CHAPTER 2

Review of Related Literature
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This chapter primarily aims at presenting the various studies conducted on the anthropometrical and psychological variations among long distance runners at different level and also on other team games. In this pursuit, the researcher had gone through various books, journals, periodicals & other related materials. The information that came out after the painstaking review of all these material had helped the researcher greatly in pursuance of this study.

_Saha, G. C. (2012)_ the study was to compare the Anthropometric measurements and Body Composition among Individual and Team Game. The subjects for this study were thirty male students, each from Soccer and Track and Field Intervarsity teams of Lakshmibai National University of Physical Education, Gwalior. They were selected with the view of obtaining scores on selected Anthropometric measurements and Body Composition. The age of the subjects ranged between 18 to 25 years. The variables selected for the study under Anthropometric measurements were Standing Height, Sitting Height, Total Arm Length, Total Leg Length, Upper Arm Girth, Hand Girth, Thigh Girth, Calf Girth and Chest Girth while under Body Composition the variables under taken were body Weight, Percentage of Body Fat and Lean Body Mass. To
determine the significant difference between the mean scores of subjects belonging to Soccer and Track and Field on Anthropometric measurements and Body Composition variables, the ‘t’ ratio was employed. The level of significance chosen was 0.05. The results of the present study indicate that Soccer and Track and Field Athletes did not differ much on selected Anthropometric measurements and Body Composition, however a significant difference in Total Leg Length, Total Arm Length and Standing Height was obtained.

Singh, Singh and Singh (2012) conducted a study to find out anthropometric measurements, body composition and somatotyping differences in high performer and low performer shot putters. 20 male shot putters of age 18 to 25 years were assessed for the present study. Out of which 10 were high performers and 10 were low performers. All subjects were assessed for height, weight, widths, girths and skinfold thickness. The independent samples t-test revealed that high performer shot putters were significantly taller ($p<0.01$) and had significantly greater all the length measurements when compared to low performer shot putters. The high performer shot putters also possessed significantly greater upper arm ($p<0.05$), forearm ($p<0.01$), chest ($p<0.05$), thigh ($p<0.05$) circumferences and bi-humerus ($p<0.01$), wrist ($p<0.05$), bi-acromial ($p<0.01$), hip ($p<0.05$) diameters as compared to low performer shot putters. Endomorphy ($p<0.05$) was significantly higher in low
performers while the lean body mass (p<0.05) was significantly greater in high performer shot putters. It is concluded that in most of the parameters there were significant differences between high performer shot putters and low performer shot putters, and the high performer athletes showed better anthropometric measurements and somatotyping scores.

Abraham (2010) conducted a study to analyze the anthropometry and body composition associated with performance of university level male track and field athletes of South India. This study was conducted on 93 track and field athletes from South India, comprised of 22 sprinters (100 & 200 mts), mean age 19.5 years, height 172.1 cm and weight 68.2kg, 20 middle distance runners (800 & 1500 mts), mean age 19 yrs, height 166.8 cm and weight 62.5 kg, 16 long distance runners (5000 & 10000 mts), mean age 18.7 years, height 167.2 cm and weight 62.1 kg, 20 throwers, (shot, discus & hammer throw), mean age 19 years, height 170.8 cm and weight 72.6 kg and jumpers (High, long & triple jump), mean age 18.3 years, height 169.9 cm and weight 64.1 kg. Besides height and weight, six skin folds (triceps, chest, sub scapular, abdomen, supra iliac & calf), two bicondylar breadths (humerus & femur) and two girths (biceps & calf) were measured. Somatotype evaluations were made according to Carter and Heath (1990) method. BMI was calculated as body mass divided by square of height (kg/m2). The somatocart indicated that sprinters and middledistance runners are ectomorphic
mesomorphs, long distance runners are mesomorph ectomorphs while throwers are endomorphic mesomorphs. The jumpers fell into the somatotype category of balanced mesomorphs. Among all groups body fat percent is lowest in sprinters (6.23±0.83%) and highest in throwers (7.38±0.85%). This was reflected in their endomorphic components which is lowest in sprinters (2.53±0.45) and highest in throwers (3.39±0.65). Ectomorphic component is highly marked in long distance runners (3.56±0.65) while mesomophy was highest in sprinters (4.31±0.91). Throwers have significantly higher values of skin folds than other groups. Compared to their overseas counterparts, the athletes of both track and field events in the present study exhibited greater endomorphic values.

