CHAPTER II

REVIEW OF RELATED LITERATURE
CHAPTER - II

REVIEW OF RELATED LITERATURE

Before any research is undertaken, the literature related to the problem area much be searched. The reasons for such a research are to determine if the study has already been completed or is in progress; to discover research allied to the problem; to provide ideas, explanations, or hypotheses valuable in understanding and formulating the problem; to locate comparable material useful in interpreting the results; and to understand the significance of the research. The investigator has made every attempt to acquire literature related to this problem. For this the efforts were made to have access to the major libraries pertaining to the literature on physical education and sports. The investigator could make access to the libraries of Panjab University, Chandigarh; NSNIS, Patiala; Government College of Physical Education, Patiala; and Lakshmibai National College of Physical Education, Gwalior. A brief review of the studies relevant to the problem has been presented in this chapter in chronological order under each measurement separately.

PART I : STUDIES ON MOTOR FITNESS

Kraus (1954) contented that sufficient scientific evidence has been provided to show that the general health
and physical ability of the people demand mainly on their physical fitness level. Esslinger (1960) has attracted the attention of scientists in physical education, psychology and medicine to develop better tests to measure physical fitness.

Maan (1954) conducted a study on Philippine entering freshmen students American and Japanese boys. The performance tested by AAHPER Youth Fitness test reported that Philippine boys were generally lower and their performance in the pull ups, soft ball throw for distance, sits up, showed considerable deficiency in arms and abdominal fitness. There is enough evidence indicating the influence and involvement of various physical and motor characteristics on the physical fitness and attitudes of students toward physical activity.

Hebbelink and Postma (1963) obtained the data from 52 male physical education majors, comprising all the students available. Selected anthropometric measurements (as weight is one of the variables and somatotype ratings of physical education majors) were studied and their relationship to the performance of certain motor fitness tests. Speed, Dynamic strength and Agility was measured in motor fitness. The determined motor fitness tests were 60 yards dash, standing broad jump, straight vertical jump, chinning, dipping and putting the shot put. The findings have shown
that there is insignificant correlation between anthropometric measurements and motor fitness tests except the significant correlation between shot put and weight (.44), shoulder width (.38) and neck girth (.69) respectively.

Clarke and Degutis (1964) conducted a study to determine the relationship between the standing broad jump as a test of leg power and the maturational, anthropometric, and strength characteristics of 12 year old boys. The subjects were tested within two months of their birthdays. This had the effect of largely partialling out chronological age in the correlations. Seven of the 16 correlations with the jump, all experimental variables being strength tests, were significant at the .05 level. But there was no zero order correlation between standing broad jump (power) with body weight. The highest multiple correlation obtained was .694.

As a consequence it may be concluded that leg power as evaluated in this study is dependent in part upon the body size and muscular strength; however, this trait is also distinctive in as much as the coefficient of multiple determination which is .482.

James (1966) selected the subjects for the experiment from the men studying physical education at Mississippi College of Dinton and administered to them the AAHPER Physical Fitness Test which related that: (1) The state of fitness of college male students can be kept at their
present fitness level by the normal physical education programme stressing physical activities present in current physical education classes. (2) A three week inactive period is not long enough to reduce physical fitness significantly.

Lootter Moser (1967) studied certain cardio-respiratory changes on two grade seven physical education classes of equal physical fitness. One class ran 880 yards daily in addition to the normal programme and both classes were tested before and after the 8 week programme. The control group did not increase their cardio-respiratory endurance. The experimental group improved significantly in the 600 yards run-walk (+4.4 sec), and the Kaoch pulse recovery test (6.9 points) but not in McCloy endurance run (0.8 points). The 600 yards run-walk proved the best in terms of administration reliability and sensitivity to change.

Bakker (1969) studied factors associated with success in volleyball. Subjects were 28 members of the women's extra-mural volleyball teams at Illinois State University. The experienced volleyball coaches established the criterion by rating each player on her playing. The following variables were measured: height, weight, leg strength (Extensor) using the multiple angle testing unit, grip strength using an adjustable dynamometer, skinfolds using the lange caliper, jumping ability the jump and
reach test, and on apparatus constructed by the investigator
to measure reaction and movement times. Through this
test and correlations it was found that jumping ability
and reaching time were significantly related to success
in volleyball. A multiple Correlation (R) of 0.718 was
obtained between the nine variables and the criterion. A
R of .53 was obtained between the criterion and reaction
time plus jumping ability plus weight. The regression
equation computed in this study could be used to predict
success in volleyball playing.

Ralph (1971) administered a semantic differential
attitude towards physical education scale and AAHPER Youth
Fitness Test to 100 Negro and 100 white, 5th and 6th grade
boys and the same number of 9th and 10 grade boys from the
same Texas School district in 1969-70. He utilized "t" test
for differences between means to test the difference
between Negro and white students on the measures of
physical fitness. Correlations for each ethnic group to
each level were obtained between physical education and
physical fitness and between physical fitness and academic
achievement. The significance of difference between
correlations was determined by the "Z" technique. He found
that negro boys scored significantly higher than white
boys in overall physical fitness at both levels. Correlations
between attitude towards physical education and physical
fitness were found to be positive and quite low for each of the four groups.

Malcalm (1972) through a historical study found that physical fitness occupies a prominent place in physical education. The study was based on the concepts of physical fitness of physical education between 1943 and 1948.

Basco (1973) reviewed the physical and physiological characteristics of champion male gymnasts and concluded that champion gymnasts possess less superficial fat, a higher centre of gravity, more strength, more flexibility, better balance, more agility, more explosive power, a faster reaction time, a lower heart rate and lower blood pressure.

Shondell (1975) established the relationship between selected motor performance and anthropometric traits of successful volleyball players. He used a six item battery for this purpose. He found out that power appeared to be the most significant factor in successful volleyball performance.

Louis (1976) selected 75 subjects to study the effects of the physical education programme "Fitness for Life" on cardio-vascular endurance of college men. The subjects were assigned to either experimental (N=41) or control (N=34) groups. It was concluded that participation in the "fitness
for life" programme contributed to the development of cardio-
vascular endurance of both men and women subjects.

Watson (1978) had studied the measures of physique
and physical performance which were conducted on 31 students
beginning a specialist course of physical education. The
subjects were compared with a reference group of final year
school boys of the same age.

Hand grip and back strength were measured and the
following tests were administered: Standing long jump,
agility run, sitting basketball throw, alternate hand ball
toss. The physical working capacity at a heart rate of 170
beats per minute (PWC 170) was determined from the steady
state heart rate at three submaximal work loads on a
bicycle ergometer. Height and weight were measured and
somatotype determined photocopically. The students scored
more highly on all tests with the single exception of hand
grip strength. There was no difference in height but the
students were heavier and had higher ratings for mesomorphy
and lower rating for ectomorphy. The differences in
strength and PWC170 remained after allowance for the difference
in body weight, but the differences in strength can be
accounted for in terms of differences in body size and
shape. Physique appears to influence performance in 5 out
of 7 tests conducted.

In the table for relationship of physical performance
variables to height and weight and strength index, it is found
that standing long jump has no correlation with weight neither at .05 level nor at .01 level of confidence. But shuttle run has negative significant relationship with weight at .05 level of confidence.

Kiesel (1978) determined the relationship between physical fitness knowledge and the physical fitness level of the young, adult males and senior high boys, aged between 17 and 30 years. A low and significant positive linear relationship was found between the knowledge of the facts pertaining to physical fitness and a person's physical fitness level. The curvilinears were calculated between physical fitness knowledge and physical fitness level and were found to be insignificant.

Similar trend in findings is indicated in correlational studies. Clawer (1979) reported that for low fitness subjects there is a moderate positive correlation for movement concept and self esteem. Movement concept is related to several TSCS subscores for the low fitness subjects, but high fitness subjects exhibited a correlation only with the physical self esteem. There is apparently some threshold level of physical fitness above which there is a positive "r" for movement concept and physical fitness.

Saha (1980) conducted a study on selected anthropometric measurements and physical fitness variables of tribal and non-tribal students of Tripura. AAHPER fitness test was used.
The study did not show any significant difference between physical fitness of tribal and non-tribal school students.

Uppal, et al. (1980) have concluded that the regular participation in a programme of physical education, comprising callisthenics, endurance training, circuit training, strength developing exercises and regular practical instruction in games and sports effectively improved strength in legs and grip in case of women students.

In a similar study, Mehta (1981) compared physical fitness of tribal and non-tribal school girls of Indore Division. She also used six physical fitness tests of AAHPER Physical Fitness Test. The result showed that tribal girls were better in arms strength, abdominal strength and agility. Non-tribal girls were better in explosive strength and endurance.

Uppal, et al. (1982) had conducted a study on junior women badminton players, who were under intensive training for a period of four weeks. The programme of physical fitness and skill training helped in improving performance, cardio-respiratory endurance and the strength in abdomen, legs, arms and shoulders.

