Chapter Two

Review of Related Literature
REVIEW OF RELATED LITERATURE

In this modern age of science sport scientists have contributed in the field of high performance sports by conducting numerous researches on the various aspect of the performance factors. The physique and the variables of physical fitness are of prime importance in deciding the performance limits and in predicting the performance. Sport scientists have conducted lot of researches in this field.

Sincere efforts have been made by the research scholar to locate literature related to this study. The relevant studies selected from various sources which the research scholar had come across and which are of direct relevance to the present study are cited below.

*Hoare (2002)* conducted a study to predict success in junior elite athletic players-the contribution of anthropometric and physiological attributes. This study measured the attributes of 125 male and 123 female junior athletic competing at the Australian under 16 championship in 1998. In addition experienced coaches rated the performance of players during the championship. Performance profiles were compared across playing positions and by playing performance (best vs rest). Differences in anthropometric characteristics were present across some playing positions for both males and females. Speed and agility differences between some playing positions were also present. Best players differed to rest players on a number of anthropometric and physiological variables for both males and females.
Regression analysis indicated the test variables accounted for a significant proportion of variance in playing performance for both females (41.3%) and males (38.3%). Anthropometric and physiological profiling can contribute to selection procedures in junior athletes, however determinants of success are multi-factorial.

Kaur, Kaur and Singh (2001) conducted a study to measure the anthropometric attributes of 17 junior athletic players attending National camp for preparation of an International championship. The players age range was from 16 to 18 years with mean age as 17.46 ± 0.68 years. Their mean stature and body mass were measured as 181.54 c.m. and 69.4 kg respectively. Body mass in relation to stature, an indicator of robusticity was 44.20 which showed our player were much lighter for their stature. The players possessed 33.66 kg of muscle mass which was about 48% of total body mass and indicated need for further development. The values of percent body fat and bone mass were 13.42% and 12.48 kgs respectively. It was important to observe that out of 17 players only 6 players had fallen in the required Olympic somatotype circle. On the whole, it was observed that our players were still smaller in height and lighter in their body mass and require somatotypic development to the best of successful athletic players.

Richardson et al. (2000) studied the comparison of body weight and body fat classifications of competitive school - age club swimmers. The purpose of this study was to determine the frequency with which athletic children may be classified into inappropriate weight categories by comparing weight
classifications with estimated body fat classifications. A convenience sample of competitive school-age club 144 swimmers participated in the study. Information regarding swimmers age, race, hours of training per week, and level of swimming achievement was collected. Anthropometric measures included weight, height, a triceps skinfold thickness, and medial calf skinfold thickness. Skinfold thickness measurements were taken using electronic calipers. The results of this study indicate that most subjects classified as not overweight were also classified as not overfat. No particular trend was observed in terms of age, training hours, or levels so achievement among subjects classified as overweight but not overfat.

*Kumar and Panda (2000)* examined the body composition and anaerobic power of athletic trained vegetarians and non-vegetarians. The percentage of body fat, body surface area and anaerobic power of trained vegetarian and non-vegetarian college girls were studied. 30 vegetarians and 30 non-vegetarian athletic trained college girls, age ranging from 16 to 20 years were randomly selected from the degree colleges. Height and weight were measured to calculate the body surface area and four locations skinfold thickness were measured to find out the aerobic power. Result shows that non-vegetarian had more body surface area, percentage of body fat and aerobic power than the vegetarians. It was concluded that non vegetarians are dominating in body surface area, body fat and anaerobic power.

*Anand and Goswami (2001)* conducted a study on 63 elite female athletes to know their eating habits and dietary preferences. It was observed
that 87.5% athletes were non vegetarians, out of non vegetarians 37.4% were taking meat products daily and 89% were taking eggs regularly. In all 60% did not like to take anything at bedtime. All the athletes preferred to take milk and fruits. Regarding the other food habits it was according to their cultural heritage or availability of food in that area from where they belong.

Ching, Makoto and Yamamoto (1999) did the comparison of anthropometrical, biochemical variables and plasma amino acids among centenarians, elderly and young subjects. Aging health is associated with nutritional changes, which were therefore evaluated in this study by comparing the nutritional status of centenarians and elderly relative to young subjects. The participants were 27 young subjects, 40 healthy elderly and 32 centenarians. The activities of daily living, height, weight, body mass index, biochemical variables and plasma amino acid profiles were evaluated. Results suggest that the centenarians had poor nutritional status, which may be due to their decreased metabolism and the possibility that only short, slender individuals with low lipids, protein and essential amino acids are those that tend to survive to be centenarians.

