Chapter II

The review of related literature

The review of related literature is instrumental in the selection of the topic, formulation of hypothesis and deductive reasoning leading to the problem. It helps to get a obvious idea and supports the finding with regard to the problem under research.

The researcher scholar came across several books, published thesis, periodicals and journals and while searching for relevant facts and finding that they were related to this present research, such as those given below for better understanding and to justify the study.

The relevant studies found from various sources which the researcher has come across, are cited below:

**Waghmare, Bondade & Surdi (2012)**, conducted the research of Flexibility, Agility and Reaction Time in Handball Players. The research was conducted in male Handball players (n=30) aged between 15-25 years and 30 age matched controls. Flexibility was evaluated using Sit and Reach test and Goniometry; Reaction time using electronic instruments, Side Step test, Quadrant Jump test and Agility using Burpee’s squat test. It was showed that flexibility and agility was significantly more and reaction time was significantly less in Handball players as compared to their age matched controls. Though, these handball players insulate far behind when compared with international Handball players. So it was concluded that players with more flexibility, agility and less reaction time are at advantage for Handball.
Satinder (2011), investigated a research on the correlation of eye-hand coordination and reaction time among Handball players. Subjects for this study were 20 Handball Players, State Level tournament held at Sujanpur Tira, Himachal Pradesh, North India in the year 2009 to 2010. To find out the correlation between eye-hand coordination and hand reaction time, products Moment Correlation Method was used.

Fathloun, Souhail Hermassi, & Bensbaa (2011), investigated a research on the relationship between medicine ball explosive power tests; jump and Handball throwing velocity performance in team Handball players. Explosive test was evaluated by a medicine ball throw. Specific explosive strength was measured by making 3 types of over arm throw: standing position, using an adapted chair (without run-up, T w), a 3-step running throw (T 3-Steps) and a jump shot (J S). The jump test (SJ, CMJ and FCMJ) were determined using the OptoJump. The medicine ball explosive power test was closely related to T 3-Steps. Significant relationships were observed between medicine ball explosive power tests and (J S) and (T w). The Medicine ball explosive power test is also positively related to vertical jump ability represented by Squat Jump (SJ) and Countermovement Jump (CMJ). The results suggest an association of the medicine ball explosive power tests to performance in throwing events.

Zwierko, Lesiakowski, & Florkiewicz (2005), conducted the selected aspects of motor coordination in young Basketball players. The research was conducted in 40 skilled Basketball players aged between 14–15 years and 40 non-sporting boys of the same age matched controls from four macroregions in Poland Computer-assisted laboratory technology was used to measure the following abilities: time of simple reaction to visual stimuli, spatial orientation, complex multiple-stimuli reaction and
focused attention, frequency of movements, dynamic-spatial differentiation, directional and temporal anticipation and rate of movement acquisition. Highly significant differences (p < 0.01) between the skilled Basketball players and the non-sporting subjects were observed in the spatial orientation, complex reaction and focused attention, and the rate of movement acquisition tests. Differences in frequency of movements, spatial and temporal differentiation and temporal anticipation were also significant, but at p < 0.05. Young basketball players, due to the well-selected recruitment criteria and training routine displayed a significantly higher level of selected motor coordination abilities as compared with their non-sporting counterparts. The results of the research reveal that the selected aspects of motor coordination are crucial during the recruitment of young players; the assessment of spatial orientation, complex reaction and focused attention as well as the movement acquisition rate could be especially helpful in selection of prospective players.

Čavala, & Katić (2010), conducted the biomotor characteristics that determine playing performance and position in female Handball. The study was conducted on 52 female Handball players. Research findings revealed the high-quality female handball players to predominantly differ from the less successful ones in the specific factor of throw strength and basic dash factor, followed by the specific abilities of movement without and with ball, basic coordination/agility and specific ability of ball manipulation, and a more pronounced mesomorphic component. Results also revealed the wing players to be better in the speed of movement frequency (psychomotor speed), run (explosive strength) and speed of movement with ball as compared with players at other playing positions. Furthermore, endomorphic part was less definite in
players at the wing and back player positions as compared with goalkeeper and pivot positions, where endomorphic part was significantly more pronounced.

Zachopoulou et.al, (2006), conducted the ability to be rhythmically accurate and to maintain a steady rhythm in movement execution can be considered one of the basic abilities of an athlete. The purpose of this research was to compare children's levels of rhythmic ability that were trained in different sports. The research was conducted in four groups of children aged between 9.2 ± 4.8 years old: Subjects were 50 tennis players, 53 basketball players, 52 swimming players and 52 control groups. Every child experienced a test for the two variables of rhythmic ability: Rhythmic accuracy and rhythm maintenance, both in two tempos. The analysis of the data exhibited that the tennis group was more accurate than the three other groups. Players in the swimming group had the top performance in the test of rhythm maintenance, in both tempos. All groups performed better at the fast tempo than at the slow tempo, for both factors of rhythmic ability. The differences in rhythmic accuracy and rhythm maintenance for both sexes were not statistically significant.

