Chapter - II

REVIEW OF RELATED LITERATURE

The study related literature is an essential step to get a good comprehension of what has been done with regard to the problem under study. Such review is instrumental in the selection of topic, transaction of hypothesis and deductive reasoning leading to the problem. It will bring out a deep and clear perspective of overall field.

In this chapter the investigator reviewed the related literature in the following heads:

1. Studies on Circuit Resistance Training
2. Studies on Football
3. Studies on Skill Performances
4. Studies on effect of Resistance Training
5. Studies on effect of Football Skill Drill Training
6. Summary of literature

2.1 Studies on Circuit Resistance Training

Silva et.al., (2015) conducted a study on strength training in soccer with a specific focus on highly trained players. This review examines the extent to which distinct modes of strength training improve soccer players' performance, as well as the effects of concurrent strength and endurance training on the physical capacity of players. A selection of studies was performed in two screening phases. The first phase consisted of identifying articles through a systematic search using relevant databases, including the US National Library of Medicine (Pub Med), MEDLINE, and Sport Discus. Several
permutations of keywords were utilized (e.g., soccer; strength; power; muscle function), along with the additional scanning of the reference lists of relevant manuscripts. Given the wide range of this review, additional researchers were included. The second phase involved applying six selection criteria to the articles. After the two selection phases, 24 manuscripts involving a total sample of 523 soccer players were considered. Our analysis suggests that professional players need to significantly increase their strength to obtain slight improvements in certain running-based actions (sprint and change of direction speed).

Strength training induces greater performance improvements in jump actions than in running-based activities, and these achievements varied according to the motor task [e.g., greater improvements in acceleration (10 m) than in maximal speed (40 m) running movements and in non-squat jump (SJ) than in SSC-based actions (countermovement jump)]. With regard to the strength/power training methods used by soccer players, high-intensity resistance training seems to be more efficient than moderate-intensity resistance training (hypertrophic). From a training frequency perspective, two weekly sessions of strength training are sufficient to increase a player's force production and muscle power-based actions during pre-season, with one weekly session being adequate to avoid in-season detraining. Nevertheless, to further improve performance during the competitive period, training should incorporate a higher volume of soccer-specific power-based actions that target the neuromuscular system. Combined strength/power training programs involving different movement patterns and an increased focus on soccer-specific power-based actions are preferred over traditional resistance exercises, not only due to their superior efficiency but also due to their ecological value. Strength / power training programs should incorporate a significant number of exercises targeting the efficiency of stretch-shortening-cycle activities and
soccer-specific strength-based actions. Manipulation of training surfaces could constitute an important training strategy (e.g., when players are returning from an injury). In addition, given the conditional concurrent nature of the sport, concurrent high-intensity strength and high-intensity endurance training modes (HIT) may enhance a player's overall performance capacity. Our analysis suggests that neuromuscular training improves both physiological and physical measures associated with the high-level performance of soccer players.

Moreira et al.,(2015) conducted a study to examine the training periodization of an elite Australian Football team during different phases of the season. Training-load data were collected during 22 wk of preseason and 23 wk of in-season training. Training load was measured using the session rating of perceived exertion (session-RPE) for all training sessions and matches from 44 professional Australian Football players from the same team. Training intensity was divided into 3 zones based on session-RPE (low, <4; moderate, >4 AU and <7 AU; and high, >7 AU). Training load and intensity were analyzed according to the type of training session completed. Higher training load and session duration were undertaken for all types of training sessions during the preseason than in-season (P<.05), with the exception of "other" training (ie, re/prehabilitation training, cross-training, and recovery activities). Training load and intensity were higher during the preseason, with the exception of games, where greater load and intensity were observed during the in-season. The overall distribution of training intensity was similar between phases with the majority of training performed at moderate or high intensity. The current findings may allow coaches and scientists to better understand the characteristics of Australian Football periodization, which in turn may aid in developing optimal training programs. The results also indicate that a polarized training-intensity
distribution that has been reported in elite endurance athletes does not occur in professional Australian Football.

Malone et al.,(2015) investigated on quantifying the seasonal training load completed by professional soccer players of the English Premier League. Thirty players were sampled (using GPS, heart rate, and rating of perceived exertion [RPE]) during the daily training sessions of the 2011-12 preseason and in-season period. Preseason data were analyzed across 6×1-wk micro cycles. In-season data were analyzed across 6×6-wk meso cycle blocks and 3×1-wk micro cycles at start, midpoint, and end-time points. Data were also analyzed with respect to number of days before a match. Typical daily training load (ie, total distance, high-speed distance, percent maximal heart rate [%HRmax], RPE load) did not differ during each week of the preseason phase. However, daily total distance covered was 1304 (95% CI 434-2174) m greater in the 1st meso cycle than in the 6th. %HRmax values were also greater (3.3%, 1.3-5.4%) in the 3rd meso cycle than in the first. Furthermore, training load was lower on the day before match (MD-1) than 2 (MD-2) to 5 (MD-5) d before a match, although no difference was apparent between these latter time points. The authors provide the 1st report of seasonal training load in elite soccer players and observed that periodization of training load was typically confined to MD-1 (regardless of mesocycle), whereas no differences were apparent during MD-2 to MD-5. Future studies should evaluate whether this loading and periodization are facilitative of optimal training adaptations and match-day performance.

Fanchini et al.,(2015) investigated on examining the effect of different exercise-intensity distributions within a training session on the session rating of perceived exertion (RPE) and to examine the timing of measure on the rating. Nineteen junior players (age 16±1 y, height 173±5 cm, body mass 64±6 kg) from a Swiss soccer team were involved in the study. Percentage of heart rate maximum (%HR) and RPE (Borg CR100®) were
collected in 4 standardized training sessions (conditions). The Total Quality of Recovery scale (TQR) and a visual analogue scale (VAS) for pain of the lower limbs were used to control for the effect of pre training fatigue. Every session consisted of three 20-min blocks of different intensities (ie, low-moderate-high) performed in a random order. RPE was collected after every block (RPE5), immediately after the session (RPE-end), and 30 min after the session (RPE30). RPE5s of each block were different depending on the distribution sequence (P<.0001). RPE-end, TQR, and VAS values were not different between conditions (P=.57, P=.55, and P=.96, respectively). The %HR was significantly different between conditions (P=.008), with condition 3 higher than condition 2 (74.1 vs 70.2%, P=.02). Edwards training loads were not significantly different between conditions (P=.09). RPE30 was not different from RPE-end (P>.05). The current results show that coaches can design training sessions without concern about the influence of the within-session distribution of exercise intensity on session-RPE and that RPE can be collected at the end of the session or 30 min later.

McMaster et al.,(2013) carried out a study on Strength and power are crucial components to excelling in all contact sports; and understanding how a player's strength and power levels fluctuate in response to various resistance training loads is of great interest, as it will inevitably dictate the loading parameters throughout a competitive season. This is a systematic review of training, maintenance and detraining studies, focusing on the development, retention and decay rates of strength and power measures in elite rugby union, rugby league and American football players. A literature search using MEDLINE, EBSCO Host, Google Scholar, Ingenta Connect, Ovid LWW, Pro Quest Central, Science Direct Journals, SPORT Discus and Wiley Inter Science was conducted. References were also identified from other review articles and relevant textbooks. From 300 articles, 27 met the inclusion criteria and were retained for further
analysis. STUDY QUALITY: Study quality was assessed via a modified 20-point scale created to evaluate research conducted in athletic-based training environments. The mean ± standard deviation (SD) quality rating of the included studies was 16.2 ± 1.9; the rating system revealed that the quality of future studies can be improved by randomly allocating subjects to training groups, providing greater description and detail of the interventions, and including control groups where possible. Percent change, effect size (ES=[Post-Xmean - Pre-Xmean]/Pre-SD) calculations and SDs were used to assess the magnitude and spread of strength and power changes in the included studies. The studies were grouped according to (1) mean intensity relative volume (IRV = sets × repetitions × intensity; (2) weekly training frequency per muscle group; and (3) detraining duration. IRV is the product of the number of sets, repetitions and intensity performed during a training set and session. The effects of weekly training frequencies were assessed by normalizing the percent change values to represent the weekly changes in strength and power. During the IRV analysis, the percent change values were normalized to represent the percent change per training session. The long-term periodized training effects (12, 24 and 48 months) on strength and power were also investigated. Across the 27 studies (n = 1,015), 234 percent change and 230 ES calculations were performed. IRVs of 11-30 (i.e., 3-6 sets of 4-10 repetitions at 74-88% one-repetition maximum [1RM]) elicited strength and power increases of 0.42% and 0.07% per training session, respectively. The following weekly strength changes were observed for two, three and four training sessions per muscle region/week: 0.9%, 1.8 % and 1.3 %, respectively. Similarly, the weekly power changes for two, three and four training sessions per muscle group/week were 0.1%, 0.3% and 0.7 %, respectively. Mean decreases of 14.5% (ES = - 0.64) and 0.4 (ES = -0.10) were observed in strength and power across mean detraining periods of 7.2 ± 5.8 and 7.6 ± 5.1 weeks, respectively. The long-term training studies
found strength increases of 7.1 ± 1.0% (ES = 0.55), 8.5 ± 3.3% (ES = 0.81) and 12.5 ± 6.8% (ES = 1.39) over 12, 24 and 48 months, respectively; they also found power increases of 14.6% (ES = 1.30) and 12.2% (ES = 1.06) at 24 and 48 months. Based on current findings, training frequencies of two to four resistance training sessions per muscle group/week can be prescribed to develop upper and lower body strength and power. IRVs ranging from 11 to 30 (i.e., 3-6 sets of 4-10 repetitions of 70-88% 1RM) can be prescribed in a periodized manner to retain power and develop strength in the upper and lower body. Strength levels can be maintained for up to 3 weeks of detraining, but decay rates will increase thereafter (i.e. 5-16 weeks). The effect of explosive-ballistic training and detraining on pure power development and decay in elite rugby and American football players remain inconclusive. The long-term effects of periodized resistance training programmes on strength and power seem to follow the law of diminishing returns, as training exposure increases beyond 12-24 months, adaptation rates are reduced.

