CHAPTER-II

REVIEW OF RELATED LITERATURE

The researcher has made effort to go through the literature related to the Kabaddi game. The researcher has collected through almost every source like research quarterly, journals and periodicals, encyclopedia, relevant books and e-resources on Kabaddi and other discipline to pick up the related studies. While going through the various sources of literature, it has been observed that very little work has been done on Kabaddi game. However, the scholar has gone through the literature of allied studies that are related with other disciplines to collect the necessary information. The research scholar visited Library of University of Mysore Mysore, Bangalore University Library Bangalore, Y.M.C.A. College of Physical Education, for collecting the reviews related to this study. The purpose of this section was to relate the studies pertaining to the under study and to organise the collected review into meaningful sub sections as listed below:

The researcher made a systematic attempt to review the related literature by keeping the aforesaid points in mind. The researcher reviewed the some detailed in the following studies:

2.1 Studies on Kabaddi Game related to Morphological and Motor Ability Variables to Kabaddi Game Performance

Singh; Kannan and Singh (2014)\(^1\) conducted a study on prediction of Kabaddi playing ability in the anthropometric and bio- motor contexts. The aim of this present research was to predict the kabaddi playing ability of the East Zone male kabaddi player in the anthropometric and Bio–Motor contexts. One hundred and thirty kabaddi players were selected through random sampling approach during the East Zone kabaddi tournament in the year 2012 and their age span was 17 to 27 years. Several measurements based on the above parameters were carried out on each individual. Height was measured through stature, weight was measured by weighing

machine and leg length was measured by Lufkin Anthropometric Tape. The bio–motor abilities were measured using different testing procedure protocols. Agility was measured by 40-meter agility test; leg explosive power was measured by standing broad jump, flexibility was measured by sit and reach test, muscular endurance was measured by knee bent sit–up test, and muscular power was measured by the number of push–ups. Pearson “r” was used to determine the inter correlation among them and the regression model was used to predict the playing ability with respect to the above mentioned aspects at the 0.05 level of statistical significant. Results indicated that, there were high correlations existing between playing ability against Agility, Explosive leg Power, Muscular strength and Moderate correlations exist between playing ability versus Muscular endurance, leg length, Weight, Flexibility and low correlations exist between playing ability versus Grip Strength and very low correlation for height with playing ability in kabaddi.

Jeyaraj and Gopinathan (2014)² conducted a study on relationship of selected physical fitness and psychological variables to kabaddi playing ability. To achieve the objectives of the study six physical fitness and three psychological variables were selected as independent variables and playing ability as dependent variable, which was assessed through subjective rating by three experts during the tournaments. Forty men Kabaddi players took part in the University of Madras Inter-Collegiate Kabaddi tournaments in the 2012-2013 sessions were selected as subjects. The subjects were belonged the age group of 18 to 28 years. Pearson’s product moment correlation (Zero order) was used as a statistical tool to find out the result of the study and it reveals that the physical fitness variables of speed, agility, explosive power, shoulder strength, endurance and flexibility and the psychological variables of sports competition anxiety, aggression and achievement motivation were significant relationship with Kababdi playing ability.

Ali and Adhikari (2014)³ examined status on physical and anthropometric characteristics of kabaddi players. The present study was carried out through descriptive survey method within ex-post-facto research design. Seventy one men

Kabaddi players of the teams of different Indian Universities were considered as the sample. Data was collected from the Kabaddi players in course of Inter-University Kabaddi (Men) Tournament, held in the University of Kalyani during October 12-14, 2006. The height, weight, leg length, arm length, mid thigh girth, calf girth, body composition (i.e. body fat %, fat mass and lean body mass) and body mass index were considered as physical and anthropometric characteristics. These were measured in usual and popular method. Descriptive statistics of the physical and anthropometric characterizes of Kabaddi players was calculated by using SPSS 10.1 software. Descriptive statistics of physical or anthropometric variables (viz., Thigh Girth in cm, Calf Girth in cm, Arm Length in cm, Leg Length in cm, Height in cm, Body Fat Percentage, Body Weight in kg, Fat Mass in kg, Lean Body Mass in kg and Body Mass Index in kg/m2) shows that in case of thigh girth the minimum of the scores was 38.00 cm. and maximum of those was 61.00 cm. the mean and standard deviation of the said distribution were 52.20 cm. and 4.26 cm. respectively. In case of calf girth minimum of the scores was 30.00 cm. and maximum of scores was 49.00 cm. The mean and standard deviation of the said distribution were 34.64 cm. and 2.88 cm. respectively. Here the minimum of arm length scores was 51.00 and maximum of those was 63.00. The mean and standard deviation of the said distribution were 56.69 and 2.76 respectively. In case of the leg length minimum of the scores was 73.00 and maximum was 96.00. The mean and standard deviation of the said distribution were 84.10 and 4.88 respectively. It is observed that the minimum and maximum scores of height were 155.00 and 182.00 respectively. The mean and standard deviation of the said distribution were 169.45 and 6.39 respectively. In case of body fat percentage the minimum of scores was 6.90 and the maximum of scores was 25.10. The mean and standard deviation of those were 14.28 and 3.88 respectively. In case of body weight minimum of the scores was 55.00 and the maximum of scores was 94.00. The mean and standard deviation of those were 67.46 and 8.31 respectively. In case of fat mass minimum of the scores was 3.8 and maximum of those was 21.84. The mean and standard deviation of the said distribution were 9.86 and 3.76 respectively. In case of lean body mass the minimum of the scores was 48.39 and the maximum of scores was 72.85. The mean and standard deviation of the said distribution were 57.60 and 5.40 respectively. In case of body mass index the minimum of the scores was 19.38 and maximum was 28.53. The mean and standard deviation of the said distribution were 25.45 and 2.13 respectively.
Devaraju and Needhiraja (2013)\textsuperscript{4} conducted a study to predict the playing ability in Kabaddi from selected Anthropometrical, Physical, physiological and psychological variables among College level Players. One hundred and twenty six male inter collegiate Kabaddi players were randomly selected from various colleges in Tamilnadu state, India and their age ranged between 18 and 28 years. The subjects had past playing experience of at least three years in Kabaddi and only those who represented their respective college teams were taken as subjects. A series of anthropometrical measurements was carried out on each participant. These included Standing height measured by Stadiometer; Body weight measured by weighing machine, Two Length measurements-Arm length, Leg length, measured by Lufkin Anthropometric Tape. The data were collected by following standard testing protocol of International Society for the Advancement of Kinanthropometry. Physical fitness components were measured by the following tests. Speed were assessed by 50 meter dash, Flexibility assessed by Sit and reach test, Leg explosive strength assessed by Standing broad jump, Muscular power assessed by Modified sit–ups and Muscular endurance assessed by 2.4 km run. The Physiological parameters namely resting heart rate by Digitalized heart rate monitor, Peak expiratory flow rate was assessed by Peak flow meter and Breath holding time was assessed by Manual nose clip method. The results revealed that there was a correlation exists between the playing ability versus leg length, arm length, speed, Leg Explosive strength, Breath holding time, Muscular endurance, Muscular Power and Self confidence. The results also revealed that Leg explosive strength, Speed, Self confidence, Muscular endurance, and Muscular power become the common characteristics which can predict the playing ability in Kabaddi players.

Parab (2012)\textsuperscript{5} conducted a study to see significance of body height and their relation with skill used by 12th Shiv Chatrapati Chashak Kabaddi player. The research material included the video recordings of 162 kabaddi players that had taken place during tournament held at Baramati, Maharashtra from 23rd to 27th March 2010. The competitors were surveyed about their height. Using the criterion $x \pm 0.5$


the players were divided into tall, medium and short category. The analysis covered skill (Bonus, Hand touch, Toe touch and Kick) performed and Height of the player. Main findings Hand touch skill was mostly used by the players other remaining skill used are Bonus, Toe touch and Kick. Height wise it was found that overall skill used by the Medium heighted players were more than the tall and short players.

Majlesi, Azadian and Rashedi (2012)\(^6\) in their study examined correlation between anthropometric and physical fitness traits: a case study in Hamedan kabaddi team. The agility, dynamic balance, VO\(_2\) max and body composition 2 measure for determined kabaddi player. Research was carried out on a sample of 18 teen age Hamedan kabaddi players. Significant relationships were found between balance test and length of leg and hand, as well as a negative relation with body fat. The result showed that the Players right and left sides have better agility than the other players. Generally Hamadan kabaddi team members were found to have good body compositions but did not assess in an ideal amount in the physical fitness components especially aerobic capacity and agility.

Karve (2012)\(^7\) conducted a study on personality traits, need patterns and locus of control of Karnataka and Maharastra kabaddi players. The study was to find out the differences in personality traits, need patterns and locus of control of Karnataka and Maharastra state level Kabaddi players as a focal point and differences due to sex as a subsidiary interest. For the purpose of present study a total number of 126 Kabaddi players were selected from National championship held at Bangalore. The samples were drawn on the principle of random sampling technique. Subjects were equally matched. The subjects were in the age range of 24 to 35 years with mean age of 26.5 years. Standardized tests and questionnaires of Cattell’s 16 PF Questionnaire, Sanghi’s Need Pattern Scale (SNPS) and Sanjay Vohra’s Locus of Control Scale (LOC) were used. There was a significant difference between the Kabaddi players of Karnataka and Maharastra on personality factors B, C, E, F, G, M, Q1 and Q2. The


female Kabaddi players have scored significantly high on personality factor Q1 than the male Kabaddi players. There was significant difference between the Kabaddi players of Karnataka and Maharastra in locus of control. There was significant gender difference in locus of control females believed that their behavior is influenced by powerful person and chance factor while male player’s behavioral outcomes are attributed to internal self. The Karnataka Kabaddi players have higher need for aggression, achievement, power and affiliation than the Maharastra Kabaddi players. The Maharastra Kabaddi players have high need for security than Karnataka Kabaddi players. There was significant differences in the need pattern between the male and female Kabaddi players.

