12.0	42.1	11.5	40.3
4	10.0	14.7	51.4	14.2	49.7	13.7	48.0	13.2	46.3	12.7	44.6	12.3	42.9
5	10.5	15.3	53.6	14.8	51.9	14.4	50.3	13.9	48.7	13.4	47.0	13.0	45.4
6	11.0	15.9	55.7	15.5	54.2	15.0	52.6	14.6	51.1	14.1	49.5	13.7	47.9
7	11.5	16.5	57.9	16.1	56.4	15.7	54.9	15.3	53.4	14.9	52.0	14.4	50.5
8	12.0	17.1	60.0	16.7	58.6	16.3	57.2	15.9	55.8	15.5	54.4	15.1	53.0
9	12.5	17.8	62.2	17.4	60.9	17.0	59.5	16.6	58.2	16.3	56.9	15.9	55.6
10	13.0	18.4	64.4	18.0	63.1	17.7	61.9	17.3	60.6	17.0	59.4	16.6	58.1
11	13.5	19.0	66.5	18.7	65.3	18.3	64.2	18.0	63.0	17.7	61.8	17.3	60.6
12	14.0	19.6	68.7	19.3	67.6	19.0	66.5	18.7	65.4	18.4	64.3	18.1	63.2
13	14.5	20.2	70.8	19.9	69.8	19.7	68.8	19.4	67.8	19.1	66.7	18.8	65.7
14	15.0	20.9	73.0	20.6	72.0	20.3	71.1	20.1	70.2	19.8	69.2	19.5	68.3
15	15.5	21.5	75.1	21.2	74.3	21.0	73.4	20.7	72.5	20.5	71.7	20.2	70.8
16	16.0	22.1	77.3	21.9	76.5	21.6	75.7	21.4	74.9	21.2	74.1	20.9	73.3
17	16.5	22.7	79.5	22.5	78.7	22.3	78.0	22.1	77.3	21.9	76.6	21.7	75.9
18	17.0	23.3	81.6	23.1	81.0	22.9	80.3	22.8	79.7	22.6	79.1	22.4	78.4

19	17.5	23.9	83.8	23.8	83.2	23.6	82.6	23.5	82.1	23.3	81.5	23.1	81.0
20	18.0	24.5	85.9	24.4	85.4	24.3	85.0	24.1	84.5	24.0	84.0	23.9	83.5

Reference: Table of prediction of MET, VO_2 max is in the Armed forces sports medicine center, Pune.

STAGE	VEL KM/H	AGE											
		13		14		15		16		17		18+	
		MET	VO_2	MET	VO_2	MET	VO_2	MET	VO_2	MET	VO_2	MET	VO_2
1	8.5	9.5	33.3	9.0	31.4	8.4	29.4	7.9	27.5	7.3	25.5	6.7	23.6
2	9.0	10.3	35.9	9.7	34.0	9.2	32.2	8.7	30.3	8.1	28.5	7.6	26.6
3	9.5	11.0	38.5	10.5	36.7	10.0	35.0	9.5	33.2	9.0	31.4	8.5	29.6
4	10.0	11.7	41.1	11.3	39.4	10.8	37.7	10.3	36.0	9.8	34.3	9.3	32.6
5	10.5	12.5	43.8	12.0	42.1	11.6	40.5	11.1	38.9	10.6	37.2	10.2	35.6
6	11.0	13.3	46.4	12.8	44.8	12.4	43.3	11.9	41.7	11.5	40.2	11.0	38.6
7	11.5	14.0	49.0	13.6	47.5	13.1	46.0	12.7	44.6	12.3	43.1	11.9	41.6
8	12.0	14.7	51.6	14.3	50.2	13.9	48.8	13.5	47.4	13.1	46.0	12.7	44.6
9	12.5	15.5	54.2	15.1	52.9	14.7	51.6	14.4	50.3	14.0	48.9	13.6	47.6
10	13.0	16.3	56.9	15.9	55.6	15.5	54.4	15.2	53.1	14.8	51.8	14.5	50.6
11	13.5	17.0	59.5	16.7	58.3	16.3	57.1	16.0	55.9	15.7	54.8	15.3	53.6
12	14.0	17.7	62.1	17.4	61.0	17.1	59.9	16.8	58.8	16.5	57.7	16.2	56.6
13	14.5	18.5	64.7	18.2	63.7	17.9	62.7	17.6	61.6	17.3	60.6	17.0	59.6
14	15.0	19.2	67.3	19.0	66.4	18.7	65.4	18.4	64.5	18.1	63.5	17.9	62.6
15	15.5	20.0	69.9	19.7	69.1	19.5	68.2	19.2	67.5	19.0	66.5	18.7	65.6
16	16.0	20.7	72.6	20.5	71.8	20.3	71.0	20.1	70.2	19.8	69.4	19.6	68.6
17	16.5	21.5	75.2	21.3	74.5	21.1	73.7	20.9	73.0	20.7	72.3	20.5	71.6
18	17.0	22.2	77.8	22.1	77.2	21.9	76.5	21.7	75.9	21.5	75.2	21.3	74.6
19	17.5	23.0	80.4	22.8	79.9	22.7	79.3	22.5	78.7	22.3	78.2	22.2	77.6
20	18.0	23.7	83.0	23.6	82.5	23.5	82.1	23.3	81.6	23.2	81.1	23.0	80.6

