Chapter -II
REVIEW OF RELATED LITERATURE
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The research scholar has gone through the available literature which is relevant to anthropometry, motor performances, physiological and psychological variables of players participating in different sports events have been presented in this chapter to provide the background material of the study.

In a comparative study of physical structure of Olympic athletes, Carter and associates\(^1\) concluded that rowers were heavier and taller, and had greater sitting height, leg length, shoulder and hip width and thigh girth than most other sportsmen. Gymnasts were lighter and shorter and had shorter arms and legs, smaller hip breadth and thigh and calf girth than other athletes. Swimmers, hockey players, fencers and cyclists were intermediate on most variables, with a few differences among themselves.

Hebbelinck\(^2\) studied the anthropometric measurements, somato


type rating and certain motor fitness tests of Physical Education majors in South Africa. The data were obtained from fifty-two male Physical Education majors comprising all the students available. Anthropometric measurements included: height, weight, shoulder width, neck girth and waist girth. Somato-type rating was done on the basis of Sheldon method. Motor fitness tests were speed, dynamic strength, agility. The following fitness tests were administered: 60 yards dash, chinning, dipping, standing broad jump, standing vertical jump and putting the shot. The anthropometric data showed a predominant trend towards athlete type as described by Kretschmer. The relationship between motor fitness and body measurement found to be low except neck girth and shot put. The mosmorphic trait was most distinctive feature of the subject somato type. Mesomorphs were superior in all motor fitness tests except 60 yards dash. Ectomesomorphs were better than endomesomorphs in all events except shot put.

Terral\(^\text{3}\) studied the relation of pre and post puberty anthropometric measurements and physical fitness tests scores of American Negroes and Caucasian females. To measure physical fitness AAHPER Youth Fitness Test was used. Anthropometric measurements and physical

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\(^3\) Ruth E. Terral, "Relationship of Pre and Post Puberty Anthropometric Measurements and Physical Fitness Test Scores of American Negro and Caucasian Females as Measured by AAHPER Physical Fitness Battery," Completed Research In Health Physical Education and Reaction, (1968): 73.
fitness scores of 50 pre and post puberty Negro females of junior high school, age were the data used for determining relationship between anthropometric measurements and physical fitness. Negro’s have significantly longer legs, longer arms and hands, longer feet, a wider shoulder girdle and narrower pelvic girdle than Caucasians and therefore they proved better in 50 yards dash and soft ball throw for distance.

Read⁴ assessed the anthropometric and strength characteristics of the high school competitive gymnasts. The upper and lower one-third of a group of gymnasts as determined were used as subjects. Good gymnasts were found to be average, significantly less than poor gymnasts in measure of standing height, sitting height, iliospinal height, arm span, lower extremity length, and left and right upper arm extremity length. Good gymnasts were significantly more Ponderous than poor gymnasts and were found to possess a proportional greater chest breath then chest depth.

Hammes⁵ concluded that the total height, sitting height, foot


length, metatarsal, phalangeal to calcaneus, and medial malleolus to calcaneus length, had no relationship to vertical jumping ability. There was relationship but not of predictive value of weight, total leg length and lower leg length to vertical jumping ability. He used 146 girls as subjects.

Martin conducted a study by comparing the selected anthropometric measurements and physical performance between Mexican American and Anglo-American adolescent boys. Also comparison of body size, body structure and physical performance were made between the subjects at adjacent age levels with in each individual racial groups. The body size was assessed by standing height and body weight measurements. Body structure was interpreted as upper arm girth, chest girth, abdominal girth, thigh girth and calf girth measurements. The physical performance was determined by selected motor ability tests. It was concluded that the Anglo-American subjects were significantly taller than the Mexican-American subjects. It was also concluded that excluding standing height, the Mexican and Anglo-American subjects did not differ in body size and body structure and also these two races did not differ in physical performances.

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Nemour\(^7\) did a comparative study of anthropometric measurements of Caucasian and Negro boys and girls to find out the differences in anthropometric measurements and at the same time differences in standing broad jump, medicine ball put, and zig-zag run performance of the boys and girls of both races. A total of 900 subjects were taken. Subjects were of different age groups of six to ten years. Anthropometric measurements were standing height, sitting height, weight, length of arm, length of fore arm, length of the hand, length of the upper extremity, length of the thigh, length of the leg and length of the lower extremity. He found that at the age of six to eight and ten years, boys differed from girls in most anthropometric measurements. However, there were no differences in standing height, leg and lower extremity length, Negro boys and girls had longer appendages and were taller than Caucasians. Negro boys and girls were not superior in the events of power and agility.

Dey et al.,\(^8\) made an attempt to find out whether at certain levels of achievement, sportsmen participating in different games and


characterized by district anthropometric measurement, and to find out proportionate ratio of segmental and total body measurement required for a sportsman for a particular game. For this study, 12 from each sport i.e. swimming, basketball, handball and table tennis were selected from the top first four standing teams of National School Games. The result of the study have indicated that a) Basketball players have significantly higher height, arm length, leg length, thigh girth and weight than those of the handball, swimming and table tennis players. b) Handball players possess more height, leg length, thigh girth and weight as compared to swimmers and table tennis, c) Arm length, arm girth of swimmers are more as compared to handball and table tennis players, d) There was no significant difference between table tennis players and players of other games in the selected anthropometric measurements.

