CHAPTER II

REVIEW OF RELATED LITERATURE

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

French and Stalter\(^1\) constructed tests of footwork, wrist action and smashing ability to supplement the previously validated French test items and from a battery of skill tests in Badminton to measure playing ability. A four-test battery of serve, clear, wall volley and shuttle resulted in a validity coefficient of .698. Eliminating the serve, govern three tests battery with a validity of .678.

Success depends to a greater degree on skill than speed of movement. The Miller wall volley test was the best single predictor of success in singles competition and total body movement time predictor.

\(^1\)Erther French and Evelyna Stalter, "Study of Skill Test in Badminton for college women", Research Quarterly 32 (October 1949) p.257.
Ikeda studied the relationship of selected measures of wrist flexibility, kinesthesia and agility to Badminton playing ability. He studied during the last two weeks of an eight weeks Badminton units a series of test: including wrist flexibility shuttle race and various measures of kinesthesia, such as arm forward, wrist flexion, wrist extension, and target finger spread, supination, pronation and grip pressure were administrated to 72 women students. These test scores were compared to the result on volley and clear Badminton tests. There was no significant relationship between wrist flexibility, kinesthesia or agility and Badminton playing ability.

Kowert constructed a Badminton ability test battery for men. The judges' rating scale yielded a reliability coefficient of .88 when correlated with the class ranking of the subjects' badminton playing ability. An r of .97 was obtained for the reliability of the Judges' rating scale as determined by the intra-class correlation method. The coefficient of multiple correlation between the some of the three judges' rating and found that the


badminton playing ability of male college students (N=46) can be successfully measured by multiple regression equation containing the variables of the diagonal run test, French's long serve Test and Miller's wrist test.

Hicks⁴ constructed and evaluated a battery of five badminton skills. Data were collected from three judges rating on the subjects' ability to execute the selected skills in a game situation; tournament scores; total judges' evaluation of over-all playing ability; the performance scores for each of 20 trials on the clear test, smash test, overhead drop shot test, and strategy test; and scores for each of 3 trials on the footwork test. It was concluded that the strategy, clear and smash tests are valid and reliable measures whereas the overhead drop shot and footwork test are not valid tests to measure a beginning player's ability.

Atkinson⁵ conducted a study to predict performance in tennis, badminton, and handball from certain physical traits.

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Regression equations, using physical traits and class commitment as predictors were developed for determining potential skill in beginning tennis, badminton and handball for college men. Skill level was determined by a round-robin tournament in each sport. The results of the study revealed that 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 gains in agility and hand-eye coordination; students taught tennis by part method experience greater gains in shoulder girdle.

Craston \textsuperscript{6} studied the relationship of reaction time, movement time and visual tracking to performance in badminton.

A reaction time-movement time device, a pursuit rotor, and the Miller Badminton Wall Volleyball test were used to collect the data on 32 college women enrolled in badminton classes at Smith College. Reaction time, movement time and visual tracking had no apparent relationship to performance in Badminton.

Brooks has stated that due to differences in leg length among the athletes it seems logical that leg length would be a better indicator of stride length than height, and Hoffman (1972) gives a ratio of leg length to stride length for world class female sprinters of 2.38 to 2.50.

Talton investigated the selected physical and physiological assessment as predictor of successful high school football performances by selecting 156 football players who were classified by coaches into successful or unsuccessful player category based on performance in the 1971 football season.

The purpose of the Joseph's study was to find out whether there is any relationship of selected anthropometric and strength variables to speed performance. Twenty four male sprinters of L. N. C. P. E., Gwalior, who were undergoing regular training at the College


track and preparing for inter collegiate and inter-varsity athletic meet was selected as the subjects for the study. The study reveals that there is a significant relationship of lower leg power, abdominal strength, thigh girth, and calf girth to speed performance. Height, leg length and crural index are not significantly related to speed performance.

Pankonin selected 33 college women randomly from seven beginning tennis classes, who were tested for agility, balance, hand eye co-ordination, grip strength, height and shoulder strength. The criterion of tennis ability was the combination T-score from the Dyer Test, Brower and Miller fore hand and backhand test and skill rating by the judges. The most economical predictor of tennis ability combined agility balance arm and shoulder gridle strength for an r of .62 height and grip strength improved the r slightly, although the correlation of group strength and hand-eye coordination with tennis ability was not significant.

Amusa selected 46 subjects, who were well-conditioned soccer player's with at least two years playing ability experience on the college level.


There were tested for running speed, power agility, Max VO₂, strength, anaerobic capacity and flexibility.

