Chapter II

REVIEW OF RELATED LITERATURE

A review of literature related to the present study on Volleyball, psychomotor abilities, and their contribution and effect on playing ability of Volleyball available in the library of Lakshmibai National College of Physical Education, Gwalior, has been abstracted in this Chapter to provide the background material for this study.

Cox\(^1\) studied the relationship between team performance in Volleyball and the skill component of serving and service reception, setting spiking, spike defense and freeball passing. Adopted Charting procedure was utilized 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 in 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 adoption 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

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\(^1\)Richard Hardee Cox, "The Relationship between selected Volleyball Skill Components and Team Performance of Men's North East Double A Volleyball Team". Dissertation Abstract International 34 (March 1974):5685.
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) Setting made an insignificant contribution in terms of accounting for the variance of team performance scores;
ii) Spiking and spiking 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 freeball passing.

Phipps\textsuperscript{2} 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 over all performance. The specific test model had the highest correlation with over all performance. The variables of general ability and 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 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 combination of the general ability with the specific and personality with specific are better predictors of volleyball performance than the coaches beginning of season judgement.

Shondell\(^3\) conducted a study to identify the physical and anthropometric traits possessed by successful volleyball players and to develop a physical performance battery that would prove valid, reliable and practical when used to identify successful collegiate players. He took 23 tests and measurements to measure the characteristics of successful players, a jury of four judges provided the criterion which was over all volleyball performance of ninetythree subjects. Inter-correlation coefficients between the independent variables and dependent variables, stepwise regression coefficients and constants and the square of the multiple correlation coefficient for the regression equation at each step, reliability coefficient of all items were computed by using inter-class correlations technique. Within the limitations of the study he concluded that:

1. Reliability coefficient ranged from .994 (wrist flexibility) to .496 (Reaction time)

\(^3\)Donald Stuart Shondell, "The Relationship of Selected Motor Performance; and Anthropometric Traits to Successful Volleyball Performance", Dissertation Abstract International" 32 (March 1972) : 5026.
2. Validity coefficient ranged from -0.585 (medicine ball) to 0.13 (wrist flexibility).

3. Power appeared to be the most significant in successful volleyball performance.

(4) the regression equation for the four item battery was \( X = (0.198) \) Medicine Toss + (-2.991) 30 yard dash + (0.253) wall battery correlated .708 with volleyball playing ability.

(5) The regression equation for six item battery was:

\[ X = (0.272) \text{ Medicine ball Toss} + (-3.984) 30 \text{ yard dash} + (0.281) \text{ wall catch} + (-0.375) \text{ Zig Zag Run} + (-0.210) \text{ Jump and react} + (-0.051) \text{ weight} + 47.031 \text{ constant.} \]  This battery of six items correlated .732 with volleyball playing ability. The cross validation procedure employed supported the validity of the six-item battery as a predictor of expected volleyball performance.

Bakker\(^4\) measured 28 members of Women Extramural Volleyball Team at Illinois State University for height, weight, leg extensor strength, grip strength, skinfolds, 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 (R) of .718 was obtained between

\[^4\]Clarena Bakker, "Factors Associated with Success in Volleyball", Completed Research in Health, Physical Education and Recreation 11 (1969):106
the 9 variables and the criterion. An $R^2$ 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.

Smith$^5$ formed three groups of subjects: 68 beginning players, 11 Versity players; and 3 highly skilled & experienced players to find the relationship of volleyball playing ability to scores achieved in sargent vertical jump. According to him vertical jump correlated $.35$ with Bready Test; $.55$ with judges evaluation and $.50$ with combination of Bready Test and judges evaluation for beginning players. The $r^2$ between the vertical jumping ability of the Versity players and a potential playing ability ranking by their coaches was $- .36$. It was concluded the vertical jump is not an accurate predictor of volleyball playing ability.