Arazi and Afkhami (2013) investigated the blood pressure responses during recovery after two protocols of circuit resistance exercises (CRE) with different rest intervals (RI). Eleven normotensive males (aged 19.5 ± 1.0 yrs, height 172.8 ± 5.7 cm and weight 65.1 ± 8.1 kg) performed two CRE with RI of 30 (RI30s) and 40 (RI40s) seconds between the exercises randomly, as well as a control session without exercise. The protocols consisted of 3 circuits of 6 exercises with 10 repetitions maximum (10RM) and 2 minute rest between circuits, followed by an 80 minute recovery period. Measurements were taken before exercise and at each 10min of post-exercise recovery. The Analysis of Variance (ANOVA) with Repeated Measures (group × time) was used to analyze data, followed by post-hoc Bonferroni test, for P *+-,-/"-exercise hypotension of systolic blood pressure was observed after both CRE with RI30s and
RI40s (at R40, R50, R60, R70 and R80), where as diastolic blood pressure did not differ from that measured at rest. In all measured moments, there was no significant difference between exercise trials in post-exercise levels of systolic and diastolic blood pressure. CRE with RI30s and RI40s between the exercises can lead to occurrence of PEH similarly in magnitude and duration. Our findings suggest a potentially positive health benefit of strength training.

Velusamy (2013) found out the effect of varied methods of resistance training on selected physical fitness components of inter collegiate male volleyball players. To achieve the purpose of the present study, forty five male volleyball players were selected as subjects during the academic year 2012-2013. The subjects were selected on a random basis and were divided into three equal groups that are two experimental groups and one control group. Each group consists of 15 subjects. Group – I underwent Resistance with Circuit Training (RCT), Group – II underwent Resistance without Circuit Training (RWCT) and Group – III acted as control group (CG), they didn’t take part in any specific activities. The ages of subjects were ranged from 18-28 years. Initial reading has been taken for both experimental and control groups and the readings have been carefully recorded. Whereas the experimental group was treated resistance with circuit and resistance without circuit training after six weeks of treatment, the post test was conducted for both experimental and control groups and the final readings have been recorded carefully. The collected data were analyzed statistically by using Analysis of covariance (ANCOVA) was used to determine the difference, if any among the adjusted post test means on selected dependent variables separately. The results showed that 46 experimental groups showed better performance on selected physical fitness components of inter collegiate male cricket players.
Maneet (2011) studied the effects of Circuit Training for the Development of Vertical Jumping Ability, Endurance, Agility and Skill Ability in Football Players’ Boys Aged 10 To 12 Years. The main aim of this type of study was to investigate whether additional circuit training will be of any benefit in improving the performance of the students undergoing training in the following events Cardiovascular Endurance, Vertical Jumping Ability, Agility and Muscular Endurance. 40 students of N. L Dalimiya High School, Miraroad, and Mumbai were selected at random and were divided in two groups of 20 each by random allotment one of the groups was treated as control group. Circuit training was based on the assumption that could have developmental effect in Cardiovascular Endurance, Vertical Jumping Ability, Agility and Muscular Endurance. The criterion measures adopted for experimental group were Cardiovascular Endurance, Vertical Jumping Ability, Agility and Muscular Endurance. Initial readings were taken at the commencement of the training. Experimental group followed specifically prescribed circuit training scheduled three days a week for period of eight weeks. Final readings in the criterion measures were taken. The improvement made in the test items by the two groups were tested for significance by the paired ‘t’ test. The mean gain made by the Experimental Group over the Control Group in Each of the test item was also tested for significance using the ‘t’ test.

Palanisamy et al., (2012) conducted a study on effect of circuit training on aerobic, anaerobic capacity among kabaddi players the sample for the present study of thirty men kabaddi players from Arul Anandar College at Madurai. The subjects were selected using random sampling methods. Their age ranged from 18 -23 years. There were divided into two equal groups namely circuit training group and control group. Vo2 Max bench step test (Aerobic capacity) and 300 meters run (Anaerobic capacity) were administrated to them. Aerobic capacity considered as dependent variables and
experimental group (Circuit training) and control group (No training) considered as independent variables. Circuit training group was given circuit training for the period of eight weeks three days per week for 1 hour in the morning on the playing ground. The training programmed was administrated for 45 minutes and the cool-down activates. The load was fixed based on the pilot study. The exercise was graduated from 1 week to 8 weeks by increasing the speed, resistance, duration and intensity. The intensity of each exercise started at 50% hear rate maximum and gradually increased to 90% before the end of the 8 weeks period. This is in accordance with the recommendation of the American College of Sports Medicine (1986) that recommended an exercise intensity of between 50-90% of maximal heart rate. Experimental group of the subject worked at each station and had 1 minutes of rest before changing the next station. The subject moved to the station in a clockwise direction as soon as the time allotted to each station was over, they were required to go through the 10 stations of the circuit three times. At the end of the circuit training programme, subjects were given cool down activities. The pre test and post test were taken before and after the training programme. Analysis of Covariance was used as a test of significant. There was significant difference among circuit training group and control group on selected variables such as aerobic capacity among kabaddi players. There was significant difference among circuit training group and control group on selected variables such as anaerobic capacity among kabaddi players.

Alagesan et al., (2012) conducted a study on the effect of circuit resistance training on selected strength parameters. To achieve this purpose of the study, thirty men students studying bachelors degree at Annamalai Nagar, Tamil Nadu, India were selected as subject and they were divided into two equal groups of fifteen subject each, such as circuit resistance training group and control group underwent circuit resistance
programme for three day week for twelve weeks and Group II acted as control which did not participate in any special training programme apart from the regular physical education activities as per the curriculum. Among the strength parameters, the following variables namely leg strength and strength endurance were selected as criterion variables. And they were tested by using leg lift with dynamometer and bent knee sit ups respectively. All the subject of two groups were tested on selected dependent variables at prior to and immediately after the training programme. The analysis of covariance (ANCOVA) was used to analyze the significant different, if any, between the group. The .05 level of confidence was fixed to find out the level og significance which was considered as an appropriate. The results of the study showed that there was a significant between circuit resistance training group and control group on leg strength and strength endurance. It was also found that there was a significant improvement on selected criterion variables namely leg strength and strength endurance due to circuit resistance training.

Thirumalai kumar et al., (2012) studied the effects of aerobic training and circuit resistance training on selected motor ability components among college men students. To achieve the purpose 45 college men students were selected randomly from college affiliated to Alagappa University. Their age was fixed in the range of 18 to 25 years. There were divided into three group experimental group. The data were collected before and after the training programme and statistically analyzed using analysis of covariance (ANCOVA). Significant results have been observed on speed and agility.

