CHAPTER II

REVIEW OF RELATED LITERATURE

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

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

The purpose of this review of selected literature was to relate studies pertaining to the topic under study and to organise the collected review into meaningful sub sections as listed below:

a) Studies on influence of Grid (Small Sided) training on performance related fitness variables

b) Studies on Functional Training

c) Studies on training on skills and play performances
2.1 STUDIES ON EFFECT OF GRID (SMALL SIDED) TRAINING ON MOTOR FITNESS

In recent years researchers in education and related disciplines have begun to take a closer look at the relationship between perception and movement. The frequent appearance in the literature of the terms perceptual motor and sensory motor is indicative of the fact that the interactions of input to output are being scrutinized more and more by contemporary scholars. The studies in which the perceptual abilities of motor activities have been explored in motor skills, while other information emanating from these investigations contributes to more basic understanding of how humans perceive, move and develop during the earliest months of life.

Almeida CH, et.al. (2013) analyzed 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.

Till K, et.al. (2013) evaluated the development of anthropometric and fitness characteristics of 3 individual adolescent junior rugby league players and compared their characteristics with a cross-sectional population matched by age and skill level. Cross-sectional anthropometric and fitness assessments were conducted on 1,172 players selected to the Rugby Football League's talent development program (i.e., the Player Performance Pathway) between 2005 and 2008. Three players of differing relative age, maturational status, and playing position were measured and tracked once per year on 3 occasions (Under 13s,
14s, 15s age categories) and compared against the cross-sectional population. Results demonstrated that the later maturing players increased height (player 1 = 9.2%; player 2 = 7.8%) and a number of fitness characteristics (e.g., 60-m speed-player 1 = -14.9%; player 2 = -9.9%) more than the earlier maturing player (player 3-Height = 2.0%, 60-m sprint = -0.7%) over the 2-year period. The variation in the development of anthropometric and fitness characteristics between the 3 players highlights the importance of longitudinally monitoring individual characteristics during adolescence to assess the dynamic changes in growth, maturation, and fitness. Findings showcase the limitations of short-term performance assessments at one-off time points within annual-age categories, instead of advocating individual development and progression tracking without deselection. Coaches should consider using an individual approach, comparing data with population averages, to assist in the prescription of appropriate training and lifestyle interventions to aid the development of junior athletes.

Hoffmann Jr JJ, et.al. (2013) documented that due to the broad spectrum of physical characteristics necessary for success in field sports, numerous training modalities have been utilized develop physical preparedness. Sports like Rugby, Basketball, Lacrosse, and others require athletes to not only be strong and powerful, but aerobically fit and able to recover from high intensity intermittent exercise as well. This provides coaches and sport scientists with a complex range of variables to consider when developing training
programs. This can often lead to confusion and the misuse of training modalities, particularly in the development of aerobic and anaerobic conditioning. In this review we will outline the benefits and general adaptations to three commonly used and effective conditioning methods: high intensity interval training, repeated sprint training, and small sided games. The goals and outcomes of these training methods will be discussed and practical implementations strategies for coaches and sport scientists will be provided.

Sampaio JE, et.al. (2013) compared time-motion variables, heart rate and players' tactical behaviour according to game pace (slow, normal or fast), status (winning and losing) and team unbalance (superiority and inferiority) in football 5-a-side small-sided games. To identify the most discriminating variables in classifying performances according to these constraints. The data were gathered using global positioning systems (5Hz) in 5-a-side small-sided games (7×5min) played by twenty-four footballers. The tactical performance was measured using dynamical positioning variables, processed by non-linear signal processing techniques (approximate entropy). ANOVA models were used to compare between constraints and discriminant analyses to identify the variables that best discriminate between pacing and status×unbalance constraints. The fast paced games had the highest mean speed value, followed by normal and slow paced games (8.2±0.6kmh⁻¹, 7.8±0.5kmh⁻¹ and 6.2±0.4kmh⁻¹, respectively). The stronger predictor variables of pacing were the randomness in distance to team centroid and the distances...
covered above 13km$^{-1}$. The results also changed according to game status and team unbalance. The strongest predictor variables were the distance covered below 6.9km$^{-1}$, distance and randomness to team centroid, with higher values when winning in superiority conditions. Practice task design manipulating game pace, status and team unbalance significantly influenced the emergent behavioural dynamics. Collective positioning variables were more accurate in discriminating these constraints and, therefore, need to be considered when planning and monitoring performance.

Davids K, et.al. (2013) summarized research from an ecological dynamics program of work on team sports exemplifying how small-sided and conditioned games (SSCG) can enhance skill acquisition and decision-making processes during training. The data highlighted show how constraints of different SSCG can facilitate emergence of continuous interpersonal coordination tendencies during practice to benefit team game players.

