Chapter II

REVIEW OF RELATED LITERATURE

Capitalizing on the reviews of expert researchers can be fruitful in providing helpful ideas and suggestions keeping this in mind the research scholar made an attempt to go through the related literatures available in the libraries of Lakshmibai National Institute of Physical Education, Gwalior and Indira Gandhi Institute of Physical Education and Sports Sciences, Delhi.

The research scholar scanned the literature and research work, published so far here and abroad, on the allied field and physical education and sports. Extensive studies regarding exercise science, different exercise programme and their development, hygienic, therapeutic and other values use of big muscles activities and sports culture is available in research journals. But comparatively very few studies are reported regarding volleyball game, the relative studies found from various sources, which the scholar has come across, are cited below.
Gabbett et. al., (2006)\(^1\) the study investigated the effect of a skill based training program on measurement of skill and physical fitness in talent-identified volleyball players. Twenty-six talented junior volleyball players participated in an 8 week skill-based training program that included 3 skill-based courts sessions per week. Skills sessions were designed to develop passing, setting, serving, spiking, and blocking technique and accuracy as well as game tactics and positioning skills. Coaches used a combination of technical and instructional coaching, coupled with skill-based games to facilitate learning. Subjects performed measurements of skill (passing, setting, serving, spiking, and blocking technique and accuracy), standard anthropometry (height, standing reach height, body mass, and sum of 7 skin folds), lower body muscular power (vertical jump, spike jump), speed (5m and 10 m sprint), agility (t test), and maximal aerobic power (multistage fitness test) before and after training. Training induced significant (p < 0.05) improvements in spiking, setting, and passing accuracy and spiking, and passing technique. Compared with pretraining, there were significant improvement in 5m and 10 m speed and agility. There were no significant difference between pertaining and post training for body mass,

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skin fold thickness, lower body muscular power, upper body muscular power, and maximal aerobic power. These findings demonstrate that skill based volleyball training improves spiking, setting, and passing accuracy and spiking, and passing technique, but has little effect on the physiological and anthropometric characteristics of players.

Aziz, Chia, and Teh (2005)\(^2\) compared the differences between a multi-stage shuttle test [MST] and an incremental treadmill-run test [TRT]. Each required athletes to run on a treadmill for twenty minutes. They compared endurance athletes versus game athletes and found that that when measuring maximal oxygen uptake in endurance athletes sport specificity was especially important. They also found that the MST has the greatest levels of reproducibility.

Cetin, Karatosun, Baydar, and Cosarcan (2005)\(^3\) used a 20-meter shuttle run test to determine the maximal oxygen uptake of elite taekwondo athletes. They used eleven males and eleven females in a gymnasium setting. They found that though the shuttle run could be used to determine


maximal oxygen uptake one had also to factor in a regression equation that is not indicated with a testing package in order for it to be correct.

Boddington, Lambert, and Waldeck (2004)\(^4\) found that by comparing results from the 5-meter multiple shuttle test there was an emphasis placed upon playing ability for the results be accurate. They also compared the results to a time-motion study of field hockey games to gain an understanding of how realistic the 5 meter multiple shuttle tests were. They concluded that the 5-meter multiple shuttle test has a direct correlation to the physical fitness of players in competition.

Lemmink, Verheijen, and Visscher (2004)\(^5\) looked at the differences in Interval Shuttle Run Testing [ISRT] versus that of the Maximal Multistage Shuttle Run Test [MMSRT] in accordance with the level of soccer being played. They found that the ISRT distinguished between levels of competition and the MMSRT does not. The ISRT measured endurance levels in a more soccer specific way than the MMSRT could.


Polman, Walsh, Bloomfield, and Nesti (2004)\textsuperscript{6} compared the effectiveness of three physical conditioning programs in female soccer players: one group used specialized speed and resistance equipment, the second group used traditional coaching equipment (plastic cones, quickness and agility ladders, balls, etc.), and the third group followed their regular fitness session pattern. They found that conditioning based upon speed, agility, and quickness was most effective regardless of what type of equipment was used.