Gladden and Colacino$^6$ conducted a study on characteristics of volleyball players in which height, weight, skinfold, vertical jump and maximum anaerobic power were measured on 94 male and 88 female participants in three divisions (Men's open, Senior Men's, and Women open of the 1974 USVBA National Tournament. These players had a low skin fold total (Men's open 48.7mm Senior Men's 71.2 mm, Women's 6 mm) and a high vertical jump (Men's open 67.4 cm, Senior Men's 57.5 cm, Women's


females had a very high anaerobic power in both total anaerobic power and anaerobic power per unit of body weight when compared with normal females. When compared with other athletes, the males in the Men's open division had a high total anaerobic power but only an average anaerobic power per unit of body weight. Rank order correlations between the final standing in the tournament and team averages for each of the measured variables revealed no significant relationship in the men's open, however, in the women open division final standing was significantly correlated with age, height, reach, vertical jump and maximal height on jump. Partial rank order correlations showed that height and vertical jump were major factors correlated with final standing. The difference in the rank-order correlations between the male and females might be explained by either (1) a critical height above the volleyball net or (2) a higher skill level in the males.

Barngrover used sociometry to determine successful volleyball teams. The study involved ten teams that participated in the 73-74 AIAW Intermountain Volleyball Tournament. Six components of sociometry were investigated: status clique mutual choice, index, isolates and rejects, cohesiveness, and preception of players ranking by the coach. It was hypothesized that successful teams did not differ in structure from non-successful teams. The major hypothesis was subdivided into six subhypothesis for each of six components. No significant difference was found

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for any of these hypothesis. The Pearson's Product Moment Correlation was used for the status index. No significant difference was found. The Spearman Rank Correlation Coefficient was used to determine the relationship of the coach's ranking of players to their actual status. No significant difference was found.

Mohar and Haverstick\(^8\) conducted a study to find out the relationship between height, jumping ability and agility to volleyball skills on one hundred and two women students at the University of Maryland enrolled in eight weeks volleyball course. The subjects were given repeated volley test at 3ft and 7 ft. restraining lines. Their heights were measured and they were given tests of agility and vertical jumping. A significant relationship was found to exist between jumping and volleying between agility and volleying, and between height and volleying at 3 ft. distance.

Adhikari\(^9\) 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 jump.

\(^8\)D.R. Mohar and M.J. Haverstick, "Relationship Between Height, Jumping ability and Agility to Volleyball Skills", Research Quarterly 27 (1956) : 74-78.

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

3. Selected speed characteristics (Speed, reaction time and speed of Movement) is not an important factor in developing the block jump and three stride jump.

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

Rodionova and Plahtienko\(^{10}\) have found that top volleyball players possess similar aerobic capacities as top players in other games. The level of anaerobic capacity was similar to that of top hockey and basketball player, and is comparable to most athletes who have undergone specific anaerobic training. During a game the player manifest a high intensity of metabolisms with the aerobic and anaerobic mechanisms participating equally.

The investigations conducted by Evstifeev\textsuperscript{11} has suggested a parallelism between anaerobic energy capacity and the level of volleyball performance during the game, a feature specially marked in forward players.

Duba\textsuperscript{12} conducted a study on 11 subjects who were junior men’s provincial volleyball team members. They undertook a series of laboratory tests to determine selected motor performance and anthropometric and physiological characteristics. The motor performance tests were 20 metres sprint, three long jumps, Sargent jump, Block jump, running spike jump, push-ups, 90 mts run, shuttle run, rolls and sit-ups. The findings were:

1. The game of volleyball played at this level is a moderately stressful aerobic sport; game heart rates average 144 beats per minute. Game blood lactic and concentration averaged 32.5 mg%.

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


3. Differences in time characteristics were not significant during the various games of match. Rally durations averaged 70 seconds while rest of durations averaged 13.3 seconds. Average game length was 18 minutes and 33 seconds.

4. The predominance of play ends with the first net encounter, the more stressful the rally.

Viitasalo et al.\textsuperscript{13} studied the endurance requirement of volleyball in a series of experiments in laboratory and field conditions as well as during play. The subjects for the study were 10 players from the Finish national team and 10 players from a Finish volleyball club. In the Video tapped play analysis the national teams of U.S. and U.S.S.R. were also studied.