Dyba (1982), made a study on a group of 11 junior men provincial Volleyball team members. Players were subjected to experience a series of laboratory tests to estimate selected motor performance, anthropometric and physical characteristics. The motor performance tests comprised 20m sprint, 3 long jumps, Sargent jump, block jump, running spike jump, push-ups, 90 m run, shuttle run, rolls and sit – ups. The results of this research showed that: The game of volleyball as played at this level is a moderately stressful aerobic sport; game heart rate averaged at 144 beats per minutes; game blood lactic acid concentration averaged 32.5 mg%. Significant differences in action component profiles were observed between the subjects.
Blocking actions had the most frequency, setters performed significantly on a greater number of volleys. Differences in time characteristics were not significant during the various sets/games the match. Rally durations averaged 7.0 seconds while the rest of the durations averaged 13.3 seconds. Average game duration was 18 min and 33 secs. The predominance of play ends with first net encounters.

Katic, et.al, (2007), investigated a research on "Biomotor structures in elite female Handball Players." In order to identify biomotor structures in elite female Handball Players(n=53), factor structures of morphological characteristics and basic motor abilities of elite female Handball Players were determined first, followed by determination of relations among the morphological-motor space components obtained and the set of criterion variables assessed situation motor abilities in Handball. Factor analysis of 14 morphological measures produced three morphological factors, i.e. factor of absolute voluminosity (Meso-endomorph), factor of longitudinal skeleton dimensionality, and factor of transverse hand dimensionality. Factor analysis of 15 motor variables yielded five basic motor dimensions, i.e. factor of agility, factor of jumping explosive strength, factor of throwing explosive strength, factor of movement frequency rate, and factor of running explosive strength (sprint). The results obtained were consistent with the model of selection in female Handball Players proposed (Srhoj et al., 2006), showing the speed of movement without ball and the ability of ball manipulation to be the predominant specific abilities, as indicated by the first and second linear combination.

Gouranga (1999) investigated the relationship between coordinative abilities with shooting performance in soccer players (n= 25 male). The results showed that
there was no significant relationship between the coordinative abilities with shooting performance in soccer.

Paul, Khanna & Sandhu (2011), investigated the psychomotor performance as an indicator of training distress among athletes. The purpose of this research is to compare and investigate the relationship among the training logs, Mental and Physical State Scales (MAPSS), Athletic Burnout Questionnaire (ABQ), CSAI-2 and the eye hand coordination as assessed by the Double Labyrinthine Test on Vienna Test System (VTS). Total of 100 athletes (65 males, 35 females) were grouped in three risk groups (high risk group, moderate risk group and low risk group) according to MAPSS scores. The research showed that as the training distress and training load among athletes’ increases, the burnout risk and anxiety level increases, however the self confidence level reduces which proves to be detrimental to the psychomotor performance as calculated by eye hand coordination test.

Koley (1999) investigated a research on relationship of coordinative abilities to sprinting performance in sprinters. The finding of the research reveals that, the reaction ability, orientation ability and balance ability had significant relationship to sprinting performance.

Steiz (1964) conducted the relationship of reaction time, speed, Sargent jump, physical fitness and other variables to success in specific sports. The research was conducted on 196 Springfield College male students. They participated in one the nine freshmen sports. Subjects were experienced for speed, reaction time, physical fitness, performance time (response time) and Sargent jump. The coach for each sport ranked each squad member in terms of overall values as a criterion of success in sports. The reaction time of the left foot moving left, the Sargent jump and the
reaction time of the right foot moving left were the variables appearing most often in the numerous correlations.

**Lynch (1985)**, conducted an investigate on muscular power, reaction time and visual perception as related to striking abilities of second grade children. The purpose of the research was to determine if significant difference existed in the performance of various physical and perceptual variables. Additionally, an effort was made to predict outstanding and to find out whether significant differences existed in the performances of males and females on selected variables tested.

The research was conducted on 90 female and second grade children. They were studying in the Fayettville Arbanas School for the spring. An independent's test was calculated along with Pearson's product moment correlation stepwise multiple regression was used for the prediction of striking ability. Mean for each variable were calculated for female and male groups as each variable.