Wisloff, Castagna, Helgerud, Jones, and Hoff (2003)\textsuperscript{7} there is a strong correlation between an elite soccer player’s one repetition maximum squat strength and their sprinting and vertical jumping performance. They found that the direct relationship between player’s maximal squat and sprinting ability was because of acceleration in accordance with Newton’s 2\textsuperscript{nd} law of motion. They also reported that 96\% of sprint bouts in a soccer game are shorter than thirty meters. Both 10 meter shuttle runs and 30 meter sprint tests should be included in the sprint battery evaluated in soccer players because of the way in which they correlate with game play.

Nadler (2002)\textsuperscript{8} reports the results of the National Collegiate Athletic Association (NCAA) Division 1 pre-participation study done on incoming freshman athletes. Each athlete completed a 20 meter shuttle run to compare response times in those with previous “lower extremity injury or low back pain”. They found that the response times were significantly lower in freshman with a history of injury as compared to freshman without injury. They concluded that the slower shuttle run times of freshman may be in accordance with a lack of proper care and treatment at the high school level and that they may benefit from a core strengthening program in order to correct the problem.

Baquet, Berthoin, Gerbeaux, and Van Praagh (2001)\textsuperscript{9} used adolescents aged eleven to sixteen years, divided into high intensity and control groups. The high intensity group spent one hour, three times a week in physical education sessions; the control group did nothing. The high intensity group showed a great increase in their 20 meter shuttle run times when tested ten weeks after beginning of the study as compared to the


control group. They found that physical activity is necessary for the functional development of adolescents.

**Pellett and Nix (1996)**\(^{10}\) examined the success of practice by lower and higher skilled girls of grades 7 and 8 in response to different tasks throughout an 11 day instructional and practice period for volleyball. From the results it was found that more highly skilled girls were more successful than those lower in skill for all skills forearm pass, set, and serve.

**Gusthart, Kelly and Graham (1995)**\(^{11}\) conducted a study on students learning of volleyball skills. An examination of 222 students learning volleyball skills was conducted. Analysis of data indicated that over an eight-lesson unit performance for both serve and fore arm pass improved.

**Hascelik et. al., (1993)**\(^{12}\) studied the effect of physical training on auditory and visual reaction time of volleyball players. The subjects were twenty male volleyball players. Condition exercises by weight training for

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five days a week were applied. The result revealed that the auditory and visual reaction time was significantly shortened.

Sihi and Bandyapadhyay (1988)\textsuperscript{13} studied anthropometric measurements, movements speed and performance ability of forty-six male volleyball players. From the results he concluded that the performance level in volleyball depended on height, limb length, age, movement speed, reaction time, flexibility, strength, speed, agility and coordination.

Sharma, Khan and Butchiramaiah (1986)\textsuperscript{14} compared the reaction time and concentration among recreational and competitive volleyball players. Competitive and recreational volleyball players (40 in each group) were tested for visual and auditory reaction time and ‘t’ test was used for measuring the concentration. They concluded:

1. The competitive volleyball players respond more quickly to the visual and auditory stimuli when compared to the recreation volleyball players.

2. The competitive volleyball players have more concentration on the task requiring high attentively.


3. The national level volleyball players are superior to the state level volleyball players in visual and auditory reaction time and concentration.

**Phipps (1983)**\(^{15}\) inferred that the game of volleyball requires quickness, endurance and coordination and suggested that a player was to be evaluated through the skill tests, physical component, general ability tests and specific skill tests. In his study he first gave the general test of general ability test, successive long jumps, vertical jumps, rolling tests, seven-second run, bend reach, basketball throw, Illinois agility run, shuttle run, push up and ball roll. The vertical jump, seven-second run and shuttle run, had the highest correlation to performance.

He concluded that the specific ability and sports skill were more specific than general, especially at senior high school levels, such as blocking test, approach spiking, bump test, repeated volleys test for setting, switching and digging, and accuracy serve test. The approach spiking test, bump test, and test for passing had the highest correlation to the criterion.

He further suggests that if general and specific abilities were combined for evaluation, it could be a better predictor of playing abilities.