Devaraju and Kalidasan (2012) conducted a study on Kabaddi Playing Ability from Selected Anthropometrical and Physical Variables among College Level Players. The purpose of the study was to predict the kabaddi playing ability from selected anthropometrical and physical variables among college level players. One hundred and forty four male inter collegiate kabaddi players were randomly selected from various colleges in Tamilnadu State, India and their age ranged between 18 and 28 years. The subjects had past playing experience of at lease 3 years in Kabaddi and only those who represented their respective college teams were taken as subjects. A series of anthropometrical measures was carried out on each participant. These included standing height measured by stadiometer, body weight measured by weighing machine, two length measurements arm-length, leg length, measured by Lufkin Anthropometric tape. The data were collected by following standard testing protocol of international society for the advancement of Kinanthropometry. Physical fitness components were measured by the following tests. Speed were assessed by 50m dash, flexibility assessed by Sit and Reach test, leg explosive strength assessed by standing broad jump, muscular power assessed by modified sit-ups and muscular endurance assessed by 2.4 km run. The playing ability which was taken as the performance factor was subjectively assessed by three qualified kabaddi coaches. All testing was done 2 days before inter-collegiate competition by using scientifically approved equipments. Mean and standard deviations were calculated for each of the

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selected variables. The inter-relationship among the selected anthropometrical, physical variables and kabaddi playing ability were computed by using Pearson’s product-moment correlation coefficients. All selected anthropometrical and physical variables that statistically correlated with performance were used to form respective linear predictive models (step-wise argument selection). The results revealed that an inter-relationship exists significantly between the anthropometrical, physical and performance variables among male inter-collegiate kabaddi players. The results also revealed that speed, ability weight and flexibility become the common characteristics which can predict the playing ability in Kabaddi players.

Verma; Rana and Singh (2011) developed physical profile of kabaddi players. The purpose of study was to develop the physical profile of Kabaddi players. A sample consists of 100 male Kabaddi players were selected from West-Zone Inter-University championship as the subjects of the study. Their age ranged between 18 to 23 years. Keeping the feasibility in mind speed, agility and explosive power were selected for this study. Speed and agility were assessed by administering 50 yard dash and the performance was recorded in seconds and shuttle run respectively. To determine for the explosive power, standing board jump was used and the reading was recorded in meters. To develop the physical profile of Kabaddi players, descriptive analysis was applied. The results of study indicates that in case of 50 yard dash, standing broad jump and shuttle run Kabaddi Players were having average in scores. In case of standing broad jump kabaddi Players scored above average.

Dey; Khanna and Batra (1993) investigated morphological and physiological studies on Indian national kabaddi players. Twenty-five national kabaddi players (Asiad gold medalists 1990), mean age 27.91 years, who attended a national camp at the Sports Authority of India, Bangalore before the Beijing Asian Games in 1990, were investigated for their physical characteristics, body fat, lean body mass (LBM) and somatotype. The physiological characteristics assessed included back strength, maximum oxygen uptake capacity and anaerobic capacity.

(oxygen debt) and related cardiorespiratory parameters (oxygen pulse, breathing equivalent, maximum pulmonary ventilation, maximum heart rate). Body fat was calculated from skinfold thicknesses taken at four different sites, using Harpenden skinfold calipers. An exercise test (graded protocol) was performed on a bicycle ergometer using a computerized EOS Sprint (Jaeger, West Germany). The mean (S.D.) percentage body fat of kabaddi players was found to be higher than normal sedentary people. Their physique was found to be endomorphic mesomorph. Mean (S.D.) back strength, maximum oxygen uptake capacity (VO2max) and oxygen debt were found to be 162.6(18.08) kg, 42.6(4.91) ml kg-1 min-1 and 5.02(1.29) litre respectively. Physical characteristics, percentage body fat, somatotype, maximum oxygen uptake capacity and anaerobic capacity (oxygen debt) and other cardiorespiratory parameters were compared with other national counterparts. Present data are comparable with data for judo, wrestling and weightlifting. Since no such study has been conducted on international counterparts, these data could not be compared. These data may act as a guideline in the selection of future kabaddi players and to attain the physiological status comparable to the present gold medalists.

2.2 Studies on Kabaddi Game related to Motor Ability Variables and Kabaddi Game Performance

Panbilnathan (Jan., 2015) conducted a study to compare the physical fitness variables namely speed between men and women kabaddi and kho-kho players. A sample of one hundred and twenty players of kabaddi and kho-kho games studying in the Department of Physical Education and Sports Sciences, Annamalai University, Annamalai Nagar, Chidambaram, Cuddalore District, Tamil Nadu and India were randomly selected as subjects. Among them sixty men players (thirty men kabaddi and thirty men kho-kho players) and sixty women players (thirty women kabaddi and thirty women kho-kho players) with an age of the subjects were ranged between 18 to 24 years were selected as subjects. Speed was assessed by using standardized test item namely 50 mts run and it was statistically analysed by using 2 x 2 factorial ANOVA. Whenever, the obtained ‘F’ ratio value for interaction effect was found to be significant, the simple effect test was applied as follow up test. In all

cases, the .05 level of confidence was fixed to test the level of significance which was considered as an appropriate. There was significant difference between men and women players on selected physical fitness variables namely speed irrespective of their games (kabaddi and kho-kho). Among them, men kho-kho players were better speed than other categories of players.

**Yadav (2014)**\(^{12}\) conducted a study to assess the motor coordinative ability of male kabaddi players on different playing surfaces i.e. clay and mat. To conduct the study 50 male kabaddi players who took part in any national level kabaddi tournaments were selected randomly. The age range of the subjects was 18-25 years. The selection of subjects was done from players of such teams who stood in top four places of national tournament. To assess motor coordinative ability i.e., agility of the selected male kabaddi players. Shuttle Run test item of Cooper’s JCR test (1974) was used. This test was performed twice by a subject i.e. on clay and mat surface respectively. Paired sample ‘t’ test reveals that shuttle run timings of selected subjects was significantly less on clay surface as compared to mat. It was concluded that playing surface affect motor coordinative ability of male kabaddi players.

**Jesudoss and Premkumar (2014)**\(^{13}\) conducted a study to make comparative analysis of physical fitness variables of kho-kho and kabaddi players. The purpose of this study was to compare the physical fitness variables between kho-kho and kabaddi players of higher secondary school girls. To achieve the purpose of the study, selected 15 kho-kho players and 15 kabaddi players from P.S.G.G. Kanyakurukulam Higher Secondary School, Peelamedu, Coimbatore, who did not participate in any of the special training or the coaching programme. However they were allowed to participate in their regular physical education classes in the college as per their curriculum. The subjects were aged between 20 and 25. For the study, the physical fitness variables selected were Endurance and Flexibility. To find out whether there was any significant difference between kho-kho and kabaddi players, the dependent ‘t’ ratio was used. The result of the study showed that there was a significant


difference in Endurance and Flexibility between kho-kho and kabaddi players of Higher Secondary School girls.

**Gurpreet Singh (2014)** conducted a study to find the motor fitness of physical education college level kabaddi and kho–kho players of Jammu city. The data was collected from Physical Education College level players of Kabbadi and Kho–Kho games from the selected institution of Jammu City. The researcher was select 20 male subjects from Kabbadi game and 20 male subjects belonging to Kho–Kho games. The Phillip’s J.C.R. test was chosen to find out the motor fitness level of the two groups. The subjects were selected by using simple random sampling method. In this study data were analysed and interpreted with the help of statistical term ‘t’ test. It was found that, that there was significant difference in explosive power of legs between Kabbadi and Kho–Kho players and there was no significant difference between the muscular strength of Kabbadi and Kho–Kho player and that there does exist some difference the agility of Kabbadi and Kho–Kho players.

**Devaraju (2014)** conducted a study to predict the playing ability in Kabaddi from selected psychological variables among College level Players. One hundred and twenty six male inter collegiate Kabaddi players were randomly selected from various colleges in Tamilnadu state, India and their age ranged between 18 and 28 years. The subjects had past playing experience of at least three years in Kabaddi and only those who represented their respective college teams were taken as subjects. Psychological factors namely Somatic anxiety, Cognitive anxiety and Self confidence were assessed by Competitive Sports Anxiety Inventory–II (CSAI-2) questionnaire developed by Martens, Burton, Vealey, Bump and Smith (1990) and Sports achievement motivation level was assessed by Kamlesh (1983) SAMT questionnaire. The playing ability which was taken as the performance factor was subjectively assessed by three qualified Kabaddi coaches. All testing was done two day before inter-collegiate competition by using scientifically approved equipments. Mean and Standard deviations were calculated for each of the selected variables. The inter-relationship

among the selected anthropometrical, physical, physiological and psychological variables and Kabaddi playing ability, were computed by using Pearson’ product-moment correlation coefficients. All selected anthropometrical, physical, physiological, psychological variables that statistically correlated with performance were used to form respective linear predictive models (step-wise argument selection). The results revealed that an Inter–relationship exists significantly between the psychological variables among male inter-collegiate Kabaddi players. The results also revealed that Self confidence become the common characteristics which can predict the playing ability in Kabaddi players.

Chowdhary; Borman and Barman (2014)\(^{16}\) conducted a study to find the relationship of kabaddi performance with selected coordinative ability of the inter-district players of Paschim Medinipur. For the present study fourteen male Kabaddi players who had participated in district kabaddi competition held at Medinipur were randomly selected for this study. Age group of the subjects was 18-27 years. To find out the relationship of Kabaddi performance to selected coordinative abilities namely orientation ability, differentiation ability, reaction ability, balance ability and rhythmic ability. Product moment correlation was computed and verified at 0.05 level of significance. Findings reveals that coordinative abilities such as reaction ability and rhythmic ability were found significantly related to the kabaddi performance as their calculated Correlation Coefficient(r) were 0.66 and 0.54 respectively. Orientation ability, differentiation ability and balance ability were not found significantly related to the kabaddi performance as their calculated Correlation Coefficient(r) were 0.05, 0.01 and 0.34 respectively.

