Chapter II

REVIEW OF RELATED LITERATURE

A review of the research reports related to the present study that the research scholar could gather, is presented in this chapter in order to provide the background material to evaluate the significance of this study as well as to interpret its findings.

In his study of comparison of relationship between cardio-vascular fitness and selected anthropometric measurements in eighth grade boys and college male subjects Yoest 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 only. In adolescence, scores in the step test improved larger percentage of lean body tissue.

In their study relating to maximal oxygen consumption, body composition and anthropometry on selected Olympic male athletes Woodward and associates\(^2\) observed that the tallest rowers and water polo players had significantly larger skeletal width and length measurements. The skinfold measurements showed larger fat folds on the trunk and extremities in water polo players compared to the other three groups. Leanness of the upper extremity was significantly larger in rowers and water polo players had significantly larger skeletal width and length measurements. The skinfold measurements showed larger fat folds on the trunk and extremities in water polo players compared to the other three groups. Leanness of the upper extremity was significantly larger in rowers and water polo players, while that of the lower extremities were significantly larger in rowers only. Total body fat in absolute values was found significantly higher in water polo players.

Wells investigated in his study the physical characteristics, body composition, pulmonary functions and aerobic capacities of male and female marathon runners. He selected seven male and four female engaged in endurance training. Vital capacity, residual volume, body density and percentage of body fat were calculated. He concluded that elite class male and female distance runners have a body build with little body fat and large lung volume.

Burke and Brush studied physiological and anthropometric measures of young women who had been training regularly by running approximately 50 mile per week for two years. Anthropometric measures included selected segment lengths, diameters, skinfolds and circumferences. He concluded that these women athletes were average in height while lighter than normal for their age and sex, having a high component of ectomorphy.

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3 Wells et al., Research Quarterly for Exercise and Sport, p.285.

4 Edmund J. Burke and Florence C. Brush, "Physiological and Anthropometric Assessment of Successful Teenage Female Distance Runners" Research Quarterly 50 (May 1975): 180.
having a smaller over all skeletal frame work than normal and low in subcutaneous body fat for their age and sex.

Heblinek and Postma\(^5\) selected anthropometric measurements and somatotype ratings of physical education majors and computed their relationship to the performance of certain motor fitness tests determined. Physiological factors such as muscle-function, efficiency of the circulatory and respiratory systems, psychological factors were included. He also selected related anthropometry variables such as shoulder height width, reciprocal ponderal index, waist-neck girth index. They concluded that the mean shoulder width in the sample was smaller with respect to height. It was emphasised that the development of neck was a characteristic of sturdiness and ideal neck-waist girth proportion would be two.

Hidiji\(^6\) established a high relationship between


$\text{VO}_2\text{max}$, body weight, height and ectomorphy body types. They also found that the mean values for boys increased with age and those for girls were almost constant from age 12 to 18, but the co-efficient of correlation between absolute and relative $\text{VO}_2\text{max}$ was not significant.

Novak and others\textsuperscript{7} investigated to determine working capacity, body composition and anthropometry of female Olympic athletes. The subjects in his study were eight distance runners, seven swimmers and five gymnasts. He concluded that distance runners showed significantly higher oxygen intake which was also achieved at significantly higher work loads compared to swimmers, lean body mass was significantly lower in swimmers.

Seltzer\textsuperscript{8} conducted a study with 175 subjects to correlate various anthropometric measures with endurance performance in 1) treadmill, 2) pack test.


\textsuperscript{8}Carl C. Seltzer, "Anthropometric Characteristics and Physical Fitness" Research Quarterly 17(March 1946): 20.
3) step test and demonstrated a virtual absence of relationship between stature, weight, chest circumference, leg length, lower leg length with the criteria both before and after a training period. He also concluded that best index was height/3/√W which correlated .29 ± .049. Individuals poor in this index were poor in performance. He concluded that there was no evidence of any advantage of the tall, long-legged individuals compared to those with short stature in the pack and step test.

Cureton⁹ has studied the relative importance of body size, body composition, cardio-respiratory capacity and running speed in determining individual differences in performance on 600 yd. run and a mile run test on 196 children of age 7 to 12 years. A multi-stage multivariate path model was developed in which height, percentage of fat, Vo₂ max. and the 50 yard dash time were postulated as determinants of individual differences on the two distance running tests. He

concluded that all four independent variables had significant associations with two distance runs when the influence of the other important variables were taken into account. The 50 yard dash and percentage of fat were found to be the most important determinants of both distance runs.