George et al. (2012) conducted a study on analyse the impact of resistance circuit training on back strength among college football players. Forty women student (n=40), studying in difference college, Mahatma Gandhi university, Kerala, were randomly selected as subjects and their age ranged from 17 to 23 years. The selected subjects were
dividing into two groups of twenty subjects each. Group 1 considered as experiment that underwent resistance circuit training (RCTG) for eight weeks, group II considered as control group (CG) that did not undergo any special training programme apart from their regular activities. All the subjects of the two groups were tested on selected criterion variable namely back strength. Analysis of covariance was used to analyse the data of pre and post test of resistance circuit training group and control group on confidence. The result revealed of significance of test “f” ratio obtained by the analysis of covariance was fixed at 0.05 level of confidence. The result reviled that the resistance circuit training group produced significant improvement (p<0.05) on back strength when compared to control group.

Maria Raj et al., (2013) analysed the comparative effects of Plyometric, Circuit Training and Circuit Breaker Programmes on Selected Motor Components of School Level Basketball Players. The purpose of the study was to compare the effects of plyometrics, circuit training and circuit breaker programmes on selected motor components of school level basketball players. For the purpose of the study; four groups: three experimental groups viz: plyometrics training group (A), circuit training group (B), and circuit breaker programme group (C) and the fourth group served as the control group. Random group design was employed. Reliability coefficients for the test- re-test scores on selected motor components: Cardio respiratory endurance (1.5 mile Run) 0.87, Hip and back flexibility (Sit and Reach Test) 0.97, Spine flexibility (Bridge Up Test) 0.94, Shoulder flexibility (Shoulder Rotation Test) 0.97, Static balance (Stork Stand Test) 0.97, Dynamic balance (Modified Bass Test) 0.97 were selected to collect the data. To find out the comparative effects of plyometric training, circuit training and circuit breaker programme on selected motor components of school level Basketball players, analysis of
covariance was employed, the proposed hypothesis was tested at 0.05 level of confidence. The result revealed significant improvement in most of the selected motor components. All the three experimental groups were effective in improving the Cardio respiratory endurance (1.5 mile Run), Hip, back and spine flexibility and also balance (static and dynamic). The plyometric groups were comparatively better than the circuit training group and circuit breaker programme in improving the Cardio respiratory endurance of the subjects. In the case of shoulder flexibility all the three experimental groups did not show any significant improvement.

Harries et al., (2012) conducted a study on resistance training to improve power and sports performance in adolescent athletes: a systematic review and meta-analysis. Resistance training in untrained adolescents can positively affect health-related fitness as well as improve muscular power and sports performance. The impact of resistance training on adolescent athletes is less clear. The purpose of this review is to determine the effectiveness of resistance training programs on muscular power and sports performance in adolescent athletes. Systematic review and meta-analysis of previously published studies investigating resistance training in adolescent athlete populations. A systematic search of Medline, Embase, and SPORT Discus 41 databases was conducted on 21st March 2011 to identify studies evaluating resistance training programs on power and sports performance in adolescent athletes. Thirty-four studies were identified. All but two of the studies reported at least one statistically significant improvement in anaerobic muscular power outcome. The most common indicators of anaerobic power were vertical jump (25 studies) and sprint running (13 studies) performance. Fourteen studies provided data to allow for pooling of results in a meta-analysis. A positive effect was detected for resistance training programs on vertical jump performance (mean difference 3.08 [95% CI 1.65, 4.51], Z=4.23 [P<0.0001]). There is sufficient evidence to conclude
that resistance-training interventions can improve muscular power in adolescent athletes. A positive effect on sports performance attributable to participation in resistance training was reported by almost half the included studies, however limited objective evidence to support these claims was found. Improvements in motor performance skills, such as jumping, are widely stated as indicators of improvements in sporting performance.

Bogdanis and Gregory (2011) Conducted a study on the effects of two different half-squat training programs on the repeated-sprint ability of soccer players during the preseason. Twenty male professional soccer players were divided into 2 groups: One group (S-group) performed 4 sets of 5 repetitions with 90% of their 1-repetition maximum (1RM), and the other group (H-group) performed 4 sets of 12 repetitions with 70% of 1RM, 3 times per week for 6 weeks, in addition to their common preseason training program. Repeated-sprint ability was assessed before and after training by 10 × 6-second cycle ergometer sprints separated by 24 seconds of passive recovery. Maximal half-squat strength increased significantly in both groups (p < 0.01), but this increase was significantly greater in the S-group compared with the H-group (17.3 ± 1.9 vs. 11.0 ± 1.9%, p < 0.05). Lean leg volume (LLV) increased only in the H-group. Total work over the 10 sprints improved in both groups after training, but this increase was significantly greater in the second half (8.9 ± 2.6%) compared with the first half of the sprint test (3.2 ± 1.7%) only in the S-group. Mean power output (MPO) expressed per litre of LLV was better maintained during the last 6 sprints post training only in the S-group, whereas there was no change in MPO per LLV in the H-group over the 10 sprints. These results suggest that resistance training with high loads is superior to a moderate-load program, because it increases strength without a change in muscle mass and also results in a greater improvement in repeated sprint ability. Therefore, resistance training with high loads
may be preferable when the aim is to improve maximal strength and fatigue during sprinting in professional soccer players.

Little and Thomas (2006) conducted a study to investigate inter-subject variability and intra-subject reliability in exercise intensity during soccer drills. It was hypothesized that soccer drills that involve the highest exercise intensities would demonstrate the lowest inter-subject variability and the highest intra-subject reliability. Heart rates of 23 professional soccer players were recorded during a range of soccer training drills. The drills consisted of 2 vs. 2 to 8 vs. 8 normal scoring games and 2 further possession games. Heart rate responses were examined for variability, reliability, and suitability for soccer endurance training. Coefficients of variation across players were less than 3% for all drills. Paired t-tests showed no significant differences in heart rate on repetition of the drills and 95% ratio limits of agreement were 1.8-3.8%. There were no significant correlations between exercise intensity and the statistical measures of variability and reliability. Several drills produced exercise intensities suitable for soccer endurance training with mean heart rate responses ranging from 87-91% HRmax. Soccer drills such as those used in the present study appear to be an adequate substitute for physical training without the ball and thus provide simultaneous skill and fitness training. The increase in training time spent developing technical ability and/or a reduction in total training time required may be useful for soccer teams.

2.2 Studies of Football

Tønnessen and Shalfawi (2011) conducted a study to examine the effect of 10 weeks' 40-m repeated sprint training program that does not involve strength training on sprinting speed and repeated sprint speed on young elite soccer players. Twenty young well-trained elite male soccer players of age (±SD) 16.4 (±0.9) years, body mass 67.2 (±9.1) kg, and stature 176.3 (±7.4) cm volunteered to participate in this study. All
participants were tested on 40-m running speed, 10 × 40-m repeated sprint speed, 20-m acceleration speed, 20-m top speed, countermovement jump (CMJ), and aerobic endurance (beep test). Participants were divided into training group (TG) (n = 10) and control group (CG) (n = 10). The study was conducted in the pre competition phase of the training program for the participants and ended 13 weeks before the start of the season; the duration of the pre competition period was 26 weeks. The TG followed a Periodized repeated sprint training program once a week. The training program consisted of running 40 m with different intensities and duration from week to week. Within-group results indicate that TG had a statistically marked improvement in their performance from pre to post test in 40-m maximum sprint (-0.06 seconds), 10 × 40-m repeated sprint speed (-0.12 seconds), 20- to 40-m top speed (-0.05 seconds), and CMJ (2.7 cm). The CG showed only a statistically notable improvement from pre to post-test in 10 × 40-m repeated sprint speed (-0.06 seconds). Between-group differences showed a statistically marked improvement for the TG over the CG in 10 × 40-m repeated sprint speed (-0.07 seconds) and 20- to 40-m top speed (-0.05 seconds), but the effect of the improvement was moderate. The results further indicate that a weekly training with repeated sprint gave a moderate but not statistically marked improvement in 40-m sprinting, CMJ, and beep test. The results of this study indicate that the repeated sprint program had a positive effect on several of the parameters tested. However, the sample size in this study is only 20 participants and the results are valid only for those who took part in this study. Therefore, we advice to use repeated sprint training similar to the one in this study only in periods where the players have no speed training included in their program. Furthermore, the participants in this study have probably gained strength, however, benefits were observed even without strength training is most likely to be caused by the training specificity.
Jastrzbski and Rompa (2011) conducted a study to examine the effects of applied training loads on the aerobic capacity, speed, power and speed endurance of young soccer players during one soccer season. The participants in the study were nineteen young male soccer players (age: 16.61 ± 0.31 yrs; weight: 64.28 ± 6.42 kg; height: 176.58 ± 5.98 cm). The players completed 150 training sessions and 54 games over the course of one soccer season. The training intensity was divided into four categories: 1 – Aerobic performance (61% of the total training duration), 2 - Mixed aerobic-anaerobic performance (34%), 3 - Anaerobic-lactate performance (3%) and 4 - Anaerobic-non-lactate performance (2%). No significant changes in the VO2 max were observed throughout the season. The players' power level and speed endurance increased significantly with the coincident decrements in their 5-m sprint time. The applied training loads, including one high-intensity training session of small-sided games performed during a competitive season, did not significantly change the aerobic capacity of the young soccer players. However, the participants did maintain their VO2 max at the elite level. The first squad players (FSP) reached the highest level of aerobic fitness in the middle of the season, while substitute players (SP) at the end of the season. Moreover, the VO2 max in FSP was significantly higher (p < 0.003) than in SP in the middle of the season.