In addition, all anthropometric measurements consisting of skinfolds and body diameters were taken. Soccer playing ability served as the criterion and was measured by the rating of three experienced soccer coaches based on selected soccer skill and strategies. Analysis of data was by zero order correlation and multiple "R" analysis resulting in the following conclusions. Age (experiences) is the best single predictor of playing ability, weight L.B.W. and weight are considered good predictors of playing ability, Max VO₂, and running speed are considered important factors in soccer performance, speed strength and ability locate concentration and leg power are not considered as valid indicators of playing ability.

French ¹² constructed a satisfactory badminton test for college women. It contains two elements, a serve test and a clear test. Reliability coefficients ranging from .77 to .98 were obtained. For validity, a correlation of .85 was reported to a preliminary study between the test and a combination of subjective estimates and standing in tournament play.

Lockhart and McPherson 13 proposed a badminton test for college women, which consists of volleying a shuttlecock against a wall. In the validation of the test, the originators obtained the following correlation: .71 between the test results and the evaluation of badminton playing ability by three experienced judges, and .60 between the test results and percentage of total games won in a round-robin badminton tournament. The test-retest reliability correlation for the volleying test was .90.

From a count of the strokes utilized in a United States Amateur Badminton Championship, Miller 14 found that both the men’s and women’s finalists employed clears more than any other stroke in all of their games. After analysing movies of the various types of clears, she devised a badminton test based on this stroke. With one hundred college women as subjects, a reliability coefficient of .94 was obtained with the test-retest given one week apart. A validity coefficient of .83 was reported. The criterion was standing of the subjects after round-robin badminton play.


Chang \textsuperscript{15} presented a test of badminton skills of college men and women composed of the following five items: short serve, long serve, clear, smash, and overhead drop shot. The tests were identified as fundamental elements present in badminton play. The most effective tests were the clear for women and smash for men. Each of these tests accounted for 29-30\% of the variance in badminton playing ability as determined from tournament play.

Bobrich \textsuperscript{16} prepared a badminton observational rating scale to measure total skill development as a student participant in a regular game. The tool was developed using two classes of 67 girls enrolled in a high school beginning badminton courses. The reliability was estimated on a test-retest basis using three qualified judges. Both Pearson's $r$ and analysis of variance techniques were used to determine the reliability of the testing tool. The coefficients ranged from .77 to .87 for section I of the observational rating scale and from .60 to .83 for section II.


Hicks 17 conducted a study to measure a player's ability to execute selected badminton strokes and general playing ability using 64 college women enrolled in badminton classes. Originally, she wanted a five-item battery of valid and reliable tests, but concluded by recommending three items: a clear test, a smash test, and a strategy test. Reliability was determined by the odd-even method for each test item.

French 18 constructed a short serve test to measure the ability to serve accurately and low. A validity coefficient of .66 was reported by using a criterion of tournament rankings. The test-retest reliability was .96. Four concentric quarter circles were drawn on the right service court. A rope was stretched 20 inches above the net and parallel to it. The final score was the total of the values made on 20 serves.

GSC Badminton clear test was developed to measure the skill of beginning level players in hitting the deep clear shot. The test was administered on 61 male and 65 female students enrolled in seven beginning badminton classes at Georgia Southern College.


A badminton court was marked and a rope was stretched across the court at a height of 8 feet and at a distance of 13 feet six inches from the net. The zone in which the shuttle landed was recorded as the score. The score was the total points for the ten trials. Reliability was found to be .87 for males and .89 for females. The validity of the test was .85 for both males and females.

Sebolt developed a test to measure the achievement of the badminton short service. Logical validity of the service was .61. The inter-class reliability for the students was estimated at .72 and .79. The test was administered on a standard court, with scoring zones marked. A string was stretched 16 inches directly above and parallel to the net. The student's score was the sum of the 20 serves.

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Scott \textsuperscript{21} constructed a test to measure the accuracy of the badminton long service. A validity of .54 was reported between the service scores and the subjective rating made by three judges during play. Reliability estimates with college women were .77 and .68. The test was administered on a standard court with scoring zones marked. A restraining rope at a height of eight feet was placed parallel to and 14 feet from the net. The students score was the sum of 20 serves.

Bill Landin, Indiana University suggested a badminton rating scale. The four areas of badminton-playing ability may all be rated during competition. The area of badminton playing ability were serve, stroke, strategy, footwork and position. However, the first two areas may be rated in a non-competitive situation, if so desired, by asking the student to demonstrate the various serves and strokes. Each sub-area was scored on a 3-2-1 basis \textsuperscript{22}.