Campos et al., (2009) assessed the anthropometric profile and motor performance of young badminton athletes. The sample included 20 athletes (10 male athletes, mean age 17.24±1.18 years and 10 female athletes, mean age 15.21±2.06 years) playing in the Brazilian junior badminton team. The following variables were assessed: body weight; height; skin fold thicknesses; abdominal strength/resistance; medicine ball throw; 20-meter speed; vertical jumps: vertical squat jump, counter movement vertical jump; and aerobic power. Descriptive statistics (means and standard deviations) and student’s t-test were used for data analysis. Differences were considered significant at the level of p<0.05. The results
found in this study regarding male and female athletes were, respectively: body weight (68.0±7.8 and 61.74±6.85 kg), height (172.4±0.5 and 163.8±0.3 cm), sum of seven skin folds (83.21±22.02 and 131.58±29.36 mm), abdominal strength/resistance (33±3.3 and 28±5.8 n), medicine ball throw (7.54±1.01 and 6.98±0.78 m), 20-meter speed (3.12±0.08 and 3.5±0.14 seconds), vertical squat jump (36.7±6.0 and 27.2±2.1 cm), countermovement vertical jump (39.3±5.7 and 28.1±2.4 cm) and VO2 max (49.68±2.48 and 42.92±2.94 ml/kg/min-1). The results of this study describe anthropometric and motor test characteristics of young athletes playing in the Brazilian junior badminton team. The findings of the study may also help coaches in identifying and choosing new badminton athletes.

Ansari and Singh (2007) conducted a study of physical and physiological differences between elite middle and long distance runners of India. For the purpose of this study three sample groups of different categories of runners from various National level competitions (1st group comprises of 14 elite 800 m runners, 2nd group comprises of 17 elite 1500 – 5000 m runners and 3rd group comprises of 19 elite 5000 – 10000 m runners) were selected. Analysis of variance was applied to assess the significant difference in the physical and physiological variables of the three groups. Statistical analysis of this
study indicated that the 800 m runners’ were greater in mean weight, stature, sitting stature, shoulder breadth, hip breadth, upper arm length, fore arm length, thigh length, lower leg length, biceps muscle girth, calf muscle girth, sum of five skin fold, endomorphic rating, mesomorphic rating, thigh length – lower leg length index, hip breadth – stature index, heart rate and vital capacity than 1500 – 5000 m and 5000-10000m. runners. Whereas 5000-10000 m, runners were greater in mean Ponderal index than the 800m and 1500-10000m runners. However no differences were found between humerus biepic condyle diameter, femur biepic condyle diameter, ectomorphic rating, sitting height – stature index, upper arm length – lower arm length index and shoulder breadth – stature index of 800 m,1500-5000m and 5000 – 10000 m runners of India.

Singh and Singh (2007) conducted a study on selected anthropometrical characteristics of Indian elite male athlete of different throwing events. Purpose of the study was to find out the anthropometrical differences among four type of throwers (shot put, discus, javelin and hammer throwers). For this purpose100 Indian elite male throwers 25 each were selected from various national level tournaments. The analysis of variance was applied on gathered data of selected anthropometrical variables. Results of the study had shown that the shot putter were greater in weight, Femur Biepicondylar, Humerus
Biepicondylar, Hip Breadth, Shoulder Breadth, wrist breadth, skin folds, biceps muscle girth, calf muscle girth, thigh muscle girth, chest girth, chest depth, endomorphy, mesomorphy, upper arm length – lower arm length index, hip breadth stature index and fat percentage than other throwing groups. And the discus throwers were greater in height, forearm muscle girth and total leg length than the other throwers groups. Whereas the javelin throwers were greater in total arm length, ectomorphy and ponderal index than the other throwing groups and the hammer throwers were greater in shoulder breadth- stature index than the other throwing groups.

**Arrese, A.L., Ostáriz E.S. (2006)** studied to determine whether the sum of skin fold thicknesses and specific single skin fold sites were related to competitive running performance in homogeneous groups of male and female elite athletes. In total, 184 top-class runners (130 males and 54 females) volunteered to participate in the study. Skin folds were measured at the following sites: biceps, triceps, sub scapular, pectoral, iliac crest, abdominal, front thigh and medial calf. Runners were classified into groups in accordance with their best performance times. Correlation analysis and partial correlation coefficients that controlled for age and weight were applied to each single skin fold, the sum of six skin folds (excluding biceps) and the extremity (sum of triceps, front thigh,
medial calf) to trunk (sum of sub-scapular, iliac crest, abdominal) ratio and performance. Performance was rated by the scoring procedures of the International Amateur Athletics Federation. In male runners, the pectoral, iliac crest, abdominal, biceps, triceps, sub-scapular skin folds and the sum of six skin folds were not associated with performance score for any of the distances. High correlations were found between the front thigh ($r = 0.78$, $P = 0.000$) and medial calf ($r = 0.55$, $P = 0.018$) skin folds and 1500 m run time, and between the front thigh ($r = 0.59$, $P = 0.014$) and medial calf ($r = 0.57$, $P = 0.017$) skin folds and 10,000 m run time. In female runners, the front thigh and medial calf skin folds were highly correlated with 400 m run time ($r = 0.71$, $P = 0.022$ and $r = 0.81$, $P = 0.005$, respectively). The results of this study indicate that skin fold thicknesses in the lower limb are positively associated with running time over several distances, and may be a useful predictor of athletic performance.

Khalid and Singh (2005) Carried out a study to ascertain the differences between high and low performance volleyball players in relation to their Anthropometrical and physiological variables and found that the selected National or high level performance volleyball players were taller, heavier in proportion to stature, broader shoulder, wider hip, longer upper and lower extremities then the low performance volleyball players. They had lesser rating of endomorphic and mesomorphic
components but a higher rating of ectomorphic component. The fat free mass was also greater in the high performance volleyball players.

