Chapter II

REVIEW OF RELATED LITERATURE

A review of the related literature to the present study on the relationship of somatotype components to selected psychological and motor ability variables, available in the library of Lakshmibai National College of Physical Education, Gwalior has been abstracted in this chapter to provide the background material to evaluate its significance and as well as to interpret its findings. The review of literature is divided into four sections. Studies pertaining to the relationship of somatotype components to psychological traits i.e. personality traits, self concept dimensions and different modes of reaction to frustration, are included in Section I. Section II covers those studies pertaining to the relationship of somatotype components to motor ability variables. Studies in which comparisons were made either among the physical fitness levels of different somatotype groups or among the somatotype, component ratings of groups formed on the basis of performance or participation status are included in Section III. Section IV covers those studies in which the somatotype ratings of participants in different sports or sports events were compared. The findings of studies pertaining to the relationship of somatotype components to personality traits, self concept, reaction to
frustration and motor ability variables are summarized at the end of the chapter.

SECTION I

Somatotype and Psychological Factors

The study of the psychological behaviour as related to morphology and physiology of the body is a problem of constitutional psychology. Basic components of temperament have been identified, objectified by the method of tests and interviews, and scaled on 7 point scales. These components are referred to as "VISCERATONIA" "SOMATOTONIA" and "CEREBROTONIA."\(^1\)

Visceratonia is generally identified with love of comforts relaxation, sociability, conviviality and some time with glutony. It is the motivational organisation dominated by the stomach and by the function of anabolism.

Somatotonia is the motivational pattern characterized by the will to exert, exercise, and vigorous self expression. It is also noted by a drive toward dominance of the functions of the "Soma."

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Cerebrotonic refers to the attentional and inhibitory aspect of the temperament. In the economy of the cerebrotonic individuals, the sensory and the central nervous system play dominant roles. The cerebrotonic is the tense, hyper attentional and under strong inhibitory control. Their tendency is toward symbolic expression rather than direct action.

Sheldon et al.\(^2\) found these components of temperament to correlate with patterns of somatotypes and like the morphological components, combine in varying proportions in different individuals. The components within limits behave as independent variables. A list of twenty traits under each of these three aspect of temperament was found in Sheldon's varieties of delinquent youth.

Hanley\(^3\) conducted a study on junior high school boys to assess relationship between temperament and physique. Coefficients of correlation were found to be significant at 1 percent level between take chances and mesomorphy, "Good at games and Mesomorphy, Real boy and Mesomorphy, Unhappy and Ectomorphy, Daring and Mesomorphy, and Bossy and Mesomorphy.


Sheldon\textsuperscript{4} reported that personality is the product of the play of a complex pattern of environmental pressures upon the organism that carries on innately determined constitutional patterning. He found such a clear relation between physique and behaviour and between organic and constitution and mental outlook, that it seems almost fatuous to attempt to draw a line between what is organic and what is functional in the human personality. He has reported correlation as high as \textasciitilde83 between components of physique and corresponding components of temperament.

Alt\textsuperscript{5} carried out a study to find out relationship between physique and temperament. She selected one hundred and ten school childrens as subjects. She concluded that relaxation was positively related with mesomorphy and ectomorphy. She also reported a positive relationship between assertiveness and mesomorphy and a negative relationship with endomorphy. Tension and tendency to be inconspicuous were positively correlated with ectomorphy and negatively with endomorphy.

\textsuperscript{4}Sheldon, \textit{Varieties}, p.107.

\textsuperscript{5}Pauline M. Alt, "Relationship of Physique and Temperament" \textit{Social Review} 11 (May 1953):272.
Brockhoff\textsuperscript{6} conducted a study to assess relationship between physical, socio-psychological and mental characteristics of thirteen year old boys. He reported that endomorphs and mesomorphs groups scored higher than the ectomorph group on nearly all the scales of the California psychological inventory. The endomero group, when compared to the ectomorph group, the differences were significant at .05 level for capacity for status and self acceptance. The mesomorph group was found to be different on well being, good impression, flexibility tolerance and achievement than the ectomorphs and the scores were higher for mesomorphs.

