Chapter - II

REVIEW OF RELATED LITERATURE

Research scholar made sincere efforts to review the related literature pertaining to physical and physiological variables available at library of the Lakshmibai National Institute of Physical Education, Gwalior (M.P.) and some of the important studies are cited below:

Puhl et al.,\(^1\) conducted a study on eight U.S. Men's National and 14 Women's university world games volleyball teams at the U.S. Olympic centre. The purpose of the study was to examine the absolute and relative physical and physiological characteristics of elite man and women volleyball players. The parameters measured included percent body fat, maximal oxygen uptake using treadmill runs, post exercise blood lactic acid, measures of vertical jumping ability, and peak iso-kinetic torque for knee flexion and extension, shoulder extension and planter flexion at 30, 180, 240 and 300 degrees/ seconds. As would be expected, the men were taller, behaviour and a higher body density and lean body weight, and lower body fat. For gross measures of jumping ability the men archived greater absolute height for the jump and reach and greater jump distance above the standing reach, the absolute jump and reach were 130% and 124% of the respective net height. The men also had a greater $\text{Vo}_2\text{ max}$ value expressed in absolute and relative terms.LBW-1. Maximal

\(^1\) Jacqueline Puhl et. al., "Physical and Physiological Characteristics of Elite Volleyball Players", Research Quarterly for Exercise and Sport 53 (September, 1982) : 257.
exercise heart rates and post exercise blood lactic acid values were similar between groups.

The study of Promoda Devi\(^2\) was to determine the relationship of selected Physical Fitness Variables as strength (a) Arm Strength (b) Leg Strength, agility, speed, flexibility, anthropometric measurements, weight, height, arm length, leg length, fore-leg length, thigh width, ponder index, corral index to performance in shot put. Product movement correlation method was used to compute correlation and to know the significance of the study. The findings of the study revealed that:

(1) There was significant correlation between arm strength, leg strength, speed, and flexibility and shot put performance.

(2) There was no significant correlation between weight, height, arm length, leg length, foreleg length, ponderal index, crural index and shot put performance.

Hartung and Squires\(^3\) investigated two groups of marathon runner's volunteers. All runners had completed an official 42.3 Km marathon race, groups N was comprised of 25 young, novice runners. Following measurements were made: resting heart rate, resting systolic and diastolic blood pressure, maximal heart rate, maximal oxygen uptake,

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age weight, % fat, height and total plasma cholesterol. The results of stepwise regression equation using marathon time as the dependent variables yielded an R= 0.83 for group N and R=0.68 for group E. An analysis of the 4 variables model versus the full model yielded a non-significant F for each group. The single best independent prediction of marathon time was VO₂ maximum which accounted for 25% of the variance in marathon time (R=0.50) in both groups.

Bults\textsuperscript{4} tested 127 high schools female cross country runners percentage body fate, rating of perceived exertion and maximal oxygen consumption during a continuous running treadmill test. These young runners were running approximately 25 miles per week at the time of testing. They had an average VO₂ max of 50.8ml. min \textsuperscript{-1} and an HR max of 198bpm. The mean percent body fat, as determine from hydrostatic weighing, was 15.4% the onset of metabolic acidosis was estimated to occur at 78% of VO₂ max. A stepwise multiple regression with the 3000 meters run as the dependent variable indicated that max entered the equation in that order, yielding an R of 0.67. Both HR and RPE increased with work intensity, but not at equal rates. These high school female runners had higher VO₂ max than previously reported for this age group; however, they were considerable below these values reported for national caliber distance runners.

Cozen\textsuperscript{5} conducted a study of stature in relation of physical performance and indicated in his findings that height and weight apparently are influencing factor to some extent in the matte of physical performance although correlation obtained were not significant.

In a relationship study Book Walte\textsuperscript{6} showed that the relationship of physique and shape to physical performance. The Indian Motor Fitness Test was administered and study concluded that:

(a) The very obese body is the poorest performance.

(b) Size and shape seems to have an influence on physical performance.