Bryner et al. (1999) studied the effect of resistance vs. aerobic training combined with an 800 calorie liquid diet on lean body mass and resting metabolic rate. The purpose of this study was to examine the effect of intensive, high volume resistance training combined with a VLCD on these parameters. Twenty subjects, mean age of 38 years were randomly assigned to either standard treatment control plus diet or resistance exercise plus diet. Both
groups consumed 800 kcal/day liquid formula diets for 12 weeks. Groups were similar at baseline with respect to weight, body composition, aerobic capacity, and resting metabolic rate. The addition of an intensive, high volume resistance training program resulted in preservation of lean body weight and resting metabolic rate during weight loss with a very low calorie diet.

Saha (1999) studied a comparative study of anthropometric measurements and body composition among individual and team games. Soccer players and track and field athletes were not differ much on selected variables, however a significant difference in total leg length, total arm length, and standing height were obtained. The comparison of various components of body composition of the subjects did not reveal any significant difference between soccer and track and field athletes.

Fleming et al. (1998) saw the effect of graded levels of exercise on body weight, appetite and food intake in normal weight women consuming their normal diet in their natural environment. A recent study in men suggested that changes in energy expenditure (EE) through physical activity (PA) are an effective strategy to alter medium-term energy balance provided subjects are able to attain high levels of EE, while living in their natural environment and consuming their normal diets. Present study was therefore conducted to assess the effect of graded increases in EE through PA on appetite, energy intake (EI), approximate estimates of EE and body weight in women living in their normal environment. Six lean young women were each studied three times during a 9 days protocol, corresponding to no-exercise, medium exercise level and high
exercise level. On days 1-2 subjects were given a medium fat (MF) maintenance diet. On days 3-9, they self recorded dietary intake using a food diary and PETRA weighing system which had recently been validated in Rowett Research Institute laboratory. Subject completed a pre and post treatment sub-maximal fitness test on a bicycle ergometer. These data suggested that while the women showed tendency to compensate, this amounted to only about 33% of the increased EE through PA, precipitating mild weight loss. This suggests that changes in EE through PA are an effective strategy to control energy balance.

Burke et al. (1998) studied the effect of carbohydrate loading on performance of prolonged stochastic exercise. They investigated the effect of CHO loading on the performance of a novel cycling task designed to mimic the demands of road-racing. Seven well-trained cyclists completed the time trial (TT) on two occasions, following a 72 hours preparation with either a CHO loading diet or a placebo controlled diet CHO availability was optimised during both trials using the typical nutritional strategies of competitive athletes. Muscle glycogen levels were significantly increased by CHO loading study shows that CHO loading does not provide an additional advantage to the performance.

Ridder et al. (1998) conducted a study to describe the body composition and somatotypes of world class male African middle distance (MD), long distance (LD) and marathon (M) runners and to compare the three event groups in terms of body composition and somatotypes. The subjects were part of the 398 male athletes who were measured during the Sixth All Africa Games. A total of 17 MD, 16 LD and 16 M runners with a mean age of 25.6 years were
measured. The anthropometric variable and techniques selected were primarily those described in Carter and Auckland. As far as body composition is concerned, there were no significant differences in sum of 6 skinfolds, percentage body fat or percentage skeleton between the groups. The LD runners had significantly less percentage muscle than the MD runners.

*Schokman, Rutishauser and Wallace (1998)* examined pre and post-game macronutrient intake of a group of elite Australian football players. The study describes the energy and macronutrient intakes of a group of 40 elite Australian football players before and after competition. The study was conducted during the 22 weeks of the 1997 Australian Football League competitive season. Mean carbohydrate, protein and fat intakes were calculated both as percentage of total energy and as grams per kilogram of body mass (g/kg BM). A major focus was assessment of CHO adequacy, as measured by well-established minimum nutrition recommendations for endurance athletes (60% En and 6 g/kg BM). A practical outcome was an ability to provide this group of players with appropriate dietary advice regarding CHO ingestion. Weighed food records were used to collect dietary information. Results showed that this group of athletes did not meet minimum CHO guidelines. CHO intake was considerable greater pre-game than post-game. Mean protein and fat intakes fell within guidelines for endurance athletes, whereas mean overall energy intake was below that expected of such athletes. The results suggest that for groups of athletes engaging in endurance team sports where there is considerable variation in body mass, energy requirement and hence, energy
intake, recommendations for CHO intake are more appropriately expressed as g/kg BM. It is suggested that wherever practicable, dietary advice should be based on a prior assessment of dietary intake.

*Vanjana, Marwaha and Soni (1998)* conducted a study on the dietary pattern of the women probable of the IX Asian Games in training campus at NIS Patiala. Data of 19 Indian women athletes were collected at random for the study. The athletes were of a national and the international standard specializing in 8 different sports. The data were collected by using a questionnaire-cum-interview schedule consisting of structured and open ended questions. The information was obtained regarding their food habits, dietary patterns, dietary intake and energy expenditure. The survey revealed that the lack of nutritional knowledge was the cause for the dominance of food-fads and beliefs in the diet of the athletes. Efficiency and alertness, the qualities essential for an athlete might be adversely affected with high intake of food and improper balance of nutrients, especially the high intake of protein and fats. It appears that there is no need of any type of vitamins supplement in the diet, being provided to the athletes in the training camp. The low niacin intake would come up to the recommended level by increasing consumption of carbohydrate rich food like cereals that are good source of niacin.