Chauhan, M.S. (2004) carried out a study on prediction of performance of university level throwers in relation to their anthropometrical measurements. The findings of that study led to certain conclusions. Age, body weight, height, sitting height, trunk length, leg length, fore-leg length, thigh length, total arm length, upper and fore-arm length, all have positive and significant correlation with performance of university level throwers. The circumferences i.e. shoulder chest, abdomen, hip, arm and thigh circumferences have significant and positive correlation with the throwing performance. Biacromial, bicristal and elbow diameters possess positive and significant correlation with the performance in throwing event. Among skin fold measurements (biceps, sub scapular, suprailiac and calf skin fold) have positive and significant correlation with performance in throwing event. Body density and lean body mass have negative and significant but fat percent and fat weight had positive and significant correlation with throwing performance. Multiple correlations of body weight, height and total arm length collectively have significant correlation with the throwing performance. The size of multiple correlations is quite sufficient and hence the regression equation can be
used for the prediction of throwing performance of university level throwers.

**Pate Rr. et. al (2003)** studied physiological, anthropometrical and training correlates of running economy. Potential physiological, anthropometrical and training determinants of running economy (RE) were studied in a heterogeneous group of habitual distance runners (N = 188, 119 males, 69 females). RE was measured as VO$_2$ (ml.kg$^{-1}$.min$^{-1}$) during level treadmill running at 161 m.min$^{-1}$ (6 mph), (VO$_2$ -6).

Examined as potential determinants of RE were heart rate and ventilation while running at 6 mph (HR6, VE6), VO$_2$ max (ml.kg$^{-1}$.min$^{-1}$), % fat, age, gender, height, weight, estimated leg mass, typical training pace, training volume and sit-and-reach test performance. RE was entered as the dependent variable and the potential determinants as independent variables in zero-order correlation and multiple regression analyses. Zero-order correlation analysis found VO$_2$ max, HR6 and VE6 to be significantly, positively correlated with VO$_2$ -6 (P < 0.001). Multiple regression analysis, in which the independent effect of each predictor variable was examined, revealed VO$_2$ -6 to be positively correlated with VO$_2$ max (P < 0.001), HR6 (P < 0.001), VE6 (P < 0.001), and age (P < 0.05) and negatively correlated with weight (P < 0.01). These findings indicate that, in a diverse group of runners, better RE (VO$_2$ -6) is
associated with lower VO₂ max, lower sub maximal exercise VE and HR, lower age and greater weight.

**Maldonado. S, Mujika. I. and Padilla S. (2002)** studied influence of body mass and height on the energy cost of running in highly trained middle and long-distance runners. Previous studies about the influence of body dimensions on running economy did not compare athletes specialized in different competition events. Therefore, the purpose of the present study was to assess the influence of body mass (bm) and height (h) on the energy cost of running (Cr) in 38 highly trained male runners, specialized in either marathon (M, n = 12), long middle-distance (5000 - 10000 m, LMD, n = 14) or short middle-distance (800 - 1500 m, SMD, n = 12), and to assess possible differences in body dimensions for each event. Subjects performed a progressive maximal exercise on the treadmill to determine oxygen uptake VO₂ at different sub maximal velocities and maximal oxygen uptake VO₂ max. Cr was calculated from VO₂ measurements. LMD runners had significantly higher mean Cr (0.192 +/- 0.007, 0.182 +/- 0.009, and 0.180 +/- 0.009 O₂ ml.kg⁻¹.m⁻¹ for LMD, M and SMD, respectively) & VO₂ max (74.1 +/- 3.7, 68.5 +/- 2.9 and 69.7 +/- 3.4 ml.kg⁻¹.min⁻¹). Cr correlated with h (r = -0.86, p < 0.001) and m (b) (r = -0.77, p < 0.01) only in the SMD group. In conclusion, these data suggest that highly trained distance runners tend to show
counterbalancing profiles of running economy and VO\textsubscript{2} max (the higher Cr, the higher VO\textsubscript{2} max and vice versa), and that anthropometrical characteristics related with good performance are different in long-distance and middle-distance events.

Shamin P. (2002) carried out a study to ascertain the difference in physical and physiological characteristics of high and low performance basketball players and found that the high performance basketball players had greater weight, height, sitting height, femur biepic condyle diameter, humerus biepic condyle diameter, shoulder width, hip width, upper arm length, thigh length, lower leg length, biceps muscle girth, calf muscle girth and hip width – stature index than low performance basketball players. High performance basketball players had more mesomorphic – ectomorphic rating and have better segmental proportionality than low performance basketball players. There was no significant difference in ponderal index, thigh length – lower leg length index, upper arm length – lower leg length index and shoulder width – stature index of high and low performance basketball players. High performance basketball players had lower heart rate and greater vital capacity than low performance basketball players. However there was no significant difference in systolic and diastolic blood pressure of high and low performance basketball players.
Vujovic D. and Lozovina V. (1999) Examined the differences between two groups of elite athletes’ anthropometric measurements. The groups were from sports of water polo and rowing. Subject was measured with a set of 18 anthropometrical measurements. Multivariate analyses on manifest measurements as well as on score on latent dimensions were employed to analyze the differences between the groups. Differences were based on differences in measurements, which can be attributed to muscle tissues and fat tissues, which were both in favor of water polo players. There were no differences in measurements of skeleton except for the measurements of bi-cristal width and legs length. Different training procedures and different surroundings in which activities were taking place caused the differences. No, differences in skeleton measurements were the consequence of the selection process.