Bandyopadhyay (1982) found out the relationship of selected anthropometric measurements, physical fitness and motor ability to soccer skill performance. All subjects
were tested in selected anthropometric measurements, which were chest girth, upper arm girth, thigh girth, calf girth, height and weight. They were also tested in AAHPER Youth Fitness Test for assessing motor ability and McDonald Soccer Skill Test for measuring soccer skill performance. The findings indicated that the McDonald skill performance had a high correlation with physical fitness and motor ability. The obtained value was .86 and .89 respectively. Those values of correlation were statistically found significantly at .05 level of confidence. As one of the findings was that there was a high correlation in physical fitness level as obtained from AAHPER Youth Fitness Test with Soccer Skill Performance.

Barbanti (1983) conducted a study on 2,342 boys and girls enrolled in a public school system in Brazil during 1982 school year. A trained team collected two anthropometric measurements; administered the health related physical fitness test battery and two tests of athletic ability. It was revealed that: (1) for selected Brazilian School populations aged 6 to 14 years, height and weight of both sexes increased at approximately same rate; (2) Brazilian girls had higher values than boys for triceps subscapular skinfold measurements and in sit and reach test. (3) Brazilian boys performed better than Brazilian girls in modified sit-up test, nine-minute run test, 50 mts. dash test, standing
long jump test. The comparison between Brazilian and American boys and girls showed that American boys and girls, in general, were taller and heavier and had higher scores in sit-and-reach test, modified sit-up test, 50 mts. dash test, and standing long jump.

Teagandin (1983) administered Texas Physical fitness motor ability test and Bell's Attitude inventory to 665 female students enrolled in regular physical education classes. Analysis of variance and Fisher's 't' test was utilized for analysis. The analysis of the data revealed that no significant differences were identified when compared self concept among students in relation to their physical fitness motor ability and composite score in fifth, seventh, and tenth grade girls.

Chakravarty (1983) investigated the relationship between leg strength, grip strength, agility, flexibility and balance to performance in gymnastics. Agility is one of the variables measured by shuttle run 4 x 10 yards in seconds. It is found that agility of an individual was not confirmed as a factor in developing the performance in gymnastics.

A study was undertaken by Joseph (1983) to determine the relationship of power, agility, shoulder flexibility, arm length and leg length of volleyball players of Lakshmibai National College of Physical Education, Gwalior who were selected as subjects. Product Moment Correlation was used to compute correlation between playing ability and each of
the selected independent variables. The findings indicate that power of the subject is very reliable for predicting playing ability of male volleyball players as the correlational value ($r$) between power and playing ability obtained was $.65$. The correlation values between agility, shoulder flexibility and playing ability obtained were $-.08$ for agility and $.24$ for shoulder flexibility. These two values were found insignificant at $.05$ level of confidence. The findings are: (1) Power is most reliable variable in prediction of playing ability of volleyball players. (2) The agility and shoulder flexibility shows insignificant relationship in prediction of playing ability of male volleyball players.

Pinheiro (1983) determined the relationship of strength, flexibility, agility, reaction time and speed of movement to the acceleration phase in sprinting. Thirty male students, who had been training themselves for sprints during the optional hour and were studying at Lakshmibai National College of Physical Education, Gwalior, were selected as subjects. The reliability of data collected was established by test-retest method in case of shuttle run, acceleration run and standing broad jump and in the case of other variables. The final score was average of the five readings of the subjects. As one of the findings, it is concluded that the foot reaction time, speed of movement, agility and flexibility were not significantly related to performance in the acceleration phase.
Alam (1983) studied the relationship of reaction time, agility and flexibility to performance in running broad jump of 51 male students from first year degree class of Bachelor of Physical Education of Lakshmibai National College of Physical Education, Gwalior. Product moment correlation method was used to compute correlation and significance of the study was found by employing product moment correlation between running broad jump and reaction time, agility and flexibility. The findings of the study revealed that there was significant correlation between dependent variable and independent variables. There was a significant correlation between running broad jump and reaction time and also there was significant correlation between running broad jump and agility and running broad jump and flexibility. The obtained value of correlation was found statistically significant at .05 level of confidence.

Sinha (1984) found out the relationship of selected motor traits and anthropometric variables to performance in AAHPER Basketball Skill Test. To establish relationship between selected motor traits and anthropometric variables to performance the AAHPER basketball skill test, the coefficient of correlation (r) was used. On the basis of the findings of the study the following conclusions were drawn.
1) Explosive power, agility and cardiovascular endurance are the key motor traits that underline performance of skills in Basketball.

2) Height as well as relative leg length measurements (crural index) are the main anthropometric characteristics which contribute to skill in basketball.

3) The motor traits of speed, grip strength and flexibility are not the prime factors for performance of skills in basketball.

4) Excess body weight has restricting effect on Basketball performance.

Kela (1984) studied the relationship between speed of movement, agility, shoulder and spine flexibility to performance in gymnastics. Twenty-five inter-varsity women gymnasts from various universities who came to participate in inter-varsity gymnastics competition held at Amritsar (1984) were selected as subjects for this study. The average age of the subjects was 22 years. Rank correlation method was used to compute correlations between speed of movement, agility, spine and shoulder flexibility, to performance in gymnastics. The findings of the study showed that there were no significant correlations between speed of movements, spine and shoulder flexibility to performance in gymnastics, whereas agility had a high significant relationship with
performance in gymnastics. The level of significance was set at .05 level of significance.

Promoda Devi (1985) studied the relationship of selected physical variables such as strength, agility, speed, flexibility, anthropometric measurements viz. weight, height, arm length, leg length, fore leg length, thigh length, ponderal index, crural index to performance in shot put. Product moment correlation method was used to compute correlation. The findings of the study revealed that there was significant correlation between speed and shot put performance \((r = 0.428)\).

**PART II : STUDIES ON PSYCHOLOGICAL VARIABLES**

Alden (1932) in his study of student attitudes at the University of Oregon found that 71 per cent of whatever dislike there was for physical education activities in the universities was due to late afternoon classes, about 10 per cent due to lack of ability and 10 per cent to the sense of compulsion. The author recommended that unfavourable attitudes be eradicated "by improved methods and organisation."

Studies concerning the students attitudes and interest regarding the nature of activities have also been reported. Moore (1941) found that college women have a highly favourable attitude towards physical activity as a means
of recreation. However, the average amount of time spent in physical activity was low due to lack of time owing to study, lack of companions, and outside work. In a similar study Thomas (1934) administered a questionnaire to 800 high school girls. Correlations and inter relations were computed statistically and it was found that attitudes and interests of high school girls had certain relation to their physical activities. The investigator finds that, if the girls themselves feel the need of practice on certain skills they thoroughly enjoy working on them. It is interesting to note that the most popular activities have great carry-over value for leisure time, much social approval consisting of big muscle activity and are in most cases fairly inexpensive. Most of the girls like to appear vigorous and snoopy and prefer to be trained to get and keep themselves fit in physical condition.

Sperling, Abraham (1942), Booth (1958) and Keogh, Jack (1959) have stated that research into personality traits of athletes, groups (such as physical education classes and individuals with varying degrees of motor ability) have helped to bridge the gap from physique studies to the studies of total physical fitness and its relation to personality.

Carr (1945) using an attitude scale, based on the Thurstone method, conducted her study and found that attitudes of entering high school freshmen girls influenced
their success in physical education and suggested that "if undesirable attitudes are obstacles to learning they should be removed." Vincent (1967) also used college women, in an attempt to predict success in physical education from attitude, strength and efficiency measurements. She found that attitude and strength correlated significantly and attitude alone was an adequate prediction of success in physical education.

Nelson (1948) also found differences in attitudes between high school boys taking ROTC and those taking physical education. Those who took physical education had a more favourable attitude towards competition, games and athletics.

Weber (1953) had conducted the study on 246 male freshmen who were required to take physical education at the State University of Iowa. To measure physical fitness, physical efficiency profile was used and for personality measurement Minnesota Multiphasic Inventory was used. The findings were that there was no significant relationship between physical fitness scores and total Multiphasic Personality Inventory scores. The coefficient of correlation was a negative .04.

In an attempt to help evaluate the physical education programme, Margaret (1953) studied the attitudes of 173 seniors and 684 freshmen college women at the
University of Michigan and concluded that outside physical education classes, freshmen college women spent a greater percentage of their time on physical activities than do their seniors. Freshmen who have had physical education in high school have a higher mean attitude towards physical education as an activity course than the freshman who have had no physical education in high school and higher than their seniors who have had physical education in high school.

Studies of physical fitness have not kept pace with the theoretical idea that high physical fitness has positive healthy personality. Betz (1956) and Wells (1958) have found correlation between various personality variables and physical fitness measurements.