Galder\textsuperscript{7} carried out research project entitled somatotype groups and their relationship to personality, heart rate recovery and selected motor ability variables in college men. He selected one hundred college men and who were classified into five somatotype categories viz endomorphs, mesomorphs, ectomorphs, endo-mesomorphs and mid types. ANOVA followed by Scheffe's post hoc test revealed that there are no observable pattern between personality factors and a specific somatotype pattern.

\textsuperscript{6}Jan Brockhoff, "Relationship between Physical, Socio-Psychological and Mental Characteristics of Thirteen Year Old Boys" Dissertation Abstract International 32 (June 1970):3094-A.

\textsuperscript{7}Robert Bruce Van Galder, Somatotype Groups and Their Relationship to Personality, Heart Rate Recovery and Selected Motor Ability Variables in College Men" Dissertation Abstract International 31 (February 1971):3943-A.
Winthrop in reporting the consistency of attitude, found high attitude consistency values for individuals with an upper level ectomorphic component and low attitude consistency values for individuals with high endomorphic component. Endomorphic personalities appear to be form and borrow their attitude from close associations with friends and acquaintances. He states that endomorph is other directed and person oriented, and attitude wise suffers from the deficiency of his virtues. Ectomorphs tend to work out their credos and life philosophy intellectually.

McCandless concluded that young men who appear insecure in their sex typing may seek to bolster their masculine self concept by urgent efforts to develop secondary sex.

Merriman concluded that motor ability is related to personality traits. The upper motor ability group scored

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significantly higher than the lower motor ability group on the measures of poise, ascendency and interest modes.

Smith\textsuperscript{11} reported from testing ten hypotheses from Sheldon's work that verbal comprehension is related to ectomorphy positively and negatively with endomorphy.

Parnell\textsuperscript{12} found heaviest concentration of anxiety states in ectomorphs and less in mesomorphs and still less in endomorphy. In men under twenty five years of age, suicidal tendencies were more common in ectomorphic group.

Davidson et al.\textsuperscript{13} investigated body build and temperament in a group of 100 seven-year-old children, found symptoms of anxiety and emotional unrest associated with ectomorphy. They also found a relationship between ectomorphy and meticulous, fussy and conscientious traits of personality. In general the correlations between somatotype and psychological

\textsuperscript{11} Henry Clay Smith, "Psychometric Checks in Hypothesis Derived from Sheldon's Works on Physique and Temperament" \textit{Journal of Personality} 17 (March 1949):230.


\textsuperscript{13} M.A. Davidson; R.G. McInnes and R.W. Parnell, "The Distribution of Personality Traits in 7-year-old Children" \textit{British Journal of Educational Psychology} 27 (March 1957):48-61.
attributes were of a low order.

Parnell\textsuperscript{14} compared somatotype distributions in 405 healthy students with a group of some 200 students who had sought psychiatric care. Ectomorphs were six times more common in the patient group, mesomorphs five times more common in the healthy group.

Smith\textsuperscript{15} studied somatotypes in relation to M.M.P.I. scales in a group of 181 students. Many of his correlations were significant and most of them were in the direction predicted from Sheldon's system. Nevertheless the modal level of his correlation was only between .3 and .4, thus falling very short of Sheldon's claims.

Glueck and Glueck\textsuperscript{16} have found a predominance of endomorphic and mesomorphic body build in criminals and a relative of ectomorphy. Added to this, we have similar findings of Sheldon et al. Epps and Parnell.

\textsuperscript{14}R.W. Parnell, "Physique and Mental Breakdown in Young Adults." \textit{British Journal of Medicine} 1 (January 1957): 1485-1490.