Derider J. et. al. (1998) Conducted a study on world-class male African middle, long distance and marathon runners with the purpose of determining the body composition and somatotypes. The subjects were part of the 398 male athletes who were measured during the sixth All African Games held in Harare, Zimbabwe in September 1995. A total of 16 MD (800 m & 1500 m), 16 LD (3000 m, 5000 m) and 16 M runners (N = 49) with a mean age of 25.6 years were measured and the
majority of these distance runners were black (91.8%). The anthropometrical variables and techniques selected were primarily those as described by Carter & Ackland (1994). Data analysis was performed using Statistica 5.0 (Stat Soft, Inc. 1984-1996). A one-way analysis of variance procedure (ANOVA) and the Tukey HSD test were used for all comparisons. The level of significance was set at $p < .05$. The M runners were significantly older than both the MD and LD runners. The MD runners were significantly heavier and taller than the LD and M runners. As far as body composition was concerned, there were no significant differences in sum of 6 skin fold (MD = 33.3mm, LD = 37.7mm, M = 32.6mm), percentage body fat (MD = 6.6%, LD = 7.3%, M = 7.5%) or percentage skeleton (MD = 14.1%, LD = 14.1%, M = 14.7%) between the groups. The LD runners had significantly less percentage muscle (53.9%) than the MD (58.7%) and M (57.5%) runners. The mean somatotypes were 1.4-3.4-4.2, 1.6-2.9-4.3, 1.4-3.9-3.9, for MD, LD and M runners respectively, with the overall mean 1.5-3.5-4. There were significant differences ($p < .05$) by event group between the mean somatotypes as well as the means of the mesomorphic component where the LD runners were significantly lower in mesomorphy than the M runners.
Ackland T. et al. (1998) Carried out a study to determine the body morphological components of the triathlon. Competitors from 11 nations (n = 87, but 71 with complete data included in this analysis) were measured on a battery of anthropometrical dimensions prior to competition. The sample included elite males and females, as well as junior competitors who all raced over the same course and distance and under the same rules. Standardized measurement technique was used. All variables were measured on the right side of the body and the median score for skin folds (triple measures), or mean score for other variables (duplicate measures) were recorded. Bivariate Pearson correlation was performed separately for males (n = 41) and females (n = 30) subjects. For both genders, total time (TT) correlated more highly (p < 0.01) with cycle time (53% of TT) and run time (30% of TT), than swim time (17% of TT). Male triathletes who possessed an ectomorphic shape, with a large chest breadth and a high proportional thigh length, were advantaged. However, performance times were negatively influenced by high levels of adiposity (p < 0.01) and other measurements of body bulk such as hips and thigh girths (p < 0.05). Successful female triathletes showed similar characteristics to the males, being advantaged by factors pointing to a linear physique (greater arm span, proportional arm and hand lengths (p < 0.05) and with large chest girths (p < 0.1). Those athletes having greater
adiposity (p < 0.01), or greater thigh and hip girth (p < 0.05), did not perform as well.

**Orvanova E. (1990)** Conducted a study to find out the differences in body structure between young and adult weight lifter in ten weight classes, and between weight lifters and non-athletes. Weightlifters in younger age groups differed from the adult one in the parameter, which were correlated with performance results. Weight lifter differed from non-athletes according to weight classes. In lower weight classes, lifter had smaller height, shorter length and width measurements and the values increased with weight class. But weight lifters in all weight classes had shorter thighs and forearms and greater arm girths. The length of thighs and forearms can be used as important factors for talent selection.

**Chauhan, M.S. (1986)** studied relationship between selected anthropometric variable and endurance running performance. He concluded that height, leg length, thigh length, total arm length, shoulder, chest, abdomen, hip and knee girths, thigh and calf skin folds and lean body mass had significant and negative correlation with 1500 m endurance running performance, where as 10,000 m running performance had statistically insignificant correlation with linear segment, girth and diameter measurements except with skin fold
measurement (triceps, suprailiac, midaxillary, thigh and calf skin-fold) and body composition variables (i.e. body density, fat percentage, fat weight and lean body mass)

Multiple correlation of 1500 meters running performance with combination of selected anthropometric variable were significant. Similarly the multiple correlation of 10,000 meters running performance with combination of selected skin fold and body composition variables were significant. But the multiple correlations were not sufficient size to put them in to the prediction equation.