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Phipps (1982)\textsuperscript{16} compared the general ability tests, specific skill tests, and personality traits as predictors of volleyball performance in high school girls, and which of these variables had the highest relationship with overall performance. The variables of general ability personality were not related to volleyball performance. The combined equation of general and specific had the highest relationship of any combined model to the criterion scores followed by the combined and specific models.

He concluded that – (1) there is little relationship between the selected tests of general motor ability and volleyball performance. (2) There is substantial relationship between selected specific skill tests and volleyball performance. (3) There is little relationship between the selected personality traits and volleyball performance. (4) There is substantial relationship between volleyball performance and following combined models: specific and general, specific and personality, and specific general and personality combined, (5) the specific test model is the best predictors of volleyball performance (6) the best combined model for prediction is general and specific (7) the specific test model and combined of the general ability with

the specific and personality with specific are better predictors of volleyball performance than the coaches beginning of season judgement.

**Buligin (1981)**\(^{17}\) proposed a model of physical preparation for volleyball players for combination of various physical qualities and to check the improvement in the players. This model was prepared and worked out over a period of several years in volleyball improvement groups in Izmailski pedagogical instate where planning of the training and checking of progress is done with the use of eight indicates. The speed of movement was with shuttle run, muscle strength by throwing medicine ball, speed of arm movement by throwing a tennis ball against a wall rebound, the strength of the extremities by executing the maximum number of repetitions (push and squat thrust) in 15 seconds. The model directs the combination of the various qualities of a volleyballer. The conclusions were:

1. The constructed model allows effective planning for improvement in the physical qualities of a player by taking into consideration their individual characteristics.

2. The scores in the separate parameters of the model can be used as control norms for evaluation of physical preparation.

3. The proposed model makes it easier to evaluate the capabilities of the players for selection.

Disch et. al., (1980)¹⁸ examined the relationship between a battery of motor performance test and a set of volleyball skill tests designed to discriminate among level of volleyball playing capacity. A sample of 46 school female volleyball players were tested on skills-serve pass, spike and volley, motor performance – vertical jump, triple hop, agility run, twenty yard dash, and basketball throw. A canonical correlation analysis was performed to examine the relationship existed. The variables represented by the significant correlations were primarily related to following factors.

Variable 1 – vertical jump, triple hop and agility associated with pass & volleying; variable 2 – vertical jump, agility, twenty yard dash associated with passing and spiking, and variable 3 – basketball throw associated with serving and spiking. It was concluded that the motor performance battery was concurrently valid with the selected skill tests.

Morrow et. al., (1979)¹⁹ and his associates obtained various anthropometric, strength and speed variables on 180 inter-collegiate women

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volleyball players and related them to team success. Factor analysis of the measured variables showed that the variable could be dimensioned as body size, speed/fat, and strength. Multiple discriminant analysis showed that teams were significantly different on the factors of strength and speed/fat. Team centroids were plotted in two dimensional discriminant spaces, and the graphic representation showed that the stronger, faster and leaner teams were the most successful in tournament play. Multiple discriminant analysis identified upper body strength and fat weight as most important in differentiating between players of the most and least successful teams.

Disch et. al., (1977)²⁰ developed a test battery in 1974 to analyse the performance of volleyball players. This battery was developed with the help of U.S.A. Women volleyball coaching staff and measurement specialized staff of Rice and Houston University. It assessed the playing ability of women volleyball players. The teams were selected from the various physical fitness components following the procedure of most reliable and valid information to volleyball playing capacity and also keeping in view that the tests could be administered in teaching and coaching situation and they were closely related to various phases of the game. The tests were age,

weight, height; reach height, percentage of fat, vertical jump, triple hop, 20 meter dash, agility run, basketball throw and queen's college step test to assess the maturity, structure, body size, leg power, coordination speed, controlled speed, arm power, coordination and an aerobic condition.