(c) Maximum size and shape do not produce performance fitness.

(d) The large and fat boys were poorer in physical performance than the normal and thin body.

Hensley, East and Stillwell\textsuperscript{7} conducted a study to investigate, the relationship between selected physical performance tests and body fatness in preadolescent boys and girls. Measures of age, height, weight, skin fold thickness at two sites and performance scores on the vertical

\textsuperscript{5} Fredrick W. Cozen, "A Study of Stature in Relation to Physical Performance, Research Quarterly (March, 1930) : 35.


\textsuperscript{7} Larry D. Hensley; Whitfield B. East and Jim L. Stillwell, "Body Fatness and Motor Performance During Pre-Adolescence, Research Quarterly for Exercise and Sport", 53 (June, 1982) : 133.
jump, standing broad jump, modified pull-up, 40-yard dash, and 400-yard run were obtained on 563 pre pubescent elementary school children 289 boys and 274 girls). The results of a one way ANOVA indicated that there was a significant difference between boys and girls on all the physical performance tests, although the boys were slightly taller, heavier and scored better than the girls on the performance tests, there was no significant difference between the sexes in the sum to two skin folds. Separate regression equation for the sum of two skin folds by performance on each test indicated that, with the exception of the modified pull up test, body fatness was only marginally related to performance. These findings indicated that, although inversely related to the ability to move the total body weight, body fatness was of minimal importance in explaining performance differences between young boys and girls.

Bakker\(^8\) studied factors associated with success in volleyball. 28 women subjects played extramural volleyball tournament. Their playing ability was rated by two experienced volleyball coaches. Then the following variables were measured: height, weight, leg strength, grip strength, jumping ability, reaction and movement time. These measurements and playing ability was correlated and it was found that jumping ability and reacting time were significantly related to success in volleyball. A multiple correlation (R) of 0.178 was obtained between the

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\(^8\) Clarena Bakker, "Factors Associated with Success in Volleyball", Completed Research in Health, Physical Education and Reaction, 7 (1969) p. 106.
nine variables and the criterion and (R) of 0.53 was obtained between the
criterion and reaction time plus jumping ability plus weight. The regression
equation computed in this study could be used to predict success in
volleyball playing.

One hundred Chinese junior high school boys were administered a
devised physical fitness test by Haung⁹. Factor analysis has yields seven
factors; 70% of total variance of physical fitness was observed. The factor
identified by him were speed, explosive strength, size of the body,
endurance, coordination, strength of leg muscles, dynamic flexibility,
dynamic strength and flexibility.

Conger¹⁰ conducted a study of physical performance of body form
as related to physical activity of college women. Thirty five college women
ranging in age from 18 to 22 years were divided into more and less active
group on the basis of their activity history strength, flexibility, specific
gravity, skin fold fat, widths, girth, height and weight were measured and
some selected indices computed. Mean difference between groups were
tested for significance with F and t ratio. The study concluded that more
active grip was heavier and had greater lean body mass. Specific gravity,
arm, shoulder and trunk strength and all body forms measures were

⁹ Chen Hing Huang, "A Factor Analysis of Physical Fitness Seventh Grade
Chinese Students" Completed Research in Health, Physical Education and
Recreation, 24 (1982).

¹⁰ Conger, Patricia, "Physical Performance of Body Form as Related to Physical
Activity of College Women" Completed Research in Health Physical Education and
height significant, maximum difference were found between percentage of fat, pondal index, hip, leg and total strength.

Alteri\textsuperscript{11} selected 63 college females between seventeen and twenty-two years of age to study the effects of endurance and interval running on selected physiological parameters. Resting pulse rate was one of the physiological parameters selected. Analysis of data revealed that both treatments significantly lowered resting pulse rate.