Palgi \(^{10}\) investigated the extent to which \(V_{O_2}\) max. and three additional independent variables—anaerobic threshold, anaerobic capacity and percent body fat can account for variance in endurance performance. Thirty girls and twenty eight boys of 10-14 years of age underwent a multistage treadmill test with assessment of \(V_{O_2}\) max. and anaerobic threshold. Regression equation and two-kilometer run was selected as to estimate body fat and endurance task. He concluded that there is a substantial relationship between measures of anaerobic and aerobic function, although to some extent each provides independent information about

endurance performance. When boys and girls were compared, boys exhibited reliably higher values for VO₂ max. and A.T. He also concluded that in general more fit and active children tended to excel in a variety of tests of aerobic and anaerobic capacities.

Wear and Miller\textsuperscript{11} conducted a study to find out the relationship of physique and developmental level, determined by use of Wetzel grid to performance of junior high school boys on four fitness tests. Pull-ups, 50 yard dash, standing broad jump and softball throw were included. Subjects from different physique group (heavy, medium, thin) who are alike developmentally (accelerated, different, normal) differed more markedly in performance than did subjects of different developmental levels who are alike with regard to physique. Subjects who were medium in physique and normal in development were the best performer subjects to heavy physique were the poorest performer.

\textsuperscript{11}C.L. Wear and Kenneth Miller, "Relationship to Physique and Developmental Level to Physical Performance" \textit{Research Quarterly} 30 (December 1962): 265.
Anderson investigated on twenty female engaged in one week pre-training session consisting of riding a bi-cycle ergometer 200 yards per week at a heart rate of 135-145 beats per minute for ten minutes followed by an eleven week training programme. Pre and post measures were recorded on cardio-vascular efficiency, eleven blood constituents, systolic amplitude and percentage of body fat. He had one control group and other two groups were trained separately at a heart rate of 125-135 beats and 145-155 beats per minute respectively. He concluded that a significant reduction in percentage of body fat in group and big increase in cardio-vascular efficiency when compared to control group.

Lee in his studies determined maximal oxygen intake by treadmill running, body composition by water

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immersion densiometry and percent body fat estimated by the formulae of Key and Borzek. Fat free weight which correlated 0.39 with maximal oxygen intake which was significant at .05 level concluded as the best maximal metabolic references standard of these measured. He also concluded that more satisfactory estimate of the maximal oxygen intake, resulted from the inclusion of fat free body weight, total body fat and total body weight instead of fat free body weight alone.

In their study on national level archers, Sundarajan, Pande and Salaudden concluded that physical measurements i.e., height, weight, bi-acromial diameter and arm length were correlated with the performance of the individual archer at the varying distances. Further, it was concluded that the physical measurements correlated also with the total performance scores.

In an attempt to develop scientific criteria for the selection of budding athletes based on their morpho-

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logical status, Kansal\textsuperscript{15} studied 246 male students ranging the age from 11 to 17 years. Their weight, height, bi-acromial, humerus, by-condyles chest and calf circumference and performance in 100 meter sprinting shot-put and standing broad jump was examined. He {\textsuperscript{15}}

Raynal and Ashada\textsuperscript{16} compared various aspects concluded that above said body measurements showed significant body structure and body shape in 100 mile and 100

significant degree of relationship with individual performance indicators. They reported that when somatotype test studied, extroversion were acquired and somatotypes were the most.

In their study on Montreal Olympic athletes,\textsuperscript{16} Carter and others\textsuperscript{16} concluded after examination that the jumpers were heavier and had larger thigh and calf girth than the sprinters and the distance runners. They also had larger lower extremity length than the sprinters and larger sum of six skinfold than the distance runners. The distance runner had smaller upper arm and forearm girth than sprinter or jumpers, but larger


bi-iliac breadths than sprinters. There were no significant difference he could find on age, height, sitting height, upper extremity length or bi-acromial breadths.

Reynold and Askawa\textsuperscript{17} compared various aspects of body structure and body shape in 100 male and 100 female adults. They reported that when somatotype extremes were compared, endomorphs were the heaviest, had the lowest ponderal index, the thickest legs, most fat and least muscle and bone, relative to body bulk. The mesomorph exhibited the largest amount of muscle and bone to total body bulk and were intermediate in size. The ectomorph were highest in weight and had the highest ponderal index and the least amount of muscle and bone.

Laubach and others\textsuperscript{18} included two measures of cardio-vascular fitness as Howard Step Test, Ohio State

\textsuperscript{17} E.L. Reynold and T. Askawa, "Comparison of Certain Aspects of Body Structure and Body Shape in 200 Adults" cited in Physical Fitness Research Digest 3 (October 1973): 257.