Wong and Pui-lam (2010) conducted a study on the effects of on-field combined strength and power training (CSPT) on physical performance among U-14 young soccer players. Players were assigned to experimental (EG, n = 28) and control groups (CG, n = 23). Both groups underwent preseason soccer training for 12 weeks. EG performed CSPT twice a week, which consisted of strength and power exercises that trained the major muscles of the core, upper, and lower body. CSPT significantly (p < 0.05) improved vertical jump height, ball-shooting speed, 10 m and 30 m sprint times, Yo-Yo
intermittent endurance run (YYIER), and reduced sub maximal running cost (RC). CSPT had moderate effect on vertical jump, ball-shooting, 30 m sprint, and YYIER, small effect on 10 m sprint, RC, and maximal oxygen uptake. YYIER had significant (p < 0.05) correlations with 10 m (r = -0.47) and 30 m (r = -0.43) sprint times, ball-shooting speed (r = 0.51), and vertical jump (r = 0.34). The CSPT can be performed together with soccer training with no concomitant interference on aerobic capacity and with improved explosive performances. In addition, it is suggested that CSPT be performed during the preseason period rather than in-season to avoid insufficient recovery/rest or overtraining.

Wong and Chaouachi(2010) examined the effect of concurrent muscular strength and high-intensity running interval training on professional soccer players' explosive performances and aerobic endurance. Thirty-nine players participated in the study, where both the experimental group (EG, n = 20) and control group (CG, n = 19) participated in 8 weeks of regular soccer training, with the EG receiving additional muscular strength and high-intensity interval training twice per week throughout. Muscular strength training consisted of 4 sets of 6RM (repetition maximum) of high-pull, jump squat, bench press, back half squat, and chin-up exercises. The high-intensity interval training consisted of 16 intervals each of 15-second sprints at 120% of individual maximal aerobic speed interspersed with 15 seconds of rest. EG significantly increased (p < or = 0.05) 1RM back half squat and bench press but showed no changes in body mass. Within-subject improvement was significantly higher (p < or = 0.01) in the EG compared with the CG for vertical jump height, 10-m and 30-m sprint times, distances covered in the Yo-Yo Intermittent Recovery Test and maximal aerobic speed test, and maximal aerobic speed. High-intensity interval running can be concurrently performed with high load muscular strength training to enhance soccer players' explosive performances and aerobic endurance.
Bartolini and Albert (2011) conducted a study to determine the optimal elastic cord assistance for sprinting performance. Eighteen collegiate women soccer players completed 3 testing sessions, which consisted of a 5-minute warm-up, followed by 5 randomized experimental conditions of 0, 10, 20, 30, and 40% Body Weight Assistance (BWA). In all BWA sessions, subjects wore a belt while attached to 2 elastic cords and performed 2 maximal sprints under each condition. Five minutes of rest was given between each sprint attempt and between conditions. Split times (0-5, 5-10, 10-15, 15-20, and 0-20 yard) for each condition were used for analysis. Results for 0-20 yard demonstrated a significant main effect for condition. Post hoc comparisons revealed that as BWA increased, sprint times decreased up to 30% BWA (0%: 3.20 ± 0.12 seconds; 10%: 3.07 ± 0.09 seconds; 20%: 2.96 ± 0.07 seconds; 30%: 2.81 ± 0.08 seconds; 40%: 2.77 ± 0.10 seconds); there was no difference between 30 and 40% BWA. There was also a main effect for condition when examining split times. Post hoc comparisons revealed that as BWA increased, sprint times decreased up to 30% BWA for distances up to 15 yard. These results demonstrate that 30% of BWA with elastic cords appears optimal in decreasing sprint times in collegiate women soccer players for distances up to 15 yard.

Chan and Lee (2011) researched on comparing the physical abilities of youth soccer players and professional soccer players. Specific training can be suggested to young players according to the differences of physical abilities. Young 85 soccer players (19 professional, 62 youth) performed counter movement jump (CMJ) on a jump mat, 20m sprint and arrowhead agility test timed by infra-red timing gate Height and weight were also measured. BMI was calculated. An independent t-test was used to compare the differences between youth and professional players. A significant level of p<0.05 was used. The results of the study was that significant differences (See Table 1) were found
in all tests except counter movement jump test (p<0.05). Youth soccer players have a better performance than professional soccer players in the 20m sprint test. The conclusions that can be drawn from the above finding is that poor performance compared to youth players in 20m sprint for professional soccer players was unexpected. It is possible that speed is not the most important ability in the game or the players have already developed their speed when they were young. Similar lower limb muscle power relative to body weight was found in both groups in CMJ test. However, better performance was found in arrowhead agility test for the professional. Players as the longest distance in arrowhead test is only 10m, fast maximum speed is not a necessary ability to have good performance in arrowhead agility test. The test results implied that professional players can accelerate and decelerate better than the young players. This difference involves the abilities of proprioception, balance, muscle coordination and motor skill. The practical applications of this study are that static balance exercise, dynamic balance exercise, and plyometric exercise with multi-direction movement are suggested to improve agility. Exercises, such as eye close single leg balance on ground or foam, zigzag single leg hop with balance when landing, lateral single leg plyometric jump, bounding, running and cutting, are the examples which will improve agility.

Clark and Brooks(2011) conducted a study to determine the relationship of physiological characteristics to soccer-specific variables, such as kick velocity (KV), knee torque (KT), and body fat percentage (BF%) specifically in female collegiate soccer players. The subjects of this study consisted of 22 NCAA Division I female soccer players. Anthropometric data was collected on age, height, weight, and body composition. Body composition was assessed using the Jackson-Pollock 3- Site Skin fold Formula procedure using the Lange skin fold calipers. A one repetition max (1-RM) squat parallel test was used to determine the maximum lower body strength of the athlete.
Lower body explosive power (VJ) was measured using a Vertec vertical jump device. A 40 yard dash was measured to evaluate acceleration and 100 meter sprint was used to determine speed. [latin capital V with dot above]o2Max was done with a 2-mile run test and prediction equations, while agility was tested using the Illinois Agility Test. Knee Torque (KT) was measured using the knee extension on the Biodex III and Kicking Velocity (KV) was determined using the Speed Trac radar gun. Statistical significance was set an alpha level of p < 0.05. Significant correlations were found between KT and KV (r = 0.89), as well as vertical jump and KV (r = 0.91). Aerobic power (r = 0.93), agility (r = 0.88), and vertical jump (r = 0.84) were highly correlated to BF%. These data suggest that significant relationships exist between physiological characteristics and soccer-specific variables. The practical application of this finding is that although sports specific skill training is essential and desirable among coaches and athletes, it is important to recognize that athleticism is multifaceted. The possession of these fitness characteristics in isolation does not predispose the athlete for success in soccer; instead there must be a balance between these components.