Aguiar M, et.al. (2012) documented that over the last years there has been a substantial growth in research related to specific training methods in soccer with a strong emphasis on the effects of small-sided games. The increase of research in this topic is coincident with the increase of popularity obtained by specific soccer conditioning, which involves training players to deal with soccer match situations. Given the limited time available for fitness training in soccer, the effectiveness of small-sided games as a conditioning stimulus needs to be
optimized to allow players to compete at the highest level. Available studies indicate that physiological responses (e.g. heart rate, blood lactate concentration and rating of perceived exertion), tactical and technical skill requirements can be modified during small-sided games by altering factors such as the number of players, the size of the pitch, the rules of the game, and coach encouragement. However, because of the lack of consistency in small-sided games design, player fitness, age, ability, level of coach encouragement, and playing rules in each of these studies, it is difficult to make accurate conclusions on the influence of each of these factors separately.

Unnithan V, et.al. (2012) reviewed article was firstly to evaluate the traditional approach to talent identification in youth soccer and secondly present pilot data on a more holistic method for talent identification. Research evidence exists to suggest that talent identification mechanisms that are predicated upon the physical (anthropometric) attributes of the early maturing individual only serve to identify current performance levels. Greater body mass and stature have both been related to faster ball shooting speed and vertical jump capacity respectively in elite youth soccer players. This approach, however, may prematurely exclude those late maturing individuals. Multiple physiological measures have also been used in an effort to determine key predictors of performance; with agility and sprint times, being identified as variables that could discriminate between elite and sub-elite groups of adolescent soccer players. Successful soccer performance is the product of multiple systems
interacting with one another. Consequently, a more holistic approach to talent identification should be considered. Recent work, with elite youth soccer players, has considered whether multiple small-sided games could act as a talent identification tool in this population. The results demonstrated that there was a moderate agreement between the more technically gifted soccer player and success during multiple small-sided games.

Owen AL, et.al. (2012) examined the effects of periodized small-sided game (SSG) training intervention during a 4-week in-season break on the physical performance changes (i.e., speed, aerobic performance, and repeated sprint ability) within elite European soccer players. Fifteen, elite, male, professional players (age: 24.5 ± 3.45 years; height: 181.1 ± 5.78 cm; body mass: 78.7 ± 7.67 kg; VO2max: 54.88 ± 5.25 ml·kg(-1)·min(-1)) from a Scottish Premier League team participated in 7 separate SSG sessions (3 vs. 3 plus goalkeepers) of which games lasted for a 3-minute duration for the selected number of games (ranged from 5 to 11) increasing over the intervention period. To examine the effects of the SSG intervention on physical performance changes, pre- and posttesting sessions took place over a 2-day period (day 1: anthropometry and repeated sprint ability [RSA] assessments; day 2: running economy [RE] and blood lactate assessments). Results show that the 4-week SSG training intervention induced significant improvement in RSA as indicated by faster 10-m sprint time (p < 0.05, small effect), total sprint time (p < 0.05, medium effect), and smaller percentage decrement score (p < 0.05, medium
effect). Furthermore, the SSGs also led to an improvement in RE as indicated through significantly reduced VO₂ and heart rate at running speed 9, 11, and 14 km·h⁻¹ (all p's < 0.05, large effects). In conclusion, the present study demonstrates that implementing a periodized SSG training intervention during the 4-week in-season break is capable of improving elite-level soccer players’ physical fitness characteristics. Being able to develop physical characteristics in conjunction to technical and tactical elements of the game, within a relatively short period, makes SSGs an appealing proposition for fitness coaches, players, and technical coaches alike.

Davies MJ, et.al. (2013) compared the agility demands of 4 small-sided games (SSGs) and evaluate the variability in demands for elite Australian Football (AF). Fourteen male elite Australian Football League (AFL) players (mean ± SD; 21.7 ± 3.1 y, 189.6 ± 9.0 cm, 88.7 ± 10.0 kg, 39.4 ± 57.1 games) completed 4 SSGs of 3 × 45-s bouts each with modified designs. Video notational analysis, GPS at 5 Hz, and triaxial accelerometer data expressed the external player loads within games. Three comparisons were made using a paired t test (P < .05), and magnitudes of differences were reported with effect size (ES) statistics. Reduced area per player (increased density) produced a small increase in total agility maneuvers (SSG1, 7.2 ± 1.3; SSG2, 8.8 ± 4.1), while a large 2D player load was accumulated (P < .05, ES = 1.22). A reduction in players produced a moderate (ES = 0.60) total number of agility maneuvers (SSG 3, 11.3 ± 6.1; SSG 2, 8.3 ± 3.6); however, a greater variability
was found. The implementation of a 2-handed-tag rule resulted in a somewhat trivial decline (P > .05, ES = 0.16) in agility events compared with normal AFL tackling rules (SSG 2, 8.3 ± 3.6; SSG 4, 7.8 ± 2.6). SSG characteristics can influence agility-training demand, which can vary considerably for individuals. Coaches should carefully consider SSG design to maximize the potential to develop agility for all players.