Gladden and Colacino\(^9\) studied the height, weight, skin folds, vertical jump and maximal anaerobic power of 88 female participants of the 1974 United States Association National Tournament. The volleyball player were (172.2 cm.) tall with (68.5 kg.) of weight, with regard to total skin folds. The players were very lean when compared to the national population of females. The final standing in the tournament

was significantly correlated with age, height, vertical jump and maximal height on jump. The partial rank correlation showed that height and vertical jump were the major factors correlated with final standing.

Luce\textsuperscript{10} did a comparative study of body size, body structure and physical performance between Mexican-American and Anglo-American adolescent boys at ages eleven, twelve, thirteen, fourteen, fifteen, sixteen and seventeen. Four hundred and forty subjects were selected, 125 Mexican-American and 315 Anglo American male students. The subjects were classified into fourteen experimental groups - according to race and chronological age. Each racial group consisted of seven age levels. The Mexican-American and Anglo-American subjects were compared on body-size, body structure and physical performance. Body-size was ascertained by standing height and body weight measurements. Body structure was interpreted as upper arm girth, chest girth, abdominal girth, thigh girth and calf girth measurements. The data was analyzed by analysis of variance design. It was found that the Anglo-American subjects had significantly higher mean standing height at the eleven, fourteen, fifteen, sixteen and seventeen years old age levels. Although a few isolated significant differences were found between the

Mexican American and Anglo-American subjects in the other body-size and body structure measurements at same age levels. None of these differences were consistent throughout the age levels tested.

Carter\textsuperscript{11} has conducted a study on somato types of college level football players. The purpose of study was to describe the somato type of college football teams. Thirty-five Lotenman at San Diego State were somato typed and compared by positions and with other samples. The findings indicated that there were somato type and size differences between playing positions between players at different college levels. Some somato types, which are rare in the general population, are common in football players. The dominant physique in the study was the extreme endomorphic mesomorph. Gross size is an outstanding characteristic of college football players.

In a comparative study of physiques of Olympic athletes Tanner\textsuperscript{12} concluded that there are very striking differences in body size, shape and structure between competitors in different events. It was observed that sprinters were relatively short and very muscular men compared with middle distance runners. The 110 M. hurdlers were large, long legged


\textsuperscript{12} Tanner, \textit{The Physique of the Olympic Athlete}, pp. 103-104.
sprinters. High jumpers were tall men. The throwers of discus, shot, javelin and hammer differed greatly in physique from the other athletes. The weight lifters had a physique that was some ways similar to the throwers.

Shandall\textsuperscript{13} established the relationship of selected motor performances and anthropometric measure traits in successful volleyball players. He used a six-item battery for this purpose and he found out that the power appeared to be the most significant factor in the successful volleyball performance.

Marrow, Jackson, Hoster and Kachurik\textsuperscript{14} established the importance of strength, speed and body size for team success in women's Intercollegiate Volleyball. Various anthropometric, strength and speed variables were obtained on 180 Intercollegiate women volleyball players who participated in the regional round - robin tournament. The purpose of this study was to determine the factors underlying the motor performance of women and then determine if there was any relationship between the factors and team success. Factor


analysis of the measured variables showed that the variables could be
dimensioned as body size, speed, fat, and strength. Multiple
discriminant analysis showed that the teams were significantly different
on the factors of strength and speed/fat. The two dimensioned
discriminant space were plotted and the graphic representation showed
that the stronger, faster and leaner teams were the most successful in
tournament play. The results showed that the basic factors of speed/fat
and strength were related to team success. Multiple discriminant
analysis helped to identify the two most important individual variables
for team success. Upper body strength and fat weight were identified as
most important in differentiating between players of the most and least
successful teams.

Ward and Associates\textsuperscript{15} conducted a study to compare
anthropometric measurements between master and first class Olympic
weight lifters and to assess if body segments proportionately contributed
to performance level. A total of 39 measurements were record which
included length, circumferences, age and center of gravity position. The
results indicated few statistically significant differences between seven
first class and three master Olympic weight lifters. The master were

\textsuperscript{15} Terry Ward, Jack L. Goppel and Michael Stone, “Anthropometric and
Performance in Master and First class Olympic Weight Lifter”. \textit{The Journal of
stouter in body type than the first class lifters.

Marrow and Hoster\(^\text{16}\) related the volleyball playing ability to various anthropometric, speed, and strength variables were obtained on 180 inter collegiate women volleyball players who participated in regional tournament. Factor’s analysis of the variables showed that the variable could be dimensioned as the body size, speed/fat and strength multiple discriminant analysis showed that the terms were different significantly on the factors of speed and strength/fat. The graphic representation of team centroids showed that the stronger, faster and leaner teams were not successful in tournament. The results showed the basic factor of speed and fat/strength which are related to success upper body strength, weight and fat were identified as most important in differentially between the players of the most at the least successful teams.

Wells\(^\text{17}\) conducted a study where the measurements of body weight, body height, leg strength, vertical jump, and length of body


segments (Foot Shank, Thigh and Leg) were taken on 49 male college students to see whether significant relationships existed between vertical jump, height and any of the following leg strength/body weight ratio length of selected segments of the lower limbs and ankle, heel length/metatarsal length ratio. More of the relationships proved to be statistically significant.

Dutler\textsuperscript{18} concluded that the measures and indices which were significantly larger at the 0.05 level for good vaulters, were tibial height, chest girth, shoulder girth, shoulder width, right grip strength, leg power and speed, illiospinal height, thigh length and shoulder width plus shoulder girth and sitting height.