*Gretsov (1998)* examined the anthropometric and physical fitness parameters for high jumpers of different age groups. Research works conducted on the leading high jumpers throughout the world reveal that each level of achievement in high jump has got its own age limits and is closely connected
with the physical preparedness and physical development. Physical development, especially anthropometric parameters are given much significance. It must be noted that there is no prospective in training those young boys and girls whose parameters are considerably lower than the orientations is no other way for attaining high performance in high jump within a short period of 4-5 years other than spotting young talented tall boys and girls and training them. Height of the sportsperson is an essential component and therefore much significance must be given to this parameter during talent search.

Day, Sinha and Debsray (1997) had a comparative study of selected anthropometric and motor quality profiles of Girls (8-14 years) of Eastern and North Eastern Region of India. The study was carried out on 700 healthy school going girls of ER and NER of India. ER girls were taller than NER girls but NER girls were heavier than their ER counterparts except at the age of 13 years, where ER girls were found to be heavier. Height and weight were found to be the strong predictor of strength and anaerobic performances, where adiposity as selected by sum of skinfolds (fat %) was the weakest predictor of running, jumping and endurance performance. It was concluded that regional variations for different anthropometric and motor quality variables may be attributed due to geographical variation, environmental influences, genetic factor, nutritional variation and differences in socioeconomic status of ER and NER girls.

Vega and Jackson (1996) studied the dietary habits of bodybuilders and other regular exercisers. Specific questionnaire providing information about variables affecting dietary habits was designed and information was collected
from 13 body builders and 40 non body builders. The 24-hours recall for one week day was used to obtain dietary information. Data were evaluated for five food groups-dairy, meat, grain, fruit, and vegetables using standard serving sizes. Body builders emphasized the consumption of certain foods-meats and potatoes. Non body builders calorie intake was below the recommendations but the distribution among food groups was more balanced than body builders.

**Musiager, Ragheb and Marjoq (1994)** organized a study to know the body composition of athletes in Bahrain. A total sample of 304 athletes was selected from first class clubs related to four common sports (Football, Handball, Basketball and Volleyball) and compared with 53 non-athlete adults. Weight, height, mid-arm circumference and skinfold thickness were measured. The findings revealed that their differences in body composition among athletes according to the type of sport. Basketballers and volleyballers were the tallest athletes, while handballers were the heaviest ones. Skinfold thickness measurements showed that athletic and handball players had more subcutaneous fat than other athletic groups. As compared with the non-athletes, the Bahrain players had higher means for height, weight, subcapular, suprailiac thickness and mid-arm circumference.

**Halfrisch et al. (1994)** studied the physical conditioning status and diet intake in active and sedentary older men. The diets and body composition of 16 endurance-trained older athletes were compared to those of 24 healthy and BMI-matched sedentary men. Percent body fat and waist/hip ratio were lower in athletes than in controls. Protein and kcal intake per kg body weight were
greater in athletes. The composition of the diets was different also, with athletes consuming a greater percentage of their calories as carbohydrate, percent body fat was inversely related to kcal/kg intake in athletes but not in control. These results shows that older endurance-trained male athletes can maintain high levels of desirable weight and body composition despite calorie intakes comparable to levels of much younger men.

Singal, Bhatnagar and Dhillon (1993) conducted a study to throw some light on the inter sportive differences in anthropometric measurements and body composition of sportswomen playing at National level. For these 100 sports women namely, Athletic (11), Gymnastic (18), Hockey (35), Volleyball (18) and track and field athletics (18) and 100 non-sports women constitute the control group. While comparing with controls the sports women of all games were generally taller, with bigger trunks, broader shoulders, wider elbows, wrist, knees, and ankles except Gymnastics. The circumferences were larger and the subcutaneous tissue was lesser in all categories of players as compared to controls. The body fat and percent body fat was lesser in players and the lean body mass and percent lean body mass have been found to be larger in all sports women.

Battistini et al. (1992) researched food intake in university students and its impact on nutritional status. The study has assessed the composition of the food distributed by a university canteen analysing the principal nutrients. The computerized data were compared with the laboratory data and both with LARN (Italian RDA, recommended daily allowance) for a male and female student
aged 18-29 years. The energy intake exceeded LARN both in male and female. Proteins exceeded LARN of 25-40% in male and 40-50% in female lipid intake was unbalanced in both sexes being 10-20% in excess for men and 30-40% in excess for female. The daily complex carbohydrate intake was deficient for male and less deficient for female. These were also consuming too much simple carbohydrates.