Tom Ecker. (1985) stated that human running permit the body to float in the air between strides, with both feet off the ground approximately half the time. Thus the runners’ strides can be considerably longer than the length of the legs. In theory, an increase in either stride length or stride frequency will increase a runner’s speed. However, each of these factors has such an effect on the other that there are times when increasing one reduces the other enough to produce a slower speed. There is the direct relationship between leg length and both stride length and stride frequency. A sprinter with short legs has naturally shorter strides, which brings the foot back to the ground sooner if the stride was longer. Generally, shorter the leg, shorter the stride and slower the frequency.
Sodhi H.S. and Sidhu L.S. (1984) stated that in case of the middle and long distance, the use of aerobic power increases with the increasing distance of the event. The performance mainly depends on much muscular effort, unlike the sprinters. Since the force applied on the lower limbs depends upon the utilization of oxygen in the muscles throughout the period of running. Under these circumstances, the athlete run at some cruising speed without putting the pace to maximal. The natural greater length of the lower extremities will help to provide them with the greater stride. Therefore those athletes, who are endowed with proportionally longer lower extremities, have an additional advantage.

Gerhardt Schmolinsky (1983) observed the athletes of 800/1500 m and 5000/10000 m demonstrated a continuous gradient in many anthropometrical measurements and in musculo-skeletal tissue in the limbs. The first mentioned being the largest and the last mentioned is the smallest among them. However, the subischial length with respect to stature formed a gradient in the reverse order. The 800/1500 m and 5000/10000 m athletes showed a reduced amount of body fat as compared with the short distance runners, but the musculo-skeletal tissue decreased even up to marathon athletes. The marathon runners were found to be slightly larger than the 5000/10000 m runners in most
of the measurements. The 800/1500 m runners and marathoners had relatively narrow shoulders but the latter possessed relatively broad hips.

Boileau RA, Mayhew JL, Riner WF, Lussier L. (1982) in their study compared the physiological responses of highly trained middle (MD) and long distance (LD) runners during treadmill running. The oxygen uptake (VO2) of 74 elite runners (42 MD and 32 LD) was measured during treadmill running at several speeds (201, 241, 282, and 322 m/min at 0% grade) and at maximal effort. The mean VO2max (ml/kg X min) of the LD runners (76.9) was significantly higher (p less than 0.01) than the value for the MD group (68.9). At each running speed, the relative oxygen costs (%VO2) was lower (p less than 0.01) for the LD group averaging 8% less across the four running speeds. The slopes of the relationship between submaximal VO2 (ml/kg X min) and running speed of 0.183 and 0.216 for the MD and LD groups, respectively, were not significantly different. The relationship between running performance, maximal treadmill running time (TRT), and VO2 was studied for each group. VO2max was more highly correlated with running performance in the MD group (r = 0.70) than in the LD group (r = 0.32) although the standard errors of estimate were similar for both groups. Results of this
investigation demonstrated that there were differences in the metabolic characteristics of the MD and LD runners.

**Garay et al. (1974)** reported Mexico Olympic weight lifters had an average somato type of 2.4-7.1-1.0. They found increase in endomorphy and mesomorphy in the lifters of increasing weight categories. In the two lightest weight categories, the three medalists averaged close to 1.7-1. All seven medalists among the weight lifters studied were for above in mesomorphy. One heavy weight medalist had a somato type rating of 4.5-10-0.5. This was the highest rating of somatotype. In size, the Mexico Olympic weight lifters were 168 cm in height and 76.6kg in weight. An increase in these measurements was noticed in the lifters of increasing weight categories (de Garay et al. 1974).

**Sidhu and Wadhan (1974)** in their study on throwers found to be heavy and tall with relatively large limb circumferences and bi-condylar diameters. They had better-developed lean tissue in the limps associated with greater amount of fatty tissue.

**Muttiah and Venketswarlu (1973)** studied the Indian track and field athletes and noticed the trawlers 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 sprinters, but were the second heaviest as they are all-rounder.

**Eliben (1972)** studied 125 women athletes at European athletics championship. He found that in each anthropometrical character the sprinters had small dimensions than all other women athletes. Their small stature was mainly due to their short trunk. The lower extremities especially their thighs were long as compared with the trunk. The development of their width was moderate, the upper extremities less muscular, the lower limbs, especially the lower legs, were strong with well-developed muscles. As regards to the proportion of the lower extremities the relatively long legs and shorter thigh were characteristics of them. Their extremities were muscular especially the lower legs.

**Malhotra (1972)** studied the functional capacity and body composition of the throwers, Jumpers, Sprinters and the middle and long distance runners. The trackmen and jumpers were found to have a higher lean body mass with less flat content than the throwers who were tall and heavily built. The middle and long distance runners had highest and the throwers, the lowest maximum or intake capacity values in terms of body weight and lean body mass, similarly, the trackmen had lower maximum heart rate than the other groups of athletes. The Jumpers and throwers had
stronger muscle power; however the latter were strange in arm and shoulder muscle strength too.