Choudhary\textsuperscript{12} conducted a study on selected physiological variables on eighty inter-college level judokas with the purpose to sketch the profiles and to compare them in different weight categories. The variables selected for the study were resting heart rate, vital capacity, negative breath holding capacity, positive breath holding capacity, and anaerobic capacity. Mean and standard deviations on all the variables for all the weight categories were calculated and ANOVA was used to find out the significant difference in the mean scores. On the basis of results, following conclusions were drawn:

1. The training age does not depend upon the weight category.
2. The training programme for the judokas should be according to the body weight category.
3. The training programme for low and middle weight categories should be more strenuous than heavy weight categories.


relation to positive breath holding capacity, no significant difference was found in different weight categories. (5) In relation to the resting heart rate, vital capacity, negative breath holding capacity and anaerobic capacity, significant difference was found in different weight categories.

Khanna et al.\textsuperscript{13} study consisted of seven judo players and fourteen normal subjects of sedentary habits. On the first day their anthropometric characteristics including body fat percentage, grip strength and anaerobic power were measured. On the second day their maximum aerobic power was determined. Body fat percentage was determined by measuring the skinfold thickness over 4 different sites, namely: ps, triceps, suprailliac and subscapular regions with skinfold caliper.

Mean age, height and weight of the judo players did not differ much from the normal sedentary group, even the judists did not differ among themselves (6.10 - 64.6 kg) and they formed a single weight category, mean body fat percentage (12.5\%) of the judo players was significantly lower than that of the sedentary persons (P < 0.05). This signifies that this athletic group has a higher mean lean body mass than that of the normal group. Average fat percentage of the judists studied, was also comparable to the Canadian Judo Team (Tyler and Brasord 1981). However, the fat percentages of the judists of the present investigation and also of the Canadian teams were higher than the reported value of the trained weight categorized athletes (Wilmore 1970).

\textsuperscript{13} G. L. Khanna et al., "Physiological Status of Some Judosists in India", \textit{SNIPES Journal} (April, 1983) : 21.
Australia's best male judo players were tested in laboratory, on the mat, and in the weight room by Tumilty et al. The players were divided into junior and senior groups on the basis of ability as assessed by the coach. There were no differences between the two groups (at .05 level of significance) on tests of body fat, maximum oxygen uptake etc. The chief coach separated the players into two groups on the basis of ability, the division coinciding also with age, the less able junior group being under 20 years. Statistical comparison of the heights and weight were not useful as the players within the two groups were distributed differently in the weight classes. There was no significant difference between the means of the groups on skin folds. Since the range of values was wide 41.8 to 12.06 mm. for the juniors and 39.4 to 5.2 mm. for the seniors. The figure suggest that a number of players, especially juniors, were over fat, since the means of many groups of athletics at the Australian institute of sport is under 60 mm. with many individuals lying between 35 and 45 mm. (Telfer, 1984). The penalties of excess fat can include having to compete in too high a weight class, reduced power to weight ratio with concomitant reduction to diet and an appropriate training volume are necessary to overcome the problem.

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Callister et al.\textsuperscript{15} studied eighteen male and nine female nationally ranked judo athletes to construct profiles that would provide some understanding of the physiological capacities underlying successful judo performance. Body composition, aerobic capacity, Isokinetic elbow and knee flexion and extensor strength, and muscle fiber size and composition of the vastus lateralis were examined. Higher ranked males (except heavy weight) differed from lower ranked males in percentage of body fat $5.1 \pm 0.6 \text{Vs} \ 8.2 \pm 0.8 \ P < 0.05)$. While more successful females tended to have greater upper body strength than less successful females. More striking, however, was that the characteristics examined varied ($P < 0.05$) as a function of weight division for both male and female athletes. A weight division increased, percentage of body fat increased ($r = 0.64, 0.72$). Among females in particular athletes in the higher weight divisions were stronger relatively to LBM than those in the lower divisions.

Sady et al.\textsuperscript{16} compared the body composition and physical dimensions of 23 young experienced wrestlers with 23 school children. Standard densitometric and anthropometric techniques were used to measure the body composition and physical dimensions of each group. The wrestlers were 4 kg. lighter ($P \ 0.05$) and had a smaller percent fat than the comparison group ($13.3 \pm 0.66\%$ and $20.0 : 1.13\%$).


respectively). The weight differences between groups were due to the weight of the comparison group since lean weight differed by only 0.8 kg. Fat differences were also reflected in the larger skin folds and fat circumferences of the composition group. No group differences were noted in diameters. It was concluded that compared to other children, young experienced wrestlers had similar skeletal structures and lean body weight. The comparison group possessed more body fat.

