CHAPTER II

REVIEW OF RELATED LITERATURES

2.1 REVIEW OF LITERATURE RELATED WITH SOMATOTYPES

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CHAPTER - II
REVIEW OF RELATED LITERATURES

In this chapter a brief review of literature surveyed has been presented. Attempted was made to locate literature related in several angles with the present study. Theses reviews were useful to make available explanation for verification in the concerned areas and to expand the sphere of knowledge. Reviews were also helpful to avoid the risk of duplication. All the literatures were available in the form of books, journals, reviews and other documents. For the purpose of better understanding these literature have been presented in three separate sections as follows:

- Review of Literature related with Somatotype.
- Review of Literature related with Motor Fitness Profile.
- Review of Literature related with Psychology.

2.1 REVIEW OF LITERATURE RELATED WITH SOMATOTYPES

Slaughter, Lohman and Misner (1977) investigated into the association of somatotype and physical performance of 7 to 12 years aged 68 boys to find out a inter-relationships among themselves. They used Sheldon's trunk index method and Heath-Carter's anthropometric method for assessing the somatotype, and mile run, 600-yard run, 50-yard run, standing broad jump and vertical jump for measuring physical performance of the subjects. Among others, they concluded that the somatotype components had lower correlations with running and jumping performance. Heath-Carter's third component (ectomorphy) correlated more closely with performance scores than other components of somatotype. Somatotype components in combination with each other, in a multiple regression analysis, indicated little association with jumping. Mesomorphy was the least significant somatotype component as indicated by the standardized regression coefficient.

Jansusz et al. (1989) conducted a study on relationship between morphological features, expressed in the form of somatotype and the level of motor ability of children in early school years. Three components of individual's somatotype were estimated: Fatness (F), muscularity (M) and linearity (L). Despite the similarity of the
basic morphological features of boys and girls there was a strong sexual dimorphism in the basic motor ability in favor of boys. The increase of frequency of L dominancy in somatotype of children over 9th year of age was observed with the simultaneous decrease of frequency of M dominancy. Somatotype with F dominancy found the worst in motor ability.

Ji Cy (1991) compared somatotypes between Chinese and Japanese children of 7 to 17 years age and found significant differences in limb length, bone width, muscle circumference and skinfolds. Ectomorphy component was superior in Chinese boys where as mesomorphy and endomorphy components were superior for Japanese boys. The somatotypes of these two nations were also quite different at different level of ages, though they showed similar changing trend of somatotype around adolescent growth spurt.

Leake and Carter (1991) measured the body composition and somatotype of 16 trained female triathletes aged 18.8 – 32.8 years. All of the subjects were engaged in a competitive training programme and participated in the same triathlon. Anthropometric variables included height, mass, selected diameters, girths and skinfolds, and a Heath-Carter anthropometric somatotype. Body composition was determined by hydrostatic weighing procedures and skinfold patterns. Comparisons were made with Olympic swimmers and runners. The triathletes had a mean body mass of 55.2 kg and a mean height of 162.1 cm. When compared to swimmers, the triathletes were somewhat shorter and significantly (P less than 0.005) older. On most other measures, including a balanced mesomorph somatotype of 3.1 – 4.3 – 2.6, they were similar to swimmers. This group of triathletes were generally heavier, less lean, more mesomorphic and less ectomorphic than elite runners. Reported body densities from other studies indicated little differences between the triathletes and other groups. Skinfold patterns were similar in shape for all groups, but the runners had smaller values, at all sites, than either swimmers or triathletes. Because of lack of information on cyclists, adequate comparisons were not possible. Regression analysis indicated that training parameters were more important than anthropometric measures in the prediction of performance. It was concluded that this group of triathletes were closer, with respect to both body composition and somatotype, to swimmers than to runners.
Gualdi-Russo et al. (1993) in a study showed that somatotypes of 1593 young Italian sport participants (717 males and 876 females) were described and analyzed. The average somatotype for sport participants was 2.7-4.7-2.7 for males and 3.6-3.7-2.8 for females. The predominance of mesomorphy on the other two components was found in all sport-groups examined. This was particularly evident in males for gymnasts and rowers and in females for martial arts competitors. As for sexual dimorphism, females were endo-mesomorphs, while males were balanced mesomorphs. Somatotypes show statistically significant changes with the level of performance in some sport-groups with an increase in the mesomorphic component (in ballgames and martial arts) and in the endomorphic component (in swimming). Comparisons with other sport-groups from literature were greatly limited by several genetic and environmental factors.

Rosique et al. (1994) conducted a study to find out relationship between somatotype and centripetal fat patterning of 8 to 19 years old Basque boys and girls and found mean somatotype changed for mid-adolescent boys. The mesomorphy and endomorphy was diminished and ectomorphy was slightly increased. For the girls, in the same time period, striking changes they noticed reduced in mesomorphy. Meanwhile there was an increase in endomorphy and a decrease in ectomorphy for the girls.