\textsuperscript{18} L.L. Laubach et al., "Relationship Between Two Measures of Cardio-vascular Fitness and Selected Body Measurements of College Men" Research Quarterly 55 (December 1982): 615.
University Step Test and twenty direct and derived anthropometry measurements were obtained on thirty college men and inter-relationship was investigated. The anthropometric measurements of fat and body composition correlated significantly with scores obtained on Harvard Step Test. Neither stature, sitting height, lower extremity length or the mesomorphic component of body build seen to affect the score of the two tests. He concluded that within the limitation of the study, it would appear that measures of body weight, fat and composition are more of a limiting factor in the performance of Harvard Step Test or cardio-vascular efficiency.

In their study of Olympic athletes at Rome of different categories or events, Drozdowski\(^{19}\) on the ground of calculative method was stated the contents of dry substance, water and fat in the total weight of body of athletes for different distance runs. He stated that the teams of athletes specializing on long distance

are characterised on the average by a greater contents of dry substance and water, and a smaller content of fat in the composition of body than athletes specializing on shorter distance.

In an intensive study of 17 female volleyball players of Indian Volleyball Team, Grewal and Sidhu\(^{20}\) observed that by taking age, height, weight and ponderal index along with Mirata's Method of "Absolute Evaluating Method of Physique" the women volleyball players in national level can be selected.

In a study of 64 college age males, Fease\(^{21}\) concluded that speed of hand was only significant predictor of the ability to shoot in basketball.

Hosler, Morrow, Jr., and Jackson\(^{22}\) studied 180


\(^{21}\) G. Dale Fease, "Relationship of Selected Hand and Wrist Measurements to Ability to Shoot in Basketball" Perceptual and Motor Skills 52 (December 1981) 1793.

collegiate women volleyball players and concluded that women collegiate volleyball players tended to be slightly taller, heavier, broader shoulder and narrow hips.

In a relationship study Abdo\(^2\) concluded that excess weight had the greatest deleterious effect on cardiovascular efficiency. The correlation was definitely higher for subject with normal weight. The linear correlation between cardiovascular efficiency and ponderal index was significant.

Cureton\(^2\) in his study of champion athletes has stated that all round athletic ability is characterised by wide shoulder width compared to hip width. Davenport's Crural Index is a valuable guide for the selection of individual built in an agility pattern for bony leverage. Higher values of leg length, trunk length indicated agility types. Ability of putting and throwing is indicated by relatively greater height and arm span.


\(^2\) Cureton Jr., Physical Fitness of Champion Athletes, p.49.
Hagan and others studied to examine the relationship of marathon performance time with maximal aerobic power, body composition and training factors recorded for nine weeks prior to a race. He suggested that maximal aerobic power is the best indicator of marathon performance and that lean body mass and percent body fat are physical attributes important to distance running performance. Male elite distance runners have a body mass generally between 60 kg. and 70 kg., a body fat between 1.0 to 6.0 percent maximal aerobic power between 70 to 85 ml.kg./min. He also concluded that lean body mass and skinfolds and high maximal aerobic power are physical attributes related to faster marathon performance times.

A few studies have also reported no correlations with the proficiency in sports.

In his study on male collegiate track and field athletes, Godden concluded that there were no


significant relationships between the anthropometric measurements and speed in the 50 yard dash.

In a relationship study of the leg strength, body weight ratio and length of the lower limb segment to vertical jump on 49 male college students, Wells\(^{27}\) concluded that none of the relationships studied proved to be statistically significant.

In his study of 89 high school level swimmers Albrecht\(^{28}\) did not find significant relationship between physique measures and swimming success.

Khayamleashi\(^{29}\) made a relationship study on 53


male subjects between hip width, leg length and weight to the total movement response time. He found that obtained correlations were low and not significant except for leg length.

Some studies have adopted the design of comparing the anthropometric characteristics of good and poor performance in a given game.

Dutler concluded that the measures and indices which were significantly larger at the .05 level for good vaulters, were tibial height, chest girth, shoulder girth, shoulder width, right grip strength, leg power and speed, ilipinal height/thigh length and shoulder width plus shoulder girth and sitting height.

In his study on good and poor college women bowlers, Sabel concluded that said groups were

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significantly different in all anthropometric variables undertaken in this study i.e., height, weight and arm length.

In a comparative study of anthropometric measurements of upper and lower one third of a group of gymnasts, determining them as good and poor gymnast, Read\textsuperscript{32} concluded that good gymnasts were significantly more ponderous than the poor gymnasts and were found to possess a proportionally greater chest breadth than chest depth.