Booth (Jr) (1958) has determined in his study that differences in personality traits as measured by MMPI do exist between athletes and non-athletes and between participants in individual and in team sports.

In his study, Burton (1960) has administered California Psychological Inventory (CPI) and the Philips JCR tests to 808 high school boys for the purpose of comparison. The subjects were classified.

Upper and lower motor-ability groups; athletes and non-athletes matched according to their motor ability scores; and participants in team sports, participants in
individual sports and participants in team individual sports all were classified thus.

The upper motor-ability group scored significantly higher than the lower motor ability group on the measures of poise, ascendancy, self assurance and on the measures of intellectual and interest modes. Few significant differences were found between CPI scores when athletes and non-athletes were matched according to motor ability. Few significant ones were found between mean CPI scores for participants in team sports, participants in individual sports and participants in team individual sports. The results of this study indicate that motor ability is related to personality traits.

Van H. (1960) claimed that physical education text books and related writings in the field of physical education stressed the value and effect of physical activities on a person's personality.

Svenson (1961) gives strong support to a view which recognises the existence of two clearly defined and highly important dimensions which have been called extraversion/introversion and neuroticism respectively. As already stated, physical education students tend to be significantly more extraverted than other students.
Brumbach and Cross (1965) also reported that students who entered the University of Oregon had a favourable attitude towards physical activity. Participation in a high school athletic programme appeared to have salutary effect upon one's attitude towards physical education. The more years of physical education high school students had the better attitude toward physical education they were likely to have.

In his study, Tillman (1965) administered physical fitness test to 386 high school Jr. and Sr. boys in first phase of the study. The boys who furnished in the upper 15% to the test were compared by use of a battery of three personality tests, with the boys who were in lower 15%. Significant personality differences were found in second phase of the study. The low physical fitness group was divided into a control and an experimental group. A nine month physical fitness programme was devised for experimental group. The experimental group's personality traits changes were found to be significantly different on only one test item.

Similar studies regarding the attitudes of college freshmen have also been carried out. In one such study Mayer (1966) administered Modified Wear Attitude Inventory to 422 freshmen and 364 junior girls enrolled in 117 different courses of physical education from
Northern Illinois University to evaluate the physical education offerings in terms of student needs. The findings indicated a performance for individual sports, a highly favourable attitude towards a physical education activity on the part of both freshmen and junior, a need for re-evaluation of methodology and interpretation of objective and teaching in the required physical education programme.

The majority of the research has dealt with male athletes in such sports as track and field, boxing, weight lifting, swimming and team sports. Kane (1968) summarised some of the recent research by stating that the athletic ability goes along with such traits as aggression, dominance, drive, tough-mindedness, confidence, lack of anxiety, and emotional stability.

Joseph (1969) also concluded that physical education attitudes of college freshmen from East Texas and North were only slightly favourable. The attitudes of those from East Texas were less favourable than of those from North Louisiana.

Employing 't' tests, correlation coefficient and multiple correlation on fifty matched pairs of Negro and Caucasian subjects selected at Random from different California Junior Colleges, Jersy (1969) found that the Negro
superiority indicated cannot be explained in terms of aspects of socio-economic status and attitude towards physical education activities and individual's attitude toward physical education activities does not lend to the prediction of his motor performance.

Carty (1969) reported that amount and type of previous experience in physical education has a positive relationship to a favourable attitude. Students enrolled in a programme offering a variety of activities express a favourable attitude towards physical education. Johnson (1972) also concluded that the male students had favourable attitudes towards physical education throughout the fall semester, 1970-71.

Kane (1970) found in a study that both men and women students of three years degree course in physical education, who were involved in physical education and games differed in personality structure from the general population of students who were non-athletes.

Lashley (1972) used AAHPER Youth Fitness Test, the California Psychological Inventory and the American Home Scale to 500 Junior High School boys who were enrolled in required physical education classes in North East Texas. It was found that there are some significant relationships between the personality characteristics and levels of
Gravin (1972) conducted a study to determine a relationship existing between physical fitness (as measured by Fleishman's Basic Fitness Test) and personality as measured by Cattel Sixteen Personality Factor Questionnaire. One hundred eighty-nine male volunteers from Mississippi C. Coast Junior College, Gautier Mississippi, were tested. On the basis of fitness index scores, the subjects were divided into high, average and low fitness groups. The investigation revealed that within the confines of this study there is a strong relationship between personality and physical fitness. The canonical correlation analysis indicated that relationship did not lie between independent personality factors and independent physical fitness factors. However, the relationship did lie between physical fitness and personality when considered a composite. The multivariate analysis indicated that there was a significant difference in personality between high, average and low physical fitness group.

Similarly Reeves (1972) conducted a study on all the Freshman students at San Diego Mesa Community College enrolled in physical education activity classes who were given the Wear Attitude Inventory in the fall semester of 1970. A 't' test, correlation, analysis of covariance and
£' values were computed. It was found that there was a positive change in the stated attitudes of all freshman students towards physical education that was significant at .01 level. All types of activities showed trends towards positive changes in attitude. However, no significant difference was found among them.

In a similar study Youngen (1972) on a sample of 196 college freshmen and women attending the University of Oregon tested on the Kenyon Attitude Inventory Form D and Marlowe-Crowne social desirability scale. The results indicated that there were no statistically significant differences between high and low need for approved women in their attitude toward physical activity perceived. Ego and non-ego involving assessment conditions had no effect on attitude toward physical activity as expressed by low need for approval women. The two highest rankings were given to physical activity perceived as the pursuit of vertigo and as an aesthetic experience. The two lowest rankings were given to physical activity perceived as a social experience and as an ascetic experience, respectively.

Dotson and Stanley (1972) took 699 lower division male students enrolled in 8 physical activity courses at Stephen Austin State University by administering Kenyon's attitude toward physical activity inventory. Linear
compound, Pearson's Product Moment Formula and ANOVA's two factor factorial design were used to analyse the responses. It is concluded that achievement in athletics was most highly related to the perceived value of the physical activity for ascetic experience and no significant relationships existed between attitudes towards physical activity and achievement in non-athletic curricular activities.

Paul (1973) also took 119 subjects aged 17 to 31 years dividing them into three groups to compare them on the Wear Physical Education Attitude Inventory and the Histon Personal Adjustment Inventory. One way analyses of variance was computed to compare the groups and to determine if significant differences existed. 't' ratios were used to determine if significant changes had occurred on the criterion measures. Results indicated that normal control group was still significantly higher than the adopted control group on the variable of attitude towards physical education even though the adopted group did not make a significant improvement on the attitude toward physical education variable. There were no significant differences between the adopted sub-groups or any of the criterion measures at the end of the programme.

In one such study Delforge (1973) perceived significant differences in attitude towards physical activity...
in general or toward each of six dimensions of physical activity among the four main study groups. All groups compared expressed significantly more positive attitude toward physical activity as a social experience; as a means to health and fitness; as an aesthetic experience and as a catharsis than they did towards physical activity as the pursuit of vertigo and as an ascetic experience. Attitude expressed by male students and by male and female handicapped students towards physical activity as an ascetic experience were significantly less positive than for all other dimensions.

Linda (1974) found that attitude change does occur after exposure to a physical education activity of ten weeks duration. There is some relationship between the behavioural and effective components of attitude. The type of attitude change that did occur seemed to be a direct result of the type of programme in which the subject participated. It was also found that a foundation to approach to physical education is not more effective than a recreational curriculum in changing attitude towards physical activity.

Modh (1975) and Giri (1976) went into the psychological behaviour of athletes and non-athletes on various sports specialities. Later, Sharma (1978), Bhushan and Aggarwal (1978), Mohan et al. (1979), Sharma, et al. (1981 & 1982),
Kamlesh (1982-84), Bhullar (1984) and Sharma et al. (1986) elaborated their studies on similar lines. The findings of these investigators reveal that dissimilarity is observed between team and individual sports, athletes and the mean value in various personality traits and there is significant difference among athletes and non-athletes on the most of the personality traits. It may be added that participation in sports influences the development of various personality traits, attitude and behaviour of an individual.

McGlann and Lawrence (1976) has initiated a study to know the effectiveness of physical activity programme in the improvement of an individual's mental health. It has been proven to have varying results. While the researchers in this area generally conclude that the development of programme tailored to an individual's needs and personality is the best, little research exists that can serve as a foundation for designing such programmes. The problem of this study was whether there is a statistically significant difference in self-image after participation on the part of adolescent males in any one of five, ten week activity programmes.

Adolescent males aging from 12 to 17 (N=50), were equally divided into five activity programs based on their age, activity preference and scores on three personality and physical fitness measures. These measures included AAHPER Youth Fitness test to establish level and Eysenck Personality Inventory to establish
extraversion level. The findings of the study were that there is no significant correlation between physical fitness and extraversion.