Thomson et al.\textsuperscript{17} compared the body composition and physical dimensions in young and experienced wrestlers. The best wrestlers (W) were 4 kg. \((t \, 1.9)\) lighter \((P \, 0.05)\) and had a smaller percentage of fat than local elementary school children. The percentage of body fat of W is more than 2 x the minimal value proposed by the American College of Sports Medicine for high school and college wrestlers. The lower fat of W was reflected in smaller skin folds and lower - body circumferences, height or lean body weight. It was concluded that wrestlers have lower body fat but similar skeletal structure when compared with typical children. The data suggest a need for separate standards for minimal wrestling weights of young children.

Amusa\textsuperscript{18} conducted a study on the relationship between playing ability and selected measures. Forty-six subjects were well-conditioned soccer players with at least two years playing experience on the college level; they were tested for running speed, power, agility, max Vo2, strength, anaerobic capacity, and flexibility in addition to eleven anthropometric measurements consisting of skin fold and body diameters. Soccer playing ability served as the criterion measure.

Pease\textsuperscript{19} conducted a study on the relationship of selected hand and wrist measurements to ability to shoot in basketball. In this study, 64 college-aged males were selected as the subjects, and he concluded that speed of hand was the only significant predictor of the ability to shoot in Basketball.

Atkinson\textsuperscript{20} conducted a study on prediction of performance in tennis, handball, and badminton from certain physical traits. Regression equations using traits and class commitment as predictors were developed for determining potential skill in beginning tennis, badminton, and handball for college men. The physical traits used were: agility, power, hand-eye coordination, and visual ability. Skill level was determined


\textsuperscript{19} G. Dale Pease, "Relationship of Selected Hand Wrist Measurements to Ability to Shoot in Basketball," \textit{Perceptual and Motor Skills} 52 (December, 1981) : 793.

by a round robin tournament in each sport. Subjects were 140 college men enrolled in beginning classes for each sport and taught by the whole-part method.

Amusa\textsuperscript{21} selected 46 subjects, who were well conditioned soccer playing having at least 2 playing experience on the college level. They were tested for running speed, power, agility, max vo2, strength, anaerobic capacity and flexibility, in addition, 11 anthropometric measurements consisting of skin folds and body diameters were taken. The soccer playing ability served as the criterion and was measured by the rating of 3 experienced soccer coaches based on selected soccer skill and strategies. Analysis of data was by zero order correlation and multiple regression analysis resulting in the following conclusion; age (experienced) is the best single predictor of playing ability; weight LBW and height are considered

The controlled subjects included 138 subjects enrolled in at the beginning classes and taught by part method. Another purpose of the study was to determine if practice in the sport would significantly improve scores in the physical traits. A period + was used to compare experimental and control groups. Conclusions were class commitment is probably an integral part of skill attainment in the sports studied, students taught tennis and badminton by the whole part method experience greater

gain in agility and hand eye coordination, students taught tennis by the part method experience greater gains in shoulder girdle power.

Raymond\textsuperscript{22} investigated the characteristics of potential college basketball players. Basketball coaches from 4-classes of institutions were surveyed in an attempt to identify those characteristics coaches demanded most important in recruiting potential school athletes. The four classes of institutions were: state colleges, private colleges, state universities and private universities. Thirty six characteristics were analysed under five categories: attitude and personality, playing experience, physical qualities, mental ability and financial need. Mean ratings were determined for each characteristic and each category. No significant difference was found between the types of institutions and the qualities looked for in the recruiting practices.