Reference: Table of prediction of MET, VO_2 max is in the Armed forces sports medicine center, Pune.

AII.7 - SHOULDER ROTATION TEST (FLEXIBILITY)

PURPOSE: To measure the extent to which the shoulders will rotate with as narrow a grip as possible.
AGE LEVEL: Ages six through college.
SEX: Satisfactory as a test for both boys and girls.
RELIABILITY: An ‘r’ pf 0.97 was found when the best scores of three trials was recorded from separate testing and correlated.
OBJECTIVITY: An ‘r’ of 0.99 was found when the scores from an experienced tester were correlated with scores from an inexperienced tester.
VALIDITY: Face validity was accepted for this test.
EQUIPMENT: 60 inches of rope and flexomeasure with yardstick and guide stick inserted.
DIRECTIONS: (1) Grasp one end of the rope with your left hand and grasp the rope with you r right hand in alike manner a few inches away. (2) Extend both arms to full length in front of your chest and rotate the rope over your head. As you meet resistance in rotating your shoulders, you must let the rope slide within the grip of your right hand so that the arms can spread and allow you to lower the rope until it is resting across your back. (3) Keeping your arms locked, rotate to the starting position and measure the number of inches of rope between the thumbs to your hands. The least amount of distance indicated a better level of performance (4) Secure the maximum shoulder width across the back from deltoid to deltoid with the flexomeasure.
SCORING: Your shoulder width is subtracted from the total inches of your best scores of three trials.

Thus, the lower the score, the better the performance
Shoulder rotation test

MEN	LEVEL	WOMEN
7 and less	Advanced	5 and less
11 ½ to 7 ¼	Advanced intermediate	9 ¾ to 5 ¼
14 ½ to 11 ¾	Intermediate	13 to 10
19 ¾ to 14 ¾	Advance beginners	17 ¾ to 13 ¼
Above 20	Beginners	Above 18

Reference: Practical measurement for evaluation in physical education, Third edition- Barry L. Johnson and Jack K. Nelson, Published by S.S. Chhabra for Surjeet Publication, India 1988 with permission form Burgess Publishing Company U.S.A.; Page number 85, 86, and 87.

AII.8 - FLEXIBILITY TEST (FORWARD BEND AND REACH)

TEST AIM AND PURPOSE: To measure the development of hip and back flexion as well as extension of the hamstring muscles of the legs. The object is to see how far you can extend your fingertips beyond your foot line with the legs straight.
SPORTS SPECIFICITY: (1) Vaulting, diving, and trampoline skills; (2) Straight-arm, straight-leg press to handstand in floor exercises as well as in other gymnastics skills.
AGE LEVEL: Ages six through college.