Bhullar (1976) assessed the attitude of university students towards physical activity in relation to academic performance, intelligence, socio-economic status and personality characteristics. She concluded that individuals who score high on personality factors were inclined favourably towards physical activity in general. It was also revealed that subjects with favourable attitude towards physical activity, that is top 27% and bottom 27% cases differed significantly at .05 level on personality factors and socio-economic status. Subjects having favourable attitudes were academically superior.

The relationship of degree of involvement in activities on attitudes was carried out by Smoll (1976) using CATPA Inventory and AAHPER Youth Fitness Test on 127 boys and 137 girls attending grades 4, 5 and 6 in an elementary school in Bellevue, Washington. Canonical correlation analysis was used to examine the nature and degree of the relationship among the children's attitudes, involvement and proficiency in physical activities. He found a strong relationship between the attitude domain and a combination of the involvement and performance domains. Further analysis indicated that the
basis of the association was the strength of the relationship between the attitude and the involvement domains, and that the performance domains were virtually unrelated.

Young and Ismail (1976) investigated personality differences among high-fit, young (N=7); high-fit, old (N=7); low-fit, young (N=7); and low-fit old (N=7). Groups before and after a physical fitness program consisting of jogging, calisthenics and recreational activities. Personality characteristics were assessed using the Cattel 16 PF Questionnaire, the Eysenck Personality inventory and the Anxiety Scale of the multiple effect adjective check list. ANOVA revealed that regardless of age, the high fit group was more intellectually inclined, emotionally stable, composed, self confident, easy going, relaxed, less ambitious and unconventional than the low-fit group. The high-fit young group was more dominant and aggressive than the high fit old group while the low fit young group was higher in superego strength than the old unfit group - especially at the end of the program. In general, the young group was more extraverted than the old group. As a whole, the subjects become more socially precise at the post-test than at the pretest.

In a similar study Melcher (1976) concluded that there was no significant relationship between the motor ability of the daughters who were in the upper 31% or lower 32% of the group tested and their mothers' attitude on each of the six
dimensions of physical activity. The one significant contribution to the daughter's motor ability scores when the father viewed physical activity as an ascetic experience was that the attitudinal dimensions of the daughter were significantly related to their own motor ability scores. These were when physical activity was viewed as the pursuit of vertigo and when it was viewed as a social experience.

Young and Ismail (1976) conducted the study on middle aged men, who had participated in four month fitness programme and indicated that distinct personality difference existed between high and low fit individuals.

Young and Ismail (1977) have conducted a study to compare effect of regular and non-regular adult exercisers on selected physiological and personality measures over a four-year period. Forty eight participants in the 1971 Purdue Adult Fitness Program were retested four years later. As a result three groups of 16 subjects each were established, based on responses to an exercise and leisure questionnaire. Relevant physiological data was collected and physical fitness scores were obtained for each subject using the criterion of Ismail and others. Personality traits were assessed using the same form of the Cattel 16 Personality Factor Questionnaire as both pre and post tests. The data was analysed at both test periods using the ANOVA technique. The effect of different activity level was assessed by several fitness
parameters such as per cent lean body weight, resting and submaximal heart rates, submaximal RQ, VO_{2} max and physical fitness scores. The two regularly active groups increased significantly in physical fitness over the four-year period. At both test periods, the regularly active group was significantly more confident (Factor 0) than the other two groups indicating that the relationship between physical fitness and self-confidence is stable.

Bushan and Agarwal (1978) has administered Cattel's 16 PF Questionnaire to 10 high achieving Indian Table Tennis and Badminton players who had represented India at International events, and to 10 low achieving players who had never achieved any distinction in their respective games. The high achievers scored significantly higher than their low achieving counterparts on dominance and surgency amongst the primary factors. On the second order factors outstanding sportspersons were significantly more extraverted than the low achievers. Contrary to expectations there was no significant difference in intelligence, ego-strength, self-sufficiency, tenseness and anxiety between high and low achievers. High dominance is perhaps one of the chief props of the international sportspersons who must persist and master skills and techniques. Being more extroverted than low achievers the outstanding sportspersons have higher threshold for arousal.
so that they are able to endure hard physical training programmes. They are also able to handle higher levels of arousal caused by intense competition and usually higher vociferous spectator reactions before their performance deteriorates.

The outstanding sportswomen compared to sportsmen scored significantly higher on the primary factors of dominance, suspiciousness, tenseness and lower on outgoingness, emotional stability and tendermindedness. On the second order factors the sportswomen were significantly more anxious, alert poised and independent. Perhaps, the outstanding women players have to break-through stronger barriers of custom and tradition to compete in a man's world.

In a study, Gruber and Perkins (1978) has taken fifty eight women physical education majors and forty five non-major women undergraduate students, further subdivided into levels of athletic participation — varsity, intramural and non-participant. The Cattel 16 Personality Factor questionnaire was administered to all subjects in a controlled environment in order to determine if any significant differences existed in personality trait scores among women of various levels of athletic competition as well as type of academic major in College. Results indicate that women physical education majors are happy,
go lucky and trusting than non-majors. In addition, women who competed in inter-collegiate competition were more sober, serious, tough-minded and had more favourable alert poise scores when compared to the intramural and non-participant groups. The Cattel 16 Personality Factor was not an effective instrument when an attempt was made to classify these women into their known major and level of participation category.

A different type of investigation concerning the students taking physical education as a required course and students taking physical education as an elective course was conducted by Hammonds (1931) on 375 subjects from seven universities administering the Kneer Attitude Inventory. The 't' test was used to determine if there was any significant difference between the two groups. The test revealed that both groups of students had favourable attitude towards physical education and that there was not a significant difference between the mean scores of the students taking physical education as a required course and students taking physical education as an elective course.
Attitude plays an important role in learning and teaching. Moreover, the acquisition of attitudes in itself constitutes learning process which is similar to the attainment of motor skills and academic knowledge. Langford (1982) studied 19 female and 22 male physical education majors along with 15 male and 15 female non-majors enrolled at the University of Albany as undergraduates. Attitude towards physical activities was measured by physical estimation and attitude scale and physical fitness through physical fitness test items. It is concluded that female and male physical education majors are more attracted to physical activity compared to female non-majors. Female and male physical education majors have a higher and generalized appreciation for physical activity and the benefits accorded after sport participation compared to non-majors. Female and male physical education majors are more attracted to activities requiring an ability in running endurance and speed compared to female non-majors. It was further reported that male physical education majors possess higher level of flexibility compared to male non-majors. Physical education majors possess higher level of strength compared to non-majors.

Like parents, attitude toward physical activity (research investigations dealing with the physical fitness have shown) of children have also been carried out. In
one of the recent studies Aycock (1982) included 112 children and their parents at Ridgecraft School in Carolina who were given the Glover physical fitness test items and each parent was asked to complete the Kenyon's attitude inventory. Statistical analysis of Pearson's Product Moment Correlations was carried out and its major findings were: A significant positive relationship was reported between the attitude scores of the mother and father on all six dimensions of physical activity except when mothers of girls and mothers of boys viewed physical activity as an ascetic experience and as the pursuit of vertigo.

In a similar study Onifade (1983) utilized Kenyon's attitude inventory and a physical activity Belief Scale and Background information questionnaire on 350 subjects from nine universities in Washington. Multiple regression, Pearson's Product Moment Correlation and 't' tests employed revealed that Nigerian male students could be expected to seek physical activity that would be of a social experience, while the female students would probably seek experience related to health and fitness. The male Nigerian students seem to be affected positively by physical education experience but the female do not react with a change towards physical activity. Moreover, females and males participated in physical activities for different reasons.
Soltani (1984) conducted a study to determine the attitudes of college and university students towards required physical education activity class programmes and to compare the attitudes of freshman and senior black/white students towards their required physical education activity classes. Wear Attitude Inventory short form A and a Background Questionnaire were given to the students in San Diego, California. The results showed a significant favourable attitude existing among students towards physical activity classes. Moreover, senior students' attitudes were significantly more favourable than freshman's attitudes and social science students' attitudes were significantly more favourable than science students' attitudes.

The purpose of Daino's (1985) investigation was to determine if there were significant differences in personality traits between a group of adolescent tennis players and group of not practising sports adolescent. This study was carried out on a sample of 132 subjects, boys and girls that were classified as tennis players 36 male and 30 female, no sports 36 male and 30 females from otherwise similar characteristics. Eysenck Personality Questionnaire (EPQ), Middlesex Hospital Questionnaire and Will to Win Questionnaire was administered. The obtained results indicate that the comparison groups differ from each other
on a number of personality traits. In general, tennis players scored significantly higher in extraversion and will to win, and exhibit a less "neuroticism" (emotionally unstable), anxiety apprehension, obsession and depression.