Panigrani\textsuperscript{19} conducted a study was to compare the anthropometric measurements of the sprint swimmers and sprint runners. Forty subjects (twenty from each group) who represent National and All India Inter-University Swimming and Athletics Championship were chosen. The subjects belong to different parts of India and belong to varying socio-economic status. The average age of the subjects was in years, ranging


from 20 to 28 years.

The following anthropometric measurements of the subjects were taken as criterion measures were weight, standing height, chest girth, arm length, upper arm girth, fore arm girth, thigh girth, leg length, thigh girth, calf girth. All the measurements were made using standard procedures, the scores of sprint runners and sprint swimmers in each of the criterion variables were tested for significance of the mean differences by the ‘t’ test at 0.05 level of significance.

Saha\(^{20}\) made a study to compare the selected physical fitness variables and anthropometric measures of tribal and non-tribal student’s items of AAHPER Youth Fitness test. i.e., 50 yards run, 4x10 yards shuttle run and 600 yards run/walk and selected anthropometric measurements i.e., chest girth, height, weight, upper arm length, thigh girth and calf girth. In all tests and measurements the mean score of the composite score of tribal students were higher than their non tribal counter parts, but none of difference in means was found statistically significant at 0.05 level of confidence.

Brengden\textsuperscript{21} made a comparison of physical fitness and anthropometric measures of pre-adolescent, Mexican American and Anglo American males. Three hundred Anglo American and three hundred Mexican American males between age of eight and eleven years were selected as subjects. AAPHER Youth Fitness test was used to measure physical fitness. Thirteen anthropometric measurements were taken. These were standing height, sitting height, weight, shoulder width, arm length, chest girth, waist girth, hip width, thigh girth, leg length, calf girth, foot length and arm girth. The findings revealed significant differences between the Mexican American and Anglo American males in certain physical fitness items anthropometric measures and varies physical fitness items were significantly higher for the Mexican American males the result indicated that Anglo American males are superior in performing selected physical fitness items.

Reid\textsuperscript{22} in his study examined the relationship of flexibility, strength and anthropometric measurement of lower limb to the skating


speed of hockey players. Seventeen university hockey players were assessed for leg and grip strength using cable tension method, lower limb flexibility by using Cieghten's flexometer technique anthropometry of leg and skating speed understanding the flying start conditions with and without a stick over two feet distance, 40 feet and 25 meter. The strength, flexibility and anthropometric measures were the independent variables and the skating speed was the dependent variables. The data were analyzed using Pearson product moment and step wise R statistical methods (P< .05). The results indicated that flexibility was specific to each point measured there was a general strength factor and a general body type for skating two of the skating speed tests encompassed many factors of other six, flexibility was related to strength and anthropometry.

Dey\(^{23}\) in his study on selected anthropometric measurements and physical fitness components of offensive and defensive football players concluded that offensive players possess higher cardio-vascular endurance and explosive strength than those of defensive players. Defensive players have significantly higher leg length, thigh girth,

height, weight and Crural index as compared to offensive players. The group did not differ significantly in speed, calf girth and poderal index.

Dureha\textsuperscript{24} compared the selected motor components such as speed, agility, explosive strength and endurance with selected anthropometric variables such as height, weight, leg length, arm length, thigh girth and wrist diameter of offensive and defensive hockey players at college level. Subjects were fifty male students from college of Gwalior in the academic session of 1983-84. Statistical analysis of data employed the 't' test so as to compare the offensive and defensive players. It was concluded that there was no significant difference between offensive and defensive players of hockey in selected motor and anthropometric variables.

Miller\textsuperscript{25} compared the effect of individual and team sports programmes on the motor ability of inter collegiate freshmen. Barrow's Motor Ability Test, with items of zigzag run, standing broad jump; medicine ball put, 60 yards dash, soft ball throw for distance and wall pass was used to measure the motor ability. The team sports included

\footnotesize{\textsuperscript{24} Dilip K. Dureha, "Comparison of Selected Motor Component and Anthropometric Variables of Offensive and Defensive College level Hokey Players", (Unpublished Master's Thesis, Jiwaji University, Gwalior, 1984).}

were basketball, soccer, softball and volleyball; whereas the individual sports were badminton, bowling and tennis. After the experimental period was over, subjects were retested on Barrow's Motor Ability Test. It was concluded that team sports had a significantly different effect only on the 60 yards dash team item. The ‘t’ test analysis indicated that the team sports had a significantly different effect on the wall pass test and the ‘t’ test analysis indicated the effect of soccer and volleyball was significantly different.

The Scheffe's Test was used to test the significance of the two groups. Correlations were obtained for each of the different age levels and for the total sample population on the following: physical fitness and anthropometric measures, age and physical fitness measures, age and anthropometric measures. The significant difference between the correlations was tested by two techniques.

The report showed that there exists difference in physical fitness and anthropometric measurements in the two subcultures of the United States. Both groups exhibited higher body measurements and fitness scores at each succeeding age level. This denotes a relationship between physical fitness and physical growth. Age as the predictive factor was important to both the groups.
Marrow et al.\textsuperscript{26} conducted a study on various, anthropometric, strength and speed variables. They obtained data from 100 Inter-collegiate level women volleyball players, who participated in regional round robin tournament. The purpose of this study was to determine if there was any relationship between the factors and team success.