**Sreejit (1988)** conducted a research on the variations of psychomotor performance among the players of basketball, volleyball and badminton. The subjects were subjected to experience tests on reaction time, speed of movement, multi limb coordination, arm-hand steadiness and finger dexterity. One way analysis of variance was employed to analyze the significance of difference in performance on the selected psychomotor variables. The findings of this study highlighted following inferences: The basketball and volleyball players had an obvious difference in their hand reaction timing. The basketball and volleyball players showed difference in their speed of arm movement but to a lesser extent as compared to their hand reaction time. The basketball, badminton and volleyball players did not exhibit any obvious difference in their multi limb coordination, arm – hand steadiness and finger dexterity.
Panhonin (1967) conducted the agility, balance, eye-hand coordination, grip strength, height and arm and shoulder strength on 33 college women randomly from level beginning. The measure of tennis ability was the combined 't' score from the Dyer Test, Broer and Miller Forehand-backhand test and skill rating by three judges. The most reasonable predictor of tennis ability balance and arm-shoulder grip strength for a 'r' a little though the correlation of grip strength and eye-hand coordination with tennis ability were not significant.

Memmert et.al, (2009), investigated on the relationship between visual attention and expertise in sports. In this research, they examined group differences between experts in team handball (n = 40), athletes from non-team sports (n = 40), and novice athletes (n = 40) using a series of three attention tasks: a functional field of view task, a multiple-object tracking task, and an intentional blindness task. Performance on the three attention tasks was largely independent, with no significant correlations between the tasks. Team sports specialists exhibited no better performance on the basic attention tasks than did sportspersons from non-teams sports or novice sportspersons.

Toyoda (1971) revealed through a study that the volleyball players have different types of requirements according to the nature of the activity. Researcher investigated that a volleyball player requires muscular strength and power, muscular as well as cardiorespiratory endurance, agility and speed of movement, flexibility of muscles and joints, ability to control body movements like timing, rhythm, balance or coordination and relaxation and coordination of the whole body. This study found there is significant relationship between these elements with the skills in volleyball.
Baskshi (1994) made a research on 2 groups of sports persons on coordinative abilities. They were the track and field sportsperson and swimmers. These groups were chosen because both the activities concerned cycle type of movements. They were tested on the activities test recommended by Peter Hirtz. The subject selected were either of level of inter – collegiate level or of inter – university level. Another observation the test showed is that there is no significant difference in coordinative abilities of swimmers and track & field sportsperson.

Manilal, Sebastian and Thomas (1990), made a study on the comparison of coordinative abilities of junior Indian Basketball and Volleyball players. The study was conducted on 21 girls in each category. Four examinations for examining coordinative abilities recommended by Peter Hirtz were administrated for assessment. The T-test was employed to compute the mean difference between the coordinative abilities in the Volleyball and the Basketball players.

The results of the study showed that the female Basketball players have superior differentiation ability of hands and were also better in having balance ability than the Volleyball players. However the Volleyball players were found to have a better edge in space orientation and reaction ability than the Basketball players.

Slatar-Hamel (1995), made a research to compare reaction time measures to visual stimulus and arm movement. Analysis of the data showed that only a modest relationship existed among the two reaction times existing between several groups for both reaction measures.

Ikeda (1960) revealed tests on 72 women subjects during the last two-week of an eight-week badminton unit. The tests comprised wrist-flexibility, shuttle race and different measures of kinesthesis, such as wrist extension, wrist flexion and arm
forward, target finger spread, supination, pronation and grip pressure. These assessment scores were compared to the consequence on the volley and obvious badminton tests. There was no significant relationship among agility, kinesthesis or wrist-flexibility and badminton performance.

**Dixit (1982)** revealed that interrelation of reaction time, speed of movements and agility and their comparison among players from selected sports. The researcher was conducted on 48 male college students i.e. 12 subjects from each selected sports (Football, Volleyball, Kho-kho and Kabaddi) from Lakshmibai National College of Physical Education, Gwalior. The researcher showed that speed of movement and agility was significantly related to either the speed on management on agility at 0.05 level of confidence.

**Baker (1969)**, investigated the relationship of certain selected variables with success in volleyball. This research was undertaken on 28 members of women's extramural teams at Illinois State University. Two experienced volleyball coaches found a criterion by rating each player on the basis of her playing ability. The variables calculated comprise height, weight, leg extensor strength using a dynamometer, skin fold using a large caliper, jumping ability using jump and reach test, whereas reaction time and movement time were calculated by the equipment constructed by the researcher. With the application of t test and correlations, it was found that the jumping ability and the reaction time had a significant relationship to success in volleyball.

**Black** and **Johnson (1975)** observed the effect of swimming training on reaction time of athletes who were non swimmers. Findings of this research showed
the reaction time of college sportspersons was improved during swimming instructions as compared with the control group.