Miller and Kieffer (2011) conducted a study to develop the profile of soccer-related fitness parameters on elite National Collegiate Athletic Association (NCAA) Division III male soccer players during the off-season. Sixteen under class men from a recent NCAA Division III national championship soccer team completed a series of tests across 3 separate occasions over a 15-day period, with adequate recovery time between sessions to eliminate any carryover effect. Physiological parameters measured included aerobic endurance, anaerobic power and capacity, jumping power, agility, hamstring flexibility, and body composition. Descriptive statistics such as the mean (±SD) and range were calculated for each test. Two-tailed Pearson correlations were run to determine significant relationships that existed between variables. Test results were T-Tests (9.9 ±
(34.2 ± 11.9 right, 34.0 ± 13.9 left), vertical jump (61.8 ± 7.2 cm), percent fat (5.6 ± 1.6), Progressive Aerobic Cardiovascular Endurance 1), Run (PACER) laps (113.2 ± 12.3), estimated VO2max (53.6 ± 2.9 ml·kg·min⁻¹), Wingate peak (802.7 ± 155.6 W), Wingate peak (10.9 ± 1.2 W·kg⁻¹), Wingate mean (651.2 ± 101.6 W), Wingate mean (8.9 ± 0.6 W·kg⁻¹), and Wingate fatigue rate (35.9 ± 8.4%). Strong correlations existed between PACER laps and percent fat, between peak W and peak W·kg⁻¹, and between peak W and fatigue rate. These results suggest that elite Division III soccer players maintain relatively high fitness levels during the off-season. Additionally, they provide coaches with preliminary norms that can be used to determine off-season training expectations and adjust programs accordingly for their athletes.

Spierer, David K; et.al., (2011) examined the effect of Auditory Stimuli (AS) and Visual Stimuli (VS) on sprint time, sprint speed, and reaction time in National Collegiate Athletic Association Division I male soccer players. Fifteen healthy subjects (mean age 22.1 ± 1.6 years) volunteered for the study. This experiment was conducted on a regulation soccer field, using a wireless timing system. Subjects stood on a touch-and-release pad and were instructed a prompt (AS: “go” command via a microphone interface, VS: movement of a player located 10 m from the start) to run 20 m through the finish line timing gates without decelerating. After 3 submaximal sprint trials at 50%, conditions (AS and VS) were randomized and performed 3 times by each subject. The best sprint time, sprint speed, and reaction time were recorded. Paired t-tests were conducted on dependent variables to determine statistically significant differences. An alpha level was set at 𝑝 = 0.05. Sprint time was reduced in response to VS as compared to AS (3.76 ± 0.16 seconds vs. 3.85 ± 0.15 seconds, 𝑝 = 0.001). Sprint speed (distance covered) was greater in VS compared to AS (5.3 ± 0.21 m·s⁻¹ vs. 5.1 ± 0.19 m·s⁻¹, 𝑝 < 0.001), and reaction time was reduced in VS compared to AS (0.53 ± 0.048 seconds vs.
0.61 ± 0.044 seconds, \( p = 0.001 \). These data show that VS rather than AS improve sprint response times in collegiate male soccer athletes. The data suggests that performance on the field may be improved if coaches and players strategize to integrate visual cues (e.g., gestures and signals) during practices and games.

Young et al., (2011) carried out a study to determine the validity and reliability of agility tests. Fifty junior Australian Soccer players aged 15–17 years, members of either an elite junior squad (\( n = 35 \)) or a secondary school team (\( n = 15 \)), were assessed on a new RAT that involved a change of direction sprint in response to the movements of an attacking player projected in life size on a screen. These players also underwent the planned Australian Soccer League agility test, and a subgroup (\( n = 13 \)) underwent a test requiring a change of direction in response to a left or right arrow stimulus. The elite players were significantly better than the school group players on the RAT (2.81 ± 0.08 seconds, 3.07 ± 0.12 seconds; difference 8.5%) but not in the arrow stimulus test or planned agility test. The data were log transformed and the reliability of the new RAT estimated using typical error (TE) expressed as a coefficient of variation. The TE for the RAT was 2.7\% (2.0–4.3, 90\% confidence interval) or 0.07 seconds (0.5–1.0), with an intra class correlation coefficient (ICC) of 0.33. For the test using the arrow stimulus, the TE was 3.4\% (2.4–6.2), 0.09 (0.06–0.15) seconds, and ICC was 0.10. The sport-specific stimulus provided by the new RAT is a crucial component of an agility test; however, adoption of the new RAT for routine testing is likely to require more accessible equipment and several familiarization trials to improve its reliability.

Chaouachi and Anis (2010) conducted a study on to examine the relationships between Yo-Yo IR1 and RSA performances in elite soccer players. Twenty-three soccer players (age 19 ± 1 years, height 181 ± 5.7 cm, body mass 73.2 ± 4.1 kg, % body fat 11 ± 2.4) performed the Yo-Yo IR1 and a test for RSA (7 × 30 m with 25-second recovery).
Results were $2,289 \pm 409\text{m}$, $31.21 \pm 1.13\text{ seconds}$, and $4 \pm 2.1\%$ for Yo-Yo IR1, total sprint time, and sprint decrement, respectively. Yo-Yo IR1 showed a significant and moderate relationship with sprint decrement ($r = 0.44, p = 0.04$). Splitting the sample into best and worst Yo-Yo IR1 performers according to median score (2,320 m), the best group showed lower RSA total time ($30.69 \pm 0.99$ vs. $31.79 \pm 1.06, p < 0.05$) and speed decrement ($2.90 \pm 0.86$ vs. $5.09 \pm 2.42, p < 0.01$) compared to the worst group. Sprint-time deterioration over 30m occurred earlier (from the second sprint on) in the Yo-Yo worst compared with in the Yo-Yo best group (from the fourth sprint on, $p < 0.001$). Intermittent high-intensity endurance is poorly associated with RSA performance ($r^2 = 0.19$). Consequently, coaches and strength and conditioning professionals should consider both Yo-Yo IR1 and RSA in their testing batteries. A Yo-Yo IR1 performance 2,320 m could be considered as a reasonable indicator of physical fitness in elite soccer. Relatively short time interval test protocols similar to the present study should consist of at least 5 sprint bouts.

Clark and James (2010) conducted a study to examine improvements in cardio respiratory fitness ($[\text{V} \text{O}_2]$) after the use of a Mixed-intensity Interval Endurance-Training (MI-ET) program in female soccer players, to validate the MI-ET program as an appropriate training regimen to improve cardio respiratory fitness ($[\text{V} \text{O}_2]$) in soccer players. 32 female soccer players (average 18.66 +/- 0.31 years) were recruited from a group of currently conditioning local U-19 and college soccer teams and randomly assigned to participate in an 8-week periodized training program that involved either the MI-ET program or the continuation of a current endurance-training (ET) program. Analysis of variance indicates no differences in $[\text{V} \text{O}_2]$ values within the group of athletes before participating in the exercise program. After the 8 weeks of training, the MI-ET group of athletes had
significantly greater average $\bar{O}_2$ values ($62.13 \pm 0.96 \text{ ml O}_2 \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ vs. $57.27 \pm 1.59 \text{ ml O}_2 \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$), $p = 0.015$, along with a greater group average of change in $\bar{O}_2$ ($12.44 \pm 0.92 \text{ ml O}_2 \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ vs. $7.72 \pm 0.99 \text{ ml O}_2 \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$), $p < 0.001$. The MI-ET program is shown to be a valid means to improve aerobic fitness as indicated by the MI-ET group exhibiting significantly greater $\bar{O}_2$ measures after training.

Fletcher and Iain (2010) investigated the effect of different warm-up stretch modalities on specific high-speed motor capabilities important to soccer performance. Twenty-seven male soccer players performed 3 warm-up conditions, active warm-up (WU), WU with static stretching (SPS), and WU with dynamic stretching (ADS). Heart rate, counter movement jump, 20-m sprint, and Balsom agility tests were performed after each intervention. Vertical jump heights were significantly greater ($p < 0.01$) in the WU and ADS conditions compared to those in the SPS trial. The 20-m sprint and agility times showed that the SPS condition was significantly slower ($p < 0.01$) than the WU and ADS conditions, with the ADS trial being significantly faster ($p < 0.05$) than the WU condition. Heart rate was significantly higher ($p < 0.01$) for participants post-WU and ADS trials compared to the SPS condition. These findings suggest that the superior performance of the dynamic stretch and warm-up-only conditions compared to the static stretch condition may be linked to increases in heart rate. The reasons for the dynamic stretch trial superiority compared to the warm-up condition are less clear and as yet to be established. It is recommended that for optimal performance, specific dynamic stretches need to be employed as part of a warm-up, rather than the traditional static stretches.