Grewal (1986) has conducted a study on 549 students of affiliated colleges of Panjab University, Chandigarh. He included university students also. Grewal has concluded that inter-relationship of Physical Fitness Test (AAHPER) and Attitude Towards Physical Activity and Adjustment revealed that the coefficient of correlation showed a significant relationship between attitude towards physical activity and adjustment for entire population, high and middle socio-economic level group. But the relationship between other variables were found to be insignificant at .05 level i.e., physical fitness and attitude towards physical activity (r = 0.07379 against the required value r (.05) 242 = .127. Inter-relationship of physical fitness and attitude towards physical activity was even insignificant for low socio-economic level group.

Kamlesh, et al. (1986) conducted a study on 38 males (28 general category and 10 reserved category) and 38 females of (28,"general category" and 10,"reserved category") physical education, Patiala. EPI (form A) was used to measure the two major dimensions of personality, extraversion
and neuroticism. It was concluded that male and female physical education majors, within their category groups differ significantly on extraversion and neuroticism, the two major dimensions of personality. Female subjects, by nature are "Inward going". It added that arbitrary distribution of subjects into 'general' and 'reserved' categories may be beneficial as a social phenomena, but psychologically it is not, for except on extraversion in case of general and reserved category, female sub samples, no significant differences are visible anywhere. 

Kumar, Shukla and Thakur (1986) have studied to explore differentiated personality. Correlates of extraversion, neuroticism and psychoticism in athletes and non-athletes (N=50). Non-athletes and equal number of state level athletes were subjects of the study. Hindi adaptation of Eysenck Personality Questionnaire (EPQ) was administered to the subjects individually. It was found that athletes had scored significantly higher on "extraversion" scores than non-athletes, whereas non-athletes had scored significantly higher on "neuroticism" and "psychoticism" scores than athletes. 

Mohan and Kaur (1986) conducted the study to standardize the "E.P.Q." on Indian students. A random sample of (N=600) undergoing professional courses was drawn equally from 12 faculties as a subject for the study.
The students were administered E.P.Q. (1978), E.P.I. (1964), P.E.N. Inventory (1970), Backward Alphabet Writing, Vigilance task of Mohan & Malhotra (1974) and Hand Dynamometer (Manufactured by C.H. Stealing & Co.). The response of the subjects was scored according to the manual. The reliability was established by using interval consistency (with odd-even method) and test-retest method. High reliability in all except psychoticism was found. The interval consistency .97 with Extraversion, .85 with Neuroticism, .44 with Psychoticism and .74 with lie while test retest reliability was .91 with Extraversion, .97 with Neuroticism, .87 with Psychoticism and .91 with lie. The construct validity was established using EPI and P2N inventory. The Criterion Validity with Vigilance, Reminiscence and Persistence does not permit any conclusion. Thus, on the basis of results, it was concluded that EPQ is reliable and worthy of use as a reserve tool as well as an applied instrument for measuring four major dimensions (Extraversion, Neuroticism, Psychoticism and lie (Social desirability) of Personality.

Mohan, Joginder and Seth (1989) conducted a study to explore the extent of sports special ability of the athletes. The subjects of the study were (N=50) Karate players. The subjects were administered EPQ (Eysenck & Eysenck, 1978), Achievement Motivation Scale (Lynn,1966), RTQ, (Risk taking questionnaire (Sinha V., and Arora, P.N.,1983)
and Revised Adjustment inventory - RAI (Kumar P., 1983).
The results of the present study yielded that the mean score of variables of sports special ability (Internal and external) factors, Achievement Motivation, Risk taking behaviour, adjustment and personality (Extroversion, Neuroticism, Psychoticism, lie scale) were 32.9, 15.1, 6.26, 89.42, 74.02, 14.4, 6.8, 5.24 and 9.43 respectively. The finding indicates that 40%, 46% of Karate players had very good, good and average adjustment respectively. 76% and 24% of Karate players were having moderate and no risk tendencies respectively. Further analysis of data has revealed relationship between sports special ability and achievement motivation, risk taking behaviour and psychoticism variables.

Sahni, et al. (1988) has explored a study to distinguish the sportsmen from non-sportsmen on the dimensions of personality, achievement motivation and sports abilities. The study was conducted on the 60 university students comprising 30 sportsmen and 30 non-sportsmen. The age of the subjects was ranging between 18-25 years. It is revealed from the results that sportsmen are higher on extraversion as compared to non-sportsmen. These studies are in accordance with the studies conducted by Kaur, Sperling, Golas, Morgan and Constill etc.
Holmgren and others (1960) in their study concluded that intermittent long term training (Gymnastic exercises or running once or twice a week for several weeks) and continuous short term training (daily skiing for eight to ten days) significantly decreased pulse rate of the subjects.

Michael and Gallon (1960) selected 17 basketball players and tested them periodically during and after the 1957-58 season. The changes in physical conditioning were estimated by using a step test. During this period effect of basketball conditioning was studied on blood pressure of the subjects. The resting and post-exercise systolic blood pressure measurement decreased significantly during training while the diastolic blood pressure measurements taken immediately after exercises showed a decrease. This change was significant and remained significant throughout the training. The pulse pressure measurements decreased only slightly during the training.

Wallin (1960) studied the effect of ten week jogging programme on selected physiological variables, blood pressure was one of these variables. An analysis of data revealed no significant difference between initiated blood pressure and final blood pressure tests.
Shvartz (1962) conducted a study on cardio-vascular adaptations in selected postures, two groups of ten subjects each, ranging in age from 10 to 38, were selected on the basis of crampton index. Subjects who scored 45 and above were considered as fit and those with scores of 35 and less as unfit. Blood pressure was measured in the lying and inverted position. The blood pressure in both groups in changing from lying to inverted position was similar to that in changing from the lying to standing position.

Comparative study of physically fit and unfit secondary school boys was conducted by Staudacher (1963). Twenty four subjects were selected at random and divided into two groups on the basis of their physical fitness ability. They were asked to run to exhaustion on a treadmill. Blood pressure was measured before, during and after the run. No significant change was found in the blood pressure.

Holmgren and others (1963) in their study had concluded that intermittent long term training (Gymnastic exercise or running once or twice a week for several weeks) resulted in significant increase in haemoglobin. Analysis of data also revealed significant increase in haemoglobin as a result of continuous short term training involving asking every day for eight to ten days.
Cureton and Phillips (1964) studied physical fitness of men as a result of two 8 weeks training programmes separated by eight weeks of non-training. Six volunteers of experimental group pedaled the bicycle ergometer thirty minutes per day, four days per week for six weeks at a work load that kept the heart rate at one hundred and thirty-five beats per minute. There was no significant change in haemoglobin from pre to post training on the experimental groups.

According to deVries (1967) physical conditioning can increase total haemoglobin as a result of the increased blood volume, but there will be no increase in haemoglobin concentration per unit of volume.

Stamp (1968) studied the effects of an interval running programme on selected physiological variables in which pulse rate was one of the variable. The experimental group participated in an interval programme over a 6 week period. The work load consisted of running bouts on a graded treadmill with a specific interval rest period. Statistical analysis of data indicated significant lowering of pulse rate.

Jones (1969) also studied the effect of endurance training on Haemoglobin. He selected 13 subjects for the study. The experimental group (N=9) underwent a four and
a half week endurance running training while the control group (N=5) continued their normal activities. Blood samples were taken at rest before, during, and after the training programme. Analysis of data showed no significant increase in the Haemoglobin concentration.

McKinney (1969) conducted a study to determine the effects of physical training on haemoglobin concentration. Group A consisted of male high school students while group B was comprised of male college students. Blood samples were obtained from all subjects at regular intervals throughout a programme of physical training which consisted of interscholastic basketball competition for group A and wrestling and conditioning activities for group B. Analysis of data using difference method 't' test and analysis of variance indicated that group A had significantly increased haemoglobin concentration during the training programme.

Burnett (1969) studied the effect of physical training on resting Blood pressure and concluded that physical training favourably influences resting blood pressure in the case of patients with essential hypertension.

Karpovich and Sinning (1971) were of the opinion that both systolic and diastolic pressure change during exercise. The diastolic pressure changes little and systolic pressure...
changes considerably, the pulse pressure tends to increase and decrease with the systolic pressure.

Carlston & Grimly (1966), deVries (1967), Berne and Levy (1972) and 3holon and Weiner (1982) have observed that at rest the blood pressure of endurance sportsmen is lower than that of non-sportsmen. It increased under the stimulus of emotion before and during competition. During the competition, the change in systolic pressure is much higher than that of diastolic pressure.

Gentry (1973) selected 15 male college students, ranging from 18 to 22 years to study the effects of jogging programme on selected cardio-vascular functions. Blood pressure (systolic and diastolic) was selected as one of the cardio-vascular function. The training programme consisted of jogging or walking a specified distance (one to two miles) five times per week for nine weeks. Once training commenced each subject progressed at his own rate depending upon his level of fitness and rate of adaptation. Analysis of data revealed significant decrease in resting diastolic blood pressure.