Kumar (2014)\(^{17}\) conducted a study to find the status of strength and speed between Kho-Kho and Kabaddi male players. The purpose of the study was to compare the physical fitness variable of Kho-Kho and Kabaddi Players. A total samples of the study were, 25 Kho-Kho and 25 Kabaddi players were selected for the study. Only those male players of K.U.K. were selected who have participated at


minimum inter collegiate level of K.U.K. The data were collected in different coaching camps organized by the university. The age of the selected subjects ranged from 19 to 25 years. (Standing Board Jump and 60 yard dash tests) were used to measures the selected physical fitness variables of the players. Mean value, standard deviation, ‘t’ tests were applied to analyze the data, and researcher observed the significant different between Kho-Kho and Kabaddi players.

Raspal and Hoshiyar (2013) evaluated physical fitness variables of Kabaddi, Kho-kho and Wrestling players from Haryana and Punjab, India. A comparative examination of physical fitness variables viz., power, agility, strength, speed, flexibility, and endurance was conducted on players of Kabaddi, Kho-kho and Wrestling-the three popular indigenous games of India. Data was collected during training camps of the three games. The subjects for the study were participants between age group 18-25 representing the respective games from Kurukshetra University, Kurukshetra, Guru Nanak Dev University, Amritsar, Punjab University, Chandigarh, and Punjabi University, Patiala camps. A total of 158 subjects were examined (54 from Kabaddi and Kho-Kho each, and 50 from Wrestling). The study reveals that, Kabaddi and Kho-kho players have equal leg power agility, flexibility and speed ability. Agility of Kho-kho players was the best followed by Kabaddi players with minimum scores for Wrestlers. Endurance of Kho-kho players was the best followed by Kabaddi and Wrestling players which showed similar endurance. The arm strength of Kabaddi players was the best whereas; Kho-kho and Wrestling players performed equally. Hence, as per the requirement of the respective game all the players are physically fit but, in comparison to Kabaddi and Wrestling players, Kho-kho players address a better fitness. This study provides base information for devising training module for enhancement of performance of the players of the three indigenous games.

Mukesh and Kumar (2013) carried out a comparative study of co-ordinate abilities of kabbadi and kho-kho female players at college level. A Study was


conducted at S.D. College Hansi and other local colleges in Hisar aiming to achieve the main objectives of comparing the co-ordinate ability variables of kabbadi and kho-kho female players. It also includes the balancing ability and differentiation ability between kabadi and kho-kho games players. The sample of the study was 20 Kabbadi women player and 20 Kho-Kho women players of age group of 17-21 years. These players of Kabaddi and Kho-Kho games had participated at university level tournaments. It was found that, the Kho-Kho players possessed better balance ability as compare to the kabaddi players and there was no difference in terms of agility and differentiation ability between Kho-Kho and Kabaddi game players.

Kagitha and Kumar (2013) conducted a study to find the effect of complex training with yogic practices on selected motor fitness variables and playing ability among kabaddi men players. To attain this motivation behind the study sixty male Kabaddi players were chosen at irregular from in and around the Guntur locale of Andhra Pradesh. The age, stature and weight of chosen subjected were extended from 18 to 25 years, 165 to 170 cm. what's more 55 to 65 kilogram individually. They chose subjects were isolated into three assemblies of twenty each at arbitrary. Group "An” experienced complex preparing, Group "B” experienced complex preparing with yogic practices for four session for every week and Group "C” went about as control gathering in which they didn't experience any unique preparing programme separated from their customary programme of the educational module. The entire whole subject gave a composed steady and no impulse was made to tune in the preparation programme. A qualified medical practitioner inspected the subjects and proclaimed that they were restoratively and physically fit to take part in the training.

2.3 Studies on other games related to Morphological Variables and Game Performance

Singh (Jan., 2015) conducted a study to find the relationship among the anthropometric variable and jumping performance in track and field. Present study

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was carried out in order to "assess the relationship of anthropometric Variables with the Performance of Long Jumpers in Track and Field". A total of 10 subjects (some of them were not specialized Long Jumpers) were randomly selected from Department of Physical Education and Sports Technology "Sri Guru Granth Sahib World University", Fatehgarh Sahib, because the subjects were not specialized Long Jumper, they underwent the Long Jump activity class, as scheduled during the morning and evening classes on the University's 400 meter standard Track. Through both the critical and allied literature pertaining to the problem under consideration the following anthropometric variables were selected- Standing Height, Waist Circumference, Thigh circumference, Calf Circumference. In order to find out the relationship of anthropometric Variables with the Performance of Long Jumpers in Track and Field, Pearson's Product Moment Correlation was calculated at level of significance 0.001(2-tailed). Results indicate that a significant relationship was found among anthropometric Variables with the Performance of Long Jumpers in Track and Field.

Piggott; McGuigan and Newton (2015) conducted a study on the relationship between physical capacity and match performance in semiprofessional Australian Rules football. Thirty-six semi-professional ARF players participated in this study. Physical capacity was measured using a 3 km time trial. Match performance was measured throughout the 2013 season via two methods; direct game involvements (DGI) per minute and a recording of coaches’ vote post game. The main finding of the study was that 3 km time trial performance was a significant predictor of DGI per minute. In addition, the number of senior games played was also significant in predicting DGI per minute. Furthermore, the number of senior games significantly correlated with coaches’ votes. There were no significant relationships between 3 km time trial and coaches’ vote. The results highlight the importance of developing physical capacity in the pre-season period; the players who were better performers in the 3 km time trial had a greater number of DGI’s per minute. This information is important to consider in pre-season planning to ensure sufficient time is dedicated to developing physical capacity in the training program, as it is directly

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associated with performance. In addition, this research also highlights the importance of playing experience in relation to team selection. Playing experience, as measured by the number of senior games played, had a significant relationship with both measures of match performance.

**Velkumar and Rajeswaran (2014)**\(^{23}\) studied the relationship between anthropometric and skill performance variables of volleyball players. A sample consists of the volleyball players participated in the intercollegiate tournaments of Thoothukudi and Tirunelveli Districts were selected randomly 90. The age of the subjects was fixed in the range of 18 to 25 years. It was found that, Arm length is positively related with skill performance variables of service (0.46) attack (0.51) block (0.57), passing (0.62), and defensive (0.34), it was inferred that the relationship of Arm Length with Attack, Block, and Passing was statistically significant since the obtained 'r' value of there was found to the higher than required critical value besides when testing the relationship of Arm Length with their Defense statistically not significant Leg Length was positively related with skill performance variables of service, attack Block, and Passing, Defensive, from the it was inferred that the relationship of Arm Length with Attack, Block, was statistically significant since the obtained 'r' value of there was found to the higher than required critical value. Besides when testing the relationship of Leg Length with their Passing and Defense statistically not significant. Height was positively related with skill performance variables of service, Attack, Block, Passing, and Defensive, from the it was inferred that the relationship of height with Attack, Block, and Passing was statistically significant since the obtained 'r' value of there was found to the higher than required critical value besides when testing the relationship of height with Service and Defense statistically not significant.

**Singh; Singh and Singh (2014)**\(^{24}\) in their study compared the speed among athletics basketball and kabaddi players. Randomly 30 players each of basketball, kabaddi and athletics and were selected for the study. 30 basketball players who had represented in district level basketball tournament were selected from Lucknow

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District. In the same way, 30 kabaddi players who had represented district level kabaddi tournament were selected from Lucknow District and 30 Athletics players were selected who had represented in district level Athletics competition. A programme on speed and to assess their effectiveness as measured by 50 meter dash. The analysis of data using ‘F’ test showed that variation exist among athletics, basketball and kabaddi groups in all the selected motor fitness variables. While taking it into account, the speed variable, the analysis clearly indicated variation among sports groups that was athletics and kabaddi, athletics and basketball groups. There exist no significant differences between kabaddi and basketball groups. This may be attributed to nature of the athletics performance, where speed plays a vital role for optimum performance as compare the basketball and kabaddi players. Therefore, significant difference existed basketballers scored higher than kabaddi players, though the difference was not significant. This may be due the factor that speed was not the determining factor in both the game.

Rana and Chaudhary (2014) conducted a study on relationship between selected anthropometric measurements and performance of female handball players of Delhi state. The selected Anthropometric Measurements were weight, height, sitting height, leg length, upper leg length, lower leg length, arm length, upper arm length and lower arm length. The performance of female handball players, studying in Delhi University was assessed by the three experts out of 10 marks. The data was collected on the group of 35 female handball players with the help of selected anthropometric variables and performance score. For the analysis of data, mean, standard deviation and Pearson’s product moment correlations were employed as the statistical techniques. The findings revealed that the performance was significantly related with selected Anthropometric variables. The height, leg length, arm length, lower arm length was highly correlated with performance score at .01 level of significance. Similarly, other variables such as, weight, sitting height, lower leg length, upper arm length was significantly correlated with performance score at .05 level of significance.

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Martenez et al. (2014)\textsuperscript{26} conducted a study on relation of anthropometric profile and performance in competition for Mexican High School Football Players on the offensive squad. The present study of Mexican high school football players on the offensive squad had the aim of determining the relation between their anthropometric profile, position on the team, and performance in competition. The study included 41 players from 15 to 18 years of age, studying and playing football at one of two high schools. Anthropometric measurements were taken (weight, height, diameter and perimeter of muscle areas) to determine the body mass index, body composition and somatotype. The results show that the anthropometric profile was related to performance (good/very good or poor/deficient), and that this relation depends on the position of the player. For linemen, good performance was associated with being tall, heavy and with a relatively high body fat percentage, and poor/deficient performance with a significantly lower height, lower weight and lower body fat percentage. For receivers and running backs, height did not appear to influence performance. For running backs, good performance was associated with heavy weight and a high body fat percentage. However for receivers, good performance was associated with a lower body fat percentage. The average somatotype for linemen was mesomorph-endomorph, for running backs meso-ectomorph, and for receivers mesomorph-ectomorph.

