Chapter II

REVIEW OF RELATED LITERATURE

A serious attempt was made by the research scholar to go through the literature related to the present study. A brief review of these studies are enumerated in this chapter.

Kelly\(^1\) has pointed out posture as an index of health. For good health general health habits should be checked and all possible steps should be taken to correct faulty influences. Only then posture training and posture exercises should be given to achieve the best result.

Davies\(^2\) has found that postural divergencies may inhibit or prevent a child from participating successfully in motor activities. It has often been said that balanced posture enables one to have graceful and efficient movement. If a person's body is out of alignment or is asymmetrical, he is not expected to have efficient movement pattern. It may be the result of psychological, physical, or phychosomatic difficulties.


Deaver\(^3\) has pointed out the relation of posture to mental
and physical health. He has said that posture is an index of
personality. For good health correct posture should be taught
early as one of the essentials of health. Erect posture is an
expression of intelligence and character and index of physical
efficiency. Correct posture of body is first importance as ill
health results in incorrect posture.

Cooper and Glassow\(^4\) associated erect posture with attitude
of readiness, self confidence and assurance which certainly
gives better appearance, better advantage and expression of
attentiveness.

Wells and Luttgens\(^5\) have found posture as a position,
and multisegmented organism of human body. They said that
emotional reactions of an overly sensitive individual turn to
abnormal posture. For good posture, good coordination requires
to avoid tension in muscle group.

\(^3\)G.G. Deaver, "Posture and Its Relation to Mental and
Physical Health," Research Quarterly (March 1933) : 221.

\(^4\)John M. Cooper and Ruth B. Glassow, Kinesiology 3rd

\(^5\)Katharine F. Wells and Kathryn Luttgens, Kinesiology
Scientific Basis of Human Motion 6th ed. (Philadelphia : W.B.
Nemir and Schaller\(^6\) have found the bony skeleton and muscles govern balance, which varies with age, occupation, type of activity, physique and health.

Rathbone and Hunt\(^7\) have found that an individual's habitual posture reflects the general health and state of mind. A happy person tends to be erect and extended while an ill or depressed person tends to slump and lanky. Posture is considered by many to be an indication of the spiritual as well as the emotional tone of the individual.

Moriarty and Irwin\(^8\) have found that the relationship of physical and emotional factors have effect on posture. There should be proper training of body so that best possible state of health might be obtained. Self consciousness, fatigue and other psychological states are reflected in postural pattern. Physical defects and environmental factors leave bad effect on posture which result in fatigue, infection, discouragement and physical defects.


Bortz\textsuperscript{9} had defined that bad posture with its poor mechanics is accompanied by lack of muscles tone, lowered threshold to fatigue and lessened available mechanical energy.

Kety\textsuperscript{10} found poor posture causes a cramped position of the heart, lungs and abdominal organs. Circulation of the blood is impeded and the organs farthest from heart fail to receive adequate oxygen. Undue stretching of some muscle is bad posture and causes muscles and nerve fatigue.

Brown\textsuperscript{11} has found through his investigation which was designed to determine the relationship between body type and body alignment and centre of balance. Each subject was classified into body type components of endomorphy, mesomorphy and ectomorphy. Methods used for measurement were Sheldon's technique for somatotyping a modified technique of Hawland's allignometer for body alignment and the Lovett – Reynolds techniques for determining the centre of balance. Statistically, somatotype was not significantly related with body alignment or with the


\textsuperscript{11} Gaydena M. Brown, "Relationship Between Body Types and Static Posture of Young Adult Women," Research Quarterly 31 (October 1960) : 403.
centre of balance. However, significant correlations were found to exist between height and trunk length measures and between a ratio of trunk measures and body alignment.

Pande and Gupta\(^{12}\) have pointed out that inferiority complex habit decreases efficiency. Ectomorph usually develop kyphosis, poor musculature and shyness. Endomorph includes many deformities such as flat-foot, knock-knees and bow legs. Besides these also there are many other causes i.e. poor posture, injury nervous weakness, heredity, improper clothing and accidents.

Kelly\(^{13}\) has pointed out that persons having pain and strain in the feet could develop, pronated feet and its correction is gigantic task among the school children. He also noticed that low positive significant correlations were found between flexibility of the arch and criteria of pronation and low negative correlation between flexibility of the arch and degree of out toeing. He reported that functional foot complaint is relatively un-common among children and very common among adults. Fifty to sixty percent of the child population has shown promotion to greater or lesser degree.