Bale et al. (1994) studied to investigate the differences in somatotype, %fat, and strength in relation to body mass of two groups of American football players. One hundred and forty-three football players (85 high school and 58 college) were classified into five weight groups (< 73 kg, 73 – 82 kg, 83 – 91 kg, 91 – 100 kg, > 100 kg). Body composition was estimated from skinfold, and somatotype was determined using the Heath-Carter method. Strength was measured from one-repetition maximum (1-RM) lifts in the bench press and deadlift. Most of the somatotypes were dominant mesomorphs for the high school player and endomorph-mesomorphs for the college player. The weight groups in both the high school and college footballer showed significant differences in %fat, somatotype, and strength measures between the lower and higher weight categories. Weight was a greater factor dictating strength in either lift in the high school player than in the college player. A higher mesomorphic component was a
more important factor determining strength in the college player while a lower ectomorphic component contributed more in the high school player. The proportion of the variance accounted for by regression equations for the bench press and deadlift was 17% to 41% in the high school player and 35% to 61% in the college player. Although football requires a large individual at certain positions, the question remains concerning overall size versus muscularity to achieve a superior performance level.

Carter et al. (1997) conducted a study on somatotype of 7 to 16 year old boys in Saskatchewan, Canada and observed that mean somatotype across years were differences between 7-10 years and 14-16 years. These differences were largely due to significant increases in mesomorphy (F=24.6, p<0.01) and ectomorphy (F=159.9, p < 0.01). Partial correlation between age for each component, with the other two held constant revealed poor predictions for three or more years apart. Thus, both group and individual somatotype changed between 7 and 16 years of age. The overall pattern was from endo-mesomorph through central to mesomorph – ectomorph somatotype. The trends were similar to those observed in comparable samples from other countries they reported.

Gour and Pal Singh (1997) conducted a study to investigate the charges in somatotype with age among 400 Garwali of age with Heath-Carter anthropometric protocol. Result revealed that endomorphy and mesomorphy increased with age with a reciprocal decrease in ectomorphy up to 55 years; the trend was somewhat reverses thereafter. The somatotype categories mesomorphic ectomorph and mesomorphic-ectomorph included the greatest proportion of Garhwali men <30 years; maximum percentage of man 30+ years belonged to the mesomorph-endomorph, endomorphic mesomorph and mesomorphic endomorph categories. They also reported that the Garhwali men were more ectomorphic and less endomorphic and mesomorphic than Canadian.

Malina et al. (1997) studied the relationship between the somatotype and cardiovascular risk factors in healthy adults and reported that the relationship was stronger in the older age group 14-49 years, but the pattern of correlations were different in men and women. Endomorphy tended to be positively related to risk factors in older females, whereas ectomorphy tended to be negatively related to risk
factor in older males. For each cardiovascular risk those with a poorer profile tended to be more endomorphic and mesomorphic but less ectomorphic than those with a better profile, who were more ectomorphic and less endomorphic and mesomorphic. The association was more apparent in males than in females and more so in those 40-49 years of age, than in younger age group.

**Fuster et al. (1998)** studied relationship between somatotype and physical work performance and proved high correlation of test scores implying muscularity (hand grip, pulling strength) with mesomorphic component of somatotype, mainly in males. Variability in test relative to physical fitness was mainly explained by difference in endomorphy, although regarding the step test, ectomorphy was also a factor to be taken in account in female as well as pulling strength in male.

**Cheng-Ye and Ohsawa (1998)** conducted a study to find out the changes in somatotype during growth in Chinese youth using Heath-Carter anthropometric somatotypes method and reported that age-specific trends were characterized by a consistent increase in endomorphy in girls and generally stable mesomorphy in boys. Somatotypes were consistently dominant in mesomorphy in boys and endomorphy in girls across all ages. Somatotype distributions were more influenced by age in girls than in boys. After comparisons the data with other Asian samples and with Canadian youth they suggested racial/ethnic variation in somatotype.

**Toselli and Gruppioni (1999)** conducted study to examine the variation of somatotype in Italian children aged 6 to 10 years old with Heath-Carter anthropometric technique. The sample was subdivided into urban and non-urban groups on the basis of residence of the children, to examine possible difference in growth related to the different environments. Study revealed a tendency toward an increase endomorphy with age in both sexes. In females ectomorphy tended to increase and mesomorphy showed a slight decrease during growth, while males exhibited a discontinuous trend. They also found that the difference between urban and non-urban children were not significant although generally higher values of endomorphy and mesomorphy were found in males and females of the urban sample. The difference between the sexes consisted of higher values of endomorphy and lower values of mesomorphy in females. Ectomorphy was similar in the two sexes.
Panasiuk (2000) revealed that change of somatotype anthropometric characteristics, formation and rate of growth were followed up in longitudinal study in children aged 3-7, 138 girls and 150 boys aged 3 and 54 boys and 46 girls aged 7 were studied. Somatotypes were evaluated by means of statistics. It was established that within the observation period somatotype differences in children intensify due to different rate of constitutionally significant body sizes. In nearly half of the children somatotypes change due to growth or reduction of signs determining them.

Toriola, et al. (2001) showed that in an effort to describe the physique associated with regular involvement in sports activity, the somatotypes of a group of 51 elite male athletes comprising sprinters (n = 10), basketball (n = 12), soccer (n = 15), and field hockey (n = 14) players, and 11 male non-athletes were studied. The subjects' physiques were assessed using the Health-Carter anthropometric somatotype method. Analysis of variance and Newman-Keuls post hoc method were used to test for significant differences among the mean somatotype ratings of the groups. The findings indicated that the nonathletes (3.5) were significantly more endomorphic (P less than 0.05) than the soccer players (2.5) and sprinters (2.4). The sprinters (3.6) and basketball players (3.7) had markedly higher ectomorphic ratings (P less than 0.05) as compared with the hockey players (2.0). The mesomorphic component did not differentiate the groups. The differences observed among the groups which could be attributed to genetic and environmental influences reflect the variability in the morphological characteristics of athletes and non-athletes.