*Ludbrook and Clark (1992)* examined energy expenditure and nutrient intake in long-distance runners. The daily energy expenditure and nutrient intake of 12 male and 11 female athletes who run more than 70 km/week were assessed using seven day diet and activity diaries. The mean daily expenditure exceeded the mean daily energy intake in the males and females respectively. There were no significant differences between the sexes with respect to the proportions of energy obtained from each of the major nutrients; carbohydrates provided 55.0%, protein 13.5% fat 28.0% and alcohol 3.5% of total daily energy. It shows that long distance runners have adopted a low fat, moderate to high carbohydrate diet which is quite similar to that recommended for athletes.

*Eston et al. (1992)* studied the effect of very low calorie diet (VLCD) on fat-free mass and physiological response to exercise was seen on ten moderately obese women (ages 23-57years) received VLCD (16 day-1) for 6 weeks. Fat Free Mass estimated by four conventional techniques, during a sub maximal in the 2nd and 6th week, and one week after VLCD treatment. Strength and muscular endurance of the quadriceps and hamstrings were tested by isokinetic dynamometry. The 11.5 kg reduction in body mass was approximately
63% fat and 37% FFM. The strength decrease was a natural adaptation to the
reduction in body mass as the ratio of strength to FFM was maintained.

*Kumar, Negi and Shaw (1992)* made a comparative study of body
composition of junior and senior level Indian athletic female players by selecting
senior and 10 junior National athletic players. Each player was examined for
anthropometric measurement like, body weight, height, girths of upper arm,
forearm, thigh and calf, skin folds of biceps, triceps, sub-scapular, supra-iliac
(mid-axillary), forearm, thigh and calf, diameters of humerus, femur, wrist and
ankle. The result showed that non-significant differences appeared between
both the teams, when their age, height, body weight, percentage of muscle
mass and skeletal mass were compared. Co-efficient of various measurements
showed that except percentage (%) of body fat, all other body composition
components were fairly homogeneous. Certainly both the teams differ in their
level of performance.

*Susanna et al. (1991)* studied dietary intake, food habits and nutrition
knowledge of adults by a telephone survey in Hongkong. A pilot dietary survey
using telephone interview was conducted to evaluate the current dietary intake,
food habits and nutrition knowledge of 198 random sample of adults aged
between 18-60. Data collection was undertaken by dietitians and student
teachers using a frequency questionnaire through telephone interview. There
was a high intake of meat group, low intake of rice and cereals, inadequate
consumption of vegetables and fruits, when compared to the established healthy
food guides.
Horwath (1991) examined dietary intake and nutritional status among university undergraduates. Three day diet records were used to estimate usual nutrient intake in a group of 122 undergraduate nutrition students. Information concerning dietary supplement use and dieting patterns was obtained. For men mean intakes for most nutrients were above the recommended levels, and the proportion with intakes below two-thirds of the RDA was also minimal for most nutrients. Dietary supplements were regularly taken at least once a week by 7 per cent of men.

Fogelholm et al. (1991) studied dietary intake and indicators of magnesium and zinc status in male athletes. Indices of magnesium and zinc status were measured in 114 male endurance athletes and 117 healthy controls. Dietary energy, magnesium and zinc intakes, calculated from 122 item food us questionnaires. Correlations between dietary intakes and biochemical measures were not different from zero. In conclusion found no signs of altered magnesium or zinc status in athletes or controls. However, different indicators were poorly comparable on an individual level.

Sedlock (1991) revealed the effect of acute nutritional status on post exercise energy expenditure examine the effect of acute nutritional status on excess post exercise oxygen consumption (EPOC) in women. Eight young adult women performed 200 kcal cycle ergometer exercise at 60% of maximal oxygen uptake. There were no significant differences in any of the baseline measures. The results suggest that acute nutritional status may influence the EPOC
response, therefore may partially account for some of the discrepant findings in the literature.

_Sidhu and Singh (1991)_ saw the relationship of body composition and standing broad jump of physical education students. Investigation was to determine the relationship between body composition considerates and performance in standing broad jump of 157 male physical education students. The standing broad jump was calculated strictly following the instruction given in AAHPER Youth Fitness Test Manual. Body composition variable i.e., body weight, percentage of fat and lean body weight were measured by skin fold method. Pearson's product moment correlation (zero order correlation), partial correlation and multiple correlation were utilized. It was concluded that individual body composition variable did not show any significant correlation with body weight and percentage of fat respectively. Further, it had been found that combination of body composition variable had significant correlation with power.