The mean maximal oxygen up take (max VO\textsubscript{2}) for twenty Finish volleyball players was 56.7 ml/kg/min, the aerobic Threshold (Aer T) 36.6 ml/kg/min and the anaerobic Threshold (AnT) 44.7 ml/kg/min. During a game the heart rate was below the AerT 81.6% of the total play time, and the mean blood lactate time was at the level of the AnT or lower.

It was concluded that volleyball is an aerobic sport, having high aletic, anaerobic power productions performed with fairly long recovery

Periods. Rather high \( \text{Max VO}_2 \) and \( \text{AnT} \) are needed to reduce lactate production far fast recovery during and between matches.

Morrow\(^{14}\) and his associates obtained various anthropometric, strength and speed variables on 180 inter-collegiate Women 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 the teams were significantly different on the factors of strength and speed/fat. Team centroids were plotted in two dimensional discriminant space, 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.

Coutts\(^{15}\) analysed the vertical component of ground reaction force time curves for two styles of jumping used in preparation for a spike in Volleyball in a group of 86 players. The two style consisted of a hop approach where the player lands simultaneously on both feet prior to take-off, and a step close (SC) approach where one foot is

\(^{14}\)James R. Morrow et.al.; "The Importance of Strength, Speed Body Size for Team Success in Women Inter-collegiate Volleyball", Research Quarterly 50 (October 1979) : 429.

placed on its take-off position followed by its trailing foot being placed adjacent to it before take off. A total of 15 variables from the curves for each style were compared using analysis of variance technique. The hop jump was characterised as having a higher velocity at the end of the approach resulting in a faster and larger absorption impulse. This produced a faster positive impulse with a higher average force, peak force, and acceleration which is consistent with a greater storage and utilization of elastic energy of the muscle. No significant difference was found in the time and average force for the final unweighting phase of impulse, and no difference were noted in take-off velocities. Thus the hop jump resulted in decreasing the tune of impulse by increasing the average and peak forces during the impulse with no apparent effect on jump height.

Fleck et al. compared the physical and physiological characteristics of the 1980 US Women's National Volleyball Team, and the Collegiate players who composed the 1979 U.S. Women's University Games Volleyball Team. The characteristics compared were age, height, weight, body composition via hydrostatic weighing, vertical jumping distance, vertical jumping height, Maximal O$_2$ consumption, heart rate Max and respiratory exchange ratio. Significant differences in age, percent of body fat and vertical jumping distance, between the two teams were demonstrated with the National Team being significantly older, having

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a lower percentage of body fat and possessing a larger vertical jumping distance. These results indicate trainers of elite women Volleyball players should consider including technique to reduce percentage of body fat and increase Vertical Jumping distance.

Puhl et al. examined the absolute physical and physiological characteristics of U.S. Men's National (N = 8) and Women's University World Games (N = 14) Volleyball teams. The percent body fat, maximal oxygen up take (VO₂ Max) using treadmill runs, post-exercise blood lactic Acid, measures of vertical jumping ability, and peak isokinetic torque cybex II for knee extension and flexion, shoulder extension and planter flexion at 30, 180, 240 and 300 degree/see were measured.

They concluded that the men were taller, heavier, had a higher body density and lean body weight and lower body fat for gross measures of jumping ability, the men achieved greater absolute height for the jump and reach (317.1 vs 277.3 cm) and a greater jump distance above the standing reach (67.0 vs 45.9 cm). If considered as a percentage of net height (2.43 m. for men and 2.24 m. for women), the absolute jump and reach values were 130% and 124% of the respective net height.

The men also had the greater VO₂ max expressed in absolute (ml/min⁻¹) and relative terms (ml/kg/min). Although the difference was

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not evident when expressed as ML. leg$^{-1}$ L BW. min$^{-1}$. Maximal Exercise heart rates and post-exercise blood lactic acid values were similar between groups.