Mckenzie, Clement and Taunton\textsuperscript{14} have pointed out that the runners with excessively pronated feet have features which predispose him/her to injuries that most frequently occur at the medial aspect of the lower extremity: tibial stress syndrome; patellofemoral pain syndrome; and posterior tibialis tendinitis. These problems occur because of excessive motion at the subtalar joint and control of this movement can be made through selection of appropriate foot wear, plus orthotic foot control. As runner with curve feet often has a rigid foot and concomitant problems of decreased ability to absorb the force of ground contact. The shoes should be board-lasted, straight lasted, have stable heel counter, extra medial support and wider flare than the shoes for the curve foot.

Kumar, Saronwala, Thapar and Mathur\textsuperscript{15} have proved that the higher the arch the better is the leverage, action of foot and efficiency of functional activity especially in running. High arch indicates better feet which are stronger, more elastic and more efficient in all natural uses of foot, therefore, high


arched foot should be preferred for the best runners, whereas low arched feet indicate conditions which are associated with pain, early fatigue or inefficiency in all natural uses of foot.

Morehouse and Miller\(^\text{16}\) have pointed out that standing increases fatigue by cerebral anemia and reduction in cardiac output. Local fatigue of the feet, which frequently interferes with production in job that require prolonged standing, change in posture from the upright to varying degrees of the recumbent position and periodic elevation of the feet serve as practical measures to reduce cardio-vascular strain and fatigue, especially in hot environment.

Rathbone\(^\text{17}\) has pointed out numerous factors for causing weak feet. Faulty carrying positions for infants, or faulty skeletal alignments of legs and feet during the first weight bearing on knees or feet during the creeping and toddling stages or faulty shoeing when little feet are so malleable. These mechanical features will cause poor foot statics.


Jones \(^{18}\) headed the study on flat-foot had found that "Flat Feet may actually be protective whereas high arches may be a risk factor for injury." Generations of flat-footed candidates have been rejected by the military under the assumption that they were more prone to injury. But new data indicate that flat feet may actually prevent lower-limb injuries. Researchers at the US Army Research Institute of Environmental Medicine, the Walter Reed Army Institute of Research and The Nike Sports Research Laboratory collaborated on a study. In it, the feet of 248 infantry trainees were photographed before 13 weeks of basic training. The subjects, grouped according to arch height, were then followed and monitored for training associated injuries. The findings: the higher the arch, the greater the risk of injury. Trainees with high arches were 2.4 times more likely to suffer a foot injury than were flat-footed trainees.

Hughes, Clark and Kleenerman \(^{19}\) have conducted studies on the toes movements. The importance of well-functioning toes has long been recognised but has not previously been assessed.

\(^{18}\) Bruce Jones, "Flat-foot Nonsense," Reader's Digest 137 (October 1990): 142.

\(^{19}\) J. Hughes, P. Clark and L. Kleenerman, "The Importance of the Toes in Walking," Current Awareness from Excerpta Media Section 33, 35:5 (1990): 232.
in biomechanical studies. They have examined the weight bearing function of the foot in 160 normal subjects by use of the pedograph. The function of the toes was assessed by reference to the time they were in contact with the ground and the peak pressures they exerted individually in comparison with other parts of the foot. The toes were in contact for about three quarters of the stance phase of gait and exerted peak pressures similar to those of the metatarsal region. When the foot was bearing the second peak of total force, the area in contact with the ground (the metatarsal heads and toes) was decreasing.

Rodell\textsuperscript{20} has found out that pelvic tilt had significant but slight relation with hip flexibility and essentially zero relation with the other measures. Abdominal muscle strength was substantially correlated with abdominal muscle endurance, but ankle pronation and hip flexibility were essentially uncorrelated. The leg span, leg length measurement of hip flexibility was a reliable and easily administered test. The evidence indicated that the pelvic tilt of a person with normal musculature and flexibility was due largely to postural training and habit.

Sortland, Tysvear and Stroli\textsuperscript{21} have noticed that mostly football players develop slight or moderate scoliosis due to degenerative changes in the cervical spine. Few players "headers" reported to have suffered from cervical complaints pain and stiffness for years, and some of the players develop spondylosis.

Watson\textsuperscript{22} pointed out that lumbar lardosis was significantly higher in individuals who specialised in soccer. Scoliosis and abducted scapulae were more common in the hurdlers. The flat feet was high in the foot ballers and hurdlers. Abduceted scapulae were uncommon in rugby players. In a group of footballers and soccer players who were studied lingitudinally, the degree of lumbar lordosis increased during the course of two playing seasons. Groin strain and back injury were found to be more common in sports men with lordosis. It is suggested that athletic activity may sometimes lead to postural defects which are probably a predisposing factor in certain types of sports injury.