Cox (1974)\textsuperscript{21} studied the relationship between team performance in volleyball and the skill component of serving and service reception; setting spiking, spike defence and free ball passing. Adopted charting procedure was utilised to collect the data sample games were selected from the 1922 to 1973 North West tournament volleyball schedule. A purposive sample of 107 games between the best double a teams on each of nine tournaments were charted and five game from a pre-season exhibition match between two double a teams. The statistical charting system used for evaluating the skill components was an adaptation of one proposed by James Coleman in the international volleyball review. XXVIII No. 112 (April 1971). Reliability of charting system was established prior to the season's first tournament. The results of the live charting were compared with those from the film and reliability coefficient computed. Multivariate analysis of variance discriminant analysis and multiple correlation technique were used to

analyse the data. The result of the study indicated that, considered together the volleyball skills of serving, service reception, setting, spiking, spike defence and free ball passing as measured by adapted statistical charting procedure are significantly related to team performance when viewed in terms of losing or winning and in terms of total points scored by team charted.

When the criterion variable of team performance was considered in terms of winning and losing.

1. Serving and free ball passing were of little value in predicting team success.

2. Spiking and spike defence made the greatest contribution towards predicting success.

3. The order of volleyball skills most influential in predicting team success was spiking followed by spike defence, service reception, setting, serving and free ball passing.

When the criterion variable of team performance was expressed as percent of points scored by teams being charted:

I) Setter made an insignificant contribution in terms of accounting for the variance of team performance scores;
II) Spiking and spike defence made the major contribution in terms of accounting for variance of team performance scores; and

III) The order of volleyball skills most influential in predicting team success was spike defence, followed by spiking, service reception, setting, serving and free ball passing.

Toyoda et. al., (1973)\textsuperscript{22} administered the physical fitness tests on Japanese (men’s) volleyball team to know the physical abilities of the players. The tests included: muscular strength tests, push up, grip strength, back strength, basketball distance throwing, vertical jump, block jump, three successive broad jumps, sit-ups (20 sec.) bending of upper body (20 sec.).

The agility tests included, 20 meters dash, 3 shuttle run of 9 meters distance, side step (1.2 meters main line for 20 sec.), rolling test (time required for 5 forward rolls, 5 backward rolls and standing up), total body reaction time.

The test of cardio-respiratory included, Harvard step test (for 5 min stepping on 50 cm block), maximum oxygen uptake, amount of oxygen debt.

The flexibility tests included forward bending of the body, backward bend, and duration of handstand. The tests of dexterity included those of horizontal bar, horse, mat work and trampoline.

The result indicated that the volleyball players possess these abilities.

Toyoda (1971)\(^2\) found thought his study that volleyball players have different types of physical requirements according to the nature of the activity. He concluded that a volleyball player requires muscular strength, power, and also muscular endurance, cardio-respiratory endurance, agility and speed of movement, flexibility of muscles and joint, and ability to control body movements like timing, rhythm, balance or coordination and relaxation and coordination of the whole body. These elements had a significant relationship with volleyball skills.

Knight (1970)\(^3\) to establish the relationship of repeated wall volleys, the volleyball pass and volleyball playing ability tested eleventh grade girls on Mohr and Haverstick repeated wall volley test, Liba and Stauff’s volleyball pass test and rating by four judges using Suttinger’s rating scale.


Tests were administered at the end of a six-week volleyball unit. Correlations were computed between scores of each test. It was concluded that Liba and Stauffs volleyball pass test and Mohar and Haverstick repeated wall volley test at 7 feet restraining line may be used to predict playing ability as measured by Suttinger’s rating scale.

Jacqueline (1969)\textsuperscript{25} studied the effect of mental practice on serving and volleyball skills for college women as measured by French and Cooper serving and wall volleyball test. Two preliminary studies (one with ten subjects which compared the effect of daily mental practice and no practise and a second with 68 subjects which compared three minutes and one minute of daily mental practice on each skill in addition to equal time for physical practice) revealed that, for the serving skill mental practice produce better results than did no practice and that three minute was superior to one minute. Comparison for the wall volley yielded no statistically significant results.

Bakker (1969)\textsuperscript{26} measured 28 members of women extramural volleyball team at Illionis state university for height, weight, leg extensor


strength, grip strength, skin folds, jumping ability, reaction time, and movement time. Two volleyball coaches established the criterion by rating each player on her playing. Through ‘t’ test and correlations it was found that jumping ability and reaction time were significantly related to success in volleyball. A multiple correlation ® of .718 was obtained between the 9 variables and the criterion. An R of .53 was obtained between the criterion and jumping ability plus weight. The regression equation computed in this study could be used to predict success in volleyball playing.