Ferrer$^{18}$ analysed the teams in the SIU Saluki Invitational and in the IC State Championship, 1980. Observational technique was used to collect the data and then analysed by means of r's %, ANOVA'S, Duncan's Test and 't'-test. The Inter-observer objectivity was .96. The predominant errors occurred in dig (40.73%), spike (21.77%) and block (12.26%). Significant results were: greater number of errors game won than in lost for the block and set when receiving. A difference was found in the no. of errors committed for the spike and the block, when receiving, and for the set and total errors when receiving with respect to place in tournament; however, the 1st and 2nd place teams are not the one's with fewer errors. The 't'-test indicated that more errors occurred when receiving than when serving. Intercorrections for the dig, block, spike and totals ranged from .70 to .96.

Morrow et. al.$^{19}$ obtained various anthropometric, strength and speed variables of 180 inter-collegiate women volleyball players who

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$^{19}$ James R. Morrow et.al.;"The Importance of Strength, Speed and Body size for Team Success in Women's Inter-Collegiate Volleyball" Research Quarterly 50 (October 1979): 429.
participated in a regional round-robin tournament. The purpose of the study was to determine the factors underlying the motor performance of the women and then determine if there was any relationship between the factors and team success. Factorial analysis of the measured variables showed that the variables could be dimensioned as body size, speed/fat and strength. Multiple discriminant analysis showed that the teams were significantly different on the factors of speed/fat. Team centroids were plotted in two dimensional discriminant space and this graphic representation showed that the stronger, faster and leaner teams were the most successful in tournament play. The result showed that the basic factors of speed fat and strength were related to team success. Upper body strength and fat weight were identified as most important in differentiating between players of the most and least successful teams.

The purpose of Slaymaker's study was to determine if National Championship Caliber Volleyball players possess certain measurable kinesiological attributes to a significantly greater degree than skilled players at a lower level of competition. He selected thirty two subjects in each group i.e. representing championship caliber players, tournament class caliber players and activity class caliber players.

The data were analysed by use of 'F' Test and Scheff's post-hoc Test. He concluded that:

20 Thomas Edward Slaymaker "A Comparison of Selected Physical Characteristics of Volleyball Players at these levels of Competition, including National Championship Participants, Regional Tournament and College Activity Class Participants" Dissertation Abstracts International 27 (May 1967) : 3712.
1. The performance of championship players was significantly greater than the performance of class-caliber players in majority of items tested.

2. The performance of championship players was not significantly greater than the performance of tournament caliber players in a majority of test items, indicating that areas of performance not under discussion must account for the difference in playing ability of two groups.

3. The performance of the tournament caliber group was not significantly greater than the performance of the class caliber group in a majority of test items, indicating that areas of performance not under discussion must account for the difference in playing ability of two groups.

Selected Kinanthropometric characteristics of Indian Volleyball players were studied by Sodhi et.al.21 the data of 97 volleyball players were divided into four groups - National Men (N = 12), State (N = 21 National University (N = 27) and District (N = 25) groups. The volleyballers in each group were compared with control group (N = 25) as well as the champions reported elsewhere. Each subject was examined with 12 anthropometric measurements and 10 test of performance. The latter consisted of block jump, Vertical jump, three successive jumps, 20mtr. dash, agility, Basketball Throws, 30 sec. sit ups, flexibility and 2.4 km. run. The Statistical analysis was carried out to calculate the mean, standard deviation, analysis of variance and test of significance.

The results of the study revealed that the National and State level players were better than other groups of volleyball players and the controls, with persistent decreasing gradient in most of the variables. On an average the volleyballers in each group were meso-ectomorphic in their somatotype. In skin fold, the National and State players possessed the least value, followed by the University, the district players and controls with a gradual ascending gradient. On the contrary, in all the physical performance tests the National players were the best followed by the State, the University, the District players and the controls with a descending gradient of performance.

Horak\(^{22}\) evaluated the physical fitness of the 1972 Olympic men's team of Czechoslovakia to know the level of fitness. The test battery considered of age, weight, height, percentage of fat, reach height, 3 kg medball put by both hands, right then left hand, 350 gram ball throw with run up and without run up, broad jump, triple jump, touching the basketball board by jumping, sprint 60 mts, 1000 mts run, step test and bicycle ergometer test. He found that these items were significantly related to their performance.