_Sodhi, Sohata and Mathur (1991)_ conducted a study to assess the body composition of elite Indian sportsmen. The data of 635 elite Indian athletes and sportsmen specializing in different sports and events had been reported. A set of anthropometric measurements using standard methodology were taken on each subject which included height, body weight, biocondylar widths of humerus and femur, the diameters of wrist and ankle, the circumferences of upper arm, forearm, thigh and calf and the skinfolds at biceps, triceps, forearm, thigh, calf, supracliac and subcapular sites. The muscle and bone masses have been estimated by using Matiegka's method (1921). The body density measured by
using Durnin and Womersley (1974) and body fat % by Brozek et al (1963). It's noted that the heavy class wrestlers had maximum development of bone mass as well as muscle mass as compared with any of the other game and second best is discus and hammer throwers.

*Kaur (1990)* conducted study on nutritional status of college athletes. The nutritional status of girl athletes have been assessed. A sample of 50 girl athletes and 50 girl non-athletes has been collected from Govt. women College, Patiala. The nutrient intake of athletes was significantly higher than non-athletes. The athletes were found to be significantly heavier with more developed muscles and fold-skin. But there was no significant difference in the hemoglobin level of athletes and non-athletes.

*Bhardwaj et al. (1990)* conducted a study on body composition and body segment volume proportions of Indian athletes and sportsman. Body density, extremity segment volume and total body volume were measured together with 15 other anthropometric measurements on 93 Indian sportsmen and athletes. The group consisted of runners, boxers, athletes, footballers, gymnasts, wrestlers, swimmers and the control group of active soldiers not participating in such athletic or sports events. The wrestlers had the largest body volume and were fattest. The gymnast were smallest, leanest and had greatest lean body mass per kg. body weight. Extremity segment volume when expressed as percentage of total body volume or as % of adjacent segments further differentiated the groups on the basis of arm or leg segment volume proportions.
alone, it was possible to distinguish to many groups from each other. Thus, gymnast, basketballers and wrestlers could clearly separated on these criteria.

*Kapoor and Khanna (1990)* conducted study on the dietary Intake of School Athletes in Chandigarh. A random samples of 155 athletes (B and G) who played at inter school, state and national level were chosen. The games selected were Volleyball, Hockey, Lawn-Tennis, and Football. The questionnaire-cum-interview schedule was used for obtaining the required information. The study revealed that majority of them starts playing at 11-13 yrs. And majorities of them were non-vegetarians and they liked fried and spicy food. However, they stopped such foods during or near the event and consumed more of mild and its products and fruits and fruit juices. They felt these foods give them strength and these are easy to digest. No one was taking any drug for improving performance in athletic activity. Energy intake was much below the standard value set by NIN. Similarly carbohydrate, protein intakes were less than recommended but fat contributed more calories then desired. On the whole the intake of vitamins (Thiamin, Riboflavin and Vit. C) and minerals (Calcium) were found to be satisfactory except for iron which was less than the recommended allowance specially in girl athletes.

*Kiminsky (1989)* examined the thermic effect of carbohydrate and fat intake before, during, and after graded exercise meals consisting predominantly carbohydrate or fat followed by a graded exercise test was compared to a no meal trial in 7 women. Oxygen consumption increased similarly during the 45 min period following both meals, energy expenditure was greater in CHO during
the final hour of recovery. It was concluded that CHO and FAT induce similar increases in VO₂, however, energy expenditure is slightly greater in CHO due to greater caloric cost of carbohydrate versus fat oxidation.

**Kathleen (1989)** studied the dietary carbohydrate intake and endurance exercise performance of trained female cyclists. Seven highly trained female cyclists rode on a cycle ergometer at 80% VO₂ max. to fatigue following week on consumption of isocaloric diets containing low (LCHO), moderate (MCHO) or high carbohydrate (HCHO) content. Subjects were randomly assigned to dietary treatments with all subjects eventually consuming all diets. Individually, most subjects rode the longest when consuming 6-7g CHO/kg body weight (HCHO diet). Mean R values during exercise were significantly greater. Female athletes increased their time to fatigue as the carbohydrate content of their normal diets increased.

**Vallieres, Tremblay and Jean (1989)** studied the energy balance and the nutritional status of highly trained female swimmers. Six elite female swimmers performing about 15 hrs of training/week. Their daily energy needs were assessed during a 30 days cycle of training being representative of their annual training schedule. Three-day dietary and activity records as well as body composition measurements were performed at the beginning and at the end of the study. The body composition measurements showed a slight increase in fat free mass during the study, while body weight and fat mass remained unchanged. Results show that energy intake was adequate to satisfy the increase in energy expenditure associated with training.
Bawa and Debnath (1988) studied the physique of Indian women national team. The study was conducted on 34 girl gymnasts who qualified for competition I b during the national gymnastics championship. These 34 girls were further divided into three groups i.e., high, mediocre and low performance groups on the basis of their competitive performance. High performance group consisted of the best eight girl gymnasts of competition. Age, weight, height, arm length, leg length, upper arm and thigh circumferences, biceps, triceps, subscapular, supra-iliac, calf, and thigh skinfolds were obtained on each subject. One way analysis of variance (ANOVA) was applied to find out significance of difference in each variable among three groups. Within the limitations of the study it may be concluded that the girls who excel in sub junior level Gymnastic competitions were older in that particular age group. It may also be concluded that those who had active better performance had thinner skinfolds.