Upton and Hagon\textsuperscript{27} conducted a study on seventy-three female volunteer age 13 to 15 years, of height, weight, percent body fat, forced vital capacity, forced expiratory volume for one second and maximum voluntary ventilation. During the treadmill test each subject was continuously monitored via a 12 lead. ECG heart rate was recorded for last fifteen seconds of each minute with a full 12 lead recording at the end each stage of the test. Blood pressure was monitored at end of each walking stage using a sphygmomanometer and pressure cuff. All subjects were similar in age and height but the untrained subjects were significantly greater than the trained subjects in total body weight. The sedentary women possessed a significantly greater amount of body fat, where as both groups were equivalent in lean body weight. The normal


runner had significantly greater maximal aerobic power.

Ozkan\textsuperscript{28} conducted a study of 77 male high schools soccer players between the age of 15 and 18 years old. The purpose of the study was to investigate the physical and physiological and motor skill characteristics of the players. A secondary purpose was to compare the experimental variables between playing position, age group and playing qualities. Test items consisted of age, height, weight, percentage of body fat, resting heart rate, 1.5 mile run, 50 yard sprint, vertical jump, agility, trunk extension and flexion, ball control, wall volley and obstacle dribble skill tests. The statistical analysis reveals an average height and weight of 174.92 cm and 64.74 kg. for entire group. Average resting heart rate and body fat were 70.7 bpm and 10.38 percent respectively. The other results were excellent in 1.5 mile, fair on the 50 yard and vertical jump. In agility similar level as college, below average in trunk extension and flexion and in three soccer skill tests, the players scored 85\textsuperscript{th} - 100\textsuperscript{th} percentiles.

Griffin\textsuperscript{29} made a study of heart rate of female in hockey and basketball. He concluded that the playing field hockey was more demanding in terms of heart rates of the subjects participating than in the playing basketball.

Withere, Roberts and Davies\textsuperscript{30} compared the aerobic power, anaerobic power and body composition of South Australian male representative in athletics, basketball, field hockey and soccer. The runners and walkers exhibited the highest mean VO\textsubscript{2} max. There was virtually no difference between the hockey and the soccer players. The lowest mean was registered by basketball players. The team game players scored much higher than runners and walkers on absolute power. The scores of hockey and soccer players were almost identical as were the lowest scores of runners and walkers. The average percentage of body fat for the runners and the walkers, basketball players, hockey players and soccer players were 13.1, 16.6, 15.7 and 15.7 respectively.

\textsuperscript{29} Norma S. Griffin, “Comparison of Heart Rate of Female College Participant in Field Hockey and Basketball”, \textit{Completed Research in Health, Physical Education and Recreation}, Vol. X, (1968): 79.

Sodhi concluded in his study skin fold pattern of top Indian athletes and sports persons on 289 male sportsmen and 59 normal persons collected from N.I.S., Patiala. From 1978 to 1983 skin fold measurements were taken for each individual at biceps, triceps, sub scapular, supra-iliac, thigh and calf regions. The sportsmen studied belong to athletic, aquatic sports, gymnastic and wrestling. The athletes and aquatic sportsmen have been further classified according to their weight categories. The study has been conducted to understand the distribution of fat pattern in Indian athletes and sportsman specializing in different sports.

Generally speaking, the fat fold is found to be of greater thickness at trunk region and thinner at limbs. In most sports the minimum value of the fat fold noticed at biceps and the maximum at the supra-iliac sites. The degree of homogeneity in average value between the different groups is found to be at the level of biceps. It seem that in the field conditions the assessment of only the supra-iliac skin fold may help in understanding the degree of muscular fitness in case of sportsmen. The middle and long distance running gymnastic exercise and swimming seem to be more suitable for reducing subcutaneous body fat.

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Puhl and others\textsuperscript{32} conducted a study to examine the absolute and relative physical and physiological characteristics of elite men and women volleyball players. They tested eight members of U.S. Men National team and 14 members of Women University world game volleyball team. The parameter measured indicated percent body fat, VO2 max, post exercise blood lactic acid measures of vertical jumping ability and peak isokinetic torque for knee flexion and extension, shoulder extension and planter flexion at 80, 180, 240 and 300 degrees per second. And they established following findings (1) As expected, the men were taller, heavier had a higher body density and lean body weight and lower body fat, (2) for gross measures of jumping ability the men achieved greater absolute higher for the jump and reach and a greater jump distance above the standing reach.

Wilmore and Haskell\textsuperscript{33} conducted study on body composition and endurance capacity of professional football players. The body composition was assessed on 44 professional football players using hydrostatic weight technique. Residual volumes were measured by the


nitrogen dilution technique, and FVC was measured using a Collins 9-1 spirometer. In addition, 17 of these athletes were given work capacity test on either a bicycle ergometer or treadmill during which time measurements were made to heart rate $V_E$ and $VO_2$. Relative body fat ranged between 4.0 and 29.2% weight between 80.6 and 143.4 kg and lean weight between 73.1 and 106.6 kg. RV ranged between 0.966 and 2.457, $V_c$ between 4.315 and 7.551 lit and TLC between 5.281 and 9.374 lit. $VO_2$ max and $V_E$ ranged between 33.0 and 60.0 ml/kg min and 105.7 and 208.5 L/min (BTPS) respectively. Several of these values are the highest reported in literature and are related to large body size of selected players.

The purpose of Ramaden’s investigation was to examine the maximal oxygen consumption ($VO_2$ max), maximal anaerobic power (A.P.) both body composition (B.C.) somatotype (ST), and the Profile of Mood Status (POMS) and the - State Trait Anxiety (STA) characteristics of Kuwaiti World cup Soccer Players.