Kumar\(^{23}\) conducted a study regarding the inter-relationship among leg power, tests, spiking and blocking skills on 32 volleyball players at


Devi, conducted a study on twenty four volleyball players to find out the relationship of selected strength and flexibility measures to playing ability in volleyball. She concluded that arm strength, abdominal strength, leg strength and shoulder flexibility were significantly related to playing ability in volleyball. Grip strength, wrist flexibility and ankle flexibility had insignificant relationship to volleyball playing ability. Trunk flexibility showed negative but insignificant correlation to playing ability.

The purpose of Bhola's study was to determine the relationship of absolute leg length, relative leg length, foot length, dynamic power, ankle flexibility and agility to jumping ability in volleyball using three stride rhythm. Twenty male volleyball players of Lakshmibai National College of Physical Education, Gwalior, were selected as subjects. The following conclusions were drawn:

1. Foot length and dynamic power showed significant relationship with jumping ability in volleyball using three stride rhythm.

2. Right and Left foot ankle flexibility also showed significant positive relationship to jumping ability.

3. Agility was significantly related to jumping ability of male volleyball players.

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N.I.S. Patiala. The tests were vertical jump with approach and without approach, block jump, three consecutive long jumps with both legs and with right and left legs standing broad jump, half squat, shuttle run (9-3-6-3-9), forward & back bending of body, 20 mtr.sprint, and 40 mts sprint and 60 mts. run, spiking and blocking. He concluded that spiking and blocking skills were inter-correlated. Spiking had significant correlation with 40 mts sprint, reach jump with and without approach. The approach and without approach jump tests were highly correlated with each other. Sprint test showed a significant correlation with jump tests. The test of flexibility was correlated with agility only. Blocking was highly correlated with consecutive jumps, and it had a high correlation with the approach and without approach.

24. Murugeson 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.

4. The variables of absolute leg length, fore leg length and thigh length showed insignificant relationship to jumping ability.

Siridhar\(^{27}\) 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\(^{28}\) determined 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 metres 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 Moment Correlation was used to statistically analyse the data and it

\(^{27}\)Sheela Kumari Siridhar, "Relationship of Selected Motor Fitness Components to Playing Ability in Volleyball" (Unpublished Master's Thesis, Jiwaji University, Gwalior, 1987)

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 prediction of playing ability of male volleyball players.

Hovey[^29] tried to find out the relationship between anxiety and competition in men's inter-collegiate volleyball. He tested 12 members of a men's volleyball inter-collegiate team, where all subjects completed the Sports Competition Anxiety Test during a team meeting and State Anxiety Inventory three times, once 2 min. before a practice session, once 5 min. before a regular season match, and once 5 min. before a tournament match. It was found that that Trait anxiety can not be used to predict state anxiety; the three competitive situations of practice, regular season game and tournament game do not produce different state anxiety reactions, an interaction exists between trait anxiety and the three competitive situations; a positive relationship exists between trait anxiety and tournament state anxiety.

[^29]: Kim Hovey, "The Relationship between anxiety and Competition in Men's Intercollegiate Volleyball" Completed Research in Health, Physical Education and Recreation 21 (1980): 144
Peck\textsuperscript{30} divided 32 students in a volleyball class into two matched groups on the basis of the IPAT 8 - Parallel from Anxiety Test to 13 class meetings, during which the French and Cooper serve and Repeated Volleyball Test's were given at the beginning, middle and end of meeting. Induced anxiety was attempted by Verbal and written suggestions that inadequate test performance would result in a low final grade. Performance improved significantly on the skill test but the correlations between anxiety and test performance were not significant. Induced anxiety produced significant changes in anxiety but the changes were not uniformly in the same direction.

Pankey\textsuperscript{31} conducted the study to determine the effect of interval running and weight training upon the anaerobic power, body fat, leg strength, standing long jump and vertical jump of an in-season women's volleyball team. The training programme lasted ten weeks, 5 days per week and the testing period took place on the 1st, 5th and 10th week. A one way ANOVA and Post-hoc Tukey'sh Test and t test were used to analyse the significant decrease were found in body fat, and significant increase were found in anaerobic power; leg strength, standing broad jump and vertical jump of experimental subjects. No significant change were found in the control subjects.