Meszaros et al. (2002) conducted a study to compare the growth type of 10-13-year old non-athletic children living in different geographical regions, namely in Cyprus, Egypt, Hungary and Malaysia. The growth type indices introduced by Conrad sensitively revealed the slight differences in body built and physique resulting from ethnic differences, various physical activity, etc.

Suchomel Ales (2002) examined the relations between the components of anthropometric somatotype and motor performance in boys and girls (8-9 and 12-13 years old) with considerably above-average and considerably below-average total score of the test battery UNIFITTEST. The representative sample which participated in the motor performance test consisted of 253 boys and 267 girls aged 8-9.99, 247
boys and 262 girls aged 12-13.99. For analysis of the results of selected samples (17 to 25 children), non-parametric statistical methods were used. The A. has found out a significant positive relation between ectomorphy and the level of motor performance and on the contrary significant negative relation between endomorphy as well as mesomorphy and the level of motor performance of pubescent boys and girls. Then he recorded a significantly lower variability of the results of somatotype components in the high motor efficient group than in the low motor efficient one. The samples of boys and girls with a high motor performance corresponded to their somatotypes (mesomorphic ectomorphy and ectomorphic mesomorphy with low level of endomorphy dominated) and on the contrary boys and girls with a low motor performance were difficult to characterize.

Frenkl et al. (2004) conducted a study to analyse the differences between the somatotype of the non-athletic Budapest children and adolescents in 1976 and 2001. The subjects of the second investigation were significantly taller and heavier than their age mates 25 years earlier. The significantly greater relative body fat content refers to their heavier body mass. The mean somatotype of the children and adolescents in the first data collection as they reported was endo-mesomorphic and the meso-endomorphic mean somatotype was characteristic in 2001.

Sokolov et al. (2005) showed that Somatometry and somatotyping of 435 practically healthy children in the second period of childhood (age: 8-12 years) attending the secondary schools in Rostov-on-Don was performed. In the group of children studied the representatives of macrosomal type were found to prevail. It was established that in children of both sex groups the acceleration of growth of muscular somatic component occurred during the period of accelerated rate of increment of body length and mass. Maximum activation of the growth of body fat component was found to occur at the age of 9 to 10 years in girls and at 10 to 11 years in boys. The results of this research supplement the available morphological data on the regularities of growth and development of children of the age group studied, and may be used in forming somatodiagnostic base in the region under investigation.

Li YL et al. (2006) conducted a study to assess the genetic and environmental influences on the somatotypes of children and adolescent and the effect of age and sex
on Han nationality and found the estimated heritabilities of endomorphic, mesomorphic and ectomorphic components were 0.45, 0.80, 0.44 in boys, 0.82, 0.79 and 0.81 in girls respectively after adjusting age. The genetic influence on somatotype of girls was more than that of boys especially on the endomorphic and ectomorphic components. For boys, the mesomorphic component was mainly determined by genetic factors, but the other components were mainly affected by environmental ones.

Toth (2007) in his paper on physical activity, somatotype and body composition on Hungarian boys of 7 to 18 years age and reported that active boys had significantly less fat in pre puberty and post puberty but there was no difference in puberty. Active girl had significantly less fat in puberty, but not in pre or post puberty stage.

Lee and Lin (2007) investigated the influence of gender and somatotypes on single-leg upright standing postural stability in children and reported the mesomorphic, muscular children had significantly smaller mean radius of COP (centre of pressure) distribution than the endomorphic, fatty children and the ectomorphic, linear children during the eyes closed condition. Gender differences might be due to the larger body weight in boys and somatotype differences might be due to the significantly lower body height and higher portion of muscular profile in the mesomorphic children they conducted.

Ventrello et al. (2007) found significant differences in mean somatotypes between the Italian and Estonian children in many age classes and a different constitutional trend in children from the two different countries was observed. The Italian children are more endomorphic and less mesomorphic and ectomorphic than the Estonian children. On the other hand, it emerged from factorial ANOVA, that the somatotype component do not present significant variations related to organized physical activity to the interaction between the country of origin and sport practice. Moreover, the results of the forward stepwise discriminant analyses show that mesomorphy is the best discriminator between the two countries, followed by ectomorph. Their findings suggest that the observed differences between Italian and
Estonian children could be related mainly to country rather than to the practice of organized physical activity in the two countries.

**Fuster (2007)** studied a sample of 303 Madrid Complutense University students (100 males and 203 females), aged 21-20 years in order to establish the relationship between somatotype components and physical work performance. Since particular interest is focused on a possible sexual difference in that relationship, males and females were analyzed separately. Since particular interest is focused on a possible sexual difference in that relationship, males and females were analyzed separately. Results prove the high correlation of test scores implying muscul arity (hand grips, pulling strength) with the mesomorphic component of the somatotype, mainly in males. Variability in tests relative to physical fitness is mainly explained by differences in endomorphy, although the step test, ectomorphy is also a factor to be taken into account in females, as well as the pulling strength in males.