Thomas (1968)\textsuperscript{27} compared the relationship between running speed and agility. He selected twenty subjects from the freshman baseball team for testing. Subject’s speed was measured for the last 40 yards of the 100-yard dash, and agility was measured with Mc Cloy’s zigzag run. A dekan automatic performance analyser was used to time all tests to 1/100\textsuperscript{th} of a second. Running speed and agility were found to correlate .624.

Steitz (1964)\textsuperscript{28} studied reaction time, speed and Sargent jump, physical fitness and other variables to success in specific sports. He took 196


subjects from Springfield college male students who participated in one of
nine freshman sports. They were tested on reaction time, performance time,
speed, and Sargent jump and physical fitness. The coach for each sport
ranked each squat member in terms of overall value as a performer.

The ratings were converted to numerical values as a criterion of
success in sports multiple correlation were computed for each of the
activities and “t” ratio were determined for possible difference between the
teams. The reaction time of the left foot moving left, the Sargent jump and
reaction time of the right moving left were the variables appearing most
frequently in the multiple correlations.

Jennet (1960)\(^29\) found that performances on agility tests were
accounted for in part by reaction time, speed of movement, strength,
balance, change of position, change of direction, and body size and form. A
significant difference was found between mean factor scores of the athlete
and non-athlete groups but no significant difference was found between the
mean factor scores for the various groups of athletes.

\(^{29}\) Clair W. Jennet, “An Investigation of Tests of Agility”. Completed Research in Health, Physical
Education and Recreation, 2 (1960): 44.
Wilson (1957)\textsuperscript{30} found when a series of rhythmic signals were presented with equal probability that any of them might be accompanied by a stimulus to react, the average reaction time was 6\% faster than when the signal were no rhythmic. Further he concluded that reaction time is faster when potential stimuli are presented in a rhythmic rather than non-rhythmic series during the development of fundamental motor skills at the elementary grade level than can teaching and practice without rhythmic accompaniment.

Mohr and Haverstick (1956)\textsuperscript{31} studied 102 women students at the University of Maryland enrolled in eight-week volleyball courses who were given repeated volley test at 3 ft and 7 ft, restraining lines. Their height was measured, and they were given tests for agility and vertical jumping. Correlations were computed between volley test and other factors. From a study of these correlations, and the significant of the differences, a significant relationship was found to exist between jumping and volleying, between agility and volleying, and between height and volleying at the 3 ft distance.


\textsuperscript{31} Dorothy R. Mohr, and Martha J. Haverstick "Relationship between Height, Jumping Ability and Agility to Volleyball Skills". \textit{Research Quarterly}, 27 (March 1956): 74.
White (1947)\textsuperscript{32} conducted a study to grade volleyball playing ability during actual game. Fifteen original skills were reduced to six fundamental skills (pass including set-up, spike, block, serve, offensive tip-shot, and retrievers) opportunity was provided the contestants to make each play at least ten times. Only two players were observed at a time during any one game. The final test score of each player was the total successful performances made during ten observations.

The criterion with which the test was compared in order to determine its validity was the sum of four rank order scores. The reliability of YMCA group criterion of the test for the YMCA class was found to be .708. The validity of the scores computed from the total successes was .629 for the YMCA group.

Brady (1945)\textsuperscript{33} study was to determine the volleyball playing ability of college men with relative accuracy, simplicity and lack of complex administration. Subjects were 282 unselected regular class members, 240 sophomore men of intermediate classes, and 15 un-selected members of the Knoxoille YMCA team. Subjective rating of players in actual game situation


by four experienced teachers of volleyball was the criterion to be used. The correlation was found to be .86 numbers of tests were constructed and tried, some with evidence of high reliability and validity but were discarded because of their complex administration. The tests finally chosen and used successfully for five year by the university of Tennessee department of physical education for men consist of volleyball against a wall for a period of one minute. The validity was found to be .86 and reliability was .925. These correlations indicated that the test was both valid and reliable.