Shondell (1972) derived an establishment among the relationship of selected psychomotor performance and anthropometric traits with successful Volleyball performance. At first, 23 tests and measurements were selected to evaluate the characteristics of successful collegiate Volleyball players. A panel of adjudicators of four judges supplied the criterion which was overall Volleyball playing ability.

A two-phase cross-validation procedure was adopted to determine whether the test series of six items viz, medicine ball toss, 30 yard dash, wall-catch, zig-zag run, jump and reach and weight could actually predict Volleyball potential and also to see if the tests discriminated between the highly skilled and the beginners in Volleyball. The finding showed that power appeared to be the most significant factor in the successful Volleyball performance. The test series of six-items correlated 0.732 with Volleyball playing ability.

Adhikari (1983), made a study on a group of 30 college level Volleyball players to determine comparative relationship among power, agility and selected speed characteristics to block jump and three-stride jump in Volleyball. Researcher also tested his subjects on Sargent jump and Nelson's speed of movement Test, squat thrust etc, to measure different parts and their relationship to each other.

The findings of the research showed that the Power of a person contributed much to the performance of a block jump and three-stride jumps, correlated significantly with both the block and the three stride jumps. Agility, which was a necessary component in the vertical jump, also correlated significantly with the block
and the three stride jumps. Speed, reaction time and speed of movement did not contribute much to the performance of a block and a three stride jumps.

**Lotter (1960)** made a study to determine the inter relationship among reaction time in different limbs. Two – moment basic to sports skills modified Baseball throws and Football kicks were studies in 105 college athletes of various activities. This was only a moderately high correlation among the reaction time ability of right and left legs and between right and left arms. Arm verses legs correlation was significant but low. A similar pattern of correlation between limbs was found for movement specificity was high. The reliability of individual difference was high in all the measures.

**Spence et.al, (1980)** developed a descriptive profile of 15 members of the United States Women's' National Volleyball Team, who were highly skilled. The data were obtained from anthropometric measures, strength, physiological and motor performance domains comprising jump and reach, triple hop, agility run and 20 m dash. Comparison was made between the six women Volleyball players who were selected for the Pan American Team and the nine other players who were not selected. The Pan American selected players were taller and heavier and demonstrated better motor ability than the non-selected ones. Strength measurement did not indicate consistent difference between the two sub-groups. The non-selected players had a greater VO2 max than those of the selected ones.

**Hodgkins (1963),** made a study on reaction time and speed of movement in males and females of various ages 930 men, women and children ranging in ages in their speed of reaction and movement time. The research showed that Males are faster than females both in reaction time and movement. Speed of both functions increase up
to early adulthood and then decrease. Peak speed is maintained longer by males in movement and by females in reaction time, and in majority of groups' studies no relation existed between speed of movement and speed of reaction.

**Buligin (1981)** put forth a model for the physical preparation of volleyball players by combining various physical qualities and to check the improvement in the players. This model was prepared and worked out over a period of several years on volleyball improvement groups in Izmailski Pedagogical Institute where planning of the training and checking of progress was done with the use of eight indicates. The speed of movement was assessed using shuttle-run, muscle strength by throwing medicine ball, speed of arm movement by throwing a tennis ball against wall rebounds, the strength of extremities by executing maximum number of repetitions (push and squat thrust) in 15 sec. The model directed the combination of various qualities of a volleyball player.

The finding of the research showed that the constructed model allows for effective planning for improvement in the physical qualities of a player by taking into consideration their individual characteristics. The scores in the separate parameters of the model can be used as controlled normal for the evaluation of physical preparation. The proposed model makes it easier to evaluate the capabilities of the players for selection.

A study was conducted by **Espenchade (1947)** on development of motor co-ordination of boys and girls in 1947. Researcher used Broce Test to find out the components of motor co-ordination such as agility, balance, flexibility body control and strength. The test was administered to boys and girls age ranging between 13 and 17 years.
Devī (1985) carried out her study on 36 college level volleyball players to determine the relationship of depth perception, agility and speed of movement. Her findings showed that depth perception, agility and speed of movement contribute much to the playing ability in volleyball. The significant correlation of agility and speed of movement maybe expected in the game of volleyball as it demands a quick acceleration rate for the effective execution of movements and actions in any direction during the game situations. The findings of her research showed a significant relationship with speed of movement and agility.

Joseph (1983) conducted a research on 30 male volleyball players of Lakshmibai National College of physical education, Gwalior to determine the relationship between power, agility, shoulder flexibility, arm length and length to volleyball playing ability. Product Moment Correlation method was employed to compute correlation between volleyball playing ability and each of the selected independent variables.