The Kuwaiti team exhibited moderately high aerobic (51.9 ml/kg min.) and anaerobic (119.6 kg/m/ sec.) power, both value being significantly higher than college norm, but in mid ranges for world class

athletes in general. Relative Body fitness (8.9%) and a balanced mesomorphic somatotype (2.1-4, 5-2-1) were comparable to those athletes in other high level team sports, the World cup Soccer players revealed a significantly higher value in anger factor.

Dhaka\textsuperscript{35} conducted a study was to compare sportsmen participating in different events of track and field on the selected physical and physiological variables. For this purpose 60 male athletes, 20 each belonging to the categories of sprinters, jumpers and long distance runners from Delhi were selected as subjects due to non-availability throwers could not be considered. The speed, strength and flexibility were selected as the physical variables where as the blood hemoglobin content; blood pressure and pulse rate were selected as the physiological variables. The data on the selected physical and physiological variables were collected by administering the relevant standardized tests/procedure after establishing its reliability for comparing three groups of athletes analysis of variance was applied and to test significance of differences between the paired means Scheffe's post hoc test was applied where F ratio was found significant.

\footnote{Amita Dhaka, "Comparison of Selected Physical and Physiological Variables in Sportsmen Participating in Different Events of Track and Field", (Unpublished Master's Thesis, Jiwaji University, 1986).}
Bandyopadhyya\textsuperscript{36} studied the physical and physiological profiles of 20 female Indian classical dancers and 20 female physical educators of average age of 22 years. The physical and physiological variables chosen for the study were cardio-endurance; agility, flexibility, resting heart rate; resting systolic and diastolic blood pressure, vital capacity, body composition and hemoglobin concentration. The response of classical dancers and physical educators to the selected variables in terms of recorded scores were analyzed by one way ANOVA and it was found that Indian Classical Dancer's Group had significantly superior ankle flexibility, while the physical educators group had significantly lower diastolic blood pressure and percentage of body fat, higher lean body mass and abdominal strength endurance. In the variables of cardio-respiratory endurance, vital capacity, resting heart rate, resting systolic blood pressure, hemoglobin concentration, agility, flexibility of high and back, trunk and neck as well as shoulder and wrist, both the group showed no significant difference.

The purpose of Mishra's\textsuperscript{37} study was to find out the relationship

\textsuperscript{36} Sagarika Bandyopadhyay, "Comparison of Selected Physical and Physiological Profiles of Indian Classical Dancers and Physical Educators" (Unpublished M.Phil. Dissertation of Jiwaji University, Gwalior, 1990).

\textsuperscript{37} Laljee Mishra, "Relationship of Selected Physical and Physiological Variables to Performance in Fifty Meter Front Crawl Swimming (Unpublished Master Thesis, Jiwaji University, Gwalior, 1983).
of selected physical and physiological variables to performance in fifty meter front crawl swimming. Data on the different variables was collected by administering test adopted standard procedure, arm strength was computed with the help of formula given in Roger’s physical fitness index, ankle flexibility with the help of goniometer, vital capacity with the help of spirometer, and body surface area with the help of “Du Dios” surface area formula. Analysis of the data revealed that relationship between speed in swimming and selected physical and physiological variables i.e. arm strength ankle flexibility, vital capacity and body surface was very high correlated positively as the X achieved R values were 0.6758, 0.4658, 0.4941 respectively. The required value to be significant was 0.05 level of confidence and 23 degree freedom. Relationship between speed in fifty meter swimming and body surface were not significant as the achieved value was .1710. Within the limitation identified and on the basis of the results of the study, the following conclusions were drawn. There was significant positive relationship between arm strength, ankle flexibility and vital capacity to swimming speed. There was no significant relationship between body surface area and swimming speed.
Tanaka and Matsura\textsuperscript{38} took anthropometry and physiological variables of 114 Japanese young and long distance runners and concluded that the anthropometric attributes would predict the distance running performance to about the same degree as physiological attributes. As a result of factor analysis and the multiple regression analysis, three factors i.e. linearity of physique, girth of physique and subcutaneous fat, were extracted, and the first two factors were equally related to the 800, 1500 and 5000 meters performance. The 10,000 meters, however, was best accounted for by the second factor.

Woodward and Associates\textsuperscript{39} observed in their study relating to maximal Oxygen consumption, body composition and anthropometry on selected Olympic male athletes. They observed that the latest rowers and water polo players had significantly larger skeletal width and length measurement. The skin fold measurements showed larger fat folds on the trunk and extremities in water polo players compared to the other three groups leanness of the upper extremity was significantly larger in


rowers and water polo players, while that of the lower extremities was significantly larger in rowers only. Total body fat in absolute values was found significantly higher in water polo players, percentage wise there was no significant differences between the groups even throughout water polo players the highest percentage of body fat.

Dyba\textsuperscript{40} carried out investigations on a group of 11 Junior Men Provincial Volleyball Team members. They were subjected to undergo a series of laboratory tests to evaluate selected motor performance, anthropometric and physiological characteristics. The motor performance tests included 20m sprint, 3 long jumps, Sargent jump, block jump, running spike jump, push ups, 90 m run, shuttle run, rolls and sit-ups. The findings of the investigations revealed that:

1. The game of volleyball as played at this level is a moderately stressful aerobic sport; game heart rate averaged at 144 beats per minutes; game blood lactic acid concentration averaged 32.5mg %.