**Carter (1970)** found heath rated 34 white Olympic, all category runners to be uniformly low in the first component. The 800/1500 m runners were half a unit higher on mesomorphy than 5000/10000 m runners and marathon runners, whereas the 5000/10000 m was half a unit higher on the third component than the other two groups.

**Parnell (1958)** plotted Somato charts of competitors in various track and field events and noted the difference between events, even though those athletes reached moderate standards of performance.

**Telka and his associates (1951)** studied 245 top ranking track and field athletes and wrestlers. They did not find any appreciable differences with respect to constitution among the athlete of different branches, except in certain extreme groups. However, they found them different from the control sample. They stated that material body build of a definite type did not appear to be a necessary prerequisite to the achievement of good athletics results. However during 1954, the same workers again reported the top ranking track and field athletes and related various body measurements to performance. Throwers were tallest in this material and they seemed also to benefit most from their height. The correlation between the relative shoulder breadth (with
stature) and performance was significant in throwers and long distance runners. The correlation between the relative shoulder breadth (with stature) and performance was negative and highly significant in the case of the throwers. The correlation between the relative chest circumference (with stature) and performance was negative and highly significant in the case of sprinters and positive and significant in case of throwers.

Kohlrausch (1929) studied the athletes who participated in the 1928 Olympic Games at Amsterdam. He discovered that the best sprinters in the world were 142.3 Lb in weight and 67.9 inches in height, with a weight/height index of 2.17 and a vital capacity of 4300 cc as average measurements. The 400 meters runners were slightly taller (69.2 inches), slightly heavier (143.7 Lb.), and more linear (2.10) with vital capacity of 4500 cc. The middle distance runners’ averaged 146.7 Lb in weight, 58.9 inches in height, and 2.19 for body built and 4800 cc as the vital capacity. The long distance runners’ averaged 132.7 Lb in weight, 66.8 inches tall, 2.10 for body built and 4300 cc the vital capacity. Jumpers were found to be tall with long legs and quicker. Vaulters, hurdlers and middle distance runners were quite similar in built.
Amar (1920) pointed out that people of small stature were relatively strong as compared with the tall ones and quicker because the weight decreases in proportion to the cube of the size, where as the force decreases in proportional to the cross section of the muscle, short heavy-set people are remarkably strong and make good weight-lifters, Carters and heavy labourers. The “grasshopper” types with relative runners, vaulters, hurdlers and ability athletes.

Bemies (1900) demonstrated similar trends as the results of the study of five outstanding track athletes. The runners and jumper were found to be 2 inches above average in height and with the arm reach an inch longer, with longer legs and also with the lower leg an inch longer than other persons of the same height, the calf and thigh averaged smaller and the hip an inch narrower. He suggested that these leg proportions gave a quick acting upper leg and a long reach with the lower.

Competitive Anxiety and Self-Confidence

Bhardwaj (2011) conducted study to compare the athletes on basis of psychological variables among sprinters, jumpers, middle distance runners, long distance runners & throwers. The present study was conducted on three hundred and seventy five athletes from All India Inter
varsity Athletic championship. Seventy five subjects from each group i.e. sprinters, middle distance runners, long distance runners, jumpers and throwers were taken. The age of the subjects ranged from 17 to 25 years. The results of the study revealed significant difference among sprinters, middle distance runners, long distance runners, throwers and jumpers on Excellence, Power, Sensation, success, State and Trait Anxiety among.

Adam, N. R. et al., (2010) this study was to explore the relationships between (a) coping self-efficacy and subjective performance, (b)coping self-efficacy and pre-competitive anxiety, and (c) pre-competitive anxiety and subjective performance. Participants were 307 athletes (252 males, 55 females) aged 16-34 years (mean age 21.3 years, s = 2.8) who competed at national/international (n = 18), county (n = 54), club/university (n = 139), and beginner (n = 96) level. All participants completed a measure of coping self-efficacy and anxiety before a competitive event and a subjective performance measure after competing. Our findings revealed that there was a significant and positive relationship between coping self-efficacy and subjective performance. Negative relationships between coping self-efficacy and both somatic and cognitive anxiety were also observed. However, somatic and cognitive anxiety did not predict subjective performance. The present findings support previous results regarding the influence of self-efficacy and
provide applied practitioners with recommendations that may enhance athletic performance, via improving the coping self-efficacy beliefs of their clients.

Rattanakoses, R. et al., (2009) examined the relationship between imagery and confidence in athletes. The Sport Imagery Questionnaire and a Self-Confidence questionnaire were used to collect data. The samples consisted of athletes who are from the Khon Kaen Sport School in Thailand and who regularly participate in sports training (5 days a week). All subjects (n=120) were selected by purposive sampling and consisted of 71 (59.2 %) male and 49(40.8 %) female athletes. Our analysis considered two parameters, imagery and self confidence, which were evaluated with regards to the physical fitness level and experience of the athletes. The data was analyzed using a t-test to determine the difference of the means between imagery and self-confidence measures in males and females. Analysis of variance (ANOVA) (P<0.05) was used to evaluate differences across the groups, and linear regression and correlation analyses (r =0.71) were used to compare between genders, physical fitness, and experience levels. The results show that there are significant correlations between males and females in terms of imagery and self-confidence. This result suggests that imagery and self-confidence in male
and female athletes are associated with high levels of physical fitness and more experience in sports situations.