\textsuperscript{31}Mary A.D. Pankey, "The Effect of Interval Running and Weight Training on the Selected Measures of an In-season Women's Volleyball Team", Completed Research in Health, Physical Education and Recreation 9 (1978) : 211.
Jacqueline\textsuperscript{32} studied the Effect of Mental Practice on Serving and Volleying Skills for College Women as measured by French and Cooper serving and wall volleying Test. Two preliminary studies (one with ten subjects which compared the Effect of daily mental practice and no practice 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.

Knight\textsuperscript{33} to establish the relationship of repeated wall volleys, the volleyball pass and volleyball playing ability tested eleventh grade girls on Mohar and Haversticks repeated wall volley test, Liba and Stauff's volleyball Pass Test and Rating by Four judges using Suttinger's Rating Scale. Test 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 Stauff's 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 Sutttinger's Rating Scale.

\textsuperscript{32}Marice Shick Jacqueline, "The Effect of Mental Practice on Selected Volleyball Skills for College Women at University of Minnesota". Dissertation Abstract International 29 (April 1969):3447.

Khalil studied the effect that different types of approaches and styles of take-off have on the height of the vertical jump. Fifteen male and 15 female volleyball players were tested using three types of approaches & two styles of take-off on four separate days with three test periods held each day. A 3 x 2 x 2 ANOVA with repeated measures and ANOVA of Simple Effects and Newmen-Keuls Test were utilized to analyse the data. The following conclusions were made: for males, as the number of steps in the approach increased (from 2 to 4), the height of the jump also increased but for females this had no effect; for males and females and for all approaches, the height of jump that followed the premump take off was greater than the height of the jump following the step-close take off; and the male players jumped higher than the female players.

Healy in order to determine the specific effects of the pattern of approach, 1-step approach, 2 step approach have on the performance of the vertical jump tested 43 female and 38 male subjects enrolled in the 1977 Mid. American Region Olympic Development Volleyball Camp. All the subjects were tested on three different vertical jump approaches on 2 successive days. A 2 x 3 ANOVA with repeated measures were employed to determine the interaction of three approaches and the sex of participants. A Newmen-Keuls Test was used to determine


when statistically significant difference between approaches existed. It was concluded that the height of the Vertical jump with \( \frac{1}{2} \) step is greater than with no approach and 2 step approach results in greater height than with \( \frac{1}{2} \) step approach.

Breatz\(^{36}\) measured the arm and wrist strength and the open over hand volleyball serve velocity for 44 female subjects. Cable Tensimeter and Cinematography techniques were used. Multiple Rs were used to analyse the data and indicated the relationship between arm and wrist strength and open over hand volleyball service Velocity (\( P < 0.05 \)).

Coutts\(^{37}\) studied eleven members of Canadian National Women Volleyball team who were tested on vertical jumping ability and Margaria’s test of anaerobic power with result expressed in times of power (Kgm/sec) and velocity (m/sec), or power per unit body weight (kgm/kgsec). The velocity scores on the two tests were not significantly related to each other and when correlating these values with height and weight, the relationship between velocity on the Margaria Test and height was the only significant correlation. Power values on both test were significantly related (\( P < 0.05 \)) to each other as well as height and weight. The average values of 1.52 m/sec. and 108 kg m/sec for the Margaria Test and


1.56 m/sec. and 110 Kgm/sec on the vertical jumping, thus provide
normative values on two distinct aspect of leg power per unit body
weight for female athletes.

Disch et.al.\textsuperscript{38} examined the relationship between a battery of
motor performance test and a set of volleyball skill tests designed to
discriminate among levels 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 jum, 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.

\textsuperscript{38}James G. Disch et. al.; "Analysis of Canonical Relationship
Between a Battery of Motor Performance Tests and a Battery of Volley-
Sharma, Khan and Butchiramaiah\(^3\) 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 'd' 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 attentivity.