2. Significant differences in action component profiles were observed among the players. Blocking actions had the greatest frequency, setters performed significantly on a greater number of

volleys.

3. Differences in time characteristics were not significant during the various sets/games of the match. Rally duration averaged 7.0 seconds while the rest of the duration averaged 13.3 seconds. Average game duration was 18 min. and 33 sees.

4. The predominance of play ends with the first net encounters.

Toriola, Adeniran and Ogunremi, Comparatively assessed the body composition and anthropometric characteristics of elite male basketball (n=15) and volleyball (n=15) players and male non-athletes (n=20) at the University of Ife, Nigeria. The ages of the subjects ranged from 19 to 29 years. Analysis of variance and Newman-Keuls post hoc method were used to determine significant differences in the physical characteristics of the groups. The basketball players were significantly taller and had markedly larger humerous width than the volleyball and non-athletic groups (p< 0.05). The non-athletes had significantly higher percent body fat values than both the groups of athletes (p< 0.05). The basketball (4.30) and volleyball (4.40) players who were predominantly ectomesomorph had significantly higher ectomorphic component

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(p < 0.05) than the non-athletes (2.5). The differences observed between the athletic groups are related to the morphological factors, which influence the basic components of competitive sports performance.

Mathew and Solokun\textsuperscript{42} studied the body composition of successful Nigerian female athletes physical characteristics and body composition of various athletes belonging to various games were taken. It was observed that Volleyball and Basketball players and throwers were taller than sprinters and distance runners (p < 0.05). Throwers were heaviest, followed by Basketball and Volleyball players. Sprinters and distance runners had least body weights. Throwers had largest body circumferences followed by Volleyball and Basketball players, sprinters and distance runners. Generally body diameter too were higher in throwers, Basketball and Volleyball players and comparatively lower in sprinters and distance runners (p < 0.05).

Carter\textsuperscript{43} conducted a study on body composition of the Montreal Olympic athletes and investigated by means of skin fold profiles, sum of skin fold, estimated percent fat from skin folds, estimated percent fat


from skin folds and fractional masses. The skin fold profile for both sexes were similar in shape but differed in attitude among sports. The female profiles were different in shape as compared to males. The female had longer, skin fold than males at all sites, but the differences were greater at limb sites and trunk sites. The difference on sum of skin folds and estimated percent fat were found among both male and female sports groups. The lowest means were in male and female gymnasts and distance runners and the highest mean the fencers and hockey players for males, and canoeists, rowers and swimmers for females. The student had larger skin fold than athletes even though the students were relatively larger compared to other comparable samples. In terms of factional masses, many within and between sex comparisons revealed similar proportional total body masses, but males had relatively lower adipose tissue mass and higher bone, muscles and residual masses as compared to females.

Leady et al.\textsuperscript{44} conducted a study to determine the relationship between the body composition and physical performance and related items which might be useful in estimating body composition in terms of total lean body mass and percent lean body mass as measured by

potassium determination in adult men. The data on 19 physical performance items were obtained from 40 subjects between 21 and 57 years of age. The results are of value for researchers in general and researchers in physical education in particular for estimating gross body composition using certain physical performance items.

Farrell, Wilmore and Coyle\textsuperscript{45} conducted a study of exercise heart state as a predictor of running performance. Eighteen experienced male distance runners volunteered to participate in the study. Body density residual lung volume and relative body fat was determined according to the referenced procedures. Performance data consisted of road race from 3.2 to 42.2 km. Whenever a subject ran a competitive race during the time span of the study state treadmill tests, his time was recorded and the distance verified it possible using a calibrated. The purpose of this study was to determine it a readily observable variable could be used to predict performance at several race distances. Many physiological reasons exist for the inability of exercise heart rate accurately predicts performance.

Mosher\textsuperscript{46} examined the relationship of selected body measures to exercise energy cost in women and developed a regression equation to predict energy expenditure during sub maximal exercise. The 100 volunteers who served as subjects were aged 18 to 41. The body measures recorded were age, height, weight body composition (using the hydrostatic, weighing technique). The sub maximal exercise task was treadmill jogging at predetermined target heart rate oxygen consumption was assessed by the Open Circuit Method. During the sub maximal treadmill exercise task to target heart rate the means value for oxygen consumption were 1.34912/Minutes and 22.1088 ml./Kg. Minutes. A significant relationship was found between heart rate, body composition, and weight with exercise oxygen consumption. Stepwise multiple regression analysis yield a formula for sub maximal exercise energy cost using heart rate and body composition as predictors.

Digiovanna\textsuperscript{47} determined the relation of selected structural and functional measures to success in each of several sports, namely, Baseball, Basketball, Football, Gymnastics, Tennis and Track and Field. The subjects were 944 college men between 17 and 24 years of age from


the southern Illinois University, University of Illinois and the University of Minnesota. In analysis of data the critical ratio, the index of significance and the standard score comparison techniques were employed. The following conclusions were made as per the results of this study:

1. Factor of body structure, muscular strength and explosive power are associated with athletic success.

2. It also reveals that these factors are varying importance to performance ability in different sports as indicated by the tendency for each sport to have its own unique pattern of success.

3. Conformity to a normal pattern in these factors is non-conducive to success in athletics.

Body composition plays an important role in athletic performance. A substantial amount of evidence is available to indicate that the relative degree of fat free body weight is an important factor contributing to higher levels of physical performance in activities where the total body weight must be moved. In addition studies have shown that high percentage of body fat not only serves as dead weight but also lessens the relative ability to support oxygen to the working muscles
then cutting down on one's cardiovascular endurance.  