Kumar and Singh (2014)\textsuperscript{27} conducted a study on relationship of selected relative anthropometric measurements to the performance with AAHPER volleyball test. Twenty male students of Tamil Nadu Physical Education and Sports University, Chennai were selected as subjects for the study. The criteria of their selection was university representation in Volleyball in the current and previous years, and also only those subjects were considered who possessed the same level of performance in the game of Volleyball. The average age of the subjects was twenty three years ranging from 19 to 27 years. The variables of height, arm length, leg length and upper body length were recorded in centimeters whereas the weight of the subjects recorded in


kilograms. The score of the AAHPER Volleyball Test was the number and was average of the three trials. The data so obtained was statistically treated and analyzed. For this purpose, the performance of subjects on AAHPER Volleyball Test was considered the dependent variable and the measurements of height and weight constituted the independent variables. The results indicated that, there was insignificant relationship between the height of the player and performance in serving ability, and in case of relationship between volley test and height of the player, passing test and height of the player and set-up test and height of the player was no significant relationship obtained. While there was no significant relationship found between the weight of the player and performance in passing ability, volley test and weight of the player, passing test and weight of the player and set-up test and height of the player.

**Ghosh and Kundu (2014)** conducted a study on physical, physiological and anthropometric measures as determinants of performance in kho-kho skills—a correlational study. The purpose of this study is to find out the relationships of selected physical, physiological and anthropometric variables with skill performance in Kho-Kho game. 18 to 20 years in age ranged fifty (n=50) male kho-kho players, those who participated Zonal, Inter-zonal, District, Inter- District, State and National Games, were selected from four districts in West Bengal. Cardio-respiratory endurance, agility and speed were tested as physical variable, VO₂ max and resting pulse rate as physiological variable and standing height, body weight, BMI, arm length, leg length were measured as anthropometric variables. Different Kho-Kho skills of the subject were also tested using Chair-Kho Test, Squat Run Dodging Test, Ring Game Test, Audio-Visual Reaction Test, Biped Covering the Path Test, and Zig-Zag Play Test. Using Pearson product moment coefficients of correlation it was found that the overall coefficient of correlation among three physical measures and kho-kho skills ranges between 0.58 to 0.65, among two physiological measures and kho-kho skills were and among anthropometric measures and kho-kho skills ranges between 0.59 to 0.75 which all were significant at 0.01 level. When the subjects were categorized into high, average and low in the physical, physiological and

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anthropometric measures, using Multiple Step-up Regression analysis, it was observed that, higher cardio-respiratory endurance, agility, and speed; higher VO\textsubscript{2} max and lower resting pulse rate; and average height and weight; higher BMI, arm length and leg length can predict one’s kho-kho skills.

Singh and Ram (2013)\textsuperscript{29} conducted a study on Kinanthropometric Profile as a Predictor of Basketball Players Strength Measures. The purpose of the study was to endeavour the relationship between kinanthropometric dimensions with strength measure and further, to develop the regression equation for the prediction of Basketball players strength measure. The research was conducted on University level 42 male basketball players of age ranges 18-25 years. Twenty six kinanthropometric measurements as independent variables and two strength measurement components as dependent variables were evaluated of each subject. SPSS (11.5) computer software was used to analyze the data and it explored that the weight and linear measurements, i.e., body weight, standing height, sitting height, trunk length, arm length, leg length and hand length; body diameters, i.e., elbow, hip and knee diameters; body girth, i.e., shoulder and hip girths; skin-fold measurements, i.e., biceps, sub-scapular, thigh and calf skin-folds and body composition variables i.e., fat percent, fat weight and lean body mass have significant correlations with strength measures of basketball players. The multiple correlation of six kinanthropometric variables taken together with strength measures of basketball players were found highly significant and hence the developed equation can be used in the prediction of strength measures of basketball players.

Singh and Behera (2013)\textsuperscript{30} conducted a study to find relationship of anthropometric characteristics and kinematic variables with spiking of volleyball players. The purpose of the study was to determine the relationship of anthropometric characteristics and kinematics variables with spiking of volleyball players. The subjects were twelve male junior national volleyball players (average height 177.19 cm, weight 64.35 kg, age below 19 years old). All subjects had participated in 39th


Junior National Championship for boys and girls held at Shari Dungargarh, Bikaner; Rajasthan (India) from 22-12-2012 to 28-12-2012. 12 volleyball players from Uttrakhand representing their states in under-19 national tournament were selected by purposive sampling method. In this study the spiking performance of the subject recorded by subjective judgment criterion. The performance of spike was recorded by the score in the spike which obtained by using three point scales by the three judges. The results show that the value of co-efficient of correlation of selected anthropometrics characteristics with off speed spike performance were standing height, sitting height, and body weight, where tabulated value at 10 degree of freedom at .05 level of significance is 0.553. The value of co-efficient of correlation of selected angular kinematics variables at moment of ball contact in hitting phase spike were right ankle joint, right Knee joint, right hip joint, shoulder joint, elbow joint and body inclination, whereas tabulated value for 10 degree of freedom at .05 level of significance is 0.553.

Singh (2013) conducted a study on relationship between various anthropometric variables and power test of 15 to 19 years state level basket ball players of Haryana. The present study was attempted to provide guidelines about the relationship of selected anthropometric variables and Basket Ball performance 200 school Basket Ball players from Haryana age ranging from 15 to 19 years having state as minimum participation. The data was collected at the evening and morning session before the state level campus. For physical fitness of the subject, the AAPHER youth physical fitness test was used. The collected data was analyzed by computing descriptive statistics followed by Pearson's Product moment correlation. The results revealed that leg strength, height, thigh length, total arm, upper arm length and hand length have correlated positively with scores of accuracy test, also arm girth, knee girth and calf girth showed a significant relationship with performance score. In skin fold measurements only sub scapula skin fold and calf skin fold were found to be significantly correlated with score of accuracy test. In correlations of motor fitness components 50m dash, shuttle run, softball throws for distance were found to be correlated with accuracy test and at last the multiple correlations of the selected anthropometric and physical fitness variable with performance score were significant.

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Sehgal (2013) conducted a study to find relationship between anthropometric variables and leg strength of female handball players. The purpose of this study was to determine the relationship between anthropometric variables and leg strength of female handball players. 45 female handball players were selected for 27 anthropometric measurements i.e., eleven linear, five girths, four diameters and six skinfold measurements for subcutaneous fat. All the subjects in the study were in the age of 18 to 22 years. The result of this study would provide us the guide lines to examine thoroughly the possible ingredients of anthropometric variables which are essential for the execution of leg strength of handball players. The handball game involves strength for the execution of important skills: dribbling, throwing, shooting, defensive moments. Strength is indispensable ingredient which is to define the efficiency of handball players to achieve the desired objectives of the study. For this purpose various body measurements were taken. To achieve the objective of the study Pearson’s Product moment method for calculating coefficient of correlation method was utilized.

Kumar and Singh (2013) conducted a study to find relationship between strength measures and kinanthropometric profile of volleyball players. The present study was conducted on volleyball players to endeavor the relationship between strength measures and kinanthropometric profile which are essential for volleyball players. To achieve the desired objective of this study, Sixty seven (North- East Zone) Inter-university (men) volleyball players were selected with age ranged from 18 to 28 years as subjects. Thirty one Kinanthropometric measurements and two strength measures were taken i.e., explosive arm strength and explosive leg strength of each subject. SPSS (11.5) computer software was used to analyze the data. Weight and Linear measurements, i.e., standing height, upper arm length, leg length, thigh length, lower leg length; body girth i.e., shoulder chest, abdomen, thigh and calf girths and body composition variables. i.e., lean body mass have positive and highly significant correlation with strength measure of volleyball players.


Higham et al. (2013)\textsuperscript{34} in their study examined physiological, anthropometric, and performance characteristics of rugby sevens players. Eighteen male international rugby sevens players undertook anthropometric (body mass, height, sum of 7 skinfolds, lean-mass index), acceleration and speed (40-m sprint), muscle-power (vertical jump), repeated sprint- ability (6 × 30-m sprint), and endurance (Yo-Yo Intermittent Recovery test and treadmill VO\textsubscript{2}max) testing. Associations between measurements were assessed by correlation analysis. Results of the study revealed that Rugby sevens players had anthropometric characteristics similar to those of backs in international 15-player rugby union. Acceleration and speed, muscle-power and endurance qualities were similar to, or better than, those of professional 15-a-side players. Coefficients of variation ranged from 2.5% to 22%. Relative VO\textsubscript{2}max was largely correlated with Yo-Yo distance and moderately correlated with 40-m sprint time and repeated-sprint ability.

Gaur (2013)\textsuperscript{35} conducted a study on relationship between selected anthropometric measurements and performance of women badminton players. Thirty Five (35) female players age ranging from 17-25 years who have participated in inter college or zonal championships in Badminton were randomly selected to act as subjects for the study. Weight, Standing Height, Sitting Height, Leg Length, Lower Leg Length, Upper Leg Length, Arm Length, Upper Arm Length, and Lower Arm Length were taken into consideration. Weighing Scale, Anthropometric Rod, Steel tape and Skin Fold Caliper were the tools used for the measurements whereas the performance of the selected Badminton players was gathered by the help of three experts out of 10. The collected data was analyzed by computing descriptive statistics followed by Pearson’s Product Moment Correlation. The results revealed that mean and SD values of Weight, Standing Height, Sitting Height, Leg Length, Lower Leg Length, Upper Leg Length, Arm Length, Upper Arm Length, and Lower Arm Length were found to be 50.48±5.28, 154.91±3.85, 79.03±6.32, 86.82±7.38, 47.80±3.82, 43.80±1.99, 59.73±4.68, 29.15±3.20 and 31.0±4.21 respectively. Whereas a significant relationship was found between Performance score and the selected


variables, as the values were found to be 0.324, 0.828, 0.468, 0.481, 0.655, 0.533, 0.352 and 0.658 respectively against the tabulated value 0.296 which was significant related at 0.05 level but only upper leg length was not correlated to performance score as the value was found to be 0.178.