The study of **Raschka, et al. (2007)** revealed that 39 soccer players of the third division as well as 22 handball players of the second division and 17 handball fourth division players (average age 24 years) were examined kinanthropometrically. The sports anthropological evaluations were made according to the methods of Parnell (1958), Heath & Carter (1967), Conrad (1963), Knussmann (1961a, 1961b) as well as Tittel & Wutscherk (1972). Regarding the proportionality, proportion figures and phantom stratagem were used. In the typology of Conrad (1963) above all the high hyperplasia values of the handball players stand out. According to the typognosis of Knussmann (1961a, 1961b) the handball and soccer players are to be classified as leptomorph. The tendency to the macrosomia pole is to be recognized for the handball players. In the somatochart of Parnell (1958) soccer and handball players are placed in the mesomorph ectomorph sixth. The group differences are highly significant for the endomorphy. In the somatogramm of Heath & Carter (1967) both ballplayer collectives are settled in the ectomorph mesomorph area. The group differences are here for the endomorphy and mesomorphy highly significant, for the ectomorphy significant. The proportional fat portion (calipermetry) is high-significantly lower for the soccer players with 6.6 1.6% than for the handball players (8.4 2.5%). All height and longitudinal dimensions as well as the circumferences with exception of the thigh
girth were for the larger handball players (body height: 189.1 ± 7.9 cm) very to highly significantly higher than for the smaller soccer players (body height: 178.6 ± 5.8 cm), whereby no important proportional differences were registered.

The aims of this study of Cristóbal Sánchez-Muñoz et al. (2007) were to describe the anthropometric characteristics, body composition and somatotype of elite male and female junior tennis players, to compare the anthropometric data, body composition and somatotype of the first 12 elite junior tennis players on the ranking with the lower ranked players, and to establish an anthropometric profile chart for elite junior tennis players. A total of 123 (57 males and 66 females) elite junior tennis players participated in this study. The athletes were divided into two groups, the first 12 and the lower ranked players, according to gender. A total of 17 anthropometric variables were recorded of each subject. There were no significant differences in height and weight between the first 12 and the lower ranked boys, while the first 12 girls were significantly taller than the lower ranked girls (p=0.009). Significant differences were found for humeral and femoral breadths between the first 12 and the lower ranked girls (p=0.000; p=0.004, respectively). The mean (SD) somatotype of elite male junior tennis players could be defined as ectomesomorphic (2.4 (0.7), 5.2 (0.8), 2.9 (0.7)) and the mean (SD) somatotype of elite female junior tennis players evaluated could be defined as endomesomorphic (3.8 (0.9), 4.6 (1.0), 2.4 (1.0)). No significant differences were found in somatotype components between the first 12 and the lower ranked players of both genders. When comparing the first 12 and the lower ranked elite junior tennis players of both genders, no significant differences were observed in any measured item for the boys. By contrast, significant differences were observed in height and humeral and femoral breadths between the first 12 and the lower ranked girls, whereby the first 12 were taller and had wider humeral and femoral breadths than the lower ranked players. These differences could influence the playing style of junior female players.

Abass and Angba (2008) conducted their study to find out somatotype characteristics of intellectually challenged children in Ibadan, Nigeria and reported majority of the participants have predominantly endomorphic characteristics (5.3±1.7), while significant differences were recorded only in mesomorphic (t=-6.07,
and ectomorphic (t = -5.39; P<0.05) characteristics of participants. They concluded that intellectually challenged children in Ibadan were significantly endomorphic in their somatotype characteristics.

Saranga et al. (2008) in their study conducted on Mozambique (African Country) population to determine the heritabilities of somatotype components taking the sample of 7 to 17 years of age and found genetic factors significantly influence endomorphy, mesomorphy and ectomorphy. However, environmental factors also might have significant effects on the variation in physique they concluded.

The aim of the study of Amigoa et al. (2009) was to characterize the evolution of height and weight (from 7 to 25 years old) and somatotype and body composition (from 12 to 18 years old) in elite male gymnasts. For each of the variables, a mixed-longitudinal design was used to analyze: a) its evolution with age and its differences with respect to a reference population. Somatotype was analyzed with the Heath-Carter method, fat free mass with the Slaughter formula and muscle mass with the Poortman formula. Male gymnasts were significantly shorter and lighter than the reference population. The best gymnasts were even more so with respect to their fellow gymnasts, except for specialists in vault and floor where the lower limbs are especially important. The peak height velocity occurred at the age of 14, at the same age as in the reference population. The somatotype was ecto-mesomorphic in 90% of the gymnasts. Fat mass percentage was significantly lower than in the reference population. Somatotype, fat free mass and muscle mass showed no significant increases with age. Gymnasts showed a growth pattern considered as normal in the variables analyzed in the present study. The main differences between the gymnasts and the reference group were observed from the beginning of the follow-up. These findings suggest the effects of a selection process, both before and during the training process, before the elite level is reached.