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

Coleman\(^4\) studied three age groups of male and female volleyball players from 1978 National A.A.U. Junior Olympic Volleyball Championships. Each subject's score was averaged for each leg. Analysis attempted to determine if there were significant difference between sex in same group, between age groupings of the same sex, between left and right RT, and between right and left handed subjects. Significant difference was found for male being faster than females and

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age groupings within the same sex, older grouping being faster than younger groups. No significant difference was found between right and left leg RT and right and left handed subjects.

Bhanot and Sidhu\textsuperscript{41} studied the visual and auditory reaction time of the right hand and right foot of 59 subjects including Hockey players, Volleyball Players, Weight lifters, and Gymnasts. The Weight-lifters were found significantly faster than hockey players, Volleyballers and Gymnasts for both visual and auditory reaction times of hand and foot. Hockey players were faster than volleyballers and Gymnasts but the difference was significant only in auditory reaction time of hand and foot. Volleyballers were faster than Gymnasts but the difference is not significant. Visual and auditory reaction time of hand were faster than those of foot. Auditory reaction time of hand and foot was faster than the corresponding visual reaction time.

Honcock and Milner\textsuperscript{42} conducted a study on six experience male scuba divers who performed tests of Manual Dexterity in open-ocean under water environment. Each test consist of an assembly and disassembly of bolt combinations, when size of combination was varied. For the two combinations a similar decrement of speed performance was found.


for a shallow (3.7 m) exposure 31.0% over a land control for a greater depth (15.3 m). The larger combination resulted in a greater decrement (58.5%) than the small bolt combinations 36.0%. Absolute combination time was always less for the larger combinations. These results were compared with previous data concerning Manual Dexterity in the open ocean. An overall view suggests that a quasilinear relationship exists between depth and percentage increase in completion time for manual under water.

Kacevich in order to determine the relationship between reaction time and general football playing ability and total reaction time and individual playing different positions of 82 varsity football players compared the RT as measured in laboratory with measured in field situation. Moment time was recorded electronically as the time between completion of RT necessary to run 10 yards. Total Reaction Time was taken as the sum of Reaction time and movement time for trial. Statistically significant rs were calculated between total reaction time and team ranking and total reaction time and individuals playing different positions.

Crauston\textsuperscript{44} studied the relationship of Reaction Time and Movement time and visual tracking to performance in Badminton. A reaction time-movement time device, a pursuit rotor and Miller Badminton wall volley Test were used to collect data on college women. Reaction time, movement time and visual tracking had no apparent relationship to performance in Badminton.

Canelini\textsuperscript{45} compared simple reaction time of winners and losers in the 1966 Sac-Joaquin South Sub-section Wrestling Tournaments. Daken Athletic Performance Analser was used to collect the data and the faster response of the three trials was recorded. Simple reaction time of the preferred hand was not a deciding factor in wrestling success.

Sreejit\textsuperscript{46} studied the psychomotor performance variations among players of Basketball, Volleyball and Badminton. The subjects were tested on reaction time, speed of arm movement, multilimb coordination, arm-hand

\textsuperscript{44} Virginia Agnes Crauston, "A Study of Relationship of Reaction Time, Movement Time and Visual Tracking to Performance in Badminton" Completed Research in Health, Physical Education and Recreation 10 (1968) : 95.


\textsuperscript{46} K.P. Sreejit, "Selected Psychomotor Performance Variation Among Players of Different Sports" (Unpublished Master's Thesis LNCPE, Gwalior, 1988).
steadiness and finger dexterity. The significant of differences in performance among the players of different sports on the selected psychomotor variables were analysed by means of one way analysis of variance. He concluded that:

1. Basketball and Volleyball players had a marked difference in their hand reaction times.

2. Basketball and volleyball players exhibit differences in their speed of arm movement but to a lesser degree as compared to the hand reaction time.

3. Basketball, Volleyball and badminton players did not exhibit any marked differences in their multilimb coordination, arm-hand steadiness and finger dexterity.