SEX: Satisfactory as a test for both boys and girls.
RELIABILITY: An ‘r’ of 0.94 was found when the best score of three trials was recorded from separate testing and correlated.
OBJECTIVITY: An ‘r’ of 0.99 was found when the scores from an experienced tester were correlated with scores from an inexperienced tester.
VALIDITY: Face validity was accepted for this test.
EQUIPMENT: Flexomeasure case with yard stick and tape.
DIRECTIONS: (1) Line up the 15 inch mark of the yardstick with a line on the floor and tape the ends of the stick to the floor so that the flexomeasure case (window side) is face down. (2) Sit down and line up your heels with the near edge of the 15 inch mark and slide your seat back beyond the zero end of the yardstick. (3) Have a partner stand and brace his or her toes against your heels. Also, have and assistant on each side to hold your knees in a locked position as you prepare to stretch. (4) With heels not more than 5 inches apart, slowly stretch forward, while pushing the flexomeasure case as far down the stick as possible with the fingertips of both hands. Take your reading at the near edge of the flexomeasure case.
SCORING: The best of three trials measured to the nearest quarter of an inch is your test score.
Modified sit and reach test

Men	Level	Women
23 ¾ and above	Advanced	25 ¾ and above
21 ¼ to 23 ½	Advanced Intermediate	22 ½ to 25 ½
18 ¾ to 21	Intermediate	20 to 22 ¼
17 to 18 ½	Advanced Beginner	18 to 19 ¾
Below 16 ¾	Beginner	Below 17 ¾

Data is based on the scores of 100 college men and 100 college women at Corpus Christi State University, Corpus Christi, TX. 1977.

Age	Boys			Girls		
	Satisfactory	Good	Very Good	Satisfactory	Good	Very Good
8	4 to 6	7 to 9	10 or more	4 to 6	7 to 10	11 or more
9	4 to 7	8 to 10	11 or more	4 to 7	8 to 11	12 or more

10	5 to 8	9 to 11	12 or more	5 to 8	9 to 12	13 or more
11	6 t0 9	10 to 12	13 or more	5 to 8	9 to 12	13 or more
12	6 to 9	10 to 13	14 or more	6 to 10	11 to 14	15 or more
13	7 to 10	11 to 14	15 or more	6 to 11	12 to 16	17 or more
14	7 to 10	11 to 14	15 or more	7 to 11	12 to 16	17 or more

Reference: Practical measurement for evaluation in physical education, Third edition- Barry L. Johnson and Jack K. Nelson, Published by S.S. Chhabra for Surjeet Publication, India 1988 with permission from Burgess Publishing Company U.S.A.; Page number 79 and 80.

AII.9 - SIDE SPLIT TEST (FLEXIBILITY OF HIP JOINT)

PURPOSE: To develop the extension in spreading the legs apart. The object is to get the crotch as close to the floor as possible.
AGE LEVEL: Ages six through college.
SEX: Satisfactory as a test for both boys and girls.
RELIABILITY: An ‘r’ of 0.92 was found when the best score of three trials was recorded from separate testing and correlated.
OBJECTIVITY: An ‘r’ of 0.99 was found when the scores from an experienced tester were correlated with scores form an inexperienced tester.
VALIDITY: Face validity was accepted for this test.
EQUIPMENT: Flex measure case with yardstick and ruler guide inserted. Be sure the A-B line of the case is nearest the zero end of the yard-stick.
DIRECTION: (1) From a stand, extend the legs apart from side to side until your crouch is as near to the floor as possible. (2) As you lower, an assistant should be positioned behind you with the zero end of the yardstick on the floor. (3) When you reach your lowest point, the case is raised upward until the ruler guide rests under your crotch. The reading to the nearest quarter of and inch is taken in the case window at the lower (C-D) line.
SCORING: The best score of three trials is recorded as the performance score.
ADDITIONAL POINTERS: (1) The knees must be locked at the moment of measurement. (2) The performer’s hand may touch the floor for balance during the test.