Maio Alves and José Manuel (2010) conducted a study to analyze the short-term effects of Complex and Contrast Training (CCT) on vertical jump (squat and counter
movement jump), sprint (5 and 15 m), and agility (505 Agility Test) abilities in soccer players. Twenty-three young elite Portuguese soccer players (age 17.4 +/- 0.6 years) were divided into 2 experimental groups (G1, n = 9, and G2, n = 8) and 1 control group (G3, n = 6). Groups G1 and G2 have done their regular soccer training along with a 6-week strength training program of CCT, with 1 and 2 training sessions wk-1, respectively. G3 has been kept to their regular soccer training program. Each training session from the CCT program was organized in 3 stations in which a general exercise, a multiform exercise, and a specific exercise were performed. The load was increased by 5% from 1 repetition to maximum every 2 weeks. Obtained results allowed identifying (a) a reduction in sprint times over 5 and 15 m (9.2 and 6.2% for G1 and 7.0 and 3.1%, for G2; p < 0.05) and (2) an increase on squat and jump (12.6% for G1 and 9.6% for G2; p < 0.05). The results suggested that the CCT induced the performance increase in 5 and 15 m sprint and in squat jump. Vertical jump and sprint performances after CCT program were not influenced by the number of CCT sessions per week (1 or 2 sessions wk-1). From the obtained results, it was suggested that the CCT is an adequate training strategy to develop soccer players' muscle power and speed.

Mirkov and Dragan (2010) conducted a study to explore distinctive anthropometric and physical performance characteristics of young soccer players between the age of 11 and 14 and to reveal the performance at the age of 11, which contributes to the later success. Male players of the best national male squads of the ‘Cadet League’ (14 years of age; n = 26) were annually tested starting from the age of 11 for body size and composition, flexibility, power, coordination, and agility. Randomly selected untrained but physically active age-matched boys (n = 63) were also tested over 4 consecutive years. The results revealed no difference between 2 groups regarding the body size and composition (p > 0.05). The differences in flexibility emerged only at the later age,
whereas the differences regarding the explosive power (as assessed by various jumps) were moderate and partly inconsistent. The most prominent advantage of the soccer players over the control subjects during the entire tested age period appeared to be movement agility and coordination (p < 0.01). Therefore, the explosive muscle power and, in particular, the agility and coordination characterize elite soccer players of 11-14 years of age but not the body size and body composition. In addition, the agility and coordination could be among the crucial factors of future success in 11-year-old players and, therefore, should be used for early selection.

2.3 Studies on Skill Performances

Draganidis (2013) determined the recovery rate of football skill performance following resistance exercise of moderate or high intensity. Ten elite football players participated in three different trials: control, low-intensity resistance exercise (4 sets, 8-10 repetitions/set, 65-70% 1 repetition maximum [1RM]) and high-intensity resistance exercise (4 sets, 4-6 repetitions/set, 85-90% 1RM) in a counterbalanced manner. In each experimental condition, participants were evaluated pre, post, and at 24, 48, 72 h post exercise time points. Football skill performance was assessed through the Loughborough Soccer Passing Test, long passing, dribbling, shooting and heading. Delayed onset muscle soreness, knee joint range of motion, and muscle strength (1RM) in squat were considered as muscle damage markers. Blood samples analysed for creatine kinase activity, C-reactive protein, and leukocyte count. Passing and shooting performance declined (P < 0.05) post-exercise following resistance exercise. Strength declined post-exercise following high-intensity resistance exercise. Both trials induced only a mild muscle damage and inflammatory response in an intensity-dependent manner. These results indicate that football skill performance is minimally affected by acute resistance exercise.
independent of intensity suggesting that elite players may be able to participate in a football practice or match after only 24 h following a strength training session.

Almeida et.al., (2013) aimed to analyze the interaction and main effects of deliberate practice experience and small-sided game format (3 vs. 3 and 6 vs. 6 plus goalkeepers) on the offensive performance of young soccer players. Twenty-eight U-15 male players were divided into 2 groups according to their deliberate practice experience in soccer (i.e., years of experience in federation soccer): Non-Experienced (age: 12.84 ± 0.63 years) and Experienced (age: 12.91 ± 0.59 years; experience: 3.93 ± 1.00 years). The experimental protocol consisted of 3 independent sessions separated by one-week intervals. In each session both groups performed each small-sided game during 10 minutes interspersed with 5 minutes of passive recovery. To characterize the recorded offensive sequences we used the Offensive Sequences Characterization System, which includes performance indicators previous applied in other studies. No interaction effects on the offensive performance were found between both factors. Non-parametric MANOVA revealed that the factor "experience level" had a significant effect (p<0.05) on performance indicators that characterize the development of offensive sequences, especially in 6 vs. 6 + GKS. While experienced players produced longer offensive sequences with greater ball circulation between them, the non-experienced participants performed faster offensive sequences with a predominance of individual actions. Furthermore, significant differences were observed (p<0.05) in the development and finalization of offensive sequences within each group, when comparing small-sided game formats. Evidence supports that small-sided games can serve several purposes as specific means of training. However, the manipulation of game format should always consider the players' individual constraints.
Kelly et al., (2013) developed a high-intensity soccer-specific training (SST) drill that was not only based on the demands of match-play but also would reduce the variability in the physiological response to training compared with other specific drills. To evaluate this approach to training, the SST drill was compared with a "traditional" aerobic interval training (AIT) protocol and a small-sided games (SSG) drill. Each training protocol was carried out across 4 × 4-minute exercise bouts, interspersed by 4 × 3 minutes of active recovery. Mean ± SD heart rates (HRs) for the 4-minute exercise bouts during SST (175 ± 5 b·min) and AIT (174 ± 6 b·min) were significantly higher than that observed during the SSG protocol (170 ± 6 b·min; p < 0.05). Heart rate during the SST drill showed less inter participant variability (mean ± SD HR ranged from 169 ± 6 to 180 ± 5 b·min) when compared with those during AIT (157 ± 8 to 186 ± 8 b·min) and SSG (143 ± 10 to 179 ± 78 b·min) training conditions. Ratings of perceived exertion (SST, 6 ± 2; AIT, 7 ± 1; SSG, 5 ± 1) across the entire exercise period were similar between the 3 training conditions (p > 0.05). These results indicate that the SST stimulates a more uniform physiological response than other currently adopted specific endurance training protocols used in soccer. This would suggest that it provides a valid alternative to the current approaches used for the aerobic training of players.

Abrantes et al., (2012) identified the variation of heart rate (HR), rating of perceived exertion (RPE), and technical actions between 2 soccer small-sided games (SSGs; 3 × 3 and 4 × 4) in 3 game type constraints (when playing only offense [OFF], playing only defense [DEF], and both situations [GAME]). Sixteen high-level young male players were analyzed (age 15.75 ± 0.45 years; height 172.4 ± 4.83 cm; body mass 64.5 ± 6.44 kg; HRmax199.1 ± 9.08 b·min(-1); and 8.06 ± 1.98 years of soccer practice). All tasks were performed in 4 periods of 4 minutes
interspersed with 2 minutes of active recovery. The HR was measured continuously and then analyzed by the time spent into 4 training zones according to individual %HRmax (zone 1 <75%; zone 2 75-84.9%; zone 3 85-89.9%; and zone 4 90%). Results identified that players were most frequently in zones 2 and 3. The 3 × 3 SSGs elicited higher HR and RPE and the most intense situation was GAME. Despite the known higher frequencies from technical actions in SSGs with fewer players, player effectiveness in 3 × 3 and 4 × 4 was identical. The use of GAME, OFF, and DEF game type constraints should be carefully planned. Using the 3 × 3 format seems more adequate when aiming for aerobic performance optimal effects; however, DEF situations should only be used to promote aerobic recovery effects. The inclusion of an additional player in SSGs had different interactions in game type constraints, and only GAME presented adequate intensity.

Dellal et al., (2012) examined the physical and technical activity during different periods within small-sided soccer games (SSGs). 20 elite players completed 3 different SSGs (2-a-side, 3-a-side and 4-a-side games) in which the number of ball touches per individual possession was fixed at a maximum of 2. The duration and the pitch size of each SSG were strictly controlled (2 min, 3 min, 4 min, respectively; 1:75 m²) with each period repeated 4 times (P1, P2, P3, P4). The physical and technical activities, heart rate responses, blood lactate concentration and rating of perceived exertion (RPE) were analysed. The results showed a decrease of high and very high-intensity activities (from - 26.2% to - 37.7%, P<0.001), an increase of blood lactate concentration (from + 28.0% to + 76.9%), RPE (from + 29.0% to + 32.8%), and heart rate responses (~ 6.6%), and a significant alteration of technical activities from P1 to P4 in each SSG. The greatest differences from P1 and P4 were observed for the 2-a-side game when compared to the 3-a-side and 4-a-
side games (P<0.05) for each variable analysed. In conclusion, the variation of the player's activity throughout the periods indicates that the duration and number of exercise periods used within SSGs is an important variable in determining the training stimulus in soccer-specific training.