Bassett, Glassow and Locke (1937)\(^{34}\) constructed a skill test in volleyball. The test included two items serving and volleying. The serving test measured (I) the ability to get the ball across the net, (II) placement of the ball, (III) force of the serve. The volleying test combined several elements of the game (I) timing of reaction, (II) receiving, (III) passing, (IV) accuracy of placement.

Scoring of serving test (I) A ball which strikes inside the 4 foot square or frame bounding it, 7 points, (II) A ball which lands in the 8 foot square of frame bounding it, 6 points, (III) A ball which lands in the 12 foot square of frame bounding it, 5 points, (IV) A ball which lands in the 16 foot square of

frame bounding it, 4 points, (V) A ball which goes over the net and strikes in bounds but not on the target 2 points, (VI) A ball which goes over the net and land out of bounds, 1 point, (VII) A ball which does not go over the net, 0 point.

Scoring of volleyball test: Three trials are given. Volleying against the wall for 30 seconds. Total number of volley passes made in three trial numbers of new balls used. Conclusions drawn from the studies were that two tests were reliable and valid.

**French and Cooper (1937)**\(^{35}\) constructed a test the purpose of which was classification of students into groups of similar ability, measurement of pupil progress, diagnosis of individual difference, daily practice of skill elements. Numbers of subjects were 227 girls from high school. Group A consist of 47 girls of ninth, tenth, eleventh and twelve grades and group of 180 girls of ninth and tenth grades. Test items were repeated volleys, serving test, set up and pass, recovery from the net. Results of group A of different items were as follows: - repeated volley test \( r = .7162 \) serving test \( r = .6278 \) set up and passes \( r = .605 \) and recovery from net \( r = .4227 \) reliability of same items of group B was: \( -.5846, .5602, .4332, \) and \( .4115. \)

Conclusions – (I) the best combination of measures for practical purpose appears to be the serving test with the repeated volleys, (II) because of simplicity of administering and scoring, and the economy in time and equipment, these tests may be recommended as teaching devices as well as for classifying and diagnosing.

**Beise and Peaseley (1937)** selected three different groups of women in order to study the relationship of reaction time, speed and agility of the big muscle groups to certain sports skills. First was selected on the basis of demonstrated skills in tennis, golf or archery. Second, on the basis of demonstrated inability in physical education activities. Third group was composed of those students who had made low score on brace motor ability tests. It was concluded that training of individual in tennis, golf and archery classes, meeting two hours a week for seven weeks did not significantly affect scores in the SAR test.

**Kumar (1985)** conducted a study regarding the inter relationship among leg power tests spiking and blocking skills on 32 volleyball players at N.I.S., Patiala. The tests were vertical jump without approach and with

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approach, block jump, and three consecutive long jumps with both legs and with left and right leg. Standing broad jump, half squat, and shuttle run (9-3-6-3-9), forward and backward bending of body, 20 meters sprints and 40 meters sprint and 60 meters run, spiking and blocking. He concluded that spiking and blocking skills were not inter-correlated. Spiking had significant correlation with 40 meters sprint, reach jump with and without approach. The approach and without approach jump tests were highly correlated with each other. Sprint tests showed a significant correlation with jump tests. The test of flexibility was correlated with consecutive jumps, and it has a high correlation with the approach and without approach jump.

Devi (1985)\(^3\) made a study on 36 college level volleyball players to determine the relationship of depth perception, agility and speed of movement. Her findings reveal that depth perception, agility and speed of movement contribute to volleyball playing ability. The significant correlation of agility and speed of movement may be expected in the game of volleyball, as it demands a quick acceleration rate along with performing movement in any direction. The results showed a significant relationship with speed of movement and agility.

Siridhar (1984)\textsuperscript{39} studied thirty male and female volleyball players to see the relationship of selected motor fitness components to playing ability in volleyball. Product moment correlation was used to determine the relationship of selected motor fitness components to playing ability in volleyball. She found that power was the most significant motor fitness component underlying performance in volleyball. Muscular endurance, circulatory-respiratory endurance and flexibility also contribute to playing ability in a real manner. Agility showed an insignificant relationship to playing ability in volleyball.