Harper\textsuperscript{23} conducted a study of the effect of two Physical conditioning programmes on cardio-respiratory fitness of 25 college men. The subjects were placed into three group on the basis of maximum oxygen consumption one group participated in a modified army conditioning programme and second group in interval training involving running. The third group (control) participated in recreational activities. The group met five days per week for seven weeks. Cardio-respiratory


efficiency was measured with the help of the Harvard step Test. The results showed that both interval training and army trained groups improved significantly in their cardio-respiratory efficiency. The control group did not improve significantly.

Childness\textsuperscript{24} conducted a study on a factor and discriminates analysis to identify and determine the effectiveness of selected physical variables in predicting a successful basketball performer. The purpose of this study was to identify the components of high school basketball playing ability and to construct and evaluate tool for classifying successful and unsuccessful high school basketball players. Twenty four test items were selected through a review of the related literature as valid measures of the components of high school basketball playing ability. The test items were administered to 106 high school basketball players and the resultant data were analyzed through the utilization of the principle axes method of factor analysis with various criterions for rotation. Seven factors were isolated and six factors were identified as agility, speed, relative muscular endurance, basketball speed manipulation, gross muscular strength, total body movement time and manual dexterity. One factor was unidentifiable in terms of common test items with high factor of loadings. The test batteries were conducted the first consisting of seven items loading

\textsuperscript{24} James Thomas Childness, "A Factor and Discriminant Analysis to Identify and Determine the Effectiveness of Selected Physical Variables in Predicting a Successful Basketball Performer" \textit{Dissertation Abstract International} 33 (November, 1972) 2148 - A
highest on the isolated factors, the second was composed of ten test items. The first battery was utilized in a discriminates function analysis classified as successful and unsuccessful basketball players. The result of this study indicated that the components of basketball playing ability could be isolated, measured and utilized to construct and evaluate tool for classifying successful and unsuccessful players.

Elena\textsuperscript{25} studied the relation of physiological factor to football performance. Minute played during the 1958 football season was used as the criterion. Players were measured in the 50 yard dash, right grip, left grip, arm push and pull strength. Speed correlation 0.60 and total strength, 0.40 with the criterion. Both correlations were significant but the predictive value for minutes played W.G.S. slight.

Lowson\textsuperscript{26} round out that maximum oxygen uptake, maximum oxygen deficit and Margaria Kalamen Index were the parameters most highly related to 440 yard running performance. Two mile running performance was found to be dependent upon the aerobic capacity of the subjects. Percentage of slow twitch fibers percentage of body fat and vital showed capacity also showed a significant relationship to mile running performance.


\textsuperscript{26} David Loyd Lowson, "Physiological Parameters Limiting Performance in Middle Distance and Sprint Running" Dissertation Abstracts International 36 (September 1975): 1372-A.
Vaccaro, Clarke and Wrean\textsuperscript{27} conducted study on physiological profiles of elite women basketball players. 15 members of university of Maryland women basketball team were assessed for body composition, some to type muscular strength endurance pulmonary function and aerobic capacity during the 1976-77 basketball seasons. Result of the analysis indicated the (1) measure of height and weight established here were greater than that of the average female and most other women athletes; (2) mean percentage of fat was less than those values reported for female athletes, but some what greater than those reported for women distance runners; (3) mean somatotype was similar to those reported for normal group women.

Lamba\textsuperscript{28} compared the selected physical fitness components such as agility, speed, strength and physiological variables such as blood pressures pulse rate, breath holding capacity and cardio-vascular endurance of offensive and defensive hockey players at college level.

The subjects were 60 male students of four colleges of Gwalior who participated in 1978-79 intercollegiate tournaments. Data was obtained by administering the test and was statistically analysed using t-ratio. It was concluded that: (1) the offensive players are faster and have less resting pulse rate and thus have more cardio-vascular endurance.

\textsuperscript{27} P. Vaccaro, O.K. Clarke; and J. P. Wrean "Physiological Profiles of Elite Basketball Players" \textit{Journal for Sports Medicine Physical Fitness} 19\textsuperscript{th} (March 1979): 45-54.