Munchow and Alber\textsuperscript{23} have found that in adolescent children in the age group 14-19 years ossification of spine had not completely ended. Thus scoliosis and formation of transitional vertebrae was excited by the training which was more in the case of athletes than the weight lifters. He has therefore observed that it would be important to exclude such adolescents at the beginning of the training whose ossification of spine had not completely set-in.

Barry and Cureton\textsuperscript{24} have observed three type factors of physique, one related to growth in transverse directions and adipose tissue, and two related to growth in vertical dimensions, and three related to motor performance, were isolated: power, endurance, dynamic shoulder strength. The morphological and performance measurement were found to be essentially unrelated. As one related to growth in-transverse directions and adipose tissue characterized by bulkiness, prominent girths (upper arms) broad hips, narrower shoulders and thick fatcovering.


2. One related to growth in vertical dimensions and characterised by a lean frame and attenuated limb.

3. One related to dysplastic growth in vertical dimensions and characterised by disproportionate development of trunk and legs.

Three factors related to motor ability were isolated:

(i) Power dominated by jumping events and distinguishing those with high, from those with low ability to handle the body weight.

(ii) Endurance, distinguishing individuals with high from those with low organic efficiency.

(iii) Dynamic shoulder strength, which separate those with high muscular endurance in activities requiring strength of the shoulders from those with low muscular endurance. This factor was more closely related to the morphological variables than was the case with the other two motor fitness factors and may be related to muscular growth.

(iv) The second order factors were extracted: general size, differentiating between those who are above and those below average in total body mass.
Sward et al. have made studies on the changes in thoraco-lumbar of athletes. Back pain and radiological changes of the thoraco-lumbar spine were investigated in 142 top athletes, representing wrestling, gymnastics, soccer and tennis (age range 14-25 years). All groups of athletes reported back pain at high frequencies (50-85 per cent). Male gymnasts had significantly increased incidence and severity of back pain as compared to the rest of the athletes. Radiological abnormalities occurred in 36-55 per cent of the athletes. Reduced disc height, schmorl's nodes and change of configuration of vertebral bodies correlated with back pain (P < .05, P < .01 and P < .05). Significant co-variation between these types of abnormalities was found. Athletes with great demands on the back are thus subjected to an increased risk of symptomatic damage of the spine.

The spine of athletes, at least in some vigorous sports is subjected to frequent and considerable loads with subsequent risks of back injuries and back pain. An increased frequency of radiological abnormalities of the spine has been found among young athletes in certain sports, such as wrestling (55 per cent), gymnastics (42 per cent) and water ski-jumping (45 per cent).

In the general population, most radiological abnormalities are considered non relevant or of questionable significance in individuals with back pain. Reports on the correlation between back pain and radiological thoraco-lumbar abnormalities in athletes are sparse and contradictory.

The aim of the present study was to investigate the occurrence of back pain among athletes in various sports and to analyse its correlation to radiological changes in the thoraco-lumbar spine.

Ohtsuka, Yamagata and Arai\textsuperscript{26} have stated the screening program for scoliosis started by Chiba University in 1979 consists of using moire topography, low dose roentgenography and a final ordinary X-rays examination. The number of children screened through this Chiba University Medical School (CUMS) screening program to 1986 amounted to 1, 246, 798. The incidence of scoliosis of more than 15° increased linearly according to age from the fifth grade primary school children (0.07 per cent) in boys, (0.44 per cent) in girls to the second grade Junior High School students (0.25 per cent) in boys, (1.77 per cent)

\textsuperscript{26}Y. Ohtsuka, M. Yamagata and S. Arai, "School Screening for Scoliosis by Chiba University Medical School Screening Programme," Current Awareness from Excerpta Medica Section - 33 34:2 (1989) : 75.
in girls. The female predominance of scoliosis cases with curvatures of more than 20° detected during the total period was 10:1 and this female predominance was the same for primary school children and junior high school students. According to a study of the incidence of scoliosis by districts (area were divided according to population density and urbanization) there were no significant differences in the fifth grade primary school children between the sparsely and densely populated areas. In the cases of children beyond the fifth grade primary school level, however, the incidence in the densely populated areas were significantly higher than those in the sparsely populated districts. The incidence of scoliosis of more than 20° decreased significantly every year among Junior High School students, because, they were screened periodically in school and the scoliotic students who had already been detected were left out of the next screening. This study establishes that screening for scoliosis by the CUMS Screening Program is cost-effective with a low risk of radiation hazards.