**Rokka et al., (2009)** studied to evaluate the levels of intensity and direction of the competitive state anxiety in junior handball players prior to a competition and to investigate any possible differences between male and female players, as well as in relation to their athletic experience. The sample of the study consisted of 115 handball players, members of eight handball teams (four male and four female), which participated in the Greek Junior Handball Championships finals held in Athens in 2008. For the data collection, the model used was the Competitive State Anxiety Inventory-II (CSAI-II, Martens, Burton, Vealey, Bump & Smith, 1983; Martens et al., 1990; Jones & Swain, 1992), which was modified for the Greek population by Stavrou, Zervas, Kakkos & Phychoudaki (1998). All players filled in the questionnaire 30 minutes before the competition. The results showed that male junior handball players reported lower scores of cognitive anxiety, which was facilitative to performance. On the other hand, females displayed a higher score in cognitive anxiety, which was rather debilitative to performance. Furthermore, junior male handball players displayed higher self-confidence, with positive effects on their performance, while female handball players stated lower self-confidence, which was neither facilitative nor debilitative to performance. In relation
to years of experience, the results revealed that players with four to six years of experience showed higher self-confidence with facilitating direction, while players with less years of experience displayed lower self-confidence, with neither facilitative nor debilitative effects on their performance. In conclusion, the psychological preparation of junior handball players must be taken into serious consideration, during the coaching procedure. Nonetheless, further investigation is needed for the generalisation of the results in Greek handball.

Yahaya, M. et al., (2009) conducted a study to correlate a relationship between competitive anxiety and coping strategies among athletes of different levels of representation in Malaysian sports (national, state, district, university, and school levels) and gender. The sample consisted of 902 Malaysian athletes, and comprised of national athletes (N=53), state athletes (N=395), district athletes (N=120), university athletes (N=211), and school athletes (N= 123), male (N =) and females (N =). Each participant completed an instrument that comprised of a 27-item Competitive State Anxiety Inventory–2, a 16-item Positive Coping Anxiety Strategies (Cognitive and Somatic), and a 3-item Negative Coping Strategies. The data for the Competitive State Anxiety Inventory–2 was collected twice, before and during competition. The results showed that male and national athletes used the highest level of cognitive
strategies. It was also found that male and district level athletes used the highest level of negative coping strategies. There was also a negative correlation between cognitive and somatic coping strategies, and cognitive anxiety. National and state level athletes had the highest level of performance and school level athletes' the lowest. Athletes, who used the highest levels of cognitive, somatic or negative coping strategies, achieved the highest performance in sports. The results are of significance in explaining the way athletes use coping strategies to deal with anxiety. Additionally, sport psychologists, sport counselors and coaches should use the findings to design coping strategies for their athletes to deal with anxiety and to enhance their performance.

**Doug et al., (2006)** the research aimed to conduct basic descriptions of temperamental traits and the level of state and trait anxiety of young male athletes, and to compare them by type of sports. Study participants were 277 athletes and 152 non-athletes who were all high school boys. The Korean version of the Temperament and Character Inventory (TCI) was used for checking temperamental traits while the Korean version of the State and Trait Anxiety Inventory form Y (STAI-KY) was used to estimate anxiety levels. Harm Avoidance score of athletes was higher than that of non-athletes. Harm Avoidance score of golfers was lowest and that of swimmers was highest. The state anxiety
score of baseball players was lowest and that of Taekwondo players was highest. The trait anxiety score of baseball players was also lowest and that of golfers was highest. Both trait and state anxieties of the 'winner' group were lower than those of the 'no winner' group. While prior research mainly focused on athletes’ environment and phenotypic characteristics, we studied the pattern of temperaments in athletes along with its potential influence on athletic performance.

Krane, V. and Williams, J. M. (2006) the purpose of the present study was to examine cognitive anxiety, somatic anxiety, and self-confidence in male and female high school and college track and field athletes in the USA. Athletes (N = 216) completed the Competitive State Anxiety Inventory-2 (CSAI-2) within 20 minutes of each event in which they competed at a prestigious invitational track and field relay meet. Consistent with expectations, a $2 \times 2 \times 2$ (gender by competitive level by place) MANOVA revealed male athletes reported lower somatic anxiety and higher self-confidence than female athletes and college athletes displayed lower cognitive and somatic anxiety than high school athletes. Contrary to hypotheses, the place main effect was not significant. A significant three-way interaction was found on the cognitive anxiety subscale. College male non-placers displayed the lowest levels of cognitive anxiety while high school male non-placers displayed the
highest levels. When examining the hypothesis that athletes in sports of differing complexity and duration would have different anxiety and confidence levels, only cognitive anxiety was found to differ in athletes in events of differing complexity with the high complexity athletes displaying greater cognitive anxiety than the low complexity athletes. No significant anxiety or confidence differences were found among athletes in events of differing duration.