MEN	LEVEL	WOMEN
3 to 0	Advanced	2 ¾ to 0
8 to 3 ¼	Advanced Intermediate	7 ½ to 3
17 ½ to 8 ¼	Intermediate	16 ¾ to 7 ¾
22 ½ to 17 ¾	Advanced Beginner	21 ½ to 17
Above 22 ¾	Beginner	Above 21 ¾

Based on the scores of 100 college men and 100 college women at Corpus Christi State University, Corpus Christi TX., 1977.

Reference: Practical measurement for evaluation in physical education, Third edition- Barry L. Johnson and Jack K. Nelson, Published by S.S. Chhabra for Surjeet Publication, India 1988 with permission from Burgess Publishing Company U.S.A.; Page number 82, 83.

AII.10 - THE NELSON HAND REACTION TEST (REACTION ABILITY)

OBJECTIVE: To measure the speed of reaction with the hand in response to a visual stimulus.
AGE LEVEL: Any age from Kindergarten upward. The only limiting factor would be the subject’s ability to catch the falling stick with the fingers.
SEX: Boys and Girls.
VALIDITY: the validity of the timing device is inherent, since the earth’s gravitational pull is consistent; therefore, the timer falls at the same rate of acceleration each time.

RELIABILITY: A reliability coefficient of 0.89 was obtained using average scores taken on two separate test administrators.
TEST EQUIPMENT AND MATERIALS: Nelson Reaction Timer, table and chair, or desk chair.
DIRECTION: The subject sits with this forearm and hand resting comfortably on the table (or desk chair). The tips of the thumb and the index finger are held in already to pinch position about 3 or 4 inches beyond the edge of the table. The upper edge of the thumb and index finger should be in a horizontal position. The tester holds the stick timer near the top, letting it hand between the subject's thumb and index finger. The base line should be even with the upper surface of the subject's thumb.

The subject is directed to look at the concentration zone (which is a black shaded zone between the 0.120 and 0.130 lines) and is told to react by catching the stick (by pinching the thumb and index finger together) when it is released. The subject should not look at the tester's hand; nor is he allowed to move his hand up or down while attempting to catch the falling stick. Twenty trials are given. Each drop is preceded by a preparatory command of "ready".
SCORING: When the subject catches the timer, the score is read just above the upper edge of the thumb. The five slowest and five fastest trials are discarded, and an average of the middle ten is recorded, as the score. Numbers on the timer represent thousandths of a second. Scores may be recorded to the nearest 5/1000 of a second.
SAFETY AND PRECAUTIONS: None.
ADDITIONAL POINTERS: (a) The testing environment should be such that the subject is able to concentrate. (b) Allow the subject three or four practice trials to make sure he understands the procedures and becomes familiar with the task. (c)The interval of time between the preparatory command of "ready" and the release is extremely important. It should be varied in order to prevent the subject from becoming accustomed to a constant pattern. On the other hand, this interval should remain within a range of not less than one and half second nor longer than approximately 2 seconds. If too short, it catches the subject before he is ready, and if the interval is too long the subject loses his optimal state of readiness. For standardization the tester could have a specific order of these intervals. For example on the first trial he could say "ready" then count to himself 1001, then release; on the second trial, after "ready" he might mentally say "one" then release, etc. (d) obvious anticipations should be discarded and should not be counted as one of the twenty trials. (e) The tester must be careful that the subject's thumb or index finger is not touching the timer. (f) If the subjects are young children, the test should be conducted like a challenging game. (g) The subject's dominant hand should be used if only one hand is to be tested. (h) The thumb and index finger should not be more than 1 inch apart at the start.
NORMS: The average reaction time is around 0.16 with a range of 0.13 to 0.22 with small children (first graders), the average is about 0.26.
Time in milliseconds = 2 X distance stick falls in centimeters/ acceleration due to gravity.
Time = 2 X distance the stick falls in inches / acceleration due to gravity WHOLE UNDER-ROOT

Reference: Practical measurement for evaluation in physical education, Third edition- Barry L. Johnson and Jack K. Nelson, Published by S.S. Chhabra for Surjeet Publication, India 1988 with permission form Burgess Publishing Company U.S.A.; Page number 246 and 247.