\textsuperscript{22} Baumgartner and Jackson, \textit{Measurement for Evaluation in Physical Education and Exercise Science}, p.369.
Brumbach \textsuperscript{23} constructed a low service and a clear badminton test at the University of Oregon, with the students from the Service Course Division. For low service test a cord was strung tightly six inches above and parallel to the net; another cord was strung six inches above and parallel to the first. The student's final score was the sum of the best of the six services from each court. For administering clear test a cord was strung across the net six feet from the base line and nine feet high. The students were given 12 attempts; only the best 10 were counted.

Narain \textsuperscript{24} constructed and standardized specific physical fitness test for badminton players. He used factor analysis technique on the data of 100 Inter College/District Badminton players of North India. As many as seven factors of specific physical fitness were obtained, out of which, five were considered as meaningful to select test items from each factor. One test item having the highest loading was included in the test battery, from each factor. The test items thus derived were applied to 500 badminton players to develop the norms.

\textsuperscript{23} Wayne B. Brumbach, Unpublished Research at the University of Oregon cited by Ballou, \textit{Teaching Badminton} pp.126-132.

\textsuperscript{24} Shiv Narin, "Construction and Standardization of Specific Physical Fitness Test for Badminton Players". (Unpublished Doctoral Thesis, Jiwaji University, Gwalior, 1987).
Ikeda 25 conducted a relationship study of some selected measures with the badminton playing ability. During the last weeks of an eight-week badminton unit, a series of tests including wrist flexibility, shuttle race and various measures of kinesthesia, such as arms-forward-spread, supination, pronation and grip was conducted. Pressure was administered to 72 women students. These test scores were compared to the results on the volley and clear badminton tests. There was no significant relationship between wrist flexibility, kinesthesia or agility and badminton playing ability.

Tergerson 26 conducted a study on the relationship of selected measures of wrist strength, vision and general motor ability to badminton playing ability to badminton playing ability. The French short serve and clear test, the Miller wall volley test were given to 23 Sophomore College women. Motor ability were measured through the Scott test,


planter and dorsi-flexion strength with a tensiometer, temporal vision with a parameter and depth perception with the Howard-Dolman apparatus. Total badminton playing ability correlated, significantly, with general motor ability, depth perception and peripheral vision. The wall volley test correlated, significantly, with motor ability and depth perception. The highest and the lowest six players differed significantly in motor ability, depth perception and peripheral vision, but not in total wrist strength.

0'Conor 27 studied speed and skill in relation to success achieved by college women engaged in Badminton singles competition. Various badminton skills, specific movement times and success in singles competition were tested. Analysis by multiple correlation and regression showed that speed and skill were essential to success, but success depends to a greater degree on skill than on speed of movement. The Miller Wall Volley Test was the best predictor of success in the singles competition and total body movement was the best time predictor.

The study proved that skill is more dominant than speed of movement in the success of

badminton but speed of movement is also considered to be essential. Other things being equal, speed of movement will influence success.

Poole and Nelson 28 constructed a badminton skill test battery for high school and college students of both sexes. The skill tests selected were long serve test, forehand clear test, and backhand clear test was 0.81, 0.90 and 0.78 respectively. The validity for long serve, forehand clear and backhand clear test was reported 0.51, 0.70, 0.56 respectively with the results of tournament play.

Using Johnson Badminton Set-up Machine Parker constructed a test to measure the ability in the overhead smash skill in badminton for junior high school boys and girls through college. Reliability and objectivity reported was 0.77 and 0.94 respectively. Face validity was accepted for the test. Percentile scores based on scores of 50 college men and 52 college women were also reported. Ten trials were allowed for score and the maximum score possible was ten points 29.

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Ghosh et al. investigated heart rate and blood lactate response in competitive badminton. Ten Junior level (13-14 years of age) female badminton players were studied to investigate the demands of the game on heart rate and blood lactate during competition. The mean VO$_2$ max. Anaerobic threshold level was 48.3 ml/kg/min and 66.3% of VO$_2$ max. Game analysis revealed that heart rates were higher in the second and third game than in first game, whereas no difference was found in blood lactate concentration. Anaerobic threshold heart rate and total duration of the game indicated on anaerobic-aerobic time domain ratio of 3:1. The authors concluded that junior national level female badminton players attained optimum aerobic capacity and anaerobic threshold levels that could be improved later through further training, and dissimilar strain on cardiovascular and anaerobic metabolic systems is possible due to the intermittent nature of the game.

Coad, Rasmussen and Mikkelsen investigated the physical demands of


recreational badminton. The subjects were members in a badminton club in Denmark. The subjects' maximal oxygen uptake was determined by a bicycle ergometer test. By use of a wireless transmitter, the heart rate was recorded during two or three game matches of different events in badminton. The length of work and rest periods was recorded during actual play. The heart rate for every 30 seconds was used to calculate the average rate during a game. The relative workload for every subject was also calculated.