James (1974) conducted study on the effects of isotonic and isometric exercises on heart rate and blood pressure and their relationship to physical work capacity in college men. Thirty two male university students were
used as subjects for the main study, whose data included \(O_2\) consumption, heart rate, blood pressure, and physical work capacity. Blood pressure was determined by an electrophysigmanometer and recorded by a physiograph, at rest and every fifteen seconds during two minutes of recovery. Systolic blood pressure rose significantly as a result of both exercises and returned to normal rapidly. However, it was significantly higher as a result of the isotonic exercises. Diastolic blood pressure decreased significantly as a result of the two exercises and returned to normal rapidly. Both isotonic and isometric exercises resulted in significant changes in systolic and diastolic blood pressures.

Effect of various intensities of running upon resting pulse rate was studied by Sparks (1974). Physical Education college male students were chosen as subjects and were given zero, three, six or ten minutes running training programmes in addition to their regular participation in physical education class activities. Training programme was carried out 2 to 3 times per week. At the end of the seven week training period it was found that resting pulse rate reduced significantly using zero, 3, 6, or 10 minute running programme. Ten, six, and three minutes running significantly reduced resting pulse rate as compared to zero minute running. There were no differences
among ten, six and three minute running programmes.

Alteri (1975) selected 33 college females between 17 and 22 years of age to study the effects of interval and endurance running on selected physiological parameters. Blood pressure (resting and exercise) was one of the physiological variables selected. It was concluded that both the treatments resulted in reducing the diastolic blood pressure in resting and increased systolic blood pressure after exercise.

Martha Stephens (1976) studied the effect of isotonic and isometric exercises on selected physiological variables, haemoglobin concentration being one of them. No significant increase in haemoglobin concentration was observed under exercise conditions. But isotonic conditions resulted in greater haemoglobin concentration than isometric.

Santo (1976), Buccola & Stone (1975), Gentry (1973) and Michael & Gellon (1960) have conducted their research studies with subjects of different ages and sexes and have concluded that exercise programmes of endurance type significantly reduce resting and exercise blood pressure values.

Mathew and Fox (1976) observed that total blood volume and haemoglobin showed a significant increase with training.

Frank (1976) divided seventy six college age men
into four different groups to study the effects of physical conditioning programmes on selected physiological components of which blood pressure was one of the components selected. The different physical conditioning programmes were: (1) Cooper's Aerobic Programme, (2) Interval conditioning programme, (3) Regular physical education programme and 41 Control Group. The analysis of data showed that in the case of Interval conditioning group the resting and exercise systolic blood pressure were significantly lower in comparison to control group, other groups did not differ significantly.

Mathew and Fox (1976) are of the opinion that the efficiency of an individual in performing physical activities depends basically on cardio-respiratory changes and training causes development of cardio-respiratory efficiency. Through training the efficiency of the circulatory and respiratory systems is improved and resting and exercise blood pressure values are lowered.

Hilton (1977) and Staudacher (1963) have indicated that endurance training did not have any significant effects in changing the pre-test and post-test values in resting and exercise blood pressures. Cormier (1977) formed three groups of 10 college men each, a control and two experimental groups. One experimental group trained with continuous jogging and other trained with interval
sprints of 20 minutes daily, three days per week for 12 weeks. Compared with the control group at the end of the study, the continuous jogging group and the sprint interval group had a significantly lower resting pulse rate.

Knehr, Dil and Neufeld (1977) undertook a study in which 14 college men participated in a training programme for middle distance runners. The programme was of six months duration. The training programme included one day over-distance running, one day pace running and one day speed work per week. As a result of this training, it was found that the resting heart rate reduced significantly.

Thomas (1977) as a result of his research study has contended that the high fitness group had a lower heart rate than the low fitness group and difference was worth marking at the highest work-load when working on bicycle ergometer for six minutes of work. He also concluded that high fitness group attained its maximum oxygen uptake at a significantly lower mean heart rate than the medium fitness group.

Dey and Chakaborty (1980) have conducted a study on 32 male students of first year of Bachelor of Physical Education class at Lakshmi Bai National College of Physical Education. All the students were residing in the college hostel and had almost same routine of diet, physical activities and environment. The subjects were randomly
divided into groups, consisting of 16 boys in each group. The selected physiological variables - haemoglobin, resting heart rate, resting blood pressure, vital capacity and breath holding were measured. To Group A endurance running, to group B vigorous free hand exercises were given for eight weeks, twice a week. It was found that physiological variables of male students could be improved significantly through the training programme of endurance running and vigorous free hand exercises for haemoglobin content, blood pressure and resting heart rate within a span of eight weeks. But vital capacity and breath holding time cannot be improved by the above training programme. Increase in haemoglobin content is due to voluntary hypoxia, which is produced during activities. It showed that exercise for eight weeks is potent enough to stimulate the haemopoietic system.

Uppal, et al. (1980) have conducted their research study on twenty two women students admitted to the first year Bachelor of physical education class of the Lakshmibai National College of Physical Education, Gwalior. They were selected at random for the study. They had regular schedule of training in physical education as per the programme of the college and this was same for all the students. Regular training in physical education involved endurance running, free hand exercises, participation in practical classes in different disciplines of sports and games. Tests of
physiological variables were administered to the subjects before they actually started participating in the regular programme of physical education of the college. After eight weeks of regular participation, the same tests were repeated. It was concluded that there was no significant increase in the blood haemoglobin contents of the subjects and as a result of regular participation in a programme of physical education, resting pulse rate decreased significantly as is clear from the data.

Robson and Singh (1981) have contended in their research study on thirty-five students of first year of Bachelor degree class of the Lakshmibai National College of Physical Education, Gwalior. Authors have concluded that there was (i) no relationship between cardio-respiratory performance and haemoglobin content. (ii) The study indicated no significant relationship between resting pulse rate and cardio-respiratory endurance. (iii) The study revealed no significant relationship between blood pressure and cardio-respiratory endurance. However, systolic blood pressure had high correlation with diastolic blood pressure i.e. \( r = 0.940 \).
Uppal (1982) had concluded that endurance training employing slow continuous running method on secondary school boys significantly reduced the resting systolic and diastolic blood pressure and systolic blood pressure after exercise. No significant change resulted in the case of diastolic blood pressure after exercise.

Bandyopadhyay (1984) has conducted a study to find out the changes of blood pressure, heart rate and blood lactate after performing selected speed and endurance activities. Thirty students of physical education college were selected randomly forming two groups in order to find out the changes in selected parameters after exercise. The two groups were separately meant for measuring the changes in heart rate, systolic and diastolic blood pressure and amount of blood lactate. The heart rate, systolic and diastolic blood pressure were measured and the amount of blood lactate was determined by Baker and Sumerson's modified method. A significant increase was evident in two variables, viz. heart rate, blood pressure (systolic and diastolic) and a significant decrease in diastolic blood pressure during post exercise phase for both speed and endurance groups. The existence of significant correlation of blood lactate on peak heart rate and systolic blood pressure was evident in speed group, on systolic blood pressure and diastolic blood pressure in endurance group.
respectively. A negative correlation was found between blood lactate and peak heart rate in speed performance and between diastolic blood pressure and peak heart rate in endurance performance. A significant relationship of blood lactate was found with peak heart rate and diastolic blood pressure while the effect of diastolic and systolic blood pressure was eliminated separately. The effect on blood lactate of peak heart rate, systolic and diastolic blood pressure was not significant.

PART IV : STUDIES ON BODY COMPOSITION

Kireilis and Cureton (1947) studied the relationship between fat as measured by calipers at six places on the exterior of the body to (i) certain structural physical tests, (ii) functional organic efficiency tests and (iii) motor fitness tests. There were significant negative correlations of magnitude of -0.578 to -0.264 between performances of strenuous physical exercises and external fat on the body, the correlation with the endurance running being relatively greater than for other test exercises. Fat is a real handicap in most strenuous exercises. Cardiovascular and respiratory measurements do not seem significantly related to external fat. In strenuous endurance running the fat on the abdomen and buttocks seems to be more of handicap than fat on the thighs and cheeks.
Strenuous treadmill running caused an appreciable loss of external fat over six weeks of training in 30 minutes periods, three times per week. Weight is not a good guide to the fat loss, possibly because fat loss is compensated for by increased muscular density due to the exercise.

Body composition also plays an important role in achieving top performance, lesser the amount of body fat better will be the amount of the relative strength. But excessive amount of fat creates hinderance in performance of many motor activities. Brozek and Keys (1953) expressed that body fat has long been recognised as one of the major variables associated with changes in body composition.

In a relationship study Bookwalter (1952) showed the relationship of physique and shape to physical performance. The Indiana Motor Fitness Test was administered. The study concluded that - (a) the obese body has the poorest physical performance. (b) Size and shape seems to have an influence on physical performance. (c) Maximum size and shape do not produce performance fitness. (d) Large and fat boys were poor in physical performance than the normal and thin boys.