Leady et. al. determined the relationship between body composition and physical performance and related items and to determine whether or not certain physical performance and related items height be useful in estimating body composition in terms of total lean body mass and percent lean body mass as measured by potassium 40 determinations in adult men. Data on 19 physical performance items were obtained from 40 subjects between 21 and 57 years of age. The results are of value to researchers in general and researchers in Physical Education in particular for estimating gross body composition using certain physical performance items.

Malhotra, et. al. studied the functional capacity and body composition of the throwers, jumpers, sprinters and middle and long distance runners. The trackmen and jumpers were found to have a higher lean body mass with less fat content than the throwers who were tall and heavily built. The middle and long distance runners had highest and the

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throwers, the lowest maximum oxygen intake capacity values in terms of body weight and lean body mass. Similarly, the trackmen had lower maximum heart rate than other groups of athletes.

Today performance in Sports not only demands systematic training to develop physical, physiological variable and technical aspect of Sports but also demands training and consideration of psychological characteristics for success in this field.\(^5^1\)

Weingberg\(^5^2\) studied the effect of result and achievement motivation (N.Ach) on the efficiency of motor performance and also to find out that under achievement with oriented conditions person with high achievement need perform better than person with low achievement need. Based from scores from Mehrabian Achievement Scale. 20 male College students were classified as low in resultant achievement (N.Ach) and 20 male college students were classified on high in resultant (N.Ach). 20 participants within each motivation group were randomly assigned either through relax or achievement oriented conditions. 27 trials each of 10 seconds were administered on a rotor


pursuit have each task followed by 10 second rest interval. After 10 minute rest participants completed 27 more trials. Statistical analysis included both (2) x experimental curve (2) x Block of Trial (2) x Block of Trial (2) x ANOVA for each session with repetition on final factor.

The participant results are as follows:

1. During first session, high N.Ach participants performed significantly better than low N.Ach under achievement oriented condition with the pattern of results being reversed for relaxed condition.

2. Following the 10 minute rest period no performance differences were found among the motive group.

3. The asymptotic value for high N.Ach group was significantly better than that of low N.Ach group under achievement orient condition.

4. The low N.Ach group demonstrated significantly more reminiscence than high N.Ach group under achievement oriented condition.

Kamlesh, Kumari and Kaur\textsuperscript{53} studied the level of sports

achievement motivation in the inter-collegiate female players ($N=43$) belonging to various games (volleyball=12, hockey=19, and others from kho-kho, football, kabaddi, gymnastics and track and field=12). Sports achievement motivation test by Kamlesh was administered to the subjects in convenient size groups. It was concluded that the inter-collegiate female players have a moderate level of sports achievement motivation. No inter-sport differences on the level of achievement motivation were reported.

Sangwan$^{54}$ administered (Bhargava's 1984) achievement motive test to 603 sprinters. The result revealed that high proficiency sprinters scored significantly higher on achievement motivation as compared to low proficiency and middle proficiency sprinters.

Vimal$^{55}$ in her study on track performance of secondary school students in relation to achievement motivation indicated a positive relationship between achievement motivation and performance.

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Fox\textsuperscript{56} administered achievement motivation scale to 176 male and female Canadian swimmers, constructed by him which measured level of motivation to approach success or avoid failure in athletic conditions. The results of the study failed to demonstrate any practical relationship between levels of achievement motivation and swimming performance.

Harvey\textsuperscript{57} studied that achievement is an important component in the psychological make up of the group of athletes under study. 30 non-athletes, 30 team sports athletes, 30 individual sports athletes were tested to determine their need for achievement (n-achievement) as measured by McClelland's 4-picture test and a modified 6-picture test which included two athletic team indicated no significant differences among the m-achievement response to scores of the 3 groups among the n-achievement scores of the 10 athletes sub-group.

John\textsuperscript{58} studied the effect of anxiety and need for achievement on the performance of high school wrestlers. Data were obtained from the


\textsuperscript{58} Earl R. Jones, "The Effect of Anxiety and Need for Achievement on the Performance of High School Wrestlers" \textit{Completed Research in Health, Physical Education and Recreation}, (1973): 47.
thematic perception test, the test anxiety questionnaire, expectancy
ratings by the individual and by their coach. Performance data were
obtained from match score books and observation. It was concluded that
the personality traits of anxiety. The groups scoring highest in
performance was that of low anxiety and high need for achievement.

The lowest level of performance was demonstrated by the group
high and anxiety and low in need for achievement.

Kim\(^{59}\) studied members of the men's intercollegiate volleyball
team of Springfield College. All subject completed the sport competition
anxiety test (SCAT) during team meeting. Subsequently, each subject
completed the state anxiety inventory (SAI) three times, once two
minutes before a practice session and once five minutes before a
tournament game. It was found that trait anxiety can't be used to predict
state anxiety; the three competitive situations of practice, regular season
game and tournament game do not produce different state anxiety
reactions, an interaction exists between trait anxiety and the three
competitive situations, a positive relationship exists between trait
anxiety and tournament state anxiety.

\(^{59}\) Hovey Kim, "The Relationship between Anxiety and Competition
in Men's Intercollegiate Volleyball" Completed Research in Health, Physical
Mann et al.\textsuperscript{60} studied a sample of 44 male players (Football 16, Basketball 14, Volleyball 14) and administered Hamm's Scale of Competitive Anxiety to them. It was concluded that no significant differences exist in the level of competitive anxiety in all the situations among Football, Basketball and Volleyball teams. Football team varied significantly from other two teams, depicting higher level of competitive anxiety on anger mode of response.