The findings of this study work made the following revelations Power was the most reliable variable in predicting the volleyball playing ability. The arm length and leg length were also found to be reliable variables in making prediction about volleyball playing ability. The variables of agility and flexibility did not correlate significantly to volleyball playing ability.

Sbila et al., (2004) identified the differences in the volume and intensity of large-scale cyclic movement activities performed by handball players in different playing positions - backcourt players, wings, pivots and goalkeepers. For these purpose six experimental models matches (2x20min), played by the Slovenian male handball teams (youth, juniors and seniors) were analyzed. The sample consisted of
84 players of twelve teams (average age 20.26 ± 4.28yrs; average height 182.51 ± 6.59cm; average body mass 80.61 ± 10.37kg) and was divided into four sub-samples by playing position. The collection of data on the cyclic loading of players in a handball match was based on the computer-aided automatic tracking method with the SAGIT system, based on computer vision methods. The output data on the cyclic movements obtained by the SAGIT programme were processed by the selected descriptive statistics methods in Excel and SPSS programmes. Statistically significant differences were registered among the groups of players in different playing positions in terms of average distances walked or run, during matches (volume). The greatest total distance was covered by the wings (3,855m), followed by the backcourt players (3,432m) and pivots players (3,234m), whereas goalkeepers ran the least (1,753m). Differences also appeared in the intensity of large-scale cyclic movements, which is in the percentage of time spent in all the speed classes. In the first speed class statistically significant differences occurred between all the groups – the goalkeepers spent the highest percentage of time (86%) here, followed by the pivots (62%) and wings (58%). There were no statistically significant differences in the second speed class between the groups of wings (23%), backcourt players (25%) and pivots players (25%); however, all three groups differed from the goalkeepers (11%). The highest percentage of time spent in the third speed class was that of the wings (14%) and backcourt players (14%). Nevertheless, there were no statistically significant differences between them. Pivots (10%) and goalkeepers (2%) did not spend much time in the third speed class. Therefore statistically significant differences were registered for the latter two and the groups mentioned before. In the fourth speed class statistically significant differences occurred between all the groups of players. In this speed class the wings spent the most time (4%), followed by the backcourt players
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(3%) and pivots players (2%), whereas the lowest percentage of time in this speed class was that of the goalkeepers (0.5%). There were statistically significant differences among all the groups of players in terms of average speed of movement - the fastest were the wings (1.60m/s), followed by the backcourt players (1.43m/s), pivots (1.34m/s), and goalkeepers (0.73m/s).

**Atkinson (1977)** conducted a study on prediction of performance in handball, tennis and badminton from certain physical traits. Regression equations using physical traits and class commitment as predictors were developed for determining potential skill in beginning handball, tennis and badminton for college men. The physical traits used were: agility, power, hand eye coordination and visual ability. Skill level was determined by a round robin tournament in each sport. Subjects were 140 college men enrolled in initiate classes for each sport and taught by the whole past method. The controlled subjects included 138 subjects enrolled in at the initiate classes and taught by past method. Another purpose of the study was to determine if practice in the sport would significantly improve scores in physical traits. A paired standard deviation was used to co-compare experimental and control groups. Conclusions were: class commitment is probably an integral part of skill attainment in the sports studied, students taught tennis and badminton by the whole part method experience, greater gain in agility and hand eye coordination, students taught tennis by the past method experience greater gains in shoulder girdle power.

**Chaouachi et.al, (2008)** studied anthropometric, physiological, and performance characteristics of an elite international handball team. Twenty-one elite handball players were tested and categorized according to their playing positions (goalkeepers, backs, pivots, and wings). Testing consisted of anthropometric and
physiological measures of height, body mass, percentage body fat and endurance (VO2max), performance measures of speed (5, 10, and 30 m), strength (bench press and squat), unilateral and bilateral horizontal jumping ability, and a 5-jump horizontal test. Significant differences were found between player positions for some anthropometric characteristics (height and percentage body fat) but not for the physiological or performance characteristics. Strong correlations were noted between single leg horizontal jumping distances with 5-, 10-, and 30-m sprint times ($r = 0.51-0.80; P < 0.01$). The best predictors of sprint times were single leg horizontal jumping with the dominant leg and the distance measured for the 5-jump test, which when combined accounted for 72% of the common variance associated with sprint ability.

In conclusion, performance abilities between positions in elite team-handball players appear to be very similar. Single leg horizontal jumping distance could be a specific standardized test for predicting sprinting ability in elite handball players.