Belgesundeu and Rottker\(^{27}\) have found out that Radiograms were taken of subjects with no symptoms of cervical

spine problems; the cervical spine was evaluated in the spontaneous posture and at maximal flexion and extension. The position and movement of the vertebra intervertebral height and gliding were calculated. The results showed that (1) Lordosis in women occurred less pronounced than in men, and that there was an increase with age; (2) C 2-3 was the least flexible segment and motility increased in the caudal direction; mobility decreased with age and the segment of the lower cervical spine with the highest mobility decreased the most; (3) all posterior and ventral intervertebral heights showed a decreased with age at C 5-6 and C 6-7; (4) Vertebral gliding decreased with age.

Goldberg and Dowling have found out that the handedness of 254 girls with idiopathic scoliosis minimum age eight years at diagnosis, attending our lady's hospital was related to their scoliosis convexity. Curve patterns were assigned to right or left on the basis of the convexity of the low thoracic component only, regardless of primary curve. The curve pattern matched handedness in 82 per cent of 228 right-handed children, 197 had a right convex curve pattern; of 26 left-handed children

12 had a left convex pattern. The correlation between scoliosis configuration and handedness was statistically significant. This is in contrast to the findings of previous studies, which have considered convexity only, without reference to the configuration of the whole spine. The implication is that of this findings is that scoliosis is associated with cortical functions.

The correlation between handedness and direction of curve convexity shows adolescent idiopathic scoliosis to resemble lateralized human functions. The evidence is not enough to indicate that laterality alone could be considered anetiologic factor, since the ratio of the right to left handedness in the whole group does not differ from the expected in the general population. The relevance for etiology is in the possibility of perceiving scoliosis in a different light.

Winter has noticed that recognition of the idiopathic double primary thoracic curve pattern has become increasingly important as more effective methods of internal correction of curves have been developed. Over correction of the lower thoracic curve beyond the spontaneous correctability of the upper thoracic curve may lead to an undesirable asymmetric

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neck and shoulder contour.

Herbert and Boke Chako\(^{30}\) more than ten years ago, they began the night time treatment of early scoliosis in growing children with implanted muscle stimulators. The early devices were radio frequency (RF) coupled units with an implanted receiver and external transmitter antenna which the patient used at night to power and activate the implant. Compliance with this treatment was 95 per cent. Recent developments have led to the use of a new, totally implantable stimulator for the treatment of scoliotic curves. The unit has no external components, is programmed and interrogated by telemetry and is externally, switched by the patient using a magnet. Compliance with it continues at a high level, product reliability to date has been perfect and the clinical results continue to be good.

Flint and Diehl\(^{31}\) have investigated the relationship between antero-posterior alignment of the trunk and strength of the muscles which flex and extend the trunk. The result showed significant relationship between trunk strength and alignment.


A low but definite relationship exists between back-extensor strength and alignment.

Anderson\textsuperscript{32} has surveyed hand and eye dominance, hip and eye elevation, dropped or forward shoulder, anterior and lateral cervical tilt, and whether or not glasses were worn were determined on 31 male subjects with the aid of a posture screen and has found that individuals with glasses have very low level of postural deformities. And there was no direct relationship between posture and laterality. It was a general notion that wearing of glasses affect posture whereas it is not so.

Devis\textsuperscript{33} has made the study on the status of postural patterns. The study is an analysis of 750 physical examination record cards from 5 selected years. Postural pattern changed over the years. Significant differences between the percent of the occurrence were found for many factors. The most wide spread postural deviations still include forward head, forward shoulders, protruding abdomen, pelvic tilt, and pronated feet.

\textsuperscript{32} Gerald Lee Anderson, "Significance of Laterality in Cervical Variances," Completed Research in Health, Physical Education and Recreation 7 (1965) : 42.

Nearly all types of scoliosis decreased significantly over the years studied. This study proved that with advancing age if other posture defects manifest significantly scoliosis appears to be reduced.

Nissemen et al.\textsuperscript{34} have examined a total of 1060 children (515 girls, 545 boys) for screening of trunk asymmetry and scoliosis at an average age of 10.8 years. The physical examination consisted of height, sitting height, total arm length and leg length in equality determinations and moire topography. Trunk asymmetry was measured by forward bending test and posteroanterior standing radiograph of the spine was taken of those 188 (17.7 per cent) Children who had a trunk hump $\geq 6$ m. only 20.1 per cent of the children were found to be exactly symmetric in the forward bending test, 47.3 per cent had a right-sided hump and 32.6 per cent had a left-sided hump. Humps of 6 mm. or more were significantly ($P = 0.03$) more prevalent among girls (21.7 per cent) than boys (16.3 per cent). Moire fringe asymmetry was proved to be common: only 9 per cent of the material was totally symmetric, two thirds had asymmetry of $\leq 1$ fringe, 26.6 per cent had a symmetry $> 1$ and $\leq 2$ and

\textsuperscript{34}M. Nissemen et al., "Trunk Asymmetry and Scoliosis, Anthropometric Measurement in Prepuberal School Children," Current Awareness from Excerpta Medica Section -33, 35:3 (1990) : 13)
5.4 per cent > 2. The prevalence of scoliosis (trunk hump ≥ 6 mm. and C066 angle ≥ 10°) was 4.1 per cent. The majority (72.1 per cent) of the curves were left convex.