Mokha and Siddhu (1987) organized the study to know the body fat in various sportive groups. Data collected on 81 control subjects and 458 female players of basketball, volleyball, hockey and track and field events. Body fat was calculated by using the formula of Durnin and Womersley (1974) for which four skinfold measurements were taken on each subject, i.e., biceps, triceps, subscapular and supra-iliac. Almost all the categories of players possess significantly less amount of fat as compared to the controlled (24.81%). Among players minimum amount of body fat % found in the jumpers (19.18%), followed by runners (19.69%), hockey (22.31%), volleyball (23.12%) and basketball players (23.25%) and being maximum in the throwers (23.85%).
Harrison et al. (1986) researched the composition of lean tissue in healthy volunteers for nutritional studies in health and disease. Measurements of body composition were carried out on 56 healthy female volunteers 20 - 80 years of age. Anthropometric measurements were made to estimate lean body mass older group had significantly less protein and less bone minerals than younger adults. Protein, the essential component of lean tissue, was not correlated to either ANLBM or to intracellular water. Simple anthropometric measurements may provide reasonable estimates of the fat and lean fractions of total body mass. However the composition of lean tissue varies with aging. To determine the essential components of lean tissue, direct measurements of protein and bone mass are required.

Denis, Lydia and Welke (1986) studied blood pressure in young adults as influenced by diet, anthropometrics, calcium status, and serum lipids. A sample of 197 males and 174 females between the ages of 19 to 35 yr were assessed for blood pressure, health and exercise status, use of food supplements, and anthropometrics. Calcium status was assessed by use of diet records, fasting total serum calcium levels, serum ionized calcium levels, and urine calcium excretion. Males in the elevated blood pressure group did have greater calcium excretion compared to the males with lower blood pressure. What was greater in the elevated blood pressure groups. Most of the subjects in the subsample appeared to have adequate calcium status.

Louise and Andree (1986) studied the validity of a short method based on food frequency and multiple regressions to evaluate the nutrient intakes of
French Canadian women. A short method of dietary analysis, based on food group frequencies and multiple regressions, was developed and validated from 3-day dietary records from a group of 306 French Canadian divided in two independent groups of 173. These equations were calculated for energy, protein, fat, complex carbohydrates, concentrated sugars, iron. Findings pointed out that the short method is valid to study the nutrient intakes of a group of subjects because the mean results were similar to those obtained from 3-day food record.

Chauhan et al. (1986) examined the relationship between selected anthropometric variables and performance in standing broad jump of collegiate women. For the present study, 42 college age women had been studied for 27 anthropometric variables i.e. eleven linear measurements, five girths, five diameters and six skinfold measurement for subcutaneous fat. All the subjects in the study were in the age group of 18 to 23 years. Body composition variable i.e. body density, lean body mass and fat weight were calculated by using the equations of Durning and Rehaman (1967). Among the correlations of linear measurements, the coefficient of correlation of foot breadth has been found to be positive and significant. In the case of girth measurements, only the coefficient of correlation of hip with the performance had been found to be significant i.e. the increase in the hip girth, the performance decreased. None of the body diameters had been found to have significant correlation with the performance. It is evident that body fat weight and lean body mass were significantly and negatively correlated with the performance.
Mathur and Salokum (1985) conducted the study on body composition of successful Nigerian female athletes. They included: non athletes (n=33), university level athletes (n=48) and national level athletes (n=69). Subject’s anthropometric measurements and body composition were measured. Insignificant differences (P>0.05) between the anthropometric variables and body composition of university and national level athletes were observed. The measurements were significantly different (P>0.05) between athletes and non-athletes and between the athletes of different sports (volleyball, throwers, sprinters and distance runners). Differences in various measurements within the athletic group had been attributed to physical demand of each sport.

Hanson, Garcia and Hatchkiss (1985) estimated the body composition of obese college women from anthropometric and physiological measurements. Relationships between anthropometric and physiological measurements and body composition were examined in 42 obese college women. Estimates of body density, fat weight and fat free weight were obtained by the helium dilution method. Anthropometric measurements included height, weight, four body diameters, four body girths, hand grip strengths and seven skinfold thicknesses. The equations that most accurately estimated body composition included skinfold thickness, hand grip strength, basal metabolic rate, and a variable calculated from height and weight. When equations selected from the literature were used, BD and FFW were consistently overestimated and FW underestimated.
**Hirata (1984)** described physiques through height and weight and his F-index of the athletes of Tokyo, Munich, and Montreal Olympics. He observed considerable differences in age, height, and weight of participants in different events. Hirata concluded that: (1) The average height gradually increased (between the 1964 and 1976 Olympiads). For those sports where tallness is an important factor, athletes became taller, whereas for sports where tallness is unimportant (e.g. long distance runners, cyclists), no changes were observed. (2) The F-index showed that Olympic athletes generally are becoming 'leaner' (e.g. long distance runners and high jumpers) except for sports in which a 'stout' physique is preferable (e.g. shot-putters, discus and javelin throwers). Furthermore Hirata suggested suitable criteria for Olympic top performances in terms of age and ponderal indices.