**Oxyzoglou et al., (2008)** documented that high performance in team sports depends to a great extent on the motor abilities of all players according to their position in the team. Assessing the motor abilities of elite athletes according to their playing position in the team was the aim of the study. The sample consisted of 46 handball players aged 18-21 years ($M=19.5, SD=.4.5$), belonging to national teams from Greece and Serbia. Later, the sample was divided into subgroups, representing their unique position in the team. More specifically the subgroups consisted of eight goalkeepers, fourteen extreme players, sixteen peripheral players and eight pivotal players. The motor abilities of power, agility and flexibility were assessed. The Kruskal-Wallis and Mann-Whitney U analysis were used for the comparison among groups. The results revealed that the goalkeepers have a highly developed level of pelvis flexibility and a well developed level of explosive force. The peripheral players
have high vertical jump and a high degree of wrist flexibility. Extreme players have a developed level of explosive force and big width of wrist movement. Finally, pivotal players are less flexible but very agile. Every playing position developed specific motor abilities which contribute to team performance.

Ikeda, Ogaki, & Ikeda (2007) reported that it is well known that athletes participating in different sports vary in physique and physical fitness. Although several studies on the physique and physical fitness of athletes have been conducted on both sexes, research on physique and physical fitness of female handball player is lacking. The purpose of this study was to investigate the physical characteristics and motor performance of the college women handball players. For this purpose the physique and motor performances of the college women handball players to college women basketball players and college women volleyball players were compared. Basic anthropometric indices and physical fitness such as 20M shuttle-running, vertical jump, standing jump, handball-throw for distance, trunk flexion, side step, grip strength and back strength were determined for 6 handball players, 7 basketball players and 8 volleyball players aged from 19 to 22 years. All of these ball game teams were a top level of the University in Japan and all subjects were the regular players in each team. The difference in girth of upper arm, skin fold thickness of upper arm and percentage of body fat (%Fat) among 3 ball game teams were statistically significant. The girth of upper arm of the handball players was significantly higher than that of basketball players, and the skin fold thickness of upper arm and %Fat was significantly lower in handball players than in volleyball players. The handball throw for distance, side step and back strength were significantly higher in handball players than in basketball players and volleyball players. In handball game, the transition from defense to offense occurs in about
every 25-30 sec. and the transition is very speedy and the considerable body contact to the opponent is allowed, so that muscular strength, power, agility and aerobic power are strongly required for each player. When the handball game is compared with basketball game, the playing time is longer and the charged time-out is shorter, and the shooting motion is more dynamic. In comparison with volleyball, the considerable body contact to the opponent is allowed in handball game but that is not allowed in volleyball and the ball is heavier. Therefore, it was concluded that the results of this study, as stated above, show the characteristics of female handball players.

Zetou, Vernadakis, Tsetseli, Kampas & Michalopoulou (2012) conducted a study to define which coordination abilities are the most important in tennis and to identify whether a coordination training program will improve the learning process of tennis skills (backhand and forehand). Fifteen expert coaches in tennis completed a check list of five coordination abilities and suggested that the most important coordination abilities for tennis players are “kinaesthetic differentiation” and “reaction time”. Based on the results from the questionnaires, the program was designed to practice the two most important coordination abilities. Participants were 48 novice children (age 11 ± 2 years). They were randomly divided into two group, the experimental group (EG, n=24) and the control group (CG, n=24). Both groups followed tennis training program 3 times a week for eight weeks. Participants of the experimental group performed a specific coordination program for 20 min before the skills practice and participants of control group performed the traditional practice. The tennis skill performance and learning assessed using observation technique in five basic elements of every skill. There were three measurements, pre, post and retention test, one week after post test without practice. Analysis of Variance (ANOVA) with
repeated measures (2 group X 3 measures) revealed that there was significant interaction between groups and measures. The Bonferroni post hoc analysis revealed that experimental group performs better than the control group in the post test and in the retention test in the two skills. The results of this study indicated that coordination training program help athletes to learn and perform the forehand and backhand tennis skills better.

Zwierko, Lesiakowski & Florkiewicz (2005) made a study to assess selected motor coordination aspects in young basketball players as compared with their non-sporting counterparts; the study also served as an evaluation of recruitment criteria and initial training stages. The study involved forty 14–15 year-old skilled basketball players from four macroregions in Poland. The control group consisted of 40 non-sporting boys of the same age. Computer-assisted laboratory technology was used to measure the following abilities: time of simple reaction to visual stimuli, spatial orientation, complex multiple-stimuli reaction and focused attention, frequency of movements, dynamic-spatial differentiation, directional and temporal anticipation and rate of movement acquisition. Highly significant differences (p < 0.01) between the skilled basketball players and the non-sporting subjects were observed in the spatial orientation, complex reaction and focused attention, and the rate of movement acquisition tests. Differences in frequency of movements, spatial and temporal differentiation and temporal anticipation were also significant, but at p < 0.05. Young basketball players, due to the well-selected recruitment criteria and training routine displayed a significantly higher level of selected motor coordination abilities as compared with their non-sporting counterparts. The results of the study show that the selected aspects of motor coordination are crucial during the recruitment of young players; the assessment of spatial orientation, complex reaction and focused attention
as well as the movement acquisition rate could be especially helpful in selection of prospective players.