Singh\textsuperscript{61} investigated the sport competition anxiety level of 118 top level Indian track and field players (76 male and 42 female) and 71 hockey players (45 male and 26 female) attending National camps in the age range of 18-36 (males) and 16-26 years (females) and administered to them the sport competition anxiety test by Martens (SCAT). It was concluded that the male athletes and players have less competitive anxiety as compared to female athletes. Both male and female differ significantly in competition anxiety with hockey players. Sports competition anxiety is not related to positional play in hockey.


Singh\textsuperscript{62} administered SCAT (Marten's) to Indian Athletes and Hockey players and found significant differences between the two samples on sports competition anxiety. Hockey players, both male and female were found to have less competition anxiety as compared to the players of individual events. Males exhibited less anxiety in competitive situations as compared to the females.

Miller and Miller\textsuperscript{63} administered five self-report inventories in a field setting with elite net-ball players (N=20). The questionnaire was the sports competition anxiety test, both forms of the state-trait anxiety questionnaire, the profile mood states and the short form of the activation – deactivation adjective check-list. No significant differences were found between the two groups on any psychological factors as measured by these questionnaires. The authors suggest that by themselves, self-report questionnaire cannot be used for personnel selection purposes.


Singh\textsuperscript{64} compared 64 male and 60 female judo players who participated in the national games, out of which 24 champion and 24 non-champion players and 18 champion and 18 non-champion female judo players were administered Rainer Marten's SCAT (A) for adults. It was concluded that male judo players of national level were low in sports competition anxiety than their non-champion counterparts. Champion and non-champion female judo players did not differ on sport competition anxiety level.

In a study by Morgan and Costill\textsuperscript{65} College wrestlers and experienced marathoners were found to score significantly lower than the population average on anxiety.

Smith\textsuperscript{66} conducted a study of the effects of anxiety on shooting proficiency among college women basketball players. Members of the 1977-78 South Dakota State University Women's Basketball Team (N=12) were measured on State Anxiety Inventory (SAI), Sport Competition

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Anxiety Test (SCAT), Pre-game HR, Game field Goal %, Game free throw %, Season field goal %, and Season free throw % SS in group one consisted of players who attempted over 122 field goals during the season while group two attempted 95 field goals or less. Results of ANOVA indicated significant difference between groups (P<0.05). On season field goal percentage and SAI subsequently data analysis throughout his study incorporated only the value from group 1. A significant correlation was found between scores on the SAI and SCAT. Sig. (P<0.05) multiple regression equations to estimate field goal shooting proficiency from selected measures of anxiety produced multiple R's ranging from 0.47 to 0.66 and accounted far between 22 and 44% of the variance in performance. A multiple regression equation for predicting free throw success was not significant (P<0.05).

Relationship of selected physiological and psychological factors to the beginning swimmers ability to perform the crawl stroke was determined by Crites\textsuperscript{67} who used 40 subjects from two beginning swimming classes. The beginning swimming classes met for 40 minutes twice a week. Prior to any swimming instruction, measurements were

collected on shoulder rotation, shoulder extension strength, hip extension strength, body composition, swimming anxiety and swimming ability as measured by the fox power test (revised). After five weeks of crawl stroke instruction measurement were again collected on swimming anxiety and swimming ability, Pearson Product Moment Correlation was used to analyse the data. It was found that: 1) shoulder rotation, shoulder extension, strength, hip extension strength and body composition were not significant factors in the performance of crawl stroke and 2) a significant relationship was indicated between swimming anxiety and the ability to perform the crawl stroke.

Morgan and Pallock\textsuperscript{68} reported that elite marathon runners possessed unique psychological characteristics that differentiate them from the normal population. Their findings are based primarily on the profile of Mood States (POMS), which consists of six factors: tension, depression, anger, vigour, fatigue, and confusion. The researchers found that elite runners scored higher than college norms on the POMS vigour factor in contrast to the other five mood states, which fell below college norms.

Battles\textsuperscript{69} studied the prediction equation for Selection of Women Intercollegiate basketball team members. The purpose of this study was to develop a prediction equation for selection of women intercollegiate basketball team members. The subjects for this investigation were thirty-three females who were participating in women's basketball of three colleges in Florida. Each subject completed a personal data form, the Athletic Motivational inventory (AMI), the known basketball test, Sargent jump test, and field goal speed test. Selected anthropometric measurements were also obtained from each subject. Each head coach and each assistant were asked to rank each member of the team in order of how each contributed to team success. Three different team rankings were included in the statistical analysis. The rankings were head coach's rankings, the assistant coach's ranking and the average rankings of the head and assistant coaches. Significant correlations (0.05 level) were found to exist between the head coaches rankings and age and college basketball experience, and between the average of the head assistant coaches ranking and college basketball experience. Results of step-wise multiple regression indicated that players ranked high by head coaches tended to score high on a combination of physical and psychological variables. These variables included college basketball experience, 

height, vertical jump, mental toughness and the AMI total score. Assistant coaches tended to select included interest, players with high scores on psychological variables which responsibility, mental toughness and aggression. The average ranking of the head coach and the assistants favoured players with college Basketball experience responsibility, mental toughness, age and self-confidence. Mental toughness was the only variable, which consistently appeared regardless of the method of ranking.