**Sisodiya; Singh and Rathore (2012)** conducted a study on relationship of female selected anthropometric variables to jumping ability. Fifty female sports women (except athletes) of University and National level Participation from Rajasthan were selected for this study. The age groups of the subjects were ranged from 18 years to 25 years. Total Seventeen variables i.e. twelve anthropometric and five Physical variables were selected. Anthropometric measurements included Standing Height, Weight, Shoulder width, Hip Girth, Thigh Girth, Thigh Length Leg length, Foreleg Length, Calf Girth, Foot Length, Ponderal Index and Crural Index. Weight was measured by weighing machine in kilograms. Leg length, fore leg length, thigh length was measured with the help of flexible steel tape in centimeters. Foot length and shoulder width was measured with the help of spreading caliper in centimeters. Thigh girth, calf girth, hip girth was measured with the help of flexible steel tape in centimeters. Ponderal index and Crural Index was calculated. The level of significance to check the relationship obtained by Pearson’s Product Moment Correlation was set at 0.05 level of significance. In using the Product Moment correlation, a value of 0.273 was needed for significance for forty eight (48) degree of freedom for each group.

**Ravikumar and Srinivasa (2012)** conducted a study on comparative analysis of selected anthropometric and physical fitness variables among football players. In Relation to Position play on 45 university football players of Bangalore University, Tumkur University and University of Mysore who have represented at South Zone Inter-University Football Championship, 2011-12. Anthropometric measurements such as height, weight, arm length, leg length, calf girth and thigh girth and physical fitness such as speed, agility, flexibility, endurance were tested. To

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determine the significance of the differences between the group means in different variables for the defenders, mid-fielders and attackers of football players, the one-way analysis of variance (F Ratio) was used. The significant was set at 0.05 level of confidence. The Results were found that defenders, mid-fielders and attackers had significant differences in anthropometric measurements such as calf girth and physical fitness i.e. agility among defenders, mid-fielders and attackers of football players. The study also indicated that defenders, mid-fielders and attackers had no significant differences in anthropometric measurements such as height, weight, arm length, leg length and physical fitness variables such as speed, flexibility and endurance of football players. The midfielders had better thigh girth than attackers and defenders. The attackers had superior agility to midfielders and defenders.

Mathavan (2012) conducted a study to find the relationship between Upper Body Anthropometric Parameters and Throwing Performance of Handball Players. 30 handball players were selected as a sample for the study. The nature and importance of this study was explained the subjects and they were expressed their willingness for this study. The players were selected from who had participate in the inter collegiate Handball competition in Pondicherry University their age ranged from 17 to 25 years as per college record at the year of 2009-2011 batch. There was no training programme for them. Test was conducted for Anthropometric Parameters and Throwing Performance namely Arm length, Forearm girth, Medicine ball put data was collected and analyzed statistically by Pearson product movement co-relation to find out the significant level. The handball players forearm girth anthropometric variables are influence the throwing performance in handball game. But the anthropometric variable arm length will not influence any skills in handball game and sports.

Koley and Kumaar (2012) conducted a study to find the relation between handgrip strength and selected hand-anthropometric variables in Indian inter-university softball players. The purpose of this study was to estimate the grip strength


of the dominant (right) hand and its associations with selected hand-anthropometric variables in Indian inter-university softball players. The study deals with randomly selected 243 Indian interuniversity softball players (121 males and 122 females) aged 18–25, from six Indian universities. The research was carried out in Guru Nanak Dev University, Amritsar, Punjab, India. An adequate number of controls (n = 200; 98 males and 102 females) were also taken from the same place for comparisons. Three anthropometric variables, viz. height, weight and BMI, six hand-anthropometric variables, viz. the shape index, digit index, 2D:4D ratio, palmar length, palmar width, palmar length/width ratio and right handgrip strength were measured using the following standard techniques. The one-way ANOVA showed significant differences (p ≤ .02 - .000) in all of the studied characteristics, except age, height and palmar length among the male and female Indian inter-university softball players and the controls. Highly significant (p ≤ .000) gender differences were also determined for softball players in all of the studied variables except age, the digit index and the 2D:4D ratio. The right handgrip strength has significantly positive correlations (p ≤ .03 - .000) with all of the studied variables.

Chuhan and Tanwar (2012)\(^{40}\) conducted a study on selected kinthropometric characteristics with accuracy performance of handball players. The purpose of the study was to determine the characteristics of kinthropometric and their relation with handball skills, accuracy and also to know how accuracy can be developed among the university level handball players. A total of 200 subjects at inter college and intervarsity levels were surveyed for the collecting of data. The subject were male in the age group of 17-23 years belong to Haryana State. It is very clear from the results of these measurements have significant contribution to the accuracy performance of players of handball.

Karkare (2011)\(^{41}\) conducted a study to find the relationship between anthropometric measurements and body composition of hockey players with respect to their playing positions. The objective of the present study was to compare


anthropometric measurements and body composition of hockey players with respect to their playing position. Two hundred and ten junior national hockey players seventy each from half line, back line and forward line was selected different state of India. Anthropometric measurements including height, weight, diameter, breadth, girth, and skinfold thickness was taken from entire subjects. Body composition was measure with the help of Matiegka's method (1921). To find out significant difference statistical method one way ANOVA was performed. Results found that, hockey players playing in different position found to be differs on some anthropometric measurements and body composition.

Koley; Singh and Sandhu (2010)\textsuperscript{42} studied anthropometric and physiological characteristics on Indian inter-university volleyball players. The purpose of this study was of two-folds, firstly, to evaluate the anthropometric profile of Indian inter-university volleyball players and, secondly, to search the correlation of body mass index, % body fat, hand grip strength (right dominant) and Vo2max with other anthropometric characteristics studied. Eleven anthropometric characteristics, four body composition parameters, two physical and two physiological variables and nine arm anthropometric characteristics were measured on randomly selected 63 inter-university Indian volleyball players (38 males and 25 females) aged 18–25 years from Guru Nanak Dev University, Amritsar, Punjab, India with adequate controls (n = 102, 52 males and 50 females). The results indicated that male volleyball players were taller (6.63%) and heavier (7.31%) and female volleyball players were slightly taller (0.31%) and lighter (3.74%) than their control counterparts. One way analysis of variance showed significant (p≤0.004-0.000) between group differences in all the variables (except hip circumference) between volleyball players and controls. In volley players, significantly positive correlations were found with BMI and other 19 variables, with percent body fat and 6 variables, with right hand grip strength and 20 variables and with Vo2max and other 19 variables, and significantly negative correlations were found with percent body fat and other 16 variables, with right hand grip strength and other 7 variables and with Vo2max with other 8 variables.

Koley, Singh and Kaur (2010) conducted a study of anthropometric profile in Indian university basketball players. The purpose of this study was threefold: firstly, to evaluate the arm anthropometric profile of Indian inter-university basketball players; secondly, to search for the correlations among these arm anthropometric characteristics; and thirdly, to search for the association of handgrip with arm anthropometric characteristics in Indian inter-university basketball players. Three anthropometric characteristics, nine arm anthropometric characteristics, and grip strength of both right and left hand were measured on randomly selected 60 Indian inter-university basketball players (35 males and 25 females, aged 18–25 years) of six universities, who participated in the Inter-university Championship organized at Guru Nanak Dev University, Amritsar, Punjab, India. An adequate number of control subjects were also taken from the same place for comparisons. The results indicated statistically significant (p ≤ 0.05 - 0.01) differences between the male basketball players and the controls in height, right handgrip strength, upper arm, forearm and total arm length, whereas no significant differences were found between the female basketball players and the controls. Highly significant (p ≤ 0.01) sex differences were found in the basketball players in almost all the variables studied (except BMI and arm fat area). Significant positive correlations were noted among the arm anthropometric characteristics studied (except arm fat area and arm fat index), and with right and left handgrip strength. Among these, physical abilities exert marked effects on the skills of the players themselves and the tactics of the team.

Kanwaljeet, Mandeep and Mandeep (2010) investigated on Anthropometric measurements, body composition and physical parameters of Indian, Pakistani and Sri Lankan field hockey players. This comparative study was conducted to determine the anthropometric measurements and body composition of field hockey teams of India, Pakistan and Sri Lanka. A total of 53 field hockey players from three teams were studied. The participants’ height was measured using the standard anthropometric rod, while their weight was measured with a portable weighing machine. Widths and diameters of body parts were measured using digital caliper.


Girths and lengths were taken with a steel tape. Grip strength was measured with a hand dynamometer. Skinfold thickness measurements were taken using the Harpenden caliper at 4 sites (biceps, triceps, subscapular and suprailliac). The percentage of fat was calculated from the sum of 4 measurements of skinfold thickness. It was found that there were no significant differences in height and weight among the three teams, with the Pakistani players recording a slightly higher weight. The Pakistan team had a significantly higher upper arm length (p<0.05) and bi-humerus diameter (p<0.05) as compared to the India and the Sri Lanka teams. The Sri Lanka team had significantly less wrist circumference (p<0.05), hand width (p<0.05) and lean body mass (p<0.05) as compared to the India and the Pakistan teams. The India team had significantly less % body fat (p<0.05) than the other two teams. More data would be of interest to document the changes in anthropometry and body composition during the season and out of season and also to attempt an analysis of characteristics specific to field positions.