\textsuperscript{15}D.W. Smith, "The Relation Between Ratio Indices of Physique and Selected Scales of the Minnesota Multiphasic Personality Inventory" \textit{Journal of Psychology} 43 (August 1957): 325-331.

\textsuperscript{16}S. Glueck and E. Glueck, "Unravelling Juvenile Delinquency" \textit{Common Wealth Fund} 6 (September 1950), p. 68.
Rees\textsuperscript{17} conducted a study in title Body Build, Personality and Neurosis in Women. He concluded that constitutional factors are responsible for mental abnormality and found a correlation between extraversion and eurymorph body build. He also found relationship between psychopathy and criminality.

Child\textsuperscript{18} made an attempt to study the magnitude of relationships between physique and self-rated behaviour by constructing scales of viscerotonia, somatotonia, and cerebrotonia. He selected 414 Yale students, who had been somatotyped by Sheldon himself, as subjects. The three dimensions of physique differed in the confirmation of predictions in the area of self related behaviour. The measured difference was that many fewer predictions were confirmed at acceptable levels of statistical significance for endomorphy than for the other two dimensions of physique. The resulting correlations between viscerotonia and endomorphy (.13), somatotonia and mesomorphy (.38) and cerebrotonia and ectomorphy (.27) were obtained.


Rees\textsuperscript{19} carried out a study on 60 leptomorph, 77 eurymorph, and 263 mesomorph women using an index of body build derived from his own factorial analysis. Eurymorph women were characterized by hysterical personality, very marked hysterical traits, hysterical motor and sensory conversion symptoms, and backwardness in school; whereas the leptomorph women were characterized by anxiety, depression, irritability, touchiness, suspiciousness, shut-in, weak, and dependent personality, as well as autonomic symptoms, effort intolerance, and above average vocabulary test scores.

Eysenck\textsuperscript{20} compared 156 microsomatic, 156 macrosomatic, and 688 mesosomatic male neurotic soldiers, and found the microsomatic person characterized by unskilled civilian occupation, elementary education, sexually inhibited, narrow hobbies, teetotal, poor physical health, weak and dependent, inert, non-aggressive, anxious, hypochondriacal, depressed, poor muscular tone, low intelligence, poor vocabulary.


SECTION II

Somatotype and Motor Ability Variables

Sills and Everett\(^ {21}\) studied the relationship of somatotypes to performance in motor and strength tests. Four hundred boys in the age group of 14 to 29 years as subjects were selected. They found that (i) mesomorphs were stronger than endomorphs (ii) endomorphs were stronger than ectomorphs (iii) ectomorphs were superior to endomorphs in speed, agility and endurance (iv) mesomorphs were superior to both endomorphs and ectomorphs in agility speed and endurance. (v) Excess body weight is a handicap to endomorphs in the performance of physical tests and (vi) Consideration should be given to body types in formulating standards for achievement in strength tests and motor tests.

A study of physical education majors in South Africa was conducted by Hebbelinck and Postma.\(^ {22}\) The physical education majors tend to be athletic types as described by kretschmer. The relationship between body measurement and motor fitness was found to be insignificant except between neck girth and shot put ability. Mesomorphy was the most distinctive feature of an


subject's somatotype. Mesomorphs were also superior in all motor fitness tests except in the sixty yard dash and the ectomesomorphs excelled the endomesomorphs in all test except in the shot put event.

Cullumbine in working with 7000 ceylonese men, found that individuals with narrow hips were less efficient in performing moderate effort but were more efficient in performing strenuous effort than those with wide hips.

Munroe reported that physique type did not seem to appear to be an important factor in motor ability elements of power, speed, agility or reaction time in twelve years old boys. No somatotype components was highly related to factor relating to physical ability, although endomorphy appeared to be a handicap in high physical accomplishment.