Da Silva et al., (2011) examined in young soccer players (a) the effect of varying the number of players on exercise intensity (EI) and technical actions during small-sided games (SSGs), (b) the reliability of EI and technical actions, and (c) the influence of the players' maturation on EI and involvements with the ball (IWBs). Sixteen male soccer players (mean ± SD; age 13.5 ± 0.7 years, height 164 ± 7 cm, and weight 51.8 ± 8 kg) completed 2 bouts of 3 vs. 3 (SSG3), 4 vs. 4 (SSG4), and 5 vs. 5 (SSG5) training. Exercise intensity was measured using heart rate and expressed as a percentage of maximal heart rate (%MHR). Technical actions were quantified from video recordings. Maturation stage was determined with the Tanner scale. Exercise intensity in SSG3 (89.8 ± 2%MHR) was higher (p < 0.003) than that in SSG5 (86.9 ± 3%MHR). The EI in the first set (86.8 ± 4%MHR) was lower (p < 0.001) than that in the second (89.1 ± 3%MHR) and in the third set (89.4 ± 3%MRH). No effects of number of players were found in IWB, passes, target passes, tackles, and headers. Significantly more crosses, dribbling, and shots on goal were observed during SSG3 compared to during SSG4 or SSG5 (p < 0.05). The typical error for EI, expressed as coefficient of variation, ranged from 2.2 to 3.4%. The reliability for the most frequent technical actions ranged from 6.8 to 19.3%. The level of maturation was not correlated with either EI or IWB. These results extend previous findings with adult players suggesting that SSGs can provide an adequate training stimulus for young players and are feasible for groups with heterogeneous maturation levels.
Dellal et al., (2011) examined the relationship between the playing level in soccer (i.e., amateur vs. professional players) and the physiological impact, perceptual responses, time-motion characteristics, and technical activities during various small-sided games (SSGs). Twenty international players (27.4 ± 1.5 years and 17.4 ± 0.8 km·h\(^{-1}\) of \(\text{vVO}_{2}\max\)) and 20 amateur players of the fourth French division (26.3 ± 2.2 years and 17.0 ± 1.2 km·h\(^{-1}\) of \(\text{vVO}_{2}\max\)) played 9 SSGs (i.e., 2 vs. 2, 3 vs. 3, and 4 vs. 4) in which the number of ball touches authorized by possession varied (1 ball touch authorized = 1T, 2 ball touches authorized = 2T, and Free Play = FP). Heart rate (HR), blood lactate ([La]), subjective perception of effort (rating of perceived exertion [RPE]), physical performance, and technical performance of all players were analyzed during all SSGs. Across the various SSGs, amateurs completed a lower percent of successful passes (p < 0.01), recorded higher RPE and [La] values, lost a greater amount of ball possessions (p < 0.001), and covered less total distance with respect to sprinting and high-intensity running (HIR). The HR responses, however, were similar when expressed as %HR\(_\text{max}\) and %HR\(_\text{reserve}\). The comparison of the professional and amateur soccer players’ activities during SSGs showed that the playing level influenced the physiological responses, physical and technical activities. Consequently, this study has shown that the main differences between elite and amateur players within SSGs concerned their capacity to perform high-intensity actions (HIR and sprints) and execute various technical abilities (in particular number of ball lost per possession and percentage of successful passes).

2.4.4 Studies on Resistance Training

Naclerio et al., (2009) determined the importance of muscular strength and power on a muscular endurance performance test. Fourteen firefighter recruits performed a
progressive resistance test (PRT) followed by a specific maximum repetition test (MRT40) on the bench press exercise with measurements of power, strength, and muscular endurance. Comparisons were then made to examine relationships between the 3 muscular fitness variables. The results, expressed in absolute form and related to body weight, indicate that the performance in the MRT40 is significantly related (p <or= 0.05) to body weight (r = 0.78), 1 repetition maximum (1RM) (r = 0.83), maximal power (Pmax) during the PRT (r = 0.71), Pmax produced with 40 kg in the PRT (r = 0.64), and the average power and force applied during all repetitions in the MRT40 (r = 0.78 and r = -0.64, respectively). The load that expressed the maximal average power during the PRT was 47.6 +/- 9.0% of the 1RM and did not show any significant relationship with 1RM nor performance in MRT40. It was concluded that performance in this specific upper body endurance test depends on several variables, among which maximum strength, body weight, and maximum absolute power are the most important. As the ability to repeatedly apply sub maximal force is a requirement of firefighters, and other occupations/sports, the current research suggests that the initial goal of a training program to enhance muscular endurance should be to increase maximum strength to a point that the specific load being lifted during repeated actions is less than 40% of the individuals' 1RM. Subsequent training should then focus on maintaining maximal strength levels and improving local muscular endurance in the specific task.

Harrison and Bourke G. (2009) reported that various studies have demonstrated that resistance sprint (RS) training can produce significant changes in running speed and running kinematics. The longer-term training adaptations after RS training remain unclear. The purpose of this study was to investigate whether an RS training intervention would enhance the running speed and dynamic strength measures in male rugby players. Fifteen male rugby players aged 20.5 (+/- 2.8) years who were proficient in resisted
sledge training took part in the study. The subjects were randomly assigned to control or RS groups. The RS group performed two sessions per week of RS training for 6 weeks, and the control group did no RS training. Pre- and post intervention tests were carried out for 30-m sprint, drop, squat, and rebound jumps on a force sledge system. A laser measurement device was used to obtain velocities and distance measures during all running trials. The results show a statistically significant decrease in time to 5 m for the 30-m sprint for the RS group (p = 0.02). The squat jump and drop jump variables also showed significant increases in starting strength (p = 0.004) and height jumped (p = 0.018) for the RS group from pre- to post-testing sessions. The results suggest that it may be beneficial to employ an RS training intervention with the aim of increasing initial acceleration from a static start for sprinting.

Winchester et.al. (2008) investigated the effects of ballistic resistance training and strength training on muscle fiber composition, peak force (PF), maximal strength, and peak power (PP). Fourteen males (age = 21.3 +/- 2.9, body mass = 77.8 +/- 10.1 kg) with 3 months of resistance training experience completed the study. Subjects were tested pre and post for their squat one-repetition maximum (1RM) and PP in the jump squat (JS). Peak force and rate of force development (RFD) were tested during an isometric midthigh pull. Muscle biopsies were obtained from the vastus lateralis for analysis of muscle fiber type expression. Subjects were matched for strength and then randomly selected into either training (T) or control (C) groups. Group T performed 8 weeks of JS training using a periodized program with loading between 26 and 48% of 1RM, 3 days per week. Group T showed significant improvement in PP from 4088.9 +/- 520.6 to 5737.6 +/- 651.8 W. Rate of force development improved significantly in group T from 12687.5 +/- 4644.0 to 25343.8 +/- 12614.4 N x s(-1). PV improved significantly from 1.59 +/- 0.41 to 2.11 +/- 0.75 m x s(-1). No changes occurred in PF, 1RM, or muscle
fiber type expression for group T. No changes occurred in any variables in group C. The results of this study indicate that using ballistic resistance exercise is an effective method for increasing PP and RFD independently of changes in maximum strength (1RM, PF), and those increases are a result of factors other than changes in muscle fiber type expression.

2.5 5 Studies on Football Skill Drill Training.

Tessitore and Antonio (2011) conducted a study to verify whether coordination improves as a result of pre-season soccer training. During 5 experimental sessions (days 1, 6, 11, 15, and 19), 16 semi-professional male soccer players (22.0 ± 3.6 years) were administered 3 specific soccer tests (speed dribbling, shooting a dead ball, and shooting from a pass) and an inter limb coordination test (total duration of a trial: 60 seconds), consisting of iso directional and non iso directional synchronized (1:1 ratio) hand and foot flexions and extensions at an increasing velocity of execution (80, 120, and 180 b·min 1). Furthermore, subjective ratings were monitored to assess the recovery state (RestQ) of the players, their perceived exertion (rating of perceived exertion [RPE]) for the whole body, and the perceived muscle pain (rating of muscle pain [RMP]) for the lower limbs and the internal training load by means of the session-RPE method. The ratios between post and pre-training RPE and RMP increased only during the first 2 experimental sessions and decreased after the second week of the training camp (p = 0.001). The Rest-Q showed increases (p < 0.05) for general stress, conflict/pressure, social recovery, and being in shape dimensions. Conversely, decreases (p < 0.05) were observed for social stress, fatigue, physical complaints dimensions. Throughout the preseasone, the players improved their speed dribbling (p = 0.03), shooting from a pass (p = 0.02), and inter limb coordination (p < 0.0001) performances. These coordination tests
succeeded in discriminating coordination in soccer players and could integrate field test batteries during the whole soccer season, because they were easily and inexpensively administrable by coaches.

Tønnessen and Espen (2011) conducted a study to examine the effect of 10 weeks 40-m repeated sprint training program that does not involve strength training on sprinting speed and repeated sprint speed on young elite soccer players. Twenty young well-trained elite male soccer players of age (±SD) 16.4 (±0.9) years, body mass 67.2 (±9.1) kg, and stature 176.3 (±7.4) cm volunteered to participate in this study. All participants were tested on 40-m running speed, 10 × 40-m repeated sprint speed, 20-m acceleration speed, 20-m top speed, countermovement jump (CMJ), and aerobic endurance (beep test). Participants were divided into training group (TG) (n = 10) and control group (CG) (n = 10). The study was conducted in the pre competition phase of the training program for the participants and ended 13 weeks before the start of the season; the duration of the pre competition period was 26 weeks. The TG followed a periodized repeated sprint training program once a week. The training program consisted of running 40 m with different intensities and duration from week to week. Within-group results indicate that TG had a statistically marked improvement in their performance from pre to post-test in 40-m maximum sprint (0.06 seconds), 10 × 40-m repeated sprint speed (0.12 seconds), 20-to 40-m top speed (0.05 seconds), and CMJ (2.7 cm). The CG showed only a statistically notable improvement from pre to post-test in 10 × 40-m repeated sprint speed (0.06 seconds). Between-group differences showed a statistically marked improvement for the TG over the CG in 10 × 40-m repeated sprint speed (0.07 seconds) and 20- to 40-m top speed (0.05 seconds), but the effect of the improvement was moderate. The results further indicate that a weekly training with repeated sprint gave a moderate but not statistically marked improvement in 40-m sprinting, CMJ, and beep test. The results of
this study indicate that the repeated sprint program had a positive effect on several of the parameters tested. However, because the sample size in this study was 20 participants, the results are valid only for those who took part in this study. Therefore, the advice is to use repeated sprint training similar to the one in this study only in periods where the players have no speed training included in their program. Furthermore, the participants in this study should have been probably trained on strength. However, benefits were observed even without strength training is most likely to be caused by the training specificity.

Young and Warren (2011) conducted a study to identify the factors influencing kicking performance and the research evidence relating to resistance training designed to enhance foot velocity in kicking. The review has been divided into 3 main sections. The first addresses the biomechanics of kicking to provide insights into the physical demands. The second section reviews the relationships between various measures of strength with performance indicators of maximum kicking, and the third part explores the research, investigating the effects of resistance training on maximum kicking performance. Kicking can be described as a skill involving proximal-to-distal muscle activation. Foot velocity is determined by a complex sequencing of hip flexor and knee extensor concentric contractions and also involves hip extensor and knee flexor activation to assist with movement control. Research reporting correlations between strength and kicking performance support the importance of hip flexor and quadriceps strength. Although unclear, there is some evidence that adequate strength of the support leg, trunk muscles, hip adductors, and the muscles that control pelvic rotations are important. Strength training studies have shown that foot velocity and kicking performance can be enhanced by supplementary programs to regular Soccer training, especially in non elite athletes. Potentially valuable training includes plyometrics, exercises that simulate the whole kicking action, and kicking weighted balls. Exercises that isolate parts of the kicking action are not recommended because these do not appear to transfer well to kicking performance. There are many unanswered questions that await future research.
Chaouachi et al. (2008) examined the influence of the sequence order of high-intensity endurance training and circuit training on changes in muscular strength and anaerobic power. Forty-eight physical education students (ages, 21.4 ± 1.3 years) were assigned to 1 of 5 groups: no training controls (C, n = 9), endurance training (E, n = 10), circuit training (S, n = 9), endurance before circuit training in the same session, (E+S, n = 10), and circuit before endurance training in the same session (S+E, n = 10). Subjects performed 2 sessions per week for 12 weeks. Resistance-type circuit training targeted strength endurance (weeks 1-6) and explosive strength and power (weeks 7-12). Endurance training sessions included Please purchase PDF Split-Merge on www.verypdf.com to remove this watermark. 73 repetitions run at the velocity associated with Vo2max(Vo2max) for duration equal to 50% of the time to exhaustion at Vo2 max; recovery was for an equal period at 60%Vo2max. Maximal strength in the half squat, strength endurance in the 1-leg half squat and hip extension, and explosive strength and power in a 5-jump test and countermovement jump were measured pre-and post-testing. No significant differences were shown following training between the S+E and E+S groups for all exercise tests. However, both S+E and E+S groups improved less than the S group in 1 repetition maximum (p < 0.01), right and left 1-leg half squat (p < 0.02), 5-jump test (p < 0.01), peak jumping force (p < 0.05), peak jumping power (p < 0.02), and peak jumping height (p < 0.05). The intra session sequence did not influence the adaptive response of muscular strength and explosive strength and power. Circuit training alone induced strength and power improved ends that were significantly greater than when resistance and endurance training were combined, irrespective of the intersession sequencing. Gelen and Ertugrul (2010) conducted a study to compare the acute effects of different warm-up methods on soccer performance. Twenty-six professional soccer players (23.3 +/- 3.2 years, 178.2 +/- 6.1 cm, and 73.0 +/- 6.5 kg)
performed 4 different warm-up routines in random order on non-consecutive days. The warm-up methods consisted of only 5 minutes of jogging (Method A), 5 minutes of jogging and static stretching (Method B), 5 minutes of jogging and dynamic exercise (Method C), and 5 minutes of jogging and a combination of static stretching and dynamic exercise (Method D). After each warm-up session, subjects were tested on the sprint, slalom dribbling, and penalty kick performance. Methods A-D were compared by repeated-measures analyses of variance and post hoc comparisons. In this study, existence of a significant drop in sprint, slalom dribbling, and penalty kick performances of Method C has been determined in comparison with that of Method A (p < 0.05). Again for sprint, slalom dribbling, and penalty kick performances of Method A in comparison with those of Method A, the existence of a significant increase has been determined (p < 0.05). In Method D in comparison with Method A, for sprint, slalom dribbling, and penalty kick performances, existence of no significant difference has been determined (p > 0.05). The results of this study suggest that it may be desirable for soccer players to perform dynamic exercises before the performance of activities that require a high power output.

Taskin and Halil., (2008) conducted a study to evaluate sprinting ability, density of acceleration, and speed dribbling ability of professional soccer players with respect to their positions. A total of 243 professional soccer players were examined. These soccer players are playing in different leagues of Turkey. The F-MARC test battery, which was designed by FIFA, was used for soccer players. The researcher did not find any statistical differences for 30-m sprint test and four-line sprint test values with respect to positions of soccer players (p > 0.05). On the other hand, there was a statistical difference for speed dribbling test values in terms of positions of soccer players (p < 0.05). It was found that the test values of defense players, midfielders, and forwards were better than the test
values of goalkeepers (p < 0.05). In conclusion, this study, which was done during the training season, shows that there is a similarity between the abilities of professional soccer players for 30-m sprint and four-line sprint tests. Therefore, it is believed that there must be fast players in all positions in terms of sprint ability. There is a similarity among defenders, midfielders, and forwards in terms of speed dribbling ability; in contrast, the speed dribbling ability of goalkeepers is different from the players in those three positions. Although there are many more speed dribbling exercises within the training programs of defenders, midfielders, and forwards, the speed dribbling ability test is not used much for goalkeepers. Correspondingly, speed dribbling ability is not a specific indicator for goalkeepers, and this test should not be used for the choice of goalkeepers.

2.3 Summary of Literature

The review of literature helped the investigator to spot out relevant topics and variables. Further the literature helped the investigator to frame the suitable hypotheses leading to the problems. The latest literature also helped the investigator to support his findings with regard to the problem. Further the literature collected in the study will also help the research scholar understanding in the similar areas. The review were presented under the two sections such as football fitness (n=21) and circuit Resistance training (n-20) variables with chronological and alphabetical order. All the research studies were presented in the section proves that the circuit resistance training and football training programme contribute significantly for better development of selected dependent variables.