\textsuperscript{28} Manmohan Kaur Lamba, "Comparative Study of Selected Physical Components and Physiological Parameters of Offensive and Defensive Hockey Players of College Level" (Unpublished Master's Thesis, Jiwaji university, 1980)
than defensive players (2) the defensive players and (3) there is no
difference between offensive and defensive hockey players in agility,
blood pressure and breath holding capacity.

George and Nequin\textsuperscript{29} studied two ultra marathon world record
holders, Barneyklerkar, Benchise Motow were studied immediately after a
50 mile race and in a laboratory under controlled conditions, blood sample
were obtained before and after running were analysed for lactate glucose
glycerol and free fatty acid. Muscle biopries were also performed and
analysed for glycogen, enzyme activity and fiber type. Results showed
that although these runners are fit their physiological abilities are not
extreme or unique and are similar to data obtained from marathoners.

Singh and\textsuperscript{30} Gill conducted a study to examine the physical and
physiological characteristics of volleyball players, football players and
cross country runners. Under physiological variables, vital capacity,
maximum breath holding capacity, maximum expiratory pressure were
taken and a dynamic cardio-pulmonary index was calculated results
showed that cross country runners had higher cardio-pulmonary index
than footballers and volleyball.

\textsuperscript{29} Lesmer R. George and Neol D. Nequin, "Physiological Profile of Two
Champion or Ultra-Marathoner" \textit{The Physician and Sports Medicine} 11 (May 1983):
63.

\textsuperscript{30} Ajmer Singh and J. S. Gill, "Physiological and Physical Characteristics of
Volleyballers, Footballers and Cross Country Runners" \textit{Vvayam-Vidayan} 21:23 (May-
Martin\textsuperscript{31} 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 within each individual racial group. 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, and size difference between playing position and between players at different college level Some somatotype which are rare in general population are common in football players. The dominant physique in the study was the extreme endomorphic, mesomorph gross size is an out standing characteristic of football players.

Prince\textsuperscript{32} conducted a study on the relationship of college football


players' strength, speed, and agility to the coaches' ranking of ability. Playing position were combined into offensive back, defensive back, offensive linesman, defensive linesman, and into whole group units. The players were further divided into group-I or group-II. Correlation were then computed between the objective test score and coaches' subjective evaluation. It was concluded that arm strength and agility were not valid predictors of football ability; total strength and total 't' score were moderate predictors of football abilities and leg strength and speed were significant predictors of football ability.

Sobol\textsuperscript{33} conducted a study to determine the validity of subjective ratings of the ability to handle a given weight ball as a criterion measure of bowling ability and to investigate their relationship among anthropometric strength performance. Data were collected for each subject on height, weight, arm strength, grip, pull-ups, three finger bowling grip velocity, fast ball average, and games score. All groups were significantly different in all variables: athletes 1 or 5 percent level when an analysis of variance was computed. The Duncan multiple range test was used to determine significant difference between pairs of means.

Kansal et al\textsuperscript{34} studies the physique and body composition of the intervarsity soccer players of zonal champion and runners-up team of the


\textsuperscript{34} D.K. Kansa\textsuperscript{a} et al, "Anthropometric Characteristics of Indian University Football players," \textit{The Journal of Sports Medicine and Physical Fitness}, 20 (September, 1980).
north zone. They concluded that the defense line players were significantly taller and heavier than forward line players. Forward line players had narrow hips and broader femur bicondylardiameter accompanied by better developed thighs and calves in comparison to defensive players. The forward line players had also slightly lesser percentage of body fats and more of lean body mass.

Gangadharan\textsuperscript{35} conducted a comparative study that selected anthropometric measurement i.e. height, chest girth, and weight of 60 athletes of different sports and concluded that volleyball players were significantly taller than basketball and hockey players. The groups did not differ significantly in any other anthropometric measurements undertaken in the study. Good predictors of playing ability, Max vo\textsuperscript{2} and running speed are considered important factors in soccer performance. Flexibility, agility, lactate concentration and leg power are not considered as valid indicators of playing ability.