**Carter and Yuhasz (1984)** conducted a study of skinfold and body composition of Olympic athletes. In order to estimate levels of fatness of Olympic athletes, skinfold data on 1690 male and 308 female athletes were assembled and analyzed. Data were available from five Olympics for male and three for female. Comparisons were made by gender and sport event. Olympics and reference groups, through use of skinfolds, sum of 4 and 6 skinfolds and skinfolds patterns. The results were summarized as follows: (a) Skinfolds of athletes in most of the sports are smaller than in comparable reference groups. (b) Sexual dimorphism in skinfolds, in terms of both level and pattern, is consistent within sports. (c) Female athletes have thicker skinfolds and different patterns than male. Mean skinfolds patterns of 4 or 6 sites are consistent in
pattern for the game gender, but there are differences in level according to sport. (d) The lowest skinfolds for female athletes are found in gymnasts, middle distance runners and jumpers, with the highest skinfolds found in shot-discus throwers, swimmers, roars, and canoers. (e) The lowest skinfolds for male athletes are found on gymnasts, runners, hurdlers, walkers, pole-vaulters, and in some athletes in the lighter weights of weight-class sports. (f) The highest skinfolds are found in shot, discus, hammer throwers, water polo players, fencers, and athletes weighing over 100kg in weight-class sports. (g) In general, there are few differences between events in most sports, the exceptions being track and field and the weight-class sports. (h) In male athletes there is no evidence of change in skinfolds for those in track and field, weight lifting or wrestling from 1960 to 976. (i) The consistency of skinfold levels and patterns by sport are suggested as models associated with optimal performance for athletes in these sports. (j) Skinfolds are suggested as useful for monitoring athletes in training, and 6 skinfolds are recommended as the minimal number. (k) When taken by a trained anthropometrist the sum of skinfolds is probably as accurate an indicator of levels of fatness in Olympic athletes as other procedures presently used. (l) When adiposity is low in athletes, fat free weight is probably of greater functional significance than fat weight.

Among the Indian track athletes, the hurdlers dominated all the runners and the walkers in many anthropometric measurements, except the chest circumference (Sodhi and Sidhu, 1984). They possessed a longer lower extremity in relation to the length of the trunk. The hurdlers, in both the events
had better developed bicondylar diameters, though the degree of this development was greater in the lower extremity than that in the case of all other track athletes. Among the hurdlers, the 110 mts. men were found to dominate the 400 mts. men in the length of trunk and the breadth of shoulders, but were more slender in the chest, narrower in the hip width and lighter in the weight than the latter. The 400 mts. hurdlers had a greater amount of lean body mass like sprinters, the 110 mts. hurdlers on the other hand were less muscular than the sprinters. They also had relatively small chest and lightweight as compared with all track event athletes.

Joseph (1984) determined the relationship of selected kinanthropometric variables and strength to performance in sprints. The analysis of data showed a significant relationship between leg power, abdominal strength, thigh girth and calf girth to speed performance. Where as the relationship of height and leg length to speed performance was not significant.

Wilmore (1983) compared the body composition and anthropometric characteristics of sportsmen and women participating in different sports and games and be found that athletic and volleyball players had more height and weight than sprinters and cross country runners. The percent body fat was 12.4%, 10.2%, 10.6% for sprinters, cross country runners and athletic players respectively in male section and 16.5%, 17.7%, 20.8% and 21.3% for sprinters, cross country runners, athletic players and volleyball players respectively in female section.
Kansal (1982) studied 246 male students in the age group of 11 to 17 years. Their height, weight, biacromial, humerus, bicondylar, chest and calf circumferences and performance in 100 meters running, shot put and standing broad jump were examined. He concluded that the above said body measurements showed significant degree of relationship with individual performance tests studied. Further with the help of these differential roles, preparation of selection criteria for choosing budding athletes at a young age was also attempted.

Butts (1982) tested 127 high school female cross country runners on % body fat, ratings of perceived exertion and maximum $O_2$ consumption during a continuous running treadmill test. The high school female cross-country runners had higher VO$_2$ Max. than previously reported for this age groups However, they were considerably below these values reported for national level distance runners.