The analysis revealed that men's singles is the most physically demanding event and the workload is significantly different from the relative workload during men's doubles. Mixed doubles for men is almost as demanding as singles play. While mixed doubles for women was less demanding than women's doubles. The average work period lasted 5.1 seconds and the average rest periods were 9.3 seconds. The ratio between work and rest was 1:1:81 or close to 1:2 of work to rest periods.

The calculation of energy demand in Kcal/min showed that men's, badminton is more demanding than the other activities. Only European handball, Basketball and ice hockey were higher with Soccer just slightly higher at 0.18 Kcal/min/kg. Compared to badminton 0.17 Kcal/min/kg. Women's doubles is as demanding as volleyball, tennis, gymnastics and breaststrokes swimming.
Ghosh et al. undertook a study to investigate the physiological variables of elite Indian badminton players at anaerobic threshold level. The VO$_2$ max and anaerobic capacity of male and female players were observed to be 3.75 L/min (58.0 mL/kg/min) and 2.64 L/min (51.4 mL/kg/min) 10.4 L(150.8 mL/kg) and 6.1 (119.4 ml/kg) respectively. The mean heart rate (HR), oxygen (VO$_2$) consumption, ventilation (VE), breathing (BE) equivalent, oxygen pulse (O$_2$ P) and work load (WL) of the male and female badminton players at anaerobic threshold level were HR:159.8 and 159.3 beats/min; VO$_2$ ,2.69 L/Min (39.0 ml/kg/min) and 1.64 L/min (32.1 ml/kg/min) corresponding to 67.4 and 62.3% of VO$_2$ max; VE; 88.8 and 48.6 L/min; BE; 30.25 and 29.53; O2-P; 17.66 and 10.30 ml/beat; WL;227.5 and 133.8 watts respectively.

The mean VO$_2$ max of the Indian male badminton players were comparable to that of their international counterparts as recorded in the literature. The authors conclude that though

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the physiological variables exhibited by the badminton events were lower than those of players involved in long distance events, the values reflect a high level of cardiorespiratory fitness required for badminton.

Ghosh, Goswami and Ahuja 33 studied the effect of a short three week programme, dominated by specific training, on the aerobic capacity (VO₂ max) and ventilatory anaerobic threshold (VO₂ T) of badminton players and also to evaluate the intensity of the specific training on the basis of heart rate and blood lactate concentration.

The subjects were five women badminton player who were semifinalists in the 1988 sub-junior of junior National Badminton Championships. The VO₂ max evaluated on an automatic analyzer during a graded running protocol on a treadmill and VO₂ T determined by the gas exchange method from the VE-VO₂ relationship were determined at the commencement and at the cessation of the training following the specific training programme. The mean VO₂ max and VO₂ at VO₂ T improved significantly. The mean HR and blood lactate concentration during the specific training were 160 L/min and 3.9 m mol/L while training with the shuttle cock, and 185 L/min and

6.2 m M/L respectively during shadow practice. The finding indicated that the intensity of the specific training was quite high, varying from aerobic-anaerobic transition level to aerobic overload region and was able to alter the VO$_2$ max and VO$_2$ T of the player, even with a short pre-competition training.

Wettstone $^{34}$ in his study of the tests for predicting potential ability in gymnastics and tumbling, a list of qualities which a good gymnast was expected to possess was compiled and sent to the coaches and gymnasts of twenty-five countries. These qualities were ranked according to the importance in performance ability. Fifteen highest ranking qualities were obtained. The subjects were a selected group of 22 gymnasts actively engaged in gymnastics at the University of Iowa. Eleven anthropometric measurements were taken into consideration. A test was constructed of 4 elements namely, Thigh circumference, Strength, Height, and Burpee test which predict potential ability in gymnastics with a multiple correlation of .79 by means of regression equation.

$^{34}$ Evgene Wettstone, "Test for Predicting Potential Ability in Gymnastics and Tumbling", Research Quarterly, IX (December 1938)pp: 115-127.
Ghai * conducted a study on the relationship of selected physique characteristics and motor ability components to performance of gymnastics. Twenty male gymnasts who had represented different universities in All India Inter-University Competitions were selected as subjects for the study. The subjects were tested for all the characteristics and motor ability components such as height, weight, chest girth, thigh girth, upper arm girth, strength, flexibility, agility, dynamic balance. It was concluded that strength, flexibility, agility, dynamic balance were significantly correlated with the performance in gymnastics and physique characteristics were not significant to the performance of gymnastics.