Castellano J, et.al. (2013) examined the extent to which changing the game format (possession play vs. regulation goals and goalkeepers vs. small goals only) and the number of players (3 vs. 3, 5 vs. 5 and 7 vs. 7) influenced the physiological and physical demands of small-sided games (SSGs) in soccer in semiprofessional players. Fourteen semiprofessional male soccer players were monitored with global positioning system and heart rate devices. Heart rate, player load, distance covered, running speed, and the number of accelerations were recorded for 9 different SSGs. The results show that changes both in game format and the number of players affect the players' physiological and physical demands. Possession play places greater physiological and physical demands on players, although reducing the number of players only increases the physiological load. In the 7 vs. 7 games, changing the game format did not alter the heart rate responses. Finally, in the possession play format, changing the number of players did not produce significant differences in heart rate responses, although physical demands did decrease in line with a reduction in the number of players. These results should help coaches to understand how
modifying different aspects of SSGs has a differential effect on the players' physiological and physical demands. Moreover, coaches in semiprofessional and amateur teams have now consistent information to design and optimize their training time in mixing the technical, tactical, and physical aspects.

Casamichana D, et.al. (2013) examined the physical and heart rate (HR) response of soccer players during 16 minutes of training using the same 5 vs. 5 small-sided game (SSG) in 3 different training regimes: a continuous format of 16 minutes and 2 intermittent formats (4 periods of 4 minutes; and 2 periods of 8 minutes) with the same work/rest ratio of passive recovery between the different periods (4:1). Ten male players (age $21.3 \pm 3.4$ years) belonging to a team of the third Spanish division participated in this study. Analyses were carried using a training regimen vs. drill time design (i.e., training $\times$ duration), that is, differentiating 2 training regimen (intermittent vs. continuous SSG formats) and the 4-minute periods (0-4, 4-8, 8-12, and 12-16 minutes) to determine the extent to which fatigue affected the variables studied in each regimen. During each SSG, HR and total distance covered in different speed categories and accumulated accelerations (i.e., training load) were measured. Results showed significant differences for (a) in intermittent format of $2 \times 8$ minutes, the distance covered at a speed of 7-12.9 km-h(-1) was greater in the 0- to 4-minute period than in the 12- to 16-minute period, and (b) the distance covered at a speed of 7-12.9 km-h(-1) during the 8- to 12-minute period was greater in intermittent format of $2 \times 8$ minutes than in continuous format (16
minutes). This study showed that drill regimen may affect physical responses during training SSG. The resulting evidence suggests that the continuous SSG format induces greater physical loads on players as compared with intermittent SSG format and that should help coaches to establish a better distribution of playing according to the objectives of the training.

Jastrzębski Z, et.al. (2013) examined the effects of applied training loads on the aerobic capacity, speed, power, and speed endurance of young soccer players during 1 soccer season. The participants in the study were 19 young male soccer players (age: 16.61 ± 0.31 years; 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 1 soccer season. The training intensity was divided into 4 categories: (a) aerobic performance (61% of the total training duration), (b) mixed aerobic-anaerobic performance (34%), (c) anaerobic lactate performance (3%), and (d) anaerobic nonlactate performance (2%). No significant changes in the V\[^\text{\textregistered}\]O\(_2\) 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 1 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 V\[^\text{\textregistered}\]O\(_2\) max at the elite level. The first squad players (FSPs) reached the highest level of aerobic fitness in the middle
of the season, whereas substitute players (SPs) at the end of the season. Moreover, the VO_{2max} in FSP was significantly higher (p < 0.003) than in SP in the middle of the season.

Brito J, et.al. (2012) analyzed the influence of the playing surface on movement pattern, physical loading, perceived exertion, and fatigue development during small-sided recreational soccer games. Time-motion, heart rate, blood lactate, and perceived exertion were measured for 16 recreational players aged 22 (range: 19-35) yrs. During 5-a-side soccer games on 3 different field surfaces: sand, artificial turf, and asphalt. Jump and sprint tests were performed prior to and after each game. Total distance covered was higher on asphalt and turf than on sand (3.89±0.04 and 3.73±0.12 vs. 2.59±0.21 km; p<.01), and the number of high-intensity runs was higher on asphalt than on turf (55±3 vs. 43±3; p<.05), but not sand (46±6). Mean heart rate (means±SEM, 160±3 vs. 171±1 b.p.m.) and time>90% HR(max) (20.8±5.1% vs. 44.1±5.0%) were lower (p<.05) on asphalt than on turf, with intermediate values for sand. Blood lactate was lower on asphalt than on sand (2.8±0.3 vs. 4.7±0.6 mmolL(-1); p<.05). Perceived exertion was lower on asphalt than on turf and sand (VAS 0-100: 52±3 vs. 72±3 and 72±3; p<.01). After the game, squat and countermovement jump performances were lower (4.9-8.1%, and 1.9-6.4%, respectively; p<.001) for all field surfaces, but no changes were observed in 5- and 30-m sprint performance. Small-sided recreational soccer games elicit high heart rates, multiple intense actions, and decreased jump performance for all the
investigated playing surfaces, suggesting that multiple fitness and health benefits can be achieved through soccer on sand, artificial turf and asphalt. Nonