CHAPTER II

REVIEW OF RELATED LITERATURE

The present researcher searched mainly pubmed data sources in the internet. Then identified title of the related article after reading the abstract of the article, the present researcher collected some very important related reviews. From that the most specific research items full paper has been collected from different internet sources (Google scholar, J-store, etc.). The present scholar also searches Information Library Net (UGC intra library data sources). The e-journal sources, DOAJ, DOAR, ROAR etc. also been connected through the Visva-Bharati Central Library information subsistence and collected related scientific information and special references. In the following the scholar presented related literature on aerobic, anaerobic power and cellular body composition reviews. On aerobic power there are many reviews but on anaerobic power there are limited reviews whereas, cellular body composition, the reviews are very few. In the following the present researcher chronologically presented some important reviews for ready references.

2.1 REVIEWS OF SCIENTIFIC LITERATURE

Raven et al. (1976) evaluated the physiological function of a professional soccer team in the North American soccer league. 18 players were evaluated on cardio-respiratory function, endurance performance, body composition, blood chemistry and motor fitness measures near the end of their competitive session. They observed the following means resting heart rate 50 beats/minute; maximum heart rate 188 beats/minute; maximum oxygen intake 58.4 ml/kg/min; 12 min run and walk 1.86 miles and Illinosis agility run 15.6 seconds.
Verma et al. (1979) observed maximal oxygen uptake in 40 sedentary male aged 17 to 25 years and in 96 active athletes of the same age participating in 5 different kinds of sports. The VO$_2$ max of the sedentary group was found to be 36.8±4 ml/kg/min. The mean VO$_2$ max in 96 active athletes was 48.4±5.1 ml/kg/min which is slightly low as compared to VO$_2$ max values recorded in active populations in other countries. Highest mean VO$_2$ max was recorded in group of long distance runners (56.4 ml/kg/min) while lowest mean VO$_2$ max values were recorded in the group of football players 44.2±2.1 ml/kg/min.

Bhanot and Sidhu (1981) studied the anaerobic power in different sports on 99 National senior as well as National junior player specialized in Hockey, Football, Volleyball, Basketball, etc. The National seniors were 27 Hockey, 16 Volleyball players, whereas 32 Football and 24 Basketball players was the National junior. The maximal anaerobic power of the National players was determine from maximal vertical velocity and body weight by the methods of Margaria. They observed that volleyball players possess higher maximum anaerobic power than football, hockey and basketball players.

Mangine et al. (1990) studied to develop a physiological profile of the elite soccer athletes. Protocols were developed to assess flexibility, knee ligament translation, body composition, anaerobic power, lower extremity functional performance and muscle strength. 83 male US national team players provided data for this study. The average body fat was 9.5% and all athletes perform normally on the function test. The mean power output on Windgate testing was 8.1 watts/kg body weight. They suggested that the identification measurement of key physiological qualities for the elite soccer athletes will provide students and a baseline for trainers, coaches and players.
Ostojic (2000) studied the structural and functional characteristics of elite Serbian soccer players and compared with non-elite counterparts. One of the team in this study (squad A, N = 16) competed in the professional first division national league while the other team (squad B, N = 16) played in the amateur 3rd division. Physiological measurement were made in 32 players, during the final week of the preparatory training period. Subjects from squad A were older and more experienced as compared to players in squad B. They found players from squad B had significantly lower estimated VO$_2$ max values compared with elite subjects in squad A (42.9±6.6 vs 53.5±8.6) ml/kg/min. They also observed the highest heart rate frequencies during the last minutes of the 20 meter shuttle run test were lower in elite players (183.1±6.1 vs 189.9±8.1 beats/min). Vertical jump height was significantly higher in squad A and estimated percentage of fast muscle fibers (fast twitch) was higher in squad A as compared to squad B. The result of this study was indicating a strong relationship between aerobic fitness, anaerobic power and performance results in the elite soccer players.

Andziulis et al. (2001) investigated the oxygen consumption of athlete before the beginning of preseason oxygen consumption parameters were measured with Marquepte 3.01 system during a standard exercise test protocol modified by Balk. The research included 32 male athletes (age 18-25 years) basketball and soccer players. They observe the average VO$_2$ max was 47 ml/kg/min.

Dey et al. (2003) investigated physiological responses peak VO$_2$ and its relation to other anthropometric parameters of school boys (8-14 years) from east and north-east region of India and the subject sub-divided according to their age a total no of 394 boys were participated in this study. Peak oxygen uptake of boys was measured by computerized motor driven treadmill by standard procedure. The result showed that
the body size and peak VO$_2$ of the boys from both region increased significantly from 8-14 years of age. Peak VO$_2$ of the subjects was less than untrained Japanies, European and American boys.

**Ostojic (2004)** studied to describe physical and functional characteristic of elite Serbin soccer players and make comparison with non-elite counterpart to identify any relationships between results from the physiological test and competition level. One of the team in this study (Squad A, N = 30) competed professional First Division National League and the other team (Squad B, N = 30) played in the Ameture third division. Physiological measurement was made of 60 players during the final week of preparatory training for competition. Subjects from Squad A were older and more experience compare to players Squad B. Elite players from Squad A had significantly higher estimated VO$_2$ max values compared with subjects in Squad B (52.9±9.1 vs 45.1±5.5 ml/kg/min). In addition the highest heart rate frequencies during the last minutes of the 20 minutes shuttle run test were lower in elite players (182±6 vs 190±8 beats/min). Vertical jump height was significantly higher in Squad A (49.9±7.5 vs 49.9±6.9 cm) and estimated percentage of fast muscle fibers (fast twitch) were higher in Squad A as compare to Squad B (64.1±6.1 vs56.9±7.9) the results of the present study demonstrated a strong relationship of aerobic fitness and anaerobic power with performance at the elite level of soccer players.

**Chamari et al. (2005)** assessed aerobic performance in soccer by means of a specific dribbling track: the Hoff test. They tested 18 male soccer players (14 years old) both in the laboratory and using the Hoff test before and after 8 weeks of soccer training. The present study demonstrated significant correlation between laboratory testing of VO$_2$ max and performance in the Hoff test. They found that training
induces improvements in VO2 max were reflected in improve performance in the Hoff test.

**Manna et al. (2006)** studied to find out the training induce changes of different physiological and biochemical parameters in young Indian soccer players. A total of 30 Indian male soccer players, age range 14-16 years regular playing competitive soccer were selected. A training programme consists of 6 weeks and 12 weeks of training was employed. They observe a significance increase in aerobic capacity and anaerobic power after the training. They recommended that since the data on the soccer players are limited in India therefore, the present study may provide useful information to the coaches to develop their training programme.

**Siegler et al. (2006)** evaluated the performance testing of non-elite soccer players and compared performance results between the elite and non-elite players. 13 male soccer players volunteer to participate in this study. The test included a treadmill VO2 max test, 20m sprint, vertical jump, 30 sec Windgate cycle ergometer test, the Loughbo rough intermittent shuttle test and 220 m multistage shuttle runs to exhaustion (fatigue test). Actual VO2 max (absolute and relative) scores were correlated with the estimated VO2 max score (fatigue test), 20 m sprint, vertical jump and 30 sec Windgate anaerobic test using a Pearson’s product moment correlation. Insignificant relationships were observed between actual VO2 max score and estimated VO2 max from the fatigue test (absolute and relative). Insignificant relationship was observed between peak and average power output (Windgate), 20 m sprint and vertical jump. The result of this study demonstrated that to elicit physiological differences between elite and non-elite players, assessment must include both aerobic and anaerobic players.
Gill et al. (2007) described the anthropometric and physiological characteristics of young soccer players (14-17 years old) which were associated with their being successful or not as soccer players. Somatotype, body composition and VO$_2$ max was estimated by the Astrand’s method. Sprint, jump, and endurance test were also performed. They found that most relevant differences were between selected and non-selected players belonging to the 14 years old age. Selected players were taller, heavier, leaner, faster and they had higher absolute or relative VO$_2$ max. These results indicated that around the time of puberty, parameters associated with physical maturity such as height, size, speed, VO$_2$ max or chronological age is important to determine the success of a soccer player.

Alemdaroglu et al. (2007) studied to determine the relationship among different type of anaerobic power and capacity test in young soccer players. 12 male young soccer players volunteer to participate in the 30 seconds. Windgate bicycle ergometer test, 30 second Bosco multiple jump and repeated ZigZag agility test. They found no significant relationship among pick power; average power and fatigue index obtain from the anaerobic test. The result of this study revealed that Basco multiple jump, Windgate and repeated ZigZag agility test, though these test anaerobic in nature appear to determine the different aspects of anaerobic characteristics. They suggested that although the test had the same duration they could not be used interchangeably to determine the anaerobic performance in young soccer players.

Cedric et al. (2007) studied assess the development of anaerobic power in junior elite aged between 15-19 years and to validated a performance rating of aerobic power qualities 186 players of Belgium junior national team (U-15, U-16, U-17, U-18, U-19) were evaluated anaerobic power testing session consist of two main part
vertical jump, counter movement jump, counter movement jump free arms, 6 second jumping test and sprint (20 meter with sprint times at 5m, 10m, 20m). The analysis of the evaluation of anaerobic power factors in junior elite soccer players between age 15 and 19 showed an increasing progression with the highest increases between age of 15 and 17 for all factors. The performance rating allowed the identification the players with good anaerobic power potential.

Mehmet et al. (2007) studied to determine the relationships among different type of aerobic power and capacity test in young soccer players. 36 male young soccer players (age 16.6±1.2 years), VO\textsubscript{2} max (55.72±4.94 ml/kg/min), volunteer participate in the 12 min Cooper test, Conconi test, and running test with progressively increased work load protocol. All the subject were tested approximately in 2 weeks during the competition period of young soccer league. VO\textsubscript{2} max was measured with Cosmed portable oxygen analyser. There were no significant relationship in VO\textsubscript{2} max between running test with progressively increased work protocol and the 12 min Cooper test.

Silva-Veto (2007) examined the differences in fitness profile of under 15 male soccer players in accordance to their field position. The subjects were 56 Brazilian soccer players of U-15 category. The players grouped by field position as central difenders (N-14), lateral defender (N-10), defensive midfielder (N-8), offensive midfielders (N-11) and forwards. The measurement included body mass, height, skinfold, Yo – Yo intermittent recovery test, 30 meter test, Squat Jump and counter movement jump test. Analysis of variance reveled that there were no significant differences in field position for body mass, skinfold, Yo – Yo intermittent recovery test, 30 meter sprint, Squat jump and counter movement jump test.
Castagna et al. (2007) investigated the possible relationship between VO$_2$ max and repeated sprint ability in a group of young regional level soccer players. 19 players were randomly drawn from a population of players to participate in this study. VO$_2$ max was assessed with a Yo-Yo endurance test and gas analyser perform with K$_4$B$_2$ gas analyser. Repeated sprint ability was assessed with 7 x 30 meter line sprint with 20 seconds active recovery between bouts. VO$_2$ max was not significantly correlated to speed decrement and total sprint time. Using the median split technique significant correlation was found between VO$_2$ max and fatigue index in the players with low VO$_2$ max. Result suggested a mutual influence between VO$_2$ max and repeated sprint ability in youth soccer players with lower level of fitness. That repeated sprint ability was possibly develop independent of aerobic fitness once a threshold level of aerobic power was achieved. The present data also highlighted the importance of testing both VO$_2$ max and repeated sprint ability performance separately in prospective youth soccer players.

Ordzhonikidze et al. (2007) studied the maximum aerobic power and aerobic efficiency (anaerobic threshold) in major league soccer players. They observed the aerobic capacity of soccer players from living Russian team is substantially lower than that of players from leading European teams.

Mujika et al. (2007) implemented a seven week individual training programme with a youth elite football (soccer player) that had been underperforming because of poor aerobic fitness. The inter version focused on developing aerobic power and high lacted production. After the training the player was able to return to play and exceed expected performance levels during competitive match play.
Urena and Cabrera (2009) assessed the cardio-respiratory profile (VO$_2$ max) of Costa-Rican first division football players during preseason and compared VO$_2$ max by player’s position. A total of 9 Costa-Rican first division football teams were evaluated in this study for a total sample of 219 professional players aged 20-36 with an average age of 24.64±4.35 years, average body weight of 73.34±7.34 kg and a fat percentage of 9.78±3.64%. In order to evaluate the VO$_2$ max of player and the treadmill protocol was used. They found an average VO$_2$ max of 57.71±8.8 ml/kg/min and they observe no statistically significant deference between the positions of players.

Lopez-Segovia et al. (2010) assessed the effects of the training executed by two under 19 soccer teams from the first Spanish division on aerobic power, strength and acceleration capacity. Two under 19 soccer teams that completed in the same league were evaluated on two occasions. The first evaluation was done at the beginning of the competitive period and the second evaluation was done 16 weeks later coinciding with the end of the first half the regular session. Maximum aerobic speed was evaluated with other test. Team A significantly improved a maximum aerobic speed whereas team B slightly worsened its maximal aerobic speed.

Michalczyk (2010) assessed the aerobic capacity, sprint velocity and changes in biochemical variables in football players preparing for league matches. Football players from league one (N = 19) and league four (N = 15) were subjected twice to a graded running test at the beginning and at the end of the pre session preparation period. The following variables were recorded: maximum running velocity, VO$_2$ max, pulmonary ventilation, load at the lacted threshold expressed as the threshold velocity, activities of the enzymes in plasma – creatinekinease (CK) and lacted dehydrogenase (LDH), concentrations of lactate (La), ammonia (NH$_3$) and of glucose
(Gl) in plasma. At the end of the study the players were also subjected to a 30 m sprint test. They found that negligible differences between football players from league I and league IV in their aerobic capacity and speed abilities and the marked distance from World elite players in those indices. They recommended to call for substantial changes in training strategies and schedules.

Dey et al. (2010) studied the various anthropometric parameters, motor abilities and physiological profiles of the different Indian National Club footballers and they also compared the above parameters with their International counter parts. The present study was carried out on 150 male Indian footballers of 6 different National Clubs of India including 3 from Kolkata (East Bengal, Mohanbagan and Mohamedan Sporting) and the other 3 from Goanese clubs, (Salgoakar, Vasco and Dempo). The players were also subdivided according to their specific field positions. Aerobic capacity (VO$_2$ max) was measured by standard procedures. They found VO$_2$ max were significantly different among the footballers of different National Clubs. They also observed that the mean value of VO$_2$ max of Indian National Club players were inferior to those of Europian, American and Australian footballers. The defender, mid fielder and striker of the present study were inferior in VO$_2$ max as compared to their International counter parts. They concluded that the differences among the footballers of present study with their International counter parts and specific playing position is probably the course of hereditary factors and difference in activity in the game.

Manna et al. (2010) investigated the effect of a training programme on selected physiological and biochemical variables of Indian soccer players of different age groups. The maximal aerobic capacity assessed by using metabolic analyser and a treadmill. The Windgate anaerobic test was used by a Cycle ergometer following a
standard methodology. They observed a significant increase in relative VO$_2$ max in U-16, U-19 and U-23 age groups in soccer populations. Anaerobic power increases significantly among U-19 and U-23 players but not in U-16.

**Valentae–Dos–Santos (2012)** evaluated the contribution of chronological age, skeletal age, body size and training to the longitudinal development of aerobic performance in youth male soccer players aged 10-18 years. Skeletal age, body weight and aerobic performance were measured once per year. They found that the development of aerobic performance in young soccer players was significantly related to chronological age, biological development and volume of training.