In his investigation of anthropometric profiles of champion athletes and applied hydrodynamics and selection criteria for top swimmers, using 63 students from Academy of Physical Education of Amsterdam and nine Dutch competitive Olympic level swimmers as subjects, Clarys\textsuperscript{33} came to the conclusion that shape,


body composition and dimensions of the body exert little or no influence on the hydrodynamic resistance.

In their study on 166 Olympic track and field competitors and eight swimmers at 1960 Rome Olympic, Correnti and Zanli observed significant differences in age, height, and weight among various events. It was also observed that within certain events body shape or form was similar but size varied. They also observed relationships between body proportions, dimensions and performance.

In their study relating to somatotype and body composition to physical performance on seven to twelve years old boys, Salughter and associates concluded that somatotype was not highly related to physical

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35 M. H. Salughter, T. G. Lohman and J. E. Misner, "Relationship of Somatotype and Body Composition to Physical Performance in Seven to Twelve Year Old Boys" Research Quarterly 48 (March 1977):159.
performance. However, ponderal index correlated better with performance scores. Somatotype components have lower correlations with running and jumping variables than body composition or body size variables.

Bremerg\(^{36}\) concluded that little relationship existed between the anthropometrical, motor and reaction movement variables. Seven anthropometrical characteristics, four motor ability tests and 10 reaction time were recorded for sixty five high school girls.

Crews and Meador\(^{37}\) investigated the relationship between body composition measures, reaction time and run times at 5, 15 and 40 yards. In addition, each player optimal playing weight (POPW) was predicted and the effect of being above or below one's predicted optimal playing weight on reaction time and run times were evaluated. Negative correlations between percent

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fat and run times were found to increase as the distance increased. The players who weighed more than their POPW were found to have a slower reaction time and significantly slower run times when compared to those players who weighed less than their POPW.

Barry and Cureton\textsuperscript{38} conducted a study to determine the nature of factors involved in the physique of young boys and relationship with these factors and performance. Three type factors of physique were observed. One related to growth in transverse directions and adipose tissue and two related to growth in vertical dimensions. Three factors related to motor performance were isolated, power endurance and dynamic shoulder strength and they observed three growth trends in the physique of pre-pubescent boys.

1. One related to growth in transverse directions and adipose tissue and characterised by bulkiness, prominent girths, broad hips, narrow shoulders and thick fat covering.

\textsuperscript{38} Allen J. Barry and Thomas K. Cureton, "Factorial Analysis of Physique and Performance in Pre-pubescent Boys" Research Quarterly 32(October 1961):293-299.
2. One related to growth in vertical dimensions characterised by a lean frame and attended limbs.

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

Two further growth factors were isolated and tentatively named:

1. One may be related to assymetrical development of the upper and lower limbs.

2. The other may be related to andric and gynic growth leading in this age group to wide shoulders and wide hips.

Cureton, Baiban and Lohman[^39] conducted a study on relationship between body density, total body potassium skinfold measurement and AAHPER Youth Fitness Test. Performance were determined on 49 prepubescent boys, eight to eleven years of age. It was concluded

that not only variations in body composition should be considered when interpreting results of AAMPER Test.

Ward and associates\(^{40}\) conducted a study to compare anthropometric measurements between master and first class level Olympic weight lifters and to assess if body segment proportionately contributed to performance level. A total of 39 measurements were recorded which included lengths, circumferences, age and center of gravity position. The results indicated for statistically significant differences between seven first class and three master Olympic weight lifters. The master weight lifters were, however, characterised as being stouter in body type than the first class lifters.

Follock, Cureton and Grueninger\(^{41}\) performed two experimental groups and a control group of men between


28 and 39 years of age. The training programme was same for both the groups, consisting of approximately 30 minutes of continuous running, jogging and walking with increasing intensity as exercise tolerance improved. Body composition assessment consisted of body weight and the sum of six skinfold measures obtained over chest axillar, triceps, abdomen, supra-illiac and front thigh. The results in terms of the sum of six skinfold tests showed that the control group became fatter; the twice-a-week group remained about the same; and the four times-a-week group lost appreciably.

Pollock and co-workers selected nine healthy sedentary men as subjects for their study. A control group of 10 men was also employed. The conditioning was 30 minutes each session, four times a week for 20 weeks. Initially, the subjects walked and jogged equal 110 yd. segments and progressed gradually to a continuous run. Body composition assessment consisted of body weight, sum of six skinfolds and abdominal.

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gluteal and thigh girth. The experimental group showed significant reduction in the sum of six skinfold measurements when compared to control group.