Marrow et al. (1982) studied the kinanthropometric characteristics strength and performance of forty-nine American discus throwers, hammer throwers, javelin throwers and shot putters who participated in pre-Olympic training camp. Comparison between event participants indicated that they differ significantly on the strength and kinanthropometric variables but were alike in terms of motor performance variables.

Gangadharan (1981) conducted a study on selected anthropometric measurements i.e., height, chest girth, upper arm girth, thigh girth, calf girth and weight of 60 athletes of different sports, and concluded that
volleyball players were significantly taller than athletic and hockey players. The groups did not differ significantly in any other anthropometric measurements under taken in the study.

_Cunningham and Anderson (1981)_ tested six high school cross country runners, who were members of the team which won the Massachusetts state school championship. Mean kinanthropometric values found in this team to be shorter, lighter and less fatty when compared to age related norms. The mean somatotypes was considered more ectomorphic and less mesomorphic than elite endurance athletes. It was concluded that members of a championship cross country team exhibit a physiological profile which are characteristics of endurance athletes. Team members showed little inter-individual variation. No adverse effects of season long training were noted. Several well known cardiovascular risk factors were considered low normal in this group.

_Farrel and Coyle (1980)_ investigated on 18 experienced male distance runners. Physical characteristics and responses to maximal exercise on an average of eight treadmill runs at various speed were taken. The relationship between heart rate and treadmill velocity was linear (r=.95). The correlation between performance and most of these variables are not in excess of the correlation found in this study. Thus as a predictive tool, heart rate at a standardise treadmill velocity may be preferable due to the easy data collection.
Campbell (1980) conducted research on the relationship of selected measures of physical performance and structure to quality of performance in collegiate footballers. He tested 40 male footballers for height, weight, 10, 20, 30, and 40 yard dash speed, vertical jump, agility, upper body strength and lateral movement along with a game performance assessment. No relationship was found between height, weight, agility and upper body strength to performance. Speed was found positively related to performance. He concluded that the performance in football cannot be effectively predicted by combination of structural and physical performance variable considered in the study.

Hirata (1979) reported data on age, height, weight and ponderal index of 711 females Montreal Olympic players of Basketball (N=11), Volleyball (N=104), Handball (N=81) and Athletics (N=445). All the players were in the age range of 22-35 years. He reported that the average athletic players and the average high jumpers were the tallest (177.0 cm) among all the other categories but the players of the gold medalist team of athletic had on average height 182.4 cm.

Hirata (1979) reported data in respect of the participants of Rome, Tokyo, Munich and Montreal Olympic players with respect to different events. As the distance progressively increased from 100 mts. and 200 mts. to 400 mts. and 800 mts., the runners gradually became a little taller and leaner. The tendency of increasing leanness was observed from sprinters to the long distance athletes. In Munich and Montreal Olympics the 400 mts. men were taller than the other three groups.
Diez (1979) investigated the relationship among selected kinanthropometric variables and relative body fat in college age women. The result indicates that simple anthropometric measurements can be used to predict body density and body fat in college-age women by the regression equation developed on the other samples of college age women are somewhat less predictive of fat contents.

Bevans (1978) studied female gymnasts (N-35) and distance runners (N-35) from a college population. Twelve measurements were taken to determine somatotypes by use of the Heath Carter anthropometric methods analysis of data showed that the Gymnasts were significantly greater than distance runners in body weight and skinfold measurements of subscapular and supra-illiac and calf valued as well as percent body fat. Distance runners tended to be low in fat content.

Muthiah and Venketswarlu (1973) reported data of Indian track and field athletes and noticed, the throwers to be heavier, taller and older than other athletes. Among runners, the age increased and the height and weight decreased with the increase in the distances they ran. The jumpers and hurdlers were taller and heavier than sprinter, but were shorter and lighter than throwers. The decathletes were the second heaviest as they are all-rounders.

Malhotra (1972) and his associates studied the functional capacity and body composition of the throwers, jumpers, sprinters and the middle and the long distance runners. The trackmen and jumpers 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 maximum \( O_2 \) intake capacity values in terms of body weight and lean body mass. Similarly the trackmen had lower maximum heart rate than the other group of athletes. The jumper and throwers have stronger muscles power. However, the latter were strong in arm and shoulder muscles strength too.

_Eiliben (1972)_ studied 125 women athletes during the European Athletic Championship. He found that in each anthropological character the sprinters had small dimensions than all other women athletes. Their small stature was due mainly to their short trunk. Their lower extremities, especially their thighs were long as compared with trunk. The development of their widths was moderate, the upper extremities less muscular, the lower limbs especially the lower legs, were strong with well developed muscles. The hurdlers were strong and muscular. Their stature was nearly identical with the sprinters, however their trunk was somewhat longer and their lower extremities, relatively shorter. As regards the proportions of the lower a extremities the relatively long legs and shorter thighs were characteristic of them. Their extremities were muscular specially the lower legs.