Abraham (2010) conducted a study on anthropometry, body composition and performance variables of young Indian athletes in southern region. The purpose of this study was to analyze the anthropometry and body composition associated with performance of university level male track and field athletes of South India. This study was conducted on 93 track and field athletes from South India, comprised of 22 sprinters (100 & 200 mts), mean age 19.5 years, height 172.1 cm and weight 68.2 kg, 20 middle distance runners (800 & 1500 mts), mean age 19 yrs, height 166.8 cm and weight 62.5 kg, 16 long distance runners (5000 & 10000 mts), mean age 18.7 years, height 167.2 cm and weight 62.1 kg, 20 throwers, (shot, discus & hammer throw), mean age 19 years, height 170.8 cm and weight 72.6 kg and jumpers (High, long & triple jump), mean age 18.3 years, height 169.9 cm and weight 64.1 kg. Besides height and weight, six skin folds (triceps, chest, subscapular, abdomen, suprailliac & calf), two bicondylar breadths (humerus & femur) and two girths (biceps & calf) were measured. Somatotype evaluations were made according to Carter and Heath (1990) method. BMI was calculated as body mass divided by square of height (kg/m2). The somatochart indicated that sprinters and middle distance runners are ectomorphic

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mesomorphs, long distance runners are mesomorph ectomorphs while throwers are endomorphic mesomorphs. The jumpers fell into the somatotype category of balanced mesomorphs. Among all groups body fat percent is lowest in sprinters (6.23±0.83%) and highest in throwers (7.38±0.85%). This was reflected in their endomorphic components which is lowest in sprinters (2.53±0.45) and highest in throwers (3.39±0.65). Ectomorphic component is highly marked in long distance runners (3.56±0.65) while mesomophy was highest in sprinters (4.31±0.91). Throwers have significantly higher values of skin folds than other groups. Compared to their overseas counterparts, the athletes of both track and field events in the present study exhibited greater endomorphic values. The present data will serve as a reference standard for the anthropometry and body composition of south Indian track and field athletes. The results of the study indicated that in comparison to other sports disciplines track and field athletes have lower body fat percentage. The analysis showed that athletes of various track and field events statistically differ in morphological measures, especially in dimensions of body volume and body fat. On the manifest level, only upper arm and lower leg circumference statistically differ, being significantly higher in sprinters and throwers, as well as the sub-scapular, supra-iliac and abdominal, chest and arm skinfolds, which is significantly higher in throwers. The lowest value of % body fat was present among sprinters which are reflected in their lower values of skinfold measurement. It was also evident that in relation to their skeletal dimensions they tend to be more heavily muscled than others and this may be advantageous for them at the start of the race and in the initial stages of acceleration as greater force is created by these muscles. In all groups, mesomorphic component is highly dominant while endomorphic component is the least marked.

Rami and Silawat (2009) conducted a study to find the psychological factors, anthropometric measurement and physical fitness of selected university players in Gujarat, Shodh, Samiksha aur Mulyankan. The players are creating and breaking new records in today’s competitive sports. Traditionally the motto of Olympic festival is faster, higher and stronger is still alive in the field of physical education and sports. The aim of games and sports is fastly suited with every field.

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The old records are not remaining on boards they are establishing time to time. The level of physical fitness and motor ability is increasing day to day because of development of science and technology. Today’s Athletes are trained scientifically the equipments of training are also developed scientifically the ‘dand-bethak’ and ‘akhadas’ activities become out dated and hi-tech gymnasium and health centers takes its place. Now a day in training the physiotherapist entered with traditional ‘gurus’. With the help of physiotherapist and psychologist fitness of individual players is modified increase. The modern coaching methods are prepared for the development of physical fitness, psychological ability and anthropometry. From the study of Psychological Parameters revealed that, the players of all games were seen reserved, critical, cool, emotional, mild, easily upset, conforming, accommodating, sober, prudent, serious, shy, timid, trusting, tough minded, confident serene, self-reliant, affected by feeling.2-In parameters if psychological factors kabaddi’s players were shown more significant as compared to other games, while volleyball players were for away from these factors.3-The results from the analysis of anthropometry measurement the players of Kabaddi’s highest in Height, Weight and circumference of chest, upper am, thigh and calf, were as players of kho-kho’s has shown lower in above sighted variables. The results revealed from analysis of physical fitness Athletics players were superior as compared to other games, where as basketball players were lowest

Koley and Yadav (2009)\textsuperscript{47} conducted a study to find the association of hand grip strength with some anthropometric variables in Indian cricket players. A total of 103 district and state level male cricketers from Amritsar, Punjab, India, aged 17–21 years (mean 18.29 ± 2.21) were selected purposively as the samples of the study along with an adequate control group (n=101). The findings of the present study indicate that cricketers have higher mean values in six variables and lesser mean values in seven variables than their control counterparts, showing statistically significant differences (P ≤ 0.05) in all the variables (except arm muscle area) between them. In cricketers, right and left hand grip strength have significantly positive correlations with all the variables studied except percent lean body mass.

Chauhan (2003) conducted a study to find the relationship between anthropometric variables and middle distance running performance. 56 middle distance runners which having 2 to 4 years running experience were selected as subject. There are 32 anthropometric measurements i.e., 13 linear measurements, 8 girths, 4 diameters and 7 skinfolds measurements within the age group of 18 to 30 years. An anthropometric variables such as anthropometer, vernier Caliper and Lange’s skinfold caliper and body composition variables such as body density, lean body mass (LBM), fat weight and fat percent were utilized and calculated by using equations respectively. Substantial correlations were obtained between the anthropometric variable and middle distance running performance was presented. The multiple correlation of the selected anthropometric variables collectively (i.e., height, thigh girth, biacromial diameter and thigh skinfold) with running performance is significant but the size of the multiple correlation is not sufficient, so it cannot be used in the prediction equation of the middle distance running performance.

Claessens (1999) conducted a study to find a) to identify anthropometric variables correlated with gymnastic performance, and b) to predict performance scores from a combination of anthropometric dimensions. Experimental design method was used: correlational analysis and a stepwise multiple regressions were used. Subjects were participants at the 24th World Championships Artistic Gymnastics, Rotterdam, The Netherlands, in 1987. A total of 168 female gymnasts were investigated. Each gymnast participated in all events. An extensive battery of anthropometric dimensions was taken on each gymnast. The somato type was estimated. Skeletal maturation of the hand-wrist was assessed. Competition scores for the four individual gymnastic events (balance beam, floor exercise, vault, uneven bars) and a composite score for each gymnast were the dependent variables. The results revealed that, Moderately high, significant correlations were observed between skinfold and endomorphy, and gymnastics performance scores, are varying from -0.38 to -0.60, for biceps skinfold and the score on balance beam, and for endomorphy and the total score, respectively. The correlations suggest that gymnasts with more


subcutaneous fat and higher endomorphy have lower performance scores. About 32 % to 45 % of the variance in gymnastic performance scores could be explained by anthropometric dimensions and/or derived variables, but endomorphy and chronological age are the most important predictors. It was found that there was relatively strong relationship between several anthropometric variables and gymnastic performance in a sample of elite female gymnasts, but the associations are not sufficiently high to predict performance scores on an individual basis.

Muralidharan (1984)\textsuperscript{50} conducted a study to find the relationship of anthropometric and physical performance variables measures to performance in long jump. Product moment correlations were computed to see the relationship of long jump performance to each independent variable such as standing broad jump, 50 yard dash, shuttle run (4×10 yards), sit and reach, vertical jump, leg length, height and weight. The data were tabulated in the form of scatter grams. The findings of the study indicated that the anthropometric and physical performance variables are very reliable for predicting long jump performance. It was found that Leg length, height, standing broad jump, 50 yards dash, shuttle run (4 × 10 yards), sit and reach, vertical jump were the most significant independent measurements in the prediction of running long jump, 2) body weight did not prove to be reliable when single independent variable was correlated with the performance of running long jump. Therefore, weight should not be used singly for predicting performance in running long jump.

Mathew’s (1984)\textsuperscript{51} conducted a study to find the relationship of selected anthropometric measurements to performance of Brady Volleyball test. The anthropometric measurements such as height, weight, arm length and upper body length measured and Brady Volleyball test was conducted. The statistical technique Pearson’s Product Moment Coefficient of Correlation was used to find out relationship of Volleyball playing ability with each of the selected anthropometric measurements. For testing the hypothesis the level significance was set at .05. The finding of the study indicated that the variables of height, weight and arm length


showed significantly higher relationships to performance on Bradly Volleyball test, (Weight = .764, Weight = .795, arm length = .792) as compared to the significant but low relationships of leg length and upper body length with performance on Brady volleyball test (leg length = .544, upper arm length = .641). All the above-mentioned values were found significant at .05 level of confidence. It was found that the height and weight of the players contributed to a much greater extent to the performance of Brady volleyball playing ability. Arm length was also found to be an advantageous factor in the performance of Brady Volleyball test and Leg Length and upper body length contributed to the performance on the said test to a very limited extent.

Gill (1983)\(^5\) conducted a study to find relationship between grip-strength, arm-strength, hand, foot and stepping reaction times to badminton playing ability. Sixteen district level badminton players were the subjects of the study. Grip dynamometer was used for measuring grip strength, electronic reaction timer for reaction time, Roger’s formula for arm strength and Round Robin tournament for playing ability of the subjects. By using rank difference correlation coefficient the scholar reached the following conclusions: 1) arm strength, hand foot and stepping reaction times were significantly related to playing ability in badminton; 2) grip strength was not significantly related to the playing ability in badminton.