AII.11 - STORK STAND (STATIC BALANCE TEST)

OBJECTIVE: To measure the static balance of the performer while supported on the ball of the foot of the dominant leg.
AGE LEVEL: Ages ten through college.
SEX: Satisfactory for both boys and girls.
RELIABILITY: An 'r' of 0.87 was found for this test when the best trial of the initial test was corrected with the best trial of the second test, which was administered on different days.

OBJECTIVITY: Reported as high as 0.99 as determined by Jim Knox, 1969.
VALIDITY: Face validity was accepted for this text.
EQUIPMENT AND MATERIALS: One stopwatch or a wrist watches with a second hand.
DIRECTIONS: From a stand on the foot of the dominant leg, place the other foot on the inside of the supporting knee and place the hands on the hips. Upon a given signal, raise the heel from the floor and maintain the balance as long as possible without moving the ball of the foot from its initial position or letting the heel touch the floor.
SCORING: The score is the greatest number of seconds counted between the time the heel is raised and the balance is lost on three trials with the preferred foot. Only the highest score is recorded.
ADDITIONAL POINTERS: (a) Students may be tested in pairs, with one performing while the other takes note of how long the performer balanced as the number of seconds are counted off (aloud) by the timer. (b) Students who failed to get started on time are retested. (c) The performer cannot remove this hands form his hips during the test.

MEN	PERFORMANCE LEVEL	WOMEN
51 and Higher	Advanced	28 and Higher
37 to50	Advanced Intermediate	23 to 27
15 to 36	Intermediate	8 to 22
5 to 14	Advanced Beginner	3 to 6
0 to 4	Beginner	0 to 2

Based on the scores of 50 college men and 50 college women, Corpus Christi State University,. Corpes Christi TX 1976.

Reference: Practical measurement for evaluation in physical education, Third edition- Barry L. Johnson and Jack K. Nelson, Published by S.S. Chhabra for Surjeet Publication, India 1988 with permission from Burgess Publishing Company U.S.A.; Page number 227, 228.

AII.12 - 6 X 10 METERS SHUTTLE RUN FOR AGILITY

TEST AIM: To determine the agility of the subject.
EQUIPMENT: Stopwatch, lime powder.
PROCEDURE: The subject stands behind the starting line. On getting g starting signal ‘go’ he runs faster, goes nearest to the other line and touches it with the one hand turns and comes back to starting line, touches it with hand, turns and repeats it for a total of 5 times and 6^{th} time runs over as fast as possible.
SCORING: The time taken by the performer to complete the course of 6 x 10 meters to the nearest $1/10^{th}$ of a second is recorded as score of the test. Only one chance is given.
NOTE: Participants are not allowed to use spikes and the area should be firm and non-slippery.

AGE	BOYS			GIRLS		
	SATIS-FACTORY	GOOD	VERY GOOD	SATIS-FACTORY	GOOD	VERY GOOD
8	18.3-17.5	17.4-16.5	16.4 & less	19.3-18.3	18.2-17.2	17.1 & less
9	18.0-17.2	17.1-16.3	16.2 & less	19.0-18.0	17.9-16.9	16.8 & less
10	17.5-16.5	16.4-15.5	15.4 & less	18.5-17.2	17.1-16.2	16.1 & less
11	17.1-16.2	16.1-15.4	15.3 & less	18.0-17.0	16.9-15.0	15.9 & less
12	16.8-16.0	15.9-15.2	15.1 & less	17.2-16.8	16.7-16.3	16.2 & less
13	16.5-15.9	15.8-15.1	15.0 & less	16.8-16.4	16.3-15.9	15.8 & less
14	16.3-15.8	15.7-15.0	14.9 & less	16.4-16.0	15.9-15.5	15.4 & less

Reference: Prospectus of Andhra Pradesh Sports School, Hakim pet, Secunderabad, Page no. 10 and Sports medicine center, Pune.