24 Richard A. Munroe "Relationship Between Somatotype Components and Maturity, Structural, Strength, Muscular Endurance and Motor Ability Measures of Twelve Year Old Boys" Completed Research in Health Physical Education and Recreation 7 (1965):82.
Morton\textsuperscript{25} with adolescent boys as subjects concluded that motor ability variables were not significantly related to somatotype assessment. The only variables: components which showed a consistently significant relationship were with the ectomorphy, the variables were standing broad jump, bar push ups, and physical fitness index.

Radcliff\textsuperscript{26} in fourteen year old boys found the highest correlations between somatotype components and strength. The motor ability variables were negatively related with endomorphy. These correlations were -.48 for physical fitness index; -.43 for standing broad jump and -.43 for total reaction time (Negative Connotation).

Pere and others\textsuperscript{27} conducted a study to investigate relationship between performance and physique in finish

\textsuperscript{25} Alan R. Morton, "Comparison of Sheldon's Trunk Index and Anthroposcopic Methods of Somatotyping and Their Relationships to the Maturity, Structure and Motor Ability of the Same Boys Nine Through Sixteen Year of Age" Dissertation Abstract International 25 (October 1967):16.

\textsuperscript{26} Robert A. Radcliff, "Relationship Between the Sixty Yard Shuttle Run and Various Maturity, Physique, Structural, Strength and Motor Characteristics of Fourteen Year old Boys" Completed Research in Health Physical Education and Recreation 12 (1972):36.

athletes. They reported that the followers of different branches of athletics do not differ appreciably as to their body constitution except certain extreme groups. He also reported that definite ideal type for a certain athletic event could be ascertained and that athlete differ slightly in body build from other finishing men of the same age.

Parnell\textsuperscript{28} reported in a study that Oxford students who undertook strenuous exercise were generally well equipped to do so. They fell primarily in the mesomorphic classification, but it was reported that central linear types were commonly athletic too. Where the musculature component is rated less than three, participation in sports activities becomes less common and participation in contact sports become rare. Peripheral ectomorphs, because of their lack of musculature, are likely to embarrass instructors of physical education; they may swim, provided the water is very warm. The other half of the non athletic world is populated by the peripheral endomorphs with too little musculature proportionately for much activity. They are characterized by relatively small bones and preponderance of soft tissue. Type 623 has much to carry but proportionately little to carry it with - in mechanical language, a power/weight ratio that is inadequate for quick acceleration or movement they very antithesis of type 263.

\textsuperscript{28}Parnell, \textit{Behaviour and Physique}, p.52.
According to Willgoose\textsuperscript{29} one may examine individuals ranking high or low in the components of endomorphy and ectomorphy and make a great deal about their potential motor ability by the degree of mesomorphy present in the structure.

Exposing an endomorph to a vast amount of training will not measurably improve his ability and reaction. Although mesomorphic component is the driving force in the structure, it is the magnitude of the secondary component (endomorph or ectomorph) that often determine the limits of physical abilities. A 126 body type for example may participate in hiking over a non mountainous terrain, whereas a 136 may perform in cross country competition and a 145 or 146 may hike over mountainous territory.

Phillips\textsuperscript{30} in a study of sixteen year old boys found power correlations of $-.596$ with endomorphy, $.127$ with mesomorphy and $.227$ with ectomorphy.

\textsuperscript{29} Carl E. Willgoose, "Body Types and Physical Fitness". \textit{Journal of Health, Physical Education and Recreation} 27 (September 1956):27.

Hindmarch\textsuperscript{31} conducted a study entitled significance of physique maturational, body size, strength, motor ability and reaction characteristics of eight year old boys. He found significant difference in the mean score of standing broad jump between mesomorph and the endomorphs. The mesomorphs were found to be superior in all the motor ability variables than the endomorphs.

Radcliff\textsuperscript{32} in working with boys in the Medford Growth study found significant correlations between agility and somatotype components i.e..44 with endomorphy -.14 with mesomorphy and -.19 with ectomorphy.