Thompson, et al. (1956) have conducted a study on college Basketball and hockey players. Body weights and
skinfold measurements were determined in 10 varsity, 4 freshman basketball players and 12 hockey players before and after a season of play in their respective sport. The men maintained relatively constant body weight as a redistribution of weight was evident from the skinfold findings. The men lost subcutaneous fat in the three skinfold sites measured. Attention is focussed on the skinfold method as one deserving a more attention in physical education research. The skinfold procedure is a rapid, reasonable, precise, and inexpensive method for estimating body fat. They also discussed that physical fitness tests were frequently used by physical educators to measure the effectiveness of their programme. Excessive body fat is a definite handicap in these tests and allowance for excess fat could be considered in the construction of norms when strength, per se, is assessed. The total work done is the important fact.

Rienteau, Welch and Crisp (1958) examined the relationship between per cent body fat and selected motor fitness tests. Significant negative correlation from -0.29 to -0.68 were found between per cent body fat and the selected motor fitness tests. The test items most affected by fat were those which involved running and jumping. Weight did not significantly affect the performance of any of the
Sills (1960) has concluded that athletes who have substantial amount of adipose tissue have increased energy demands owing to the inert weight of fat, thus rendering the work more difficult to perform in endurance activities where the body has to move longer with greater weight.

Ismail, Christian and Kessler (1963) found substantial positive correlations between per cent lean body mass and performance on the 50 yards dash, pull-ups and the standing long jump in 81 boys of 10 to 12 years. He also conducted a factor analysis of these boys on a large number of motor performance and physical development variables. The researchers found that per cent lean body mass (or per cent fat) was the most important item in a factor labeled "body fatness". The motor performance variables that loaded heavily on this factor were the 50 yards dash, pull-ups and vertical jump.

Cureton and associates (1964) studied the effects of 9 programmes of endurance exercises on fat reductions of 15 middle-aged men, all of whom had been sedentary for at least three years. The exercise programme was conducted at noon six days a week for six months, average attendance was 3.35 times per week. On three days each week, the programme
consisted of Cureton's progressive rhythmic endurance training regimen, or rhythmic calisthenics interspersed with walking, running and stretching, and accompanied by deep breathing. On the other three days, men ran on the indoor track. For first month the exercise sessions lasted 30 minutes; subsequently they increased the duration to three quarters of an hour. Six skinfold measures were used for the evaluation of body composition. Analysis of data showed significant reduction in the sum of skinfold measurements.

Leedy, Ismail and Kessler (1965) conducted a study on the relationship between physical performance items and body composition. The purpose of the study was (a) to determine the relationship between body composition and selected physical performance and related items, (b) to determine whether or not certain physical performance and related items might be useful in estimating body composition in terms of total lean body mass as measured by potassium 40, determinations in adult men. Data on 19 physical performance items was obtained from 40 subjects between 21 and 57 years of age. Utilizing the Pearson Product Moment formula of correlation, correlation coefficient on 19 variables were obtained. In addition, the Doolittle Method of Multiple Correlation was utilized to select those
items which would serve as best predictors of estimating total lean body mass. The same procedure was adopted for estimating the per cent of lean body mass. Following results were obtained: (a) Physical performance items, where the whole body of an individual is forced to move, are dependent on the per cent of lean body mass rather than amount of lean body mass, (b) Among adult population, there is significant relationship between lean body mass or the per cent of lean body mass and the rate of response of the heart to exercise, (c) Increase in weight in adult population is primarily due to fat deposition rather than lean body mass, (d) Body composition can be estimated reasonably by physical performance and related items.

Neilson (1969) has studied the relationship of body composition to selected measures of muscular strength. Male students (N=28), 18-25 years of age, were tested for body density from which per cent body fat, body fat weight, per cent lean body mass and lean body weight were calculated. The strength of nine major groups of muscles of body was measured isometrically. The inter-correlations of the strength measures were all positive except for elbow flexion and hip extension, although little relationship was found to exist between them or between strength and body composition variables.

John (1970) has selected thirty students to fit into one of the three body fat groups - 0-15%, 16-25%,
26% and above. The Behnke Method for calculation of body fat was used to assign these students to a group. ANOVA for repeated measures was used to measure the internal consistency of these percentages of body fat.

The 40 yards shuttle run was administered to each student ten times. ANOVA for repeated measures was used to measure the internal consistency of the trait. A one-way ANOVA indicated a significant effect of body fat upon performance of the 40 yards shuttle run. The Newman-Keuls Multiple Comparison Test identified the only significant difference between the 0-15% group and the 26% and above groups.

Bullen (1971) has incorporated that studies of body composition in certain sports indicated that the athletes who were very lean but heavy because of a well developed musculature were superior in performance in certain competitive sport activities, such as - football, weightlifting and the shotput.

Sidhu and Anand (1971) studied 42 athletes and 46 non-athletes in which the former were found to be taller and heavier than the latter. The non-athletes were seen to possess higher amount of subcutaneous fat than the athletes.

Malhotra, et al. (1972) studied the functional capacity and body composition of throwers, jumpers, sprinters
and middle and long distance runners. The track men and jumper were found to have a higher lean body mass with less fat contents than the throwers who were tall and heavily built. The middle and long distance runners had highest and the throwers, the lowest O₂ intake capacity, values in term of body weight and lean body mass. Similarly the jumper and thrower had stronger muscle power. However, the latter were strong in arm and shoulder muscle strength too.

Cureton (1973) determined the relationship between body composition and physical performance of pre-puberty boys. Fifty four puberty boys (8 to 11 years of age) were tested on three independent body composition measures and thirteen physical performance items. The body composition measures include - body density, total body potassium and sum of ten skinfold thickness measurements. The physical performance items included the seven items of the AAHPER Youth Fitness Test, vertical jump, mile run and four dynamometric strength tests. The values of the body composition measures were inter-correlated with the physical performance items using the Pearson Product Moment Correlation Coefficient. Body density was positively related to all types of physical performance except static strength. The higher relationships were obtained between
body density and performance on pull-ups, 600 yards run and 50 yards dash. Their relationships are all higher than those of the same performance items with age, height or weight. Grams of total body potassium were related highly to test of static strength or power. Negative correlation was obtained between skinfold thickness measurements and scores on all motor performance test items except the soft ball throw. The highest negative correlation was obtained between the skinfold sum and performance on 600 yards run, pull-ups and mile run. It was concluded that other factors or a combination of other factors were of more importance in predicting the physical performance items investigated except in the case of static strength or power where fat free weight appears to be the dominant factor.

Yoest (1973), in his study, concluded that age, height, lean body mass and body surface area did not significantly limit performance in Ohio State University Step Test. However, body composition representing body fat limited the performance of college men.

Cureton, Baileau and Lohman (1975) studied the relationship between body composition measures and AAHPER test performance. Relationships among total body density, total body potassium, skinfold thickness measurements and AAHPER Youth Fitness Test performance were determined
on 49 pre-puberty boys of 8 to 11 years of age. Zero order correlation between body composition measures and performance scores were low or moderate. In general, body density, body potassium and skinfold thickness predicted performance equally well when age, height and weight were held constant. Canonical correlation, analysis of relationship between AAHPER test items and the physical development variables demonstrated that there was a large proportion of common variance between the two sets of variables and significant relationships existed along two independent dimensions. It was concluded that not only variations in body size but also variation in body composition should be considered, when interpreting results of the AAHPER test for individual children and for comparison of groups of children who differ in body composition.

Swedburg (1975) studied the effects of three different distance training methods upon performance and body composition. The methods selected were continuous running, interval running and continuous pace running. Subjects for the study were 81 male college students. He concluded that continuous run made a statistically significant change in body composition at .05 level.

Muthiah and Venkatswrlu (1975) studied the Indian track and field athletes and noticed the throwers to be
heavier, taller and older than other athletes. Among runners, the age increased while the height and weight decreased with the increase in the distance they ran. The jumper and hurdlers were taller and heavier than sprinters but were shorter and lighter than throwers. The decathletes were the second heaviest as they were all rounders.

Venkateswrlu (1975) has found a positive relationship between the physical fitness and the heights and weight of 150 school boys of Madras.

Sidhu, et al. (1975) took the upper arm roentgenograms and some anthropometric measurements of 22 throwers and compared them with 45 normal non-athletes. The throwers were found to be significantly taller and heavier with bulkier builds of larger circumferential measurements and skeletal measurements. Their lean body mass was greater than that of the controlled sample.

Slaughter, Lohman and Misner (1977) determined the association of somatotype, body composition and physical performance in 7 to 12 year old boys. Two objective methods of measuring somatotype, Sheldon's Trunk Index Method and Heath Carter's Anthropometric method, were used. Body composition was estimated as fat and lean body mass from 40 K measurement, using a whole body counter and from two skinfold thickness measures. Physical performance measures consisted of
three tests of running (1 mile run, 600 yds run and 50 yds dash) and two tests of jumping, i.e. standing broad jump and vertical jump. In general somatotype components had lower correlation with running and jumping variables than did body composition or body size variables had such as height, weight and per cent fat.