Unbares et al. (2009) described the characteristics of body composition, somatotype, basic physical qualities, dermatoglyphics and bone age regarding sexual maturation stages of boys. A transversal study was carried out in 136 boys, between 10 and 14 years of age. Clinical assessment, physical examination and radiography of wrists and hands to calculate bone age were performed. A tendency of increasing total
body mass, stature, body mass index, body bone diameters and muscle circumferences and basic physical qualities was found with the advancing of puberty. No differences were found in dermatoglyphics and somatotype between different stages of puberty maturation. Due to the changes in important parameters of physical training that occur during puberty, it can be concluded that the selection of children and adolescents for sport training and competitions should be based not only on chronological age but also, and mainly on sexual maturation, for better physical assessment and appropriate training for this population.

The purpose of the study of Gaurav et al. (2010) was to compare the anthropometric characteristics and somatotype of the Guru Nanak Dev University, Amritsar's male basketball players and volleyball players. Sixty three sportspersons (volleyball=36 and basketball=27) of age group 18-25 years were selected from different colleges affiliated to Guru Nanak Dev University, Amritsar, Punjab, India. All the participants were assessed for height, weight, breadths, girths and skin fold thickness. An independent samples t-test revealed that basketball players had significantly higher height (p<0.01), weight (p<0.01) and body surface area (p<0.01) as compared to volleyball players. The basketball players were also found to have significantly greater biceps (p<0.01) and suprailliac (p<0.01) skin fold thicknesses, calf circumference (p<0.05), percent body fat (p<0.01), total body fat (p<0.01), fat free mass (p<0.05) and endomorphic component (p<0.05) as compared to volleyball players. Volleyball players had significantly greater body density (p<0.01) as compared to basketball players. The basketball and volleyball players of this study were found to have higher percentage body fat with lower body height and body weight than their international counterparts. Further investigations are needed on the above studied variables along with fitness and physiological variables to assess relationships among them and with performances in volleyball and basketball.

Mladenova et al. (2010) conducted a study to investigate age- and sex-related changes in somatotypological characteristics of Bulgarian children and adolescents from Smolyan region. The investigated sample in this work included a total 1086 (559 boys and 527 girls), aged 7-17 years and measured cross-sectional between 1998-2001. Standard anthropometric technique and instruments were used. The
anthropometric variables of the weight (W), height (H), humerus and femur width, calf and arm flexed and tensed girth were measured by Martin-Saller's method (1957). The thickness of the four skinfolds - the triceps, biceps, subscapular and medial calf on the right side also were measured. These anthropometrical measurements were required for determining three Heath-Carter anthropometric somatotype components. Data processing and statistical analysis was made by Statistical software package using descriptive analysis and one-way ANOVA for the assessment of age- and sex differences between groups. The results show specific age- and sex-related changes in somatotype characters, mean somatotype and inter-sex differences between values of somatotype components of both sexes.

Polat et al. (2011) examined the anthropometric features and somatotypes of the male children at the age of 16 in three different groups and found that three groups were significantly different from one another (P<0.05). Highest endomorphy value was obtained for sedentary group and the difference was significant from soccer and fitness group (P<0.05). Highest mesomorphy value was observed in soccer group and the lowest value was achieved for sedentary group. Ectomorphy component was found highest for fitness group and their differences were significant (P<0.05) from other two groups of children.

The purpose of the study of Gaurav et al. (2011) was to compare the somatic traits and body composition between volleyball players and controls. 48 young male subjects (volleyball players: N= 24 & controls: N= 24) of age group 18-25 years were randomly selected from the different colleges affiliated to Guru Nanak Dev University, Amritsar, Punjab, India. All the participants were assessed for height, weight, breadths, girths and skinfold thickness. The independent samples t-test revealed that volleyball players had significantly higher height (p<0.05), as compared to controls. The volleyball players were also found to have significantly greater lean body mass (p<0.01) and ectomorphic component (p<0.05) as compared to controls. Controls had significantly greater percent body fat and total body fat (p<0.05) as compared to volleyball players. The volleyball players of this study were found to have higher percentage body fat with lower body height and body weight than their international counterparts. Further investigations are needed on above studied
variables along with fitness and physiological variables to assess relationship among them and with performance in volleyball. The findings of the present study might be useful in future investigation on player selection, talent identification in the game of volleyball and its training programme development.

2.2 REVIEW OF LITERATURE RELATED WITH MOTOR FITNESS PROFILE

De et al. (1980) investigate the respiratory performance and grip strength tests in Indian school boys of different socio-economic status and found that the height and weight recorded of the subjects indicating growing process showed that the rural boys attained less physical growth than their urban counterparts. The Vital Capacity and Peak Expiratory Flow Rate data expressed either per unit of height or body surface area was significantly lower in rural boys. These findings indicated a poor development of the thorax in the rural group. However the determined grip strengths for both the groups were similar, They concluded that the grip test might reflect improvement of muscle mass in case of rural boys as a result of regular physical activity employing the arm muscles.

Chatterjee et al. (1993) conducted a study on Indian (Bengali) school going boys of 9 to 18 years of age and brought to light that gradual increase in physical and motor fitness measurements with advancement of age.

Voiver et al. (2000) studied improvement of motor abilities in pubertal girls and reported that the critical improvement of agility was reached in maturation stage-II, whereas critical increased of leg explosive strength and trunk flexibility were found in maturation stage-III.