Phillips\textsuperscript{33} also found significant relationship between agility and somatotype components i.e..551 with endomorphy, -.270 with mesomorphy and -.155 with ectomorphy.


\textsuperscript{32} Radcliff, Completed Research in Health Physical Education and Recreation 37.

\textsuperscript{33} Phillips, Completed Research in Health Physical Education and Recreation 10.
Brockhoelf found agility to be highly correlated with ectomorphy with a value of -0.235 and with mesomorphy with a value of -0.227. No relationship was observed between endomorphy and agility.

Cureton reported that certain somatotypes are related to specific types of athletic performance. Findings with a sample of springfield college men consisting primarily of athletes and a few endomorphs were as follows:

(a) Mesomorph received the highest score in athletic performance involving strength and power. (b) Ectomorphs performed better in the Brace Test, a test which require body balance, flexibility and agility. (c) Mesomorphs and meso-endomorphs did better in aquatic events (d) Ectomorphs received the lowest scores in the McCurdy Larsen Organic Efficiency Test.

Laubach, Hollering and Goulding studied the relationship of cardio-vascular endurance to somatotype components

34 Brockhoelf, Dissertation Abstract International, p.3095-A.


among 30 university men students. Two tests were used to measure cardio-vascular endurance, viz., the Harvard Step Test and the Ohio State University Step Test. Somatotype ratings were given according to the Heath Carter anthropometric method. Cardio-vascular endurance as measured by the Harvard Step Test was found to be significantly related to endomorphy and ectomorphy; the relationship being negative with endomorphy and positive with ectomorphy. Contrarily, endurance as measured by the Ohio Step Test was found to be unrelated to any of the somatotype components.

Miller\textsuperscript{37} after studying the relationship of 300 yard run time scores to ponderal index among 486 undergraduate men students, concluded that ponderosity of the body is a significant factor in the performance of the 300 yard run.

Thorsen\textsuperscript{38} found no relationship between 600 yard run time and the three somatotype components among college women.


Jones\textsuperscript{39} found total static strength among boys, averaging 17.5 years in age, to be positively related to mesomorphy. No relationship could be found between strength and the other components of somatotype.

Voisard\textsuperscript{40} has reported that motor ability is positively related to ectomorphy, negatively related to endomorphy and not related to mesomorphy. Possibility of a curvilinear relationship being present was indicated.

Watson and O'Donovan\textsuperscript{41} studied the relationship of somatotype components to strength among 53 post-pubertal boys in the age group of 16 to 18 years. It was found that the strength index was related positively to the Sheldonian somatotype ratings for endomorphy and mesomorphy, and negatively to ectomorphy. The strength index was also found to be related positively to mesomorphy ratings according to the Heath Carter Method. The endomorphy and ectomorphy ratings by this method, however, did not exhibit any relationship with strength.


Multiple linear correlation analysis revealed that Sheldonian and Heath Carter Somatotype ratings accounted for 46 and 47 per cent of the variance in strength, respectively. Somatotype ratings by both the methods made significant contributions to the prediction of strength by regression.

In one of the earliest studies of the relationship between somatotype and strength, Sheldon and Stevens\(^4\) found negative correlations between peripheral strength and endomorphy and ectomorphy, and positive correlation between strength and mesomorphy.

Hawthorne\(^5\) studied the relationship of the structural and functional aspects of college men by correlating the ratings in the three components of somatotype with scores in Roger's Physical Fitness Index, Vertical Jump and Brace Test of Motor Ability. It was observed that a real relationship

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did exist between mesomorphy and Roger's Physical Fitness Index, ectomorphy and vertical jump, and ectomorphy and motor ability as measured by the Brace Test.

The relationship of somatotype to anaerobic power among women in the age group of 18 to 30 years (N = 100) was studied by Tahamont. Somatotype ratings were given according to Heath Carter Anthropometric Method and anaerobic power was measured by the Margaria test. Statistically significant relationships were found between each of the somatotype components and anaerobic power. The multiple correlation coefficients between anaerobic power and the interactions of the somatotype components were also statistically significant. However, it was concluded that the degree of these relationships was not sufficiently high to be of practical value.