Chakravarthy * investigated the relationship between strength, leg strength, grip strength, agility, flexibility, balance and performance in gymnastics. The findings of the study showed significant correlation between arm strength, leg strength, grip strength, agility, spine and shoulder flexibility to the performance in gymnastics.

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Nail determined the relationship of balance, speed, strength, height, arm and leg strength to success in collegiate wrestling. Subjects were classified as successful, average, or unsuccessful according to their win/loss percentage. A second classification was weight (i.e., light, middle and heavy weight). All subjects were measured for height, arm length and tested for reaction time and movement time, static elbow flexion strength, explosive leg strength and dynamic balance. Treatment of the data by analysis of variance showed no significant difference among the wrestlers in the three weight divisions on dynamic balance, explosive leg strength and reaction time. In elbow flexion strength the middleweight were faster in move time and reaction time than the heavy weights. The successful wrestlers found better balance than unsuccessful ones.

The study of Promoda Devi 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, ponderal index, crural index to performance in shot put. Product movement correlation method was used to compute correlation and to know the

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significance of the study. The findings of the study revealed that (1) there was significant correlation between arm strength, leg strength, speed, 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.

The relationship of reaction time, movement time and visual tracking to performance in Badminton was carried out by Crenstone 30, who collected data on 32 college women enrolled in Badminton class at Smith College. A reaction time, movement time device, a pursuit rator and Miller badminton wall volley test were used. Reaction time, movement time and visual tracking had no apparent relationship to performance in badminton.

McCheli 40 explored the possibility to develop a regression equation whereby football ability could be predicted from an analysis of selected orthopedic measures. Strength tests, power measures, balance, standing height and body weight.


Stepwise multiple regression and polynomial regression were calculated to form predictive equations, whereby fourteen measures were multiple correlated with the criterion variables. The prediction equation for stepwise multiple regression programme was: Football ability = 190.262 + 8.212 (Bow legs) - 0.0752 (Tbial Torson) to .328 (Body weight) - 3.595 (standing height) - 0.050 (knee flexion) 'R' = .548 per cent standard error of estimate was 13.3%. The equation for the polynomial regression programme was football ability = 787.682 + 7.330 (Bow legs) - 143.525 (standing height) - 2.606 (Tbial Torson) - 33.404 (Horse Power) - 0.408 (Body weight) R = .573 % standard error of estimate error was 15.7%. The prediction of football ability for scholarship football players at the University of Arkansas. Strength test, using a tensiometer, are not a good of football ability. Static balance is not a good indicator of football ability. Margaria Anaerobic power test is a good measure of football ability.

Bakker 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 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.

A study was done by Beise and Peaseby\textsuperscript{42} was done to find out the relation between reaction time, speed and agility of big muscle groups to certain sports skills. The subjects were women students of Michigan University. After seven weeks of training, it was found that there was a significant difference in speed, agility and reaction time between skilled and unskilled individuals.

The study of Voll\textsuperscript{43} was to determine if the ability in basic modern dance skills could be predicted by means of selected anthropometric and physical fitness measurements. 24 female students of Pennspreania College were the subjects. Measurements of height, left tribiale height, upper leg length, cardio-vascular fitness, flexibility, abdominal strength, leg strength and somatotyping were recorded. These measurements and 6 anthropometric

\textsuperscript{42} Dorthy Beise and Virginia Peaseby, "Relationship between reaction time, speed, agility of big muscle groups with selected sports skills", \textit{Research Quarterly}, 8 (March 1937) p: 133.

\textsuperscript{43} Bonnie M. Voll, "Predicting ability in basic modern dance skills through selected anthropometric and physical fitness measurements". \textit{Completed Research in Health, Physical Education and Recreation}, 21 (1979)pp:114-115.
ratios were statistically treated by BMDOZR (stepwise regression programme). A regression equation with a multiple R of .8678 was presented by the author for the prediction of ability of basic modern dance skills. The prediction tables for its computation of 5 anthropometric measurements and 2 physical fitness tests on the basis of findings of this study. The author concluded that the ability in basic modern dance skills could be predicted from selected anthropometric and physical fitness measurements.

One hundred Chinese junior high school boys were administered a devised physical fitness test by Huang 44. Factor analysis has yielded seven factors; 70 per cent of total variance of physical fitness was observed. The factors identified by him were speed, explosive strength, size of the body, endurance, coordination, strength of leg muscles, dynamic flexibility, dynamic strength and flexibility.

44Chen-Hsing Huang, "A factor analysis of physical fitness components for seventh grade Chinese students" Completed Research in Health, Physical Education and Recreation, 24 (1982):