Deforche et al. (2003) assessed different aspects of physical fitness and physical activity in obese and nonobese Flemish youth and found that obese subjects had inferior performances on all tests requiring propulsion or lifting of the body mass (standing-broad jump, sit-ups, bent-arm hang, speed shuttle run, and endurance shuttle run) compared with their nonobese counterparts (p < 0.001). In contrast, the obese subjects showed greater strength on handgrip (p < 0.001).

Pena Reyes, Tan and Manila (2003) studied Urban-rural contrasts in the
physical fitness of school children in Oaxaca, Mexico and found that Urban children were significantly taller and heavier than rural children. Absolute grip strength did not consistently differ between rural and urban children, but when adjusted for age and body size, strength was greater in rural children. Explosive power (standing long jump) and abdominal strength and endurance (timed sit-ups) were better in urban than in rural children without and with adjustment for age and body size. Urban-rural differences in running speed (dash) and flexibility (sit and reach) varied by age group and sex. Younger rural children and older urban girls performed better in the distance run, whereas older rural and urban boys did not differ in endurance.

Ioakimidis et al. (2004) investigate combined effect of age and maturation on maximum Isometric leg press strength in young Basketball players and revealed that in almost all absolute force parameters the 12 and 13 years old demonstrated significantly (p<0.05) lower values compared with the 15-, 16- and 17 years old groups. Age differences were also significant when the effect of sexual maturation was taken into consideration in the statistical analysis but they were reduced when strength was adjusted for body mass. No significant difference was reported for strength per unit of fat free mass.

Monyeki et al. (2005) studied body composition and physical fitness of undernourished South African rural primary school children and reported that BMI was highly correlated with fat-free mass (FFM). Findings from Western countries showed that children with higher BMI or sum of skinfolds (SSF) performed worse in bent arm hang and in 1600m run. BMI was significantly associated with flamingo balance. Waist-to-hip ratio (WHR) was positively associated with bent arm hang and inversely with sit and reach. In contrast, significant relationships were found between BMI and standing long jump, sit and reach flamingo balance and plate tapping. SSF was significantly associated with sit and reach. Significant inverse associations were found between FFM and bent arm hang, 1600 m run and 50 m run. FFM was significantly associated with standing long jump, flamingo balance, and with sit and reach.

Ozdirenc et al. (2005) compared physical fitness between rural and urban children of Turkey's and results showed that body mass index and skinfolds thickness
were higher in the urban children \( (P < 0.05) \). There were no significant differences in the hip-waist ratio or the hip and waist circumference between the two groups. In cardiopulmonary and motor fitness, no difference was found between the two groups. In contrast, flexibility and muscle endurance were significantly higher in the rural children.

Christodoulos et al. (2006) conducted a study on obesity and physical fitness of pre adolescent children and found that physical fitness significantly improved during the school year, with little or no changes in the summer holidays. Children who reported less than 30 minutes of daily participation in physical activity demonstrated lower prevalence rates for overweight and obesity as well as superior fitness performance. The detrimental effect of the summer break on the progress of physical fitness was less in children who did participate in physical activity than in those who did not. Longitudinal modeling using generalized estimating equations demonstrated that physical activity was a major contributing factor for obesity over time, masking the singular effect of various fitness parameters.

Baquet et al. (2006) studied longitudinal follow-up of fitness during childhood: interaction with physical activity and found except for flexibility, boys' fitness performances increased more than that for the girls. Positive and significant \( (P < 0.05) \) regression coefficients were found with the regularly active for standing broad jump, 20-m shuttle run, number of sit-ups, 10 x 5-m shuttle run in both sexes, and for the girls' sit-and-reach performance. Increasing or decreasing physical activity level was not associated with changes in fitness performances over time, except for flexibility for the girls and the 20-m shuttle run for the boys.

Frey and Chow (2006) examine the relationship between body mass index (BMI), physical fitness, and motor skills in a large sample of youth with mild ID and reported after controlling for age and gender, group differences in the run and push-ups, but not in the motor or other fitness variables. After controlling for age and gender, BMI was correlated with the run and push ups. Age and gender were entered as the first block in hierarchical regression and accounted for most of the variance in all dependent variables, except sit and reach.

Ara et al. (2007) examined adiposity, physical activity, and physical fitness
among children from Aragón, Spain and reported that the prevalence of being overweight and obese in the entire sample was 31% and 6%, respectively. No difference between urban and rural children was found. The proportion of boys who were classified as overweight and obese was similar in physically active and sedentary (non-physically active) groups. However, physically active girls tended to show lower obesity prevalence compared with their sedentary counterparts.

**Aires et al. (2008)** investigated association of physical fitness and Body Mass Index in youth and reported obese and over-weight children have low physical fitness (PF) level compared to normal weight years. A large number of children with normal weight were identified as unfit. They also found that a low BMI level would significantly improve some physical fitness component.

**Fogelholm et al. (2008)** studied physical fitness in adolescents with normal weight and overweight and found prevalence of OW was 17.3% in boys and 11.8% in girls. The main effect physical activity (PA) on all fitness tests was significant (P< or = 0.005). The main effect of overweight (OW) was significant (P<0.002) for all tests, except for sit-and-reach. The association between PA and fitness was stronger than that between OW and fitness. Sit-ups, endurance shuttle-run and fitness index showed the strongest association with PA. OW was not associated with sit-and-reach test and only weakly with the ball skills test. OW had the most negative association with cardio respiratory and muscle endurance, and explosive power tests, they concluded.