SECTION III

Comparision of Physical Fitness on the Basis of Somatotype Groups

Garrity in a study involving college women, found a general tendency for the subject classified as mesomorphic ectomorphs to perform in a more efficient manner in physical fitness test. The ecto-endomorph group was consistently low in all test items.

Van Galder compared the cardio-vascular endurance, power, agility, balance, reaction time, and movement time scores of 100 men classified into five somatotype categories, viz., endomorphs, mesomorphs, ectomorphs, endomesomorphs, and mid-types. ANOVA followed by Scheffé's post hoc test revealed that endomorphs were inferior to all the other groups in cardio-vascular endurance, power, agility, and movement time, and consequently it was concluded that success in tests assessing these qualities is less likely for endomorphs than for other body types.


Sills and Everett\(^{47}\) compared the endomorphs, mesomorphs, and ectomorphs in a male university student population on tests of endurance, speed, strength, and agility. Each subject was selected as a member of one somatotype group on the basis of a high rating (5 to 7) for one component and low ratings (below 3) for the other two components. It was concluded that mesomorphs are superior to both, endo and ectomorphs, and ectomorphs are superior to endomorphs in endurance, speed, and agility. The inferiority of endomorphs and ectomorphs was identified with excess weight and inadequate strength, respectively.

Seltzer\(^{48}\) after investigating the association of body build and oxygen consumption, claimed that the linear (ectomorphic) types have a higher oxygen intake capacity than other body types.

Johnson et al.\(^{49}\) have suggested that although the mesomorphic individuals are earlier candidates for coronary heart


disease, they can avoid or delay the onset of coronary atherosclerosis through regular exercise.

Spain; Nathan and Gellis\textsuperscript{50} studied 5,000 men to find the relationship of somatotype to coronary atherosclerotic heart disease and reached the conclusion that endomorphs have a higher prevalence of heart disease as compared to other categories of somatotype.

Seltzer and Brouha\textsuperscript{51} have reported that mesomorphs are superior to endomorphs in terms of their response to endurance training.

Cureton and Hunsicker\textsuperscript{52} have expressed the opinion that, in general, mesomorphs and ectomorphic mesomorphs have

\textsuperscript{50} D.M. Spain; D.J. Nathan and M. Gellis, "Body Type and the Prevalence of Coronary Atherosclerotic Heart Disease in Males" American Journal of Medical Sciences 245 (1963):63 cited by Karpovich and Sinning, Physiology of Muscular Activity, p.300.


better physical fitness than do the other somatotypes.

Schreiber⁵³ compared the anaerobic capacity of university athletes as it was influenced by their somatotype. It was found that mesomorphs and endomorphs had higher anaerobic capacities than other somatotype categories.

Clarke and Peterson⁵⁴ compared the somatotypes of boys aged 10 to 15 years and classified into four categories of athletic ability as indicated by coaches' ratings. The categories were Exceptional-III, Good-II, Regular Participant-I, and Non-participants-NP. Comparisons were made at two levels, viz., elementary school and junior high school.

At elementary school level, 35.7 per cent of the boys in category III were mid-types, and 28.5 per cent each were mesomorphs and ectomorphs. No endomorphs and very few endomesomorphs were found in this category. Somatotypes of boys in category II were also distributed in a similar manner.

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Among the junior high school boys, a greater percentage of mesomorphs was found among the first three categories. The percentage of mid-types in category III was much less and that of endomesomorphs was more than at elementary school level.

The strength and muscular endurance scores of five categories of somatotype were compared by Clarke, Irving and Heath. Subjects were 259 boys in the age group of nine to 15 years. It was found that for strength as well as muscular endurance, endomesomorphs were superior to other somatotype groups, and were followed by ectomorphs, mesomorphs, mid-types and endomorphs in descending order.