Joseph (1983)\textsuperscript{40} determine the relationship of power, agility, shoulder flexibility, arm length, leg length to volleyball playing ability. Thirty male volleyball players of Lakshmibai National College of Physical Education, Gwalior, were selected as subjects. Power was measured by sargent jump, agility by 40 meters shuttle run, shoulder flexibility by graded stick, and arm length and leg length by steel tape, the playing ability was based on the average subjective judgement of three experts. Product movement

\textsuperscript{39} Sheela Kumari Siridhar, "Relationship of Selected Motor Fitness Components to Playing Ability in Volleyball". (Unpublished Master’s Thesis, Jiwaji University, Gwalior, 1984).

correlation was used to statistically analyse the data and it was concluded that:

1. Power is the most reliable single variable in prediction of playing ability of men volleyball players;

2. Arm length and leg length are also reliable variables in predicting the playing ability of male volleyball players, and

3. The variables of agility and shoulder flexibility show significant relationship in predicting the playing ability of male volleyball players.

Murugeson (1983)\textsuperscript{41} selected thirty male volleyball players of Lakshmibai National College of Physical Education, Gwalior, to study the relationship of height, agility and vertical jump to spiking in volleyball. He concluded that vertical jump is the most reliable single factor, which underlies the performance in spiking ability. The variable combinations of height and vertical jump proved to be most reliable. For these variables height, agility and vertical jump were found to be valid and reliable for predicting spiking ability of male volleyball players.

Dixit (1982)\textsuperscript{42} investigated the relationship of reaction time, speed of movement, and agility, and their comparison among players from selected sports. She studied 48 male college students as subject’s i. e. subjects from each selected sports (football, volleyball, kho-kho, and kabaddi) from Lakshmibai National College of Physical Education, Gwalior. She found that agility and speed of movement were significantly related with either speed or movement or agility at .05 level of confidence.

Rajan (1980)\textsuperscript{43} evaluated the effect of selected weight training exercises (half squats, supine bench press, sit up with weight, leg press, wrist curl), and specific exercises (medicine ball throw, jump and throw, lift ball, target throw, hurdle leap and other individual movements) on volleyball playing ability. There were 60 subjects in all who belonged to 10\textsuperscript{th} and 11\textsuperscript{th} classes and were divided in three groups. His results revealed that volleyball playing ability could be improved significantly by administering a programme of weight training and specific exercises in addition to regular practice of volleyball and also playing volleyball alone.

\textsuperscript{42} Poonam Dixit, “Inter-Relationship of Reaction Time, Speed of Movement and Agility and Their Comparison among Players from Selected Sports”. (Unpublished Master’s Thesis, Jiwaji University, Gwalior, 1982).

Weight training exercises and specific exercises given in addition to regular practice of volleyball were found superior to regular practice of volleyball alone for developing performance in Russell Lunge Volleyball test.

Singh (1980) conducted a study on randomly selected 60 volleyball players to construct and standardize a volleyball skill tests for men players. He selected the volley, the dig, the serve, the spike, service reception and pass, pass and set up, set up and spike. Zero order correlations and multiple correlations were computed to express the degree of relationship between the tests items by Wherry Doo- little method. Further regression equation was computed to overall playing ability. Zero order correlations stated that the test items were highly significant to criterion measure. Through multiple correlation and regression equation, it was found that the volleyball, the dig, and set up and spike contributes maximum to playing ability. Multiple regression was .7516 and the reliability, objectivity and validity of test battery was .983, .985, and .746 respectively.

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Adhikari (1979)\(^6\) while comparing the relationship of power, agility, and related speed characteristics to block jump and three stride jump in volleyball concluded that:

1. Power of an individual contributes much in performing block jump and three stride jumps.

2. Agility does not contribute in performing block jump and three stride jumps.

3. Selected speed characteristics (speed, reaction time, and speed of movements) are not an important factor in developing the block jump and three stride jumps.

4. Lastly it was found that power and agility contributes almost equally in performing block jump and three stride jumps.

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