Kais and Raudsepp, L. (2005) conducted a study to examine the relationship between the intensity and direction of competitive state anxiety, self-confidence and performance in basketball and volleyball players prior to different matches. Male basketball (n=12) and volleyball players (n=12) completed a modified version of the Competitive State Anxiety Inventory-2 (CSAI-2) prior to 11 different matches, and a total of 132 questionnaires overall. The inventory included an intensity subscale as well as direction sub-scale for somatic and cognitive anxiety. The findings revealed a moderate level of state anxiety and very high self-confidence of the players before the matches. The cognitive and somatic anxiety and self-confidence were stable prior to the different matches. Correlation analysis showed that the intensity and direction of somatic and cognitive anxiety and self-confidence of the players were not related
to their athletic performance. However, the intensity of cognitive anxiety was positively and moderately related to their athletic performance.

**Rani Usha (2004)** conducted a study to determine intentional inter-personal style and anxiety level of college boys and girls at different levels of sports participation. A sample of 300 college boys and girls were taken. Samples were divided in two levels i.e. State/ inter-collegiate and national/inter-university level competitions. Spielberger’s State-Trait Anxiety Inventory was used to measure anxiety levels. To compare these groups 2x2 factorial ANOVA was used. The result obtained from this analysis is given as under:

i) There exists a significant difference between college boys and girls on state anxiety.

ii) There exists a significant difference between high achievers on state anxiety.

iii) There exists a significance difference between college boys and girls on traits anxiety.

iv) There is no difference between high achievers and low achievers on trait anxiety.

**Tracey and Pero (2004)** the purpose of this study was to examine the relationship between self-confidence, anxiety, and mood states in
collegiate tennis players. The Competitive State Anxiety Inventory--2 (CSAI-2) and the Profile of Mood States (POMS) were utilized based on their ability to assess a number of different psychological states thought to be crucial for proper mental preparation prior to athletic competition as well as for their psychometric properties. These inventories were employed to determine pre-competition levels of anxiety, self-confidence and mood disturbance and their relationship to successful or unsuccessful tennis match outcome. Twenty-four collegiate tennis players completed the POMS and CSAI-2 30 minutes prior to their tennis match during their participation in the NCAA Regional (VII) Team Tennis Tournament. Results revealed winning tennis players displayed significantly higher self-confidence, lower cognitive and somatic anxiety levels, and lower total mood disturbance scores than losing players. In addition, winning tennis players exhibited the iceberg profile on the POMS, which is consistent with the findings in similar research conducted with successful athletes in other sports. As such, athletes who displayed high self-confidence and low anxiety levels were potentially able to remain calm and relaxed under pressure and were not as affected by negative events. Furthermore, these results suggest that mental state prior to the start of a tennis match plays a crucial role in overall success or failure. An individual's positive or negative mental state has long been thought to...
Woodman and Hardy (2003) this meta-analysis (k = 48) investigated two relationships in competitive sport: (1) state cognitive anxiety with performance and (2) state self-confidence with performance. The cognitive anxiety mean effect size was $r = 0.7010$ (P 50.05). The self-confidence mean effect size was $r = 0.24$ (P 50.001). A paired-samples t-test revealed that the magnitude of the self-confidence mean effect size was significantly greater than that of the cognitive anxiety mean effect size. The moderator variables for the cognitive anxiety–performance relationship were sex and standard of competition. The mean effect size for men ($r = 0.7022$) was significantly greater than the mean effect size for women ($r = 0.7003$). The mean effect size for high-standard competition ($r = 0.7027$) was significantly greater than that for comparatively low-standard competition ($r = 0.7006$). The significant moderator variables for the self-confidence–performance relationship were sex, standard of competition and measurement. The mean effect size for men ($r = 0.29$) was significantly greater than that for women ($r = 0.04$) and the mean effect size for high-standard competition ($r = 0.33$) was significantly greater than that for low-standard competition ($r = 0.16$). The mean effect size derived from studies employing the Competitive State Anxiety Inventory-2 ($r = 0.19$) was significantly smaller than the mean effect size derived from studies using other measures of self-confidence ($r = 0.38$).
Measurement issues are discussed and future research directions are offered in light of the results.

The purpose of this study was to extent the work of Jones and Hanton (2001) by examining difference in affective states of performers who reported facilitating or debilitating interpretations of symptoms associated with pre competitive anxiety. Competitive athletes (N=229) completed state and traits several of the CSAI-2 (Martens, Burton, Vealey, 1990), including intensity and direction subscales (Jones & Swain, 1992) and an exploratory measure of pre competitive effective responses in preparation and competition. “Facilitators” reported significantly greater positive labeling of affective experiences than “Debilitators” while cognitive interpretations of symptoms were reported to change with regard to preparation for and actual performance. The findings further support the need to examine the labeling and measurement of pre competitive affective states.

Lazarus (1966) supports the value of a slight rise in anxiety previous competition. Members of the University of Florida variety swimming teams were given an anxiety test previous the season and another approximately an hour previous the competition. It was concluded that rise in anxiety previous competition improved