Borms compared the somatotype component ratings of high and low strength groups of boys at 10, 13 and 16 years of age. Grouping for strength was based on a composite score comprising of Roger's Strength Index and Physical Fitness Index, and a mean of 11 cable tension strength tests. It was


found that the higher gross strength groups at each age level were more mesomorphic than the lower strength groups, and that the lower strength groups were more ectomorphic than the other group.

Wiley⁵⁷ made an attempt to differentiate athletes from non-participants among 12 year old boys on the basis of somatotype ratings. The three somatotype components failed to reflect the athletic participation status of the subjects.

To determine whether women gymnasts differ significantly from non-athletes in relation to somatotype, and whether place winners differ from non-place winners, Falls and Humphrey⁵⁸ somatotyped 71 gymnasts participating in a regional, university gymnastics competition and 54 non-athletes from a university population.

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The somatotype dispersion distance was used to make the comparisons. It was found that the mean somatotypes for both groups of gymnasts (place winners, and non-place winners) were significantly different from the mean somatotype of non-athletes. Difference between the two gymnast groups was not significant. However, ANOVA for each somatotype component revealed that the place winners' group was significantly lower on endomorphy than the non-place winners' group.

DeWoskin\textsuperscript{59} compared the somatotype component scores of women enrolled in a fitness program with those of a reference group which did not participate in the program. Significant differences were found for all the three components.

A number of studies have been conducted in foreign countries involving somatotypes and anthropometric measures. Heath, Hopkins and Miller\textsuperscript{60} worked with a Japanese sample and reported, it is evident that the fat and balanced somatotypes


are much rarer and the "muscular" somatotypes much more frequent in the Japanese men than in the American men.

SECTION IV

**Somatotype Components Related to Different Sports and Games**

In evaluating physique and body composition of champions, one must distinguish between two sets of factors. On the one hand we have factors of genetic origin i.e. height, bone width, which we can not change with training, and on the other hand those factors which correspond to qualities i.e. percent body fat, weight, strength etc. that can be influenced by training as a result of adaptive processes.

Carter et al. 61 have presented a review on the somatotypes of 1039 male and female athletes. Their finding supported the hypothesis that physique is selective in champion performance; but somatotype patterns were found narrower in the higher level of competition.

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When all athletes were compared to each other, the lowest level of endomorphy was found in distance runners, lumberjacks, and some wrestlers and weight lifter's i.e. they had rating of 1. As expected in regard to mesomorphy, all groups of champion athletes were rated high. Gymnasts had a rating of 6, but were not as high as weight lifters, track and field athletes, swimmers and golfers. The last component, ectomorphy, which depicted linearity, showed the greatest variability within most sports. Male gymnasts have a rating of 2 in this component. The highest ratings were usually found in distance runners. Among women, gymnasts were the least linear and track and field sprinters and jumpers the most linear. Thus on an average, the outstanding gymnast had a somatotype of 2-6-2. Highly successful gymnasts however are more mesomorphic than less successful gymnasts.

In a 1974 study of Olympic Gymnasts, Carter et al.62 says that men gymnasts are the most mesomorphic of the male athletes. Seven of the male groups are concentrated in narrow portion between the 5 and 5½ units in mesomorphy, while the lowest groups are the reference male, basketball players and long distance runners. He stated that gymnasts were significantly more mesomorphic than all of the groups except divers.

and canoeists. The Canoeists were significantly more mesomorphic than the remaining groups.

Between 1965 and 1970, Maas studied 23 top selected male gymnasts. The gymnast distinguish themselves clearly from the other groups. They were small and have a broad upper part of the body with great circumferences. The width measurement below the waist are not small for their stature. An important difference with the Judoka as a group is the small circumferences of the legs; both in the absolute and relative numbers, but they also differ from each other in relative trunk length. Gymnast have short upper legs and upper arms in cm as well as in percentages.