**Soltani et al. (2012)** compared power and aerobic fitness profile of Iranian soccer players in different playing position during competition season. In this research 24 players of soccer teams; defender (N = 8), mid fielder (N = 8), attacker (N = 8) were selected randomly. Using Astrand’s treadmill test and running based anaerobic sprint test for aerobic fitness and anaerobic power were measured in the initial competitions season and after the 15$^{th}$ match during competitions season. Mid fielder and attacker players show a significant increase in aerobic fitness or VO$_2$ max. Furthermore defenders and attackers showed a significant increase in anaerobic power during completion season. They concluded that anaerobic power and aerobic fitness profiles in soccer players changed during competition season.

**Carling et al. (2012)** compared secular changes in body size, estimated fatness, skeletal maturation and functional characteristics of youth soccer players on entry into elite academy between 1992 and 2003 annual selections group across time (1992-1995, 1996-1998, 1999-2003) playing position goal keeper, defender, mid fielder, forward and by eventual status in the sports (professional and non-
professional) were compared. Data for 158 players (age 13.4±0.4 years) at entry into the academy included skeletal age, height, weight, relative fatness, four field test of functional capacities (aerobic, anaerobic power, speed) and quadriceps concentric strength of the dominant and non-dominants legs. They found that the player size, functional characteristics and skeletal maturation did not differ among years.

**Tonnessen et al. (2013)** investigated to quantify maximal aerobic power (VO$_2$ max) in soccer as a function of performance level, position, age and time of session. 145 male soccer players (age 22±4 years) were tested for VO$_2$ max at the Norogian Olympic training center between 1989 and 2012. They observed no differences in VO$_2$ max among national team players, first and second division players at juniors. Mid fielder had higher VO$_2$ max than defenders, forwards and goal keeper. Relative to body mass, VO$_2$ max among the professional players in this study has not improved over time. Professional players tested during 2006-2012 actually had 3.2% lower VO$_2$ max than those tested from 2000-2006. The findings of this study indicated that VO$_2$ max values 62-64 ml/kg/min fulfil the demands for aerobic capacity in men professional soccer.

**Kumar et al. (2014)** observed the anaerobic power and capacity of football players. 36 male football players between the age of 17 and 28 years volunteered for this study. The mean age, height and weight of football players was 21±2 years, 172±6.81 cm and 67.5±9.94 kg respectively. The participants perform 6 sprints each of 30 meters. The maximum power, minimum power, average power and fatigue index of football players was 579.94±147.78 watt, 376.00±111.66 watts, 470.78±114.76 watts and 6.00±3.45 watts. It was concluded from the results of this study that sprint time increased, power declined with a high fatigue index, the
football players may need to focus on improving lacted tolerance and this could be a focus of their training programme.

Galanti et al. (2014) evaluated soccer players and cycling athletes. Body mass index, fat free mass, total body intra cellular and extra cellular water were measure by bioimpedence. They found body mass index were similar between the groups while the total body water and extra cellular water were significantly higher in the soccer player group.

2.2 REVIEW CONCLUSION:

Football (soccer) is a long duration game with frequently changing direction, speed, jump and with ball activities. In this game both the energy system anaerobic and aerobic are involved directly. The aerobic endurance is important by the nature of the game, the other area anaerobic endurance is more important in the time of near to the final whistle. At the same time cellular body compositions supporting the both system from the beginning till the end of the game and beyond after reviewing all the available scientific data sources the present researcher observed that scientists are more interested on aerobic power of the soccer players. Very few scientists were engaged themselves to search the anaerobic power qualities of soccer player, may be due to the procedural problems. The cellular body composition areas of soccer players were still now untouched. Probably that’s why very less report was visible in the data sources. The present researcher himself is a football player, playing football from his school days, know very well the physiological demand of the soccer and the science behind it. After identify this scientific gap of soccer requirement, the interest of the scholar to research in this area and to make a profile of cellular body composition, aerobic and anaerobic power of Indian soccer player.