Chaakravarthy (1983)\(^5\) conducted a study to find the relationship between strength, leg strength, grip strength ability, flexibility and balance to performance in gymnastics. For evaluating arm strength, leg strength, grip strength, agility, flexibility and balance the following tests were employed. Arm strength measured by (push +dips) (w/10 + H-60) in pounds. Leg strength by leg dynamometer in pounds grip strength by movements in pound. Agility by shuttle run 4x10 in seconds and spine and shoulder by flexioeasure with yardstick to the nearest inches and balance measured by modified bass dynamic test balance test in 100 points respectively. The findings of the study show significant correlation between arm strength, leg strength left grip strength, agility, spine and shoulder flexibility to the performance in

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gymnastics where as right grip strength had significant relationship with gymnastics performance. The level of significance was fixed at .05 level of confidence from the findings of the study. It was concluded that Arm strength, Leg strength and left grip strength of gymnast has got no significant relationship with gymnastics performance. Agility of an individual was not a factor in developing the performance in gymnastics. Spine and Shoulder flexibility does not contribute towards gymnastics performance. Dynamic balance and gymnastics performance have insignificant relationship. Right grip, Strength was the most important variable in prediction of performances of gymnastics.

Bandyopadhyay (1982)\textsuperscript{54} in his study he tried to establish a relationship between soccer skill performance and selected anthropometric measurements, physical fitness and motor ability. Thirty male soccer players were randomly selected from the undergraduate classes of L.N.C.P.E., Gwalior to act as the subjects. Subjects were tested in selected anthropometric measurements (chest girth, upper arm girth, thigh girth, calf girth, height and weight), physical fitness (AAHPER Youth Fitness Test), motor ability (Barrow’s Motor Ability Test) and soccer skill performance (McDonald Soccer Skill Test). After computing zero order correlation it was concluded that a high correlation between physical fitness and soccer skill performance and between motor ability and motor skill performance; thigh girth had a significant relationship with soccer skill performance and the upper arm girth, chest girth, calf girth, height and weight had no relationship with soccer skill performance.

2.4 Studies on other games related to Motor Ability and Game Performance

Jasm; Mahdi and Mahdi (2014)\textsuperscript{55} conducted a study on the most important motor skills and their relationship to their performance of frontal hands jump on the table for ground movements artistic gymnastic. The research sample consisted of 24 students representing the fourth stage-Institute of preparing teachers/ effectiveness of artistic gymnastics, which can be invested properly and in a scientific manner that


serves the achievement through the good performance. The researcher was used a descriptive approach with screening style for suitability of the nature of the problem. The sample was selected by intentional way and after the completion of the tests, data were processed according to the statistical program (SPSS) and analysis it in tables and discussed it, values of calculated (t) of the studied recipes (compatibility, speed of response, agility, flexibility) the total (0.70, 0.73, 0.80, 0.79) respectively, to achieve the goals of the research and provide everything modern like equipment and tools of technical gymnastic. The researcher found that there was a significant correlation between motor abilities and their relationship to the performance of frontal hand jump on the ground movement rug of gymnastic.

Gusain (2013)\textsuperscript{56} conducted a study to compare selected anthropometric measurement and general motor ability to football playing ability. The purpose of the study was to find out the relationship of selected anthropometric measurement and General Motor Ability to football playing ability. There would be significant relationship of selected Anthropometric measurement and Motor ability to the performance of football players. Twenty football players who represented in Inter Collegiate football competition held at Rishikesh (U.K.) were selected as subjects for this study. Tests were administered to the subjects immediately after the tournament was over. According to the eligibility records, their (ages ranged from 18 to 25 years. All the subjects involved in this study were physically fit for tests to be administered to them. This was a statistical study for the relationship of two variable, Anthropometric measurement and motor ability components to performance of football players, related to criterion measure. weight and crural index of the players did not correlate with performance as the coefficient of correlation of weight and crural index with playing ability performance was 0.174 and 0.021 respectively, whereas height, arm length, leg length, thigh length, foreleg length of an individual correlated quite satisfactorily with performance in football playing ability as their coefficient of correlation were 0.718, 0.638, 0.881, 0.683 and 0.787 respectively. Significant correlation with selected motor ability components i.e. speed (0.715; agility (0.597) and eye-leg coordination (0.685). The results of the study concluded

that the speed, agility, eye-leg coordination, height, arm length, leg length, thigh length and foreleg length were significantly correlated with football playing ability performance. The anthropometric measurements i.e. weight and crural index were not significantly related to football playing ability performance.

**Mirzaei, Nikbakhsh and Sharififar (2013)** conducted a study to find the relationship between personality traits and sport performance. This research was aimed to investigate the relationship between personality traits with sport performance. The method of the study was descriptive correlational. The data was collected using questionnaires and through field study procedure. The population of the study consisted of 229 non elite football players in the 2010-2011 season in Ardebil city. The sample size was equated with the population. Personality was assessed using the NEO Five Factor Inventory (NEO-FFI; Costa & McCrae, 1992) and athlete's performance was assessed by coach’s rating (Piedmont et al., 1999). The stepwise regression analysis indicated that from among personality components only conscientiousness have positive significant correlation with sport performance. The result also, indicated that conscientiousness was the sole predictor of sport performance.

**Raut (2012)** conducted a study to find the relationship between skill performance and selected motor fitness variables of tribal women handball players. The present study was conducted on 30 thirty women handball players randomly selected as subject from the players undergoing training camps at Pt. Ravi Shankar University Raipur, Guru Ghasidad University Bilaspur, (C.G.). Sarguja University, Ambikapur (C.G) and S.G.B.A. University, Amravati, (MH). For East zone intervarsity handball competition, the age of the subject ranged 17 to 23 years old. Skill performance as Passing ability, Defensive ability and dribbling ability were taken as independent variables. For motor fitness variables speed, explosive power, agility, cardio-respiratory endurance flexibility were taken under consideration. Defensive ability, Passing ability and Dribbling ability was assessed by Defense

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movement test, passing test and controlling dribbling test. The test selected for assessing motor fitness variables were speed by 50meter run, explosive jump by sergeant jump, agility by (6x10 meter) shuttle run Cardio-respiratory endurance by 12 minute run/walk test and flexibility by sit and reach test. To find out correlation between selected motor fitness variables to skill performance of tribal handball player Pearson Product Moment Correlation method was used at .05 level of significance. The result shows that defensive ability had positive correlation with speed and agility whereas explosive power, cardio-respiratory endurance, and flexibility had a negative correlation. The passing ability had a negative correlation with speed & agility and a positive correlation with explosive power, cardio respiratory endurance, and flexibility. The skill of dribbling had a positive correlation with speed and agility, a negative correlation with explosive power and was insignificantly correlated to cardio respiratory endurance and flexibility.

Pori et al. (2012) conducted a study to find the correlation between the Motor Abilities and Competitive Performance of Slovenian Handball Goalkeepers. The objective of the present research was to analyse the relations between selected motor abilities and the competitive performance of team handball goalkeepers. The sample consisted of 46 male goalkeepers who were members of first and second division Slovenian handball league clubs (age: 24.2 ± 5.2 years, height: 185.6 ± 4.9 cm, body weight: 88.2 ± 9.6 kg). Motor abilities were measured with seven motor tests assessing the level of strength, agility and flexibility. Independent handball professionals evaluated the goalkeepers’ competitive efficiency using values from 1 (very bad) to 5 (excellent). The correlation between motor abilities and competitive efficiency was assessed with Pearson’s correlation coefficient. Only the “heavy ball motor test” correlated statistically significant with competitive performance (p=0.00). The results show that those goalkeepers who were able to express a higher level of explosive arm strength appeared to be more effective in the handball game. As there were no other motor tests correlating with competitive efficiency, it was possible that the goalkeepers have these abilities on a similar level or the tests did not have sufficiently high sensitivity to predict the performance level.

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Singh (2012) conducted a study to find out relationship between playing ability and selected motor fitness variables of tribal women basketball players. The objective of the study was to find out the relationship between selected motor fitness variables and skill performance of tribal women handball players. The present study was conducted on 30 thirty women basketball players randomly selected as subject from the players undergoing training camps at Pt. Ravi Shankar University Raipur, (C.G.) Guru Ghasidad University Bilaspur, (C.G.). Sarguja University, Ambikapur (C.G). Skill performance as independent variables were Passing, Defensive and dribbling. Motor fitness variables involved were speed, explosive power, agility, cardio-respiratory endurance and flexibility. Defensive ability, Passing ability, Speed Shot Shooting ability and Control Dribbling ability was assessed by AAHPERD Basketball test battery (1984). The test selected for assessing motor fitness variables were speed by 50 meter run, explosive jump by sergeant jump, agility by (6x10 meter) shuttle run Cardio-respiratory endurance by 12 minute run/walk test and flexibility by sit and reach test. To find out correlation between selected motor fitness variables to skill performance of tribal handball player Pearson Product Moment Correlation method was used. The result showed that defensive ability had positive correlation with speed and agility whereas explosive power, cardio-respiratory endurance, and flexibility had a negative correlation. The passing ability had a negative correlation with speed & agility and a positive correlation with explosive power, cardio respiratory endurance, and flexibility. The skill of dribbling had a positive correlation with speed and agility, a negative correlation with explosive power and was insignificantly correlated to cardio respiratory endurance and flexibility.

Kalepwar (2011) conducted a study to find the effect of general physical fitness on the sport performance of volleyball players. The objectives of the study were to measure the physical fitness level of volleyball players. To delineate the relationship between physical fitness and the sport performance of volley ball players. The study was conducted in Nanded district of Marathwada region. Ninety six (96) volleyball players who represents different volleyball tournament at college and inter


college level was selected. The components of general physical fitness finalized by the coaches in charge of Netaji Subash National Institute of Sports (NSNIS), Patiala having poor, satisfactory, good, very good and excellent grading and scoring were selected. The performance of volleyball players have been judge and classified. The data was collected with the helps of well structured questionnaire by survey method. Growth and development are the manifestations of life and their rate and quality indirectly reflects the general health of an individual. Health of an individual is determined through the study of somatometric variables and body components. Many hereditary and environmental factors are responsible for influencing the health of an individual.