Tanner collected somatotype data on 102 Olympic, Track and Field Athletes participating in the 1964 Olympic Games held in Rome. Only those athletes who had achieved the 1960 Olympic standard in their event were included in the study.

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Fig. 21 Relationship between Factor A (Reserved vs Outgoing) and Mesomorphy.
The following observations were made:

1- In track events there was a noticeable gradient of decreasing mesomorphy and increasing ectomorphy as the distance increased from 100 and 200 m. through 400 m. to 800 m. and the longer ones.

2- The endomorphic ratings for all track events were below or equal to 2.6.

3- Jumpers, on the average were similar to sprinters, being high in mesomorphy and having the second highest rating in ectomorphy.

4- Throwers were more mesomorphic, more endomorphic, and less ectomorphic than the runners and jumpers.

5- University students could be considered as belonging to the mediocre physique category, with a slightly higher rating in ectomorphy than in endomorphy.

6- Military Cadets and Physical Education Students were quite similar except that the former had a higher ectomorphic rating than the later.

7- On the whole, the Olympic Athletes were considerably different from the university students, military cadets, and physical education students.
Cureton\(^65\) found, after studying the somatotype distributions of some of the participants in the 1948 Olympics, that every swimmer who broke a world record was highly mesomorphic; and among track athletes, sprinters were mostly ectomesomorphic; and that the long distance runners were more ectomorphic than the sprinters.

Sidhu and Wadhan\(^66\) somatotyped 101 university sportsmen specializing in four sports, namely, Hockey, Football, Basketball and Throwing. A reference group of non-participants from the same population was also somatotyped. It was found that the subjects in Hockey, Throwing, and the reference group had the highest mean endomorphic rating (3.5) while subjects in the Football, and Basketball groups had the least mean rating in endomorphy (3).

Male high school swimmers representing eight event categories (N = 70) were somatotyped by Holmes\(^67\) who found


no differences across the events.

Westlake in a study of the somatotypes of female track and field athletes, found that the whole group had either or both mesomorphy and ectomorphy as the dominant component/s. Comparisons of event groups revealed that the throwers were more endomorphic, more mesomorphic, and less ectomorphic than the sprinters, distance runners and jumpers.

Summary of Reviewed Literature

The results of review of literature presented in Sections suggest that body size and body types are of greater importance for prediction of personality traits; although more research is needed in this area.

The review of literature supports the proposition that there exists a correlation of the order of .3 to .5 between (a) Leptomorph body build and introversion and (b) Leptomorph body build and neuroticism. Both these relationships work in the direction of making the dysthymic individual particularly leptomorphs and normal extravert particularly eurymorph.

Doris J. Westlake, "Somatotypes of Female Track and Field Competitors" Completed Research in Health, Physical Education and Recreation 10 (1968):94.
There seems to be an agreement on the findings of the studies pertaining to psychological make up of each somatotype. On the whole ectomorphs were found to be highly anxious, tensed and emotionally unstable. The mesomorphs and endomorphs are warmhearted, easy going, more emotionally stable and less tensioned. Verbal comprehension is related to ectomorphy positively and negatively with endomorphy.

There seems to be more of a conflict than agreement among the findings of studies done on the relationships of somatotype components to motor ability variables. A repetition of similar studies would be needed to make general conclusions.

Comparative studies have proved to be more conclusive than relationship studies. The endomorphs and endomesomorphs exhibited poor cardio-vascular endurance and a higher risk for Coronary Heart Disease than ectomorphs and mesomorphs in almost all of the research reports reviewed. The mesomorphs have exhibited good performance in strength events. They were found to be the best performer in most of the motor ability variables.

The comparison of the somatotype ratings of sportsmen representing various sports or sport events clearly point out the close association that exists between specific somatotypes and chances of success in a particular type of sport.