**Kusy (2009)** examined social position and health-related fitness in urban boys aged 10 to 15 years and concluded that the inequality of social position of urban boys was concerned with the differences in the level of health-related fitness but its components were socially modified to a different degree.

**Halme et al. (2009)** examined relationship between standing broad-jump, shuttle run and body mass index in children aged 3 to 8 years and revealed that the age and sex adjusted correlation of BMI with both the SBJ and Shuttle run test results were significant. In the 3 to 4 years old, children in the middle BMI tertile achieved better results in the SBJ test compared with those in the lowest BMI tertile. Among both 5 to 6 and 7 to 8 years old the children in the highest BMI tertile had weaker SBJ results compared to those in the lowest and middle BMI tertile. Subjects in the highest
BMI tertile achieved lower Shuttle run results than those in the middle BMI tertile, in the age groups of 5 to 6 years and 7 to 8 years old children.

Castro-Pinero et al. (2009) studied the percentile values for 9 different muscular strength tests for Spanish children (1,513 boys and 1,265 girls) aged 6 to 17.9 years and found that boys had significantly better scores than girls in all the studied tests, except in the 3 upper-body muscular endurance tests in the 6- to 7-year-old group and in the push-ups test in the 8- to 9-year-old group. Underweight and normal weight individuals showed similar strength levels. Both underweight and normal weight children and adolescents had significantly higher performance than their overweight and obese counterparts in the lower-body explosive strength tests and in the push-ups test in boys and bent arm hang test in both boys and girls.

D’Hondt et al. (2009) investigated Relationship between motor skill and body mass index in 5- to 10-year-old children and found that scores for balance (p < 0.01) and ball skills (p < 0.05) were significantly better in normal-weight and overweight children as compared with their obese counterparts. A similar trend was found for manual dexterity (p < 0.10). They concluded that general motor skill level is lower in obese children than in normal-weight and overweight peers.

Tinazci and Emiroqlu (2009) investigated the effects of environmental factors on physical fitness of rural and urban children and results revealed that body mass index and skinfold thicknesses were higher in the urban children (P<.05). Differences in cardiopulmonary and motor fitness were also found between groups. In addition, flexibility and muscle endurance were significantly higher in the rural children.

Mak et al. (2010) reported that boys performed significantly better in sit-up and 9-minute run, but poorer in sit-and-reach than girls. All four physical fitness tests were significantly positively correlated with each other in both sexes, and BMI was only weakly correlated with sit up and sit-and-reach tests in boys. Decreasing performance was reported from normal weight to overweight and obese for push-up, sit-up, and 9-minute run in both sexes.

Pavon et al. (2010) examined the influence of socioeconomic status on health-related fitness in European adolescents and found that socioeconomic status was positively associated with health-related fitness in European adolescents
independently of total body fat and habitual physical activity.

**Gonzalez-Aguero et al. (2010)** investigated health-related Physical fitness in children and adolescents with Down syndrome fitness in children and adolescents with DS was not due to their less activeness or overprotection. Many of the training programmes carried out for them did not yield the desired response. The reasons behind the fact, as they stated, was still unknown.

**Shang et al. (2010)** investigated weight status with physical fitness in Chinese children of 6-12 years age and found that older children performed better than their younger counterparts for all physical fitness tests (standing broad jump, 50 m sprint and 50 m × 8 shuttle run). No significant differences in all three physical fitness tests were reported by them between under weight and normal weight children and both of them were performed better than their overweight and obese counterpart.

**Milanese et al. (2010)** examined anthropometry and motor fitness in children aged 6-12 years and found BMI were positively correlated with waist circumference and subcutaneous fat, and negatively correlate with body density. Motor fitness was not significantly affected by BMI, while sum of five skinfolds negatively associated with velocity in males aged 6-7 years and with jump length in females aged 8-12 years. Motor fitness significantly correlated with age and performance was higher in males. Moreover, motor fitness tests positively correlated with each other, especially in females. In the 6-12 years period motor performance improved with age and improvement was partially sex related; this correlation was higher in boys. They also suggested that explosive strength and velocity were related the 6-12 years age span, possibly because both were power events, which involve horizontal movement of the centre of mass.

**Dhondge (2011)** studied the relationship between different motor fitness with kho kho playing ability and reported positive correlation between balance and standing broad jump with kho kho playing ability where as negative correlation were found between speed, % body fat, BMI and Cardio-vascular endurance with kho kho playing ability in the boys of 18 to 25 years age.

**Chillon et al. (2011)** examine the differences in fitness components between rural and urban Spanish children and adolescents. They assessed physical fitness by 7 tests: 20m shuttle run, speed shuttle run, sit and reach, standing long jump, handgrip
strength, bent arm hang and sit-ups in 30s (s) and found that Rural Spanish children and adolescents had overall a healthier profile than their urban peers in terms of cardiorespiratory fitness, upper- and lower-limb muscular fitness and adiposity, while they performed worse in speed-agility and flexibility.