Livesey et al. (2010) conducted a study to find the relationship between motor performance and peer relations in 9- to 12-year-old children. The current study examined the link between motor performance and peer relations in 9 to 12-year-old children in both physical and non-physical (schoolwork) settings using a community sample. Participants were 192 school children whose motor performance was tested using the Movement Assessment Battery for Children. Peer acceptance was assessed using the Peer Rating Scale and teachers completed the Peer Exclusion subscale of the Child Behaviour Scale to indicate each child’s peer status. Children were also asked to indicate their level of physical activity and their perceived freedom in leisure using self-report questionnaires. The results revealed that children with poor motor performance had lower levels of physical activity, and freedom in leisure and were less preferred by their peers in both play and classroom settings. These effects were stronger for boys than for girls. Teacher indicated that children with poorer motor skills experienced higher levels of peer rejection in the classroom setting. When motor performance was separated into fine- and gross-motor performance it was found that only the latter was significantly correlated with peer acceptance in the play context but that fine-motor skills contributed significantly to variance in teacher ratings of peer exclusion in the classroom setting.

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Bradshaw (2003)\(^6\) examined the importance of running speed and an accurate take-off on gymnastics vaulting performance. Current training practice for gymnastics vaulting is to stereotype the 15-25 m run-ups to the board, which assumes that a fast and reliable approach was best controlled predominantly without visual feedback. Incidences where gymnasts make errors during their run-ups, often landing onto the back of the board, occur frequently, even at the international level. The standard deviation method for identifying visual regulation in long jump run-ups was employed in this first exploration of gymnastics vaulting to examine whether visual regulation processes are utilized. Secondly, the question of how a small number of gymnasts can run fast during the approach and perform more difficult vaults was addressed. Five elite female gymnasts aged 13-15 years performed five round-off entry vaults. One panning 50 Hz video camera recorded each trial from an elevated platform to evaluate the approach step, hurdle, and round-off characteristics, whilst two 250 Hz cameras recorded vaulting performance. Two qualified judges viewed each vaulting trial and provided a performance score. A precursor for a fast take-off from the board when vaulting is to utilize vision early to control the approach kinematics (p=0.02). High take-off velocity was directly related to judge's score (p=0.03). Coaches need to supplement gymnasts' vault training to include exercises that improve the gymnasts' ability to visually regulate their gait pattern while running.

Young; James and Motogomery (2002)\(^6\) conducted a study to identify the relationships between leg muscle power and sprinting speed with changes of direction. The study was designed to describe relationships between physical qualities and a component of sports performance. Testing was conducted in an indoor sports hall and a biomechanics laboratory. 15 male participants were required to be free of injury and have recent experience competing in sports involving sprints with changes of direction. Subjects were timed in 8 m sprints in a straight line and with various changes of direction. They were also tested for bilateral and unilateral leg extensor muscle concentric power output by an isokinetic squat and reactive strength by a drop jump. The correlations between concentric power and straight sprinting speed were

\(^3\) Bradshaw E. “Target-directed Running in Gymnastics: A Preliminary Exploration of Vaulting”. Int J. Eat Disord. 2003 Sep; 34(2):.244-250.

non-significant whereas the relationships between reactive strength and straight speed were statistically significant. Correlations between muscle power and speed while changing direction were generally low and non-significant for concentric leg power with some moderate and significant (p<0.05) coefficients found for reactive strength. The participants who turned faster to one side tended to have reactive strength dominance in the leg responsible for the push-off action. The relationships between leg muscle power and change-of-direction speed were not consistent. Reactive strength as measured by the drop jump appears to have some importance for lateral change-of-direction speed, possibly because of similar push-off actions. It was concluded that reactive strength of the leg extensor muscles has some importance in change-of-direction performance but the other technical and perceptual factors than influence agility performance should also be considered.

Gowda (1989)\textsuperscript{65} carried out the comparative study of selected physical fitness variables among Kabaddi players based on positional play. 120 Kabaddi players were selected as subjects from the Mysore University intercollegiate tournaments. These subjects were divided into three equal groups of forty each, under offensive, defensive and allround categories. The physical fitness variables selected for this study were strength, speed, endurance, agility, power and muscular endurance. The following test were administered to obtain the data (1) flexed arm hang (2) sit-ups (3) shuttle-run (4) standing broad jump (5) 50 yard dash (6) Burpee test (7) chin-ups (8) half squat jump test (9) push ups. The results revealed that there was no significant difference among offensive and defensive and allround groups in any of the physical fitness variables.

Uppal and Roy (1986)\textsuperscript{66} conducted a study on assessment of motor fitness compound or prediction of soccer playing ability. The 33 male soccer players attending coaching camp prior to inter-university students were taken as subjects. Five motor fitness compounds speed (50 mt. dash), agility (4x10 mt. shuttle run), maximum leg strength (leg dynamometer), explosive leg strength (standing broad jump) and cardio-respiratory endurance (Cooper’s 12 min. run/walk test) were


administered on graded subjects out of 50 marks in playing ability by three judges: Result showed that independent variable (speed ML strength, EC strength and cardiovascular strength) were significantly related to dependent variable. Since the multiple correlation co-efficient was higher than zero order correlation coefficients, therefore, further better performance in soccer all the independent component chosen must be considered.

**Dev (1984)**\(^\text{67}\) conducted a study to find the relationship of selected physical variables such as strength, arm strength, leg strength, agility, speed, flexibility, anthropometric measurements, weight, height, arm length, leg length, foreleg length, thigh height, ponderal index, crural index to performance in shot-put. Product moment correlation method was used to complete correlation and significance of the study. The results of the study shows that there was significant correlation between arm strength, leg strength, speed, flexibility and shot-put performance and there was no significant correlation between weight, height, arm length, leg length, foreleg length, thigh length, ponderal index, crural index and shot-put performance.

**Kela (1984)**\(^\text{68}\) undertook this study to find out the relationship between speed of movement (Nelson method), agility (shuttle run) and spine and shoulder flexibility (flexometer) to performance in gymnastics on twenty five inter-university women gymnasts at Amritsar in 1984. Rank-difference method of correlation was used in order to find out the relationship. It was found that agility had a significant relationship with performance in gymnastics and speed of movement and shoulder and spine flexibility did not contribute to performance in gymnastics.

A study was undertaken by **Kola (1984)**\(^\text{69}\) to find out the relationship between speed of movement, agility, and shoulder and spine flexibility to performance in gymnastics. Twenty-five inter university women gymnasts from various universities who came to participate in inter university gymnastics competition held at Amritsar 1994, were selected as subjects for this study. The average age of the subjects was 22

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\(^{68}\) Rashmi Kela. “Relationship of Speed Movement, Agility and Flexibility to Performance in Gymnastics”, *Unpublished Master’s Thesis*, Jiwaji University, Gwalior, 1984.

years. Rank difference method was used to compute correlation between speed of movement, agility, spine and shoulder flexibility to performance in gymnastics. The results of the study showed that there were no significant correlations between speeds of movement, spine and shoulder flexibility to performance in Gymnastics whereas agility had a high significant relationship with performance in gymnastics. Speed of movement of women gymnastics did not show significant relationship to gymnastics performance. Shoulder flexibility of women gymnasts’ did not show any significant relationship to performance in Gymnastics. Spine flexibility did not contribute to performance in Gymnastics. The agility showed a real significant improvement in the performance of women gymnasts.

Raman (1983)\(^70\) conducted a study to find the relationship of grip strength, leg power, agility and hand and foot reaction time to performance in cricket. A sample included on 30 male cricket players studying at LNCPE, Gwalior to determine the relationship of grip strength, leg power, agility and hand and foot reaction times to performance in cricket. Data on grip strength were collected by grip dynamometer, leg power by standing brad jump, agility by 40 yard shuttle run and hand and foot reaction time by electronic reaction timer. Cricket performance was assessed by subjective ratings of three experts during practice and match situations. Statistical treatment of the data was done by product moment correlation. It was concluded that hand and foot reaction time is the most important variable in the prediction of cricket performance, leg power is another important variable in the prediction of performance in cricket, grip strength is also important variable of prediction of cricket playing ability and agility is not an important factor in the prediction of cricket performance.

Joseph (1983)\(^71\) conducted a study to find the relationship of power, agility, shoulder flexibility, arm length and leg length to volleyball playing ability. The subjects were 30 male volleyball players studying in L.N.C.P.E., Gwalior. Product moment correlation was computed for finding the correlation between volleyball playing ability and each of the selected independent variables. It was concluded that


power is the most reliable variable in prediction of playing ability of men volleyball players. The arm length and leg length are also reliable variables in prediction of playing ability of male volleyball players and agility and shoulder flexibility were not significant in prediction of playing ability of male volleyball players.

**Lamba (1980)** carried out a study to compare physical fitness components and physiological variables of college offensive and defensive hockey players. Physical fitness components were agility, speed, strength and physiological variables were blood pressure, pulse rate breath holding capacity and cardiovascular endurance. Sixty male students representing four colleges of Gwalior in 1978-79 intercollegiate tournaments acted as the subjects of the study. After administering the tests ‘t’ ratio was used to statistically analyze the data. Conclusions of the study were the offensive players are faster and have less resting pulse rate and thus had more cardiovascular endurance than defensive players; the defensive players have more arm and leg strength than offensive players and there was no difference between offensive and defensive players in agility, blood pressure and breath holding capacity.

### 2.5 Summary of the Study Literature

In this chapter, totally seventy-three related literature (11 studies in Kabaddi game and 62 studies in other games) were presented. From the observations of above extracted literature it was observed that only few relationship and prediction research studies were done on players of Kabaddi game. This chapter also reveals that comparative studies, relationship studies, prediction studies in other sports discipline were very many, but only few have been added in this chapter.

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