Singer, Jones and Breidahl have surveyed the sagittal plane curve characteristics of the thoracolumbar spine which were evaluated from 286 lateral chest radiographs comparing the cobb technique with a computer-aided digitizer. Thoracic kyphosis and curve apex were measured from T-3 to T-11 segments, and in 120 cases, the level of thoracolumbar curve inflexion point was determined. An age related increase in curve magnitude was similar for both measurements, although computer generated kyphosis angles were generally larger. The apex of thoracic kyphosis was consistently located near T-7 for males compared with greater variability with age for females. The thoracolumbar inflexion point shifted caudally with increasing years, being most marked for females. The ability to describe quantitatively the thoracolumbar curve characteristics, calculate angles between selected segments, determine points of inflexion and maximum curvature, indicates that radio-graphic evaluation of sagittal spinal curvature is improved with the use of computer-aided measurement.

Flint\textsuperscript{36} has investigated the relationship of gravity line test to posture. He had found that relationship exists between the gravity line test and the massey segmental alignment posture rating test was not significant. A high negative correlation exists between hip trunk flexibility and posture of lumbar and pelvis regions. No significant relationship exists between the position of the gravity line and (a) abdominal or back extensor muscle strength or (b) hip-trunk flexibility.

Minotti\textsuperscript{37} has made study of S.S. for 3rd and 4th grade students with postural deviations. S.S. were randomly assigned to either an experiment (E) or control (C) group. The S.S. in the E group were assigned individual exercises for correction and the E group did the exercises in addition to regularly attending physical education classes for 3 months. During this time of period the C group attended only physical education classes, when both the groups tested for postural deviations. Ancora showed that the total posture and anterio-posterior component of the E group were significantly better than that of the C group. But there was no difference between the 2 groups in the lateral.


Eberting has given selected exercises for the improvement of lordotic postural deviations and he has found that the experimental group performed a graduated battery of 4 exercises involving the abdominal and lower back for 12 class periods and achieved significant improvement of lordotic postural deviations in this experiment group. Where as the control group who participated in unrelated activities during the same period could not gain any benefit. It is obvious if related programme or exercises are selected according to the requirements of the individual can give positive result.

Alderman has made study on posture by taking photographs of 83 girls revealed that 93 per cent had posture deviations. Subject had little or no previous posture instruction and after 8 lessons in regular health education classes, 62 per cent of the subject showed improvement. It is not necessary that posture correction can be done with exercises only. If we can correct their bad habits and teach them correct movement of the posture, can achieve improvement in general.


Scott's.\(^{40}\) had investigated that there was no significant difference in the muscle action potential of selected postural exercises which purport to strengthen the trapeziers muscle as measured by quantative electromyography. This hypothesis was rejected by him, as Duncan's multiple Range Test demonstrated that there was a significant difference among many of the exercises and at each age level and for the combined groups. There is no significant difference among S.S. of various age levels in the muscle action potential of the selected postural exercises as measured by quantative electromyography. This hypothesis was accepted, as Kendall's co-efficient of concordance was significant among the different age groups which ranked the 12 selected exercises. Formation of muscles can be influenced by the exercises irrespective of the age.

Barham\(^{41}\) has pointed out in his study that "The posture group" has made significant improvement because of devoted 20 per cent of each class period to posture training activities throughout the school year. Whereas non posture group did not show any kind of improvement because of the fact they


were not imparted any posture training activities.

Fullilove\textsuperscript{42} conducted a study to evaluate the nature causes and effect of selected problems related to posture research in an effort to interpret the posture literature in a proper perspective and to grasp a better understanding of future approaches to research. The inadequacies of the tools utilized in research were discussed in relation to the definitions of the products, standards for evaluation, and methods and techniques of measurement.

Munson\textsuperscript{43} has found critical changes occurred in the chest, abdominal and hip regions between grades 1 and 3 which were important to well balanced anterior - posterior posture. The frequency of anterior - posterior postural deviations indicated a crucial need for re-emphasis on posture education.