2.3 REVIEW OF LITERATURES RELATED WITH PSYCHOLOGY

Slaughter (1970) correlated somatotype and certain personality traits of 17 to 23 years aged 157 women subjects at the University of Illinois. The author used the Sheldon’s Photographic Method for assessing somatotype and the Sixteen Personality Factor Questionnaire (16 PF) and the California Psychological Inventory (CPI) for measuring the personality traits of the subjects. He concluded that out of 102 correlations between personality traits of the two tests and somatotype components, only four were significant. Only mesomorphy was significantly negatively correlated with Second-order Factor I of the 16 personality Factor (Low Anxiety); endomorphy was significantly negatively correlated with the CPI variable of socialization; endomorphy was significantly negatively, and ectomorphy was significantly positively correlated with CPI variable of Good Impression.

Garvin (1972) studied on physical fitness and personality of 189 male volunteers at Mississippi Gulf Coast Junior College, Gautier, Mississippi to determine a relationship between physical fitness and personality. He used Cattell’s Sixteen Personality and Fleishman’s Basic Fitness Test for measuring physical fitness of the subjects. He concluded that there was a strong relationship between personality and physical fitness, and significant differences in personality among high, average and low physical fitness groups.

Carron et al. (1975) in a study described that Cattell's High School Personality Questionnaire and Gough's Adjective Checklist were administered to 73 15-yr.-old boys to compare personality for groups selected on the basis of extreme scores on maturation (skeletal development, age at achievement of peak height velocity), body type (body somatotype, body skinfolds), performance (body reaction time), strength, physical fitness and socioeconomic status. Multiple discriminant analyses indicated that the only significant difference in personality between groups was for early versus
late maturers (skeletal development) on Cattell's scale. The personality scores for the remaining extreme groups did not differ on either of the scales, Cattell's or Gough's.

Olweus et al. (1980) conducted a study to show that fifty-eight normal adolescent Swedish boys, aged 16, provided two sets of blood samples for plasma testosterone assays as well as data on a number of personality inventories and rating scales assessing aggression, impulsiveness, lack of frustration tolerance, extraversion, and anxiety. Physical variables such as pubertal stage, height, weight, chest circumference, and physical strength were measured. There was a significant association ($r = 0.44$) between plasma testosterone levels and self-reports of physical and verbal aggression, mainly reflecting responsiveness to provocation and threat. Lack of frustration tolerance was also related to testosterone levels. About 40% of the variance in perfectly reliable testosterone measurements could be predicted from equally reliable Physical + Verbal Aggression and Lack of Frustration Tolerance scales. Pubertal stage was correlated with testosterone ($r = 0.44$), but the above-mentioned relationships could not be accounted for by pubertal stage as a third common variable. Previous hypotheses relating testosterone to strong body build and antisocial behavior, respectively, received only weak or no support.

Tucker (1984) determined whether measures of personality, considered compositely and individually, differ significantly among groups of college males ($N = 285$) differentiated according to subjective-perception of attractiveness. Results indicated that self-perceived mesomorphs manifested psychological qualities that were significantly more favorable than those of their counterparts.

Sattar, Naeema (1999) found out the differences in personality patterns and mental health of the students with rural and urban backgrounds. For this purpose a sample of 100 students, 50 males and 50 females, from Peshawar University was selected according to predetermined criteria set for urban versus rural differentiation. It was hypothesized that different cultural systems in urban and rural areas give rise to different socialization practices which in turn lead to different personality systems having varying implications for personality weaknesses, psychopathologies and deviant behaviors. The Personal Data Sheet was used to collect the demographic data and other relevant information related to urban versus rural differentiation. Two personality tests, viz, Sixteen Personality Factors Questionnaire (16PF) and Omnibus
Personality Inventory (OPI) were used to determine personality characteristics of urban and rural students. Local norms were determined for both the tests. The results revealed statistically significant differences between urban and rural students on certain personality characteristics. Males are emotionally more stable, tough-minded, self-assured, controlled, relaxed, introvert thinkers, theoretically oriented, personally integrated, masculine and pretenders as compared to females. By and large urban students are more intelligent, assertive, happy-go-lucky and conscientious as compared to rural students. Urban males are more assertive, happy-go-lucky and conscientious as compared to rural males, whereas urban females are more intelligent but emotionally less stable, moderately apprehensive and tense as compared to rural females. Urban males seem to be emotionally more stable, venturesome, tough-minded, self-assured, experimenting, controlled, introvert thinkers, theoretically oriented, personally integrated, relaxed, masculine and pretenders as compared to urban females. On the other hand, rural males are more intelligent, personally integrated and relaxed as compared to rural females. On the whole rural students as compared to urban students seem to be more prone towards personality disorders, manifesting a higher tendency towards avoidant and obsessive-compulsive personality disorders.

Mehta et al. (2008) made a comparative study of the personality patterns of SC, ST and non–backward higher secondary boys. The prolonged social discrimination has produced an adverse impact on the development of the personality of these downtrodden, which is a severe stumbling block in providing ‘social justice’ and ‘social equality’ to the masses. By making a comparative study, the differences in personality patterns between backward and non-backward classes can be highlighted which will enable us to understand and eliminate not only the economical but also the educational, social and political backwardness of the society as a whole. For the study, on a sample of 600 rural and urban male students of XI standard from Jaipur district belonging to SC, ST and non-backward classes, the Cattell’s High School Personality Questionnaire (HSPQ), Form A by Kapoor, Srivastava and Srivastava was administered. Results revealed significant differences in personality patterns among SC, ST and non-backward boys. These differences were more prominent in rural areas in comparison to urban areas.