Hasballa (2010) has studied on designing a varied training program for coordinative abilities and identifying its effect on some defensive moves of handball beginners. The researcher used the quasi-experimental approach with one group design (pre-/post-tests). Sample was purposefully chosen of 16 handball beginners (10-12 years) - Tanta Sports Club - season 2009-2010. Results of this study indicated a positive effect for varied training on developing the defensive moves of handball beginners under investigation. Improvement percentage between pre- and post-tests ranged from 6.34% to 86.40% and improvement percentage for defensive moves was 35.75%. In conclusion, using training aids and equipments in the recommended training program helped achieving the desired coordinative and technical levels needed for practiced activity.

Kioumourtzoglou, Derri, Mertzanidou & Tzetzis (1997) conducted an experiment with perceptual and motor skills in rhythmic gymnastics. Based on the notion of measuring motor performance, an experiment with three groups of 20 elite rhythmic gymnasts (N = 60), 9 to 10 yr., 11 to 12 yr., and 13 to 15 years of age (national level), with children of the same size and age was conducted, to identify the important abilities for the achievement of excellence in this sport. Motor abilities (whole-body coordination, dynamic balance, static balance, sense of kinesthesis, whole-body movement time, and eye-hand coordination) as well as perceptual abilities (whole-body reaction time, anticipation of coincidence, and depth perception) were compared. Analysis showed that scores on measures of whole-body coordination, dynamic balance, and static balance were higher for elite groups of
athletes than for corresponding control groups. Moreover, elite athletes in the oldest group scored higher than those in the youngest group on anticipation of coincidence, on eye-hand coordination, and on static balance. These findings indicate the presence of systematic differences between elite athletes and nonathletic on motor abilities related to experience in this sport.

**Brooks, Boleach & Mayhew (1987)**, examined the predictive potential of selected cognitive and psychomotor variables to estimate basketball performance by evaluating 50 male high school players (aged 15.1–18.8 yrs) from 3 schools in the same conference. The 3 coaches rated each S's ability on vertical jump, hand reaction time, weight, and playing experience. Discriminant analysis to classify Ss on the 3 teams indicated knowledge about basketball, dribbling, shooting accuracy, and heights were important. Using the 4 variables, 60% of the Ss could be correctly classified to their teams. (PsycINFO Database Record (c) 2012 APA, all rights reserved).

**Pavlidou, Michalopoulou, Aggeloussis & Kioumourtzoglou (2006)** investigated differences in specific perceptual and motor abilities in 60 children 8-13 years old (M=10.43±1.63 years) and to identify the relationship between these abilities and performance in fundamental basketball skills. Simple reaction time, whole body reaction time, depth perception and coincidence anticipation timing were the perceptual abilities, whereas dynamic balance, wrist-finger dexterity, kinesthesia and whole body movement time were the motor abilities that were examined in this study. The AAHPERD basketball test for passing, dribble and shooting was used to evaluate performance in the respective basketball skills. According to the results, there was a significant age effect on the evaluated abilities (p<.05). Regarding the
relationship among abilities and skills, a significant correlation was depicted between wrist-finger dexterity, whole body reaction and movement time, and performance in basketball skills for all age groups (p<.05). Furthermore, kinesthesis was correlated with dribble and shooting performance (p<.05), while depth perception was significantly correlated with shooting performance (p<.05). These findings can support any effort to detect performance variations and provide comprehensive interventions that will lead to further performance and learning enhancement through deliberate practice.

Mori, Ohtani, & Imanaka (2002) two experiments were conducted to investigate the reaction times (RTs) and anticipation of karate athletes. In Experiment 1, choice RTs and simple RTs were measured with two types of stimuli. One was videotaped scenes of opponent's offensive actions, which simulated the athletes' view in real situations, and the other was static filled circles or dots. In the choice RT task, participants were required to indicate as soon as possible whether the offensive actions would be aimed at the upper or middle level of their body, or the dot was presented either at a higher or a lower position. In the simple RT task, they were required to respond as soon as possible when the offensive action started from a static display of the opponent's ready stance, or a dot appeared on the display. The results showed significant differences between the karate athletes and the novices in the choice RT task, the difference being more marked for the video stimuli than for the dot stimuli. There was no significant difference in simple RT between the two groups of participants, for either type of stimuli. In Experiment 2, the proportions of correct responses (PCRs) were measured for video stimuli which were cut off at the seventh frame from the onset of the opponent's offensive action. The athletes yielded significantly higher PCRs than the novices. Collectively the results of the two
experiments demonstrate the superior anticipatory skills of karate athletes regarding the target area of an opponent's attack (Scott, Williams, & Davids, Studies in perception and action II: Posters presented at the VIIth International conference on Event Perception and Action, Erlbaum, Hillsdale, NJ, 1993, p. 217; Williams & Elliot, Journal of Sport & Exercise Psychology 21 (1999) 362), together with their advantage over novices in non-specific sensory functions (e.g., vertical discrimination).