Tooshi 43 formed one control and three experimental groups, each consisting of eight to nine men, 27 to 45 years of age. The experimental groups participated five days a week for 20 weeks in a progressive training programme consisting of running, jogging and walking. For the three groups the programme differed only in time of participation each day: 15, 30 and 45 minutes. The sum of eight skinfold measurements were used for the evaluation of body composition. The 45 minute training programme produced a significant reduction in total body fat, while the others did not. The investigator concluded that expenditures of less than 600 calories during exercise sessions were insufficient to cause significant change in the measures used.

43 Ali Tooshi, "Effect of Three Different Durations of Endurance Training on Serum Cholesterol, Body Composition and Other Fitness Measures" Dissertation Abstracts International 31(March 1971): 4533-A.
John selected 47 fifth grade subjects to determine the relationship of obesity to cardiovascular fitness. The subjects were measured for obesity using skinfold calipers and for fitness using the modified Balke Treadmill Test. Results indicated a significant relationship between skinfold measures and cardiovascular fitness.

With college women as subjects, 20 in an experimental and 24 in control group, Bowes studied the effects of specific exercises on skinfold measurements. The skinfold sites selected were: posterior surface of upper arm, iliac crest of the mid axillary line and medial side of thigh opposite superior ridge of patella. The experimental subjects were enrolled in a physical education class for women which met for three one hour periods per week for ten weeks. Thirty

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minutes per period were devoted to exercises, which consisted of body mechanics exercises for the first five weeks and modern dance techniques, composition and lectures for the second five weeks. For the experimental group, significant losers of arm skinfold occurred mostly during the second five weeks.

Prentiss 46 conditioned 21 obese college women on a programme of exercise. Utilizing a bicycle-type exerciser during the winter and spring quarters of the same year. The exercise regimen each day consisted of a 15 minute ride with three 30 second work periods evenly spaced during the ride. As each individual progressed and a plateau of work accomplished was reached, the number of work periods for the 15 minute ride was gradually increased. Skinfold measurements were taken at the hip, back of the arm, subscapular and abdominal. Analysis of data showed significant loss of fat specially at back of the arm and hips.

Trahan selected forty female subjects to determine and compare the effects of two kinds of conditioning programme on nine fat deposit sites i.e., biceps, triceps, forearm, scapula, fifth rib, waist, abdomen, inner thigh and knee. A randomization procedure was employed to design the subjects to one of the two experimental conditions - the strength exercise programme or endurance exercise programme. The subjects participated in the exercise programme three times per week for seven weeks. Endurance oriented exercise programme resulted in greater subcutaneous fat loss than the strength oriented exercise programme.

A study pertaining to fat reduction by middle aged women was conducted by Zuti over a period of 16 weeks. Three experimental groups of 11 women each were formed the subjects who were between the ages of 25


and 45 years. Skinfold measurements were taken at 13
selected sites. The programmes for the three groups
were designed to achieve a reduction of 500 calories
per day over normal activities, as follows: diet group,
diet reduction only. Exercise group, exercise requiring
500 calories, no change in regular diet. diet exercise
group 250 calories reduction in diet and 250 caloric
loss through exercise. The exercise regimen consisted
of walking, jogging, running, bench stepping and
calisthenics. Both the experimental groups showed
greater significant body fat reduction than did the
diet group.

Singler$^{49}$ selected 51 college men to study the
effect of vigorous exercise programme on skinfold
thickness. The subjects were divided into two groups.
The experimental group participated in the Canadian
programme for eight weeks while the remaining subjects
did not participate in vigorous physical activity.
It was observed that there was no significant change

$^{49}$ David Singler, "The Effects of Vigorous
Exercise Programme on the Subcutaneous Fat, Total
Body Fat and Body Density of Young Adult Males" Completed Research in Health, Physical Education
in the skinfold measurements.

The effect of diet and physical activity upon 15 Alesse College women enrolled in a weight control class which met for 35 minutes three times a week for a semester, was investigated by Tufts. The diet applied was the "1000 caloric exchange plan" established by the American Dietetic Association. The physical activities varied from day to day but consisted of calisthenics, rhythmic, folk dancing, badminton, basketball, hiking, jogging, bicycling, and circuit training. Body weight and eleven skinfold measurements were taken to evaluate body composition. Analysis of data showed significant reduction in skinfold measurements.

With sedentary college men as subjects, Boilean and associates formed two groups based on


their relatives' fatness. All subjects walked or ran on a motor-driven treadmill, 60 minutes per day five days per week for nine weeks. The approximate energy expenditure prescribed was 600 kilocalories per day of physical conditioning. As a result of physical conditioning programme, significant decrease occurred in the sum of 10 skinfold measurements.