Curston, et al. (1977) investigated the relative importance of body size, body composition, cardio-vascular capacity and running speed in determining individual differences in performance on 600 yards run and 1 mile run test, using data on 196 children, 7 to 12 years. A multivariate and multistage path model was developed in which height, per cent fat, Vo₂ max and 50 yards dash time were postulated as determinants of individual differences on the two distance running tests. These four independent variables accounted for 71% to 66% of the variance in 600 yards run and 1 mile run respectively. All four independent variables had significant associations with two distance runs. When the influence of other independent variables was taken into account, the 50 yards dash time and per cent fat were found to be most important determinants of both distance runs.

Slaughter, Lohman and Misner (1978) determined the association of somatotype and body composition to physical performance measures in 7 through 11 years old girls. Somatotypes were measured by Heath Carter's
Anthropometric Method. Body composition was estimated as a fat and lean body mass from 40 K measurement using a whole body counter. Physical performance measures consisted of three tests of running (mile run, 600 yards run and 50 yards dash) and the test of jumping (standing broad jump and vertical jump). Moderate relationships were found between somatotype components, measures of body size and measures of body composition with the physical performance variables of running and jumping. The first and third components were more closely related to physical performance than the second components. Per cent fat and first component, when each are combined with age, height and weight accounted for a similar amount of the variation in running and jumping performance. Lean Body Mass when combined with age, height and weight accounted for significantly more of the variation in running and jumping performance than the second component when combined with age, height and weight.

Crews and Meadors (1978) studied the relationship between body composition measures and reaction time (RT) and run time at 5, 15 and 50 yards. Forty eight candidates of a University Football Squad were investigated. Each player's optimum playing weight was predicted and the effect of being above and below one's predicted optimal playing weight (POPW) on RT and run time was evaluated. Reaction
time and run times were obtained during a 40-yards run. A multiple timing system was designated to measure the times at the designated distance. Body composition was assessed for all subjects using prediction equation. POPW was determined using body composition data of professional football players as guidelines. Negative correlation between percentage of body fat and run time was found to increase as the distance increased. The players who weighed more than their POPW were found to have a slower R.T. and significantly slower run times than compared to those players weighed less than POPW.

Verma, et al. (1978) has studied the effects of over training in sportsmen during their intensive training which are very important. The effects of over training in 5 of the 15 natural team basketballers showed deterioration of aerobic power, body weight, lean body mass, the resting pulse and the recovery.

Cureton, Hensley and Tiburski (1979) determined the extent to which the mean difference in performance between men and women on selected physical performance tests was related to the sex difference in body fatness. Percent total body fat (% fat) estimated from skinfold thickness measures and performances on the modified pull-ups, vertical jump, 50 yards dash and 12 minutes run/walk tests were measured on 55 male and 55 female college students. Males
had significantly less fat and performed significantly better than females on each of the performance tests. Mean differences were 8.2% fat, 20.0 modified pull-ups, 20.8 cm on the vertical jump, 1.3 seconds on 50 yards dash and 590 M on the 12 minutes run/walk. Linear regression equation predicting performance scores from per cent fat within the groups of men and women indicated that if body fatness in men and women was similar, performance difference would be reduced on the average, by 7 modified pull-ups, 4 cm. on vertical jump, .05 seconds on the 50 yards dash, and 146 M. on the 12-minutes run/walk. It was concluded that greater body fatness is one characteristic that partly explains why women, on the average, do not perform as well as men on the strenuous tasks requiring movement of body weight.

Carter and his co-workers (1982) studied the Montreal Olympics Gymnasts and concluded that the gymnasts have smaller skin folds and adipose tissue mass than the Canadian students.

Sodhi and Sidhu (1984) have mentioned in their book that it is evident that physique and body composition have an important role to play in the performance of various physical activities. The selected physical activities reported here are - athletics, cycling, weight lifting, wrestling, football, hockey, basketball and volleyball.
They further incorporated that the study of body composition in sports is essential because it reveals the development of different tissue components in sportsmen specialising in different physical activities. A particular proportion of the lean body mass or fat may be advantageous or disadvantageous in some way in the performance of certain events, e.g., excessive fat is advantageous for channel swimmers (Pugh and Edholm 1955). But, it is disadvantageous for long distance runners (Buskerik and Taylor, 1957, Sills, 1960).

The regional development of musculature or the lean tissue areas in limb segments may indicate a parallel or unparallel development of different regions depending upon the type of the physical activity. Thus, the study of body composition will also help us to understand the suitable conditioning exercises useful in developing those particular regions which may be most useful for a specific activity.

They also added that the percentage of body fat shows greater average values in the case of sprinters and 400 M flat runners. It decreases in the case of 800/1500 M and 5000/10000 athletes. Among hurdlers, the 110 M hurdlers have less of body fat than the 400 M hurdlers. Almost similar results are given by individual skinfolds and the average subcutaneous fat in the trunk, the upper extremity and the lower extremity. But, the fat content was estimated with the help of individual
skinfolds, the average skinfolds in the trunk, the upper extremity, the lower extremity, and the percentage of body fat in the case of the control than that in these runners. Since the sprinters and 400 M men have more weight for their height but less fat than the controls, it is evident that their greater weight for stature is only due to well developed lean body mass.

Moffatt, et al. (1984) compared the body composition, physical dimensions and maximal physiological responses of its female high school elite gymnasts to 13 randomly selected non-athletic high school females. Data was collected on age height (Stadiometer) body fat (lange caliper from six sites), lean body weight (determined by the differences), body density (hydrostatic weighing), Vo₂ max (treadmill) and anaerobic capacity (bicycle ergometer). Data was analysed. It was found that non-athletic high school females had less tissue and more body fat than that of these gymnasts, 14-22% less than that reported for more mature female gymnasts.

Johnson, et al. (1984) investigated to compare the effect of two training frequencies of aerobic dance on oxygen uptake, body composition, and personality. Subjects were 23 sedentary female students (ages 18-31 years) enrolled in two aerobic dance classes. Subjects trained at 70% of Max HR for 30 min in week I and progressed to 90 min in week 13. One group was trained twice weekly (2X) while the
other group was trained three times a week (3X). Training intensity and duration were identical in the groups.

Significant changes (P < .05) were established within each group for relative and absolute \( V_o_2 \text{ max} \), time on treadmill, and per cent body fat. The 2X group also experienced significant change in weight and HR during submaximum work. The only difference between groups was a greater decrease in per cent fat in the 3X group. Data pooled from both groups showed significant differences in the following variables of the California Personality Inventory: well being, self-control, tolerance, achievement via conformance, achievement via independence, intellectual efficiency, and psychological mindedness. It appears that aerobic dance, performed two or three times weekly, is effective in producing change in cardiorespiratory fitness and body composition when appropriate levels of intensity and duration are used. Furthermore, with the intensity and duration used, exercise frequencies of two and three weekly shifts produce similar changes in these variables. Lastly, aerobic dance training results in favourable personality changes.

Uppal and Ray (1986) have conducted a study on physical education students who were regularly participating in physical education and conditioning programme of the college. In the findings, it has been obtained that there was an insignificant relationship between shot put and
body composition variables. A significant relationship between javelin performance and lean body weight further shows the importance of explosive strength for this event.

Uppal and Ray (1986) have introduced in their study that body fat is considered to be a liability in the performance of motor activities. However, very few objective studies have been made which could establish a direct relationship between body fat and the performance of various motor activities. Direct evidence of this nature would be very useful in demonstrating to both athletes and non-athletes that excess of body fat has an adverse effect on motor performance.

Fletcher and McNaughton (1987) have compared three methods of assessing body fat in elite cyclists, underwater weighing for the "gold standard," skinfold measurement and upper arm X-ray. Road and track cyclists were compared to determine differences in their percentage of body fat. Correlational analysis revealed high statistically significant values between all these methods suggesting that using the protocols suggested all three methods are as accurate as each other. When other factors such as time and simplicity of measurement are taken into account the X-ray method is the best. As was expected the road cyclists carried less fat than their track counterparts. In the case of the
road cyclists there was 7.9% body fat and track cyclists had 12.4% (using underwater weighing results).

Chauhan, et al. (1987) have conducted a study on 42 college age women. Body composition as one of the variables was calculated by using the equations of Durnin and Rahaman (1967). Body density, lean body mass and fat weight were calculated. Siri's (1961) equation was applied to find out the body fat percentage using the body density. It was found that body weight has insignificant positive relationship with standing broad jump while percentage of fat has insignificant negative relationship with the standing broad jump. However, lean body mass has negative significant relationship with standing broad jump at 1% level of confidence.