**Zimmerman and Nicklik (1981)** conducted a study in which they stared that a six week training program showed 20% increase in performance of coordinative abilities (orientation ability, differentiation ability, balance ability and coupling ability). It was also found that sportsmen of high level of coordinative abilities can learn the technical skill more quickly and with better quality.

**Deepa (1996)** conducted a study on selected coordinative abilities on Twenty five female basketball players of L.N.I.P.E (Lakshmibai National Institute of Physical Education Of India) with the purpose to determine the relationship of coordinative abilities to shooting in basketball. The variables selected for this study were Orientation ability, differentiation ability, reaction ability, balance ability and rhythm ability. The relationship of coordinative abilities to shooting performance in basketball was established by using product moment correlation. On the basis of the result no significant relationship of coordinative abilities to shooting performance in basketball was found.

**Jinsy (2001)** conducted a study on selected coordinative abilities on Twenty male Hockey players of L.N.I.P.E (Lakshmibai National Institute of Physical Education Of India) with the purpose to find out the relationship of coordinative
abilities to shooting performance in Hockey. The variables selected for this study were Orientation ability, differentiation ability, reaction ability, balance ability and shooting ability. Product moment correlation was applied to find out the relationship of coordinative abilities to shooting performance. On the basis of the result, following conclusions were drawn: no significant relationship of coordinative abilities to shooting performance in Hockey was found. This study showed that shooting ability did not depend upon coordination but many other factors may affect it.

**Hota (2001)** conducted a study on selected coordinative abilities on twenty male football players of L.N.I.P.E (Lakshmibai National Institute of Physical Education) with the purpose to find out the relationship of coordinative abilities to playing ability in soccer. The variables selected for this study were Orientation ability, differentiation ability, reaction ability, balance ability, rhythm ability, and playing ability. The collected data were subjected to Pearson's Product moment correlation on the basis of the result, following conclusions were drawn: coordinative abilities namely Orientation ability, reaction ability, and rhythm ability are significantly related to playing ability. Differentiation ability and balance ability are not significantly related to playing ability performance. Coordinative ability plays a very crucial role in football performance.

**Devi (1985)** 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 did not show much relationship to playing ability.
Sridhar (1987) found that power was the most significant motor fitness components underlying performance in volleyball. Muscular endurance, circulatory-respiratory endurance and flexibility also contribute to playing ability in a real manner. Agility showed as insignificant relationship to playing ability in volleyball.

Shondell & Stuart (1972) revealed that power appeared to be the most significant factor in the successful Volleyball performance.

Chaouachi, Brughelli, Levin, Boudhina, Cronin, & Chamari, (2009) have studied to Anthropometric, physiological and performance characteristics of elite team-handball players. The objective of this study was to provide anthropometric, physiological, and performance characteristics of an elite international Handball team. Twenty-one elite Handball players were tested and categorized according to their playing positions (goalkeepers, backs, pivots, and wings). Testing consisted of anthropometric and physiological measures of height, body mass, percentage body fat and endurance (VO$_{2\text{max}}$), performance measures of speed (5, 10, and 30 m), strength (bench press and squat), unilateral and bilateral horizontal jumping ability, and a 5-jump horizontal test. Significant differences were found between player positions for some anthropometric characteristics (height and percentage body fat) but not for the physiological or performance characteristics. Strong correlations were noted between single leg horizontal jumping distances with 5-, 10-, and 30-m sprint times ($r = 0.51–0.80; P < 0.01$). The best predictors of sprint times were single leg horizontal jumping with the dominant leg and the distance measured for the 5-jump test, which when combined accounted for 72% of the common variance associated with sprint ability.

In conclusion, performance abilities between positions in elite team-Handball players
appear to be very similar. Single leg horizontal jumping distance could be a specific standardized test for predicting sprinting ability in elite Handball players.

Based on the experience the investigator gained, the investigator selected a suitable methodology to be followed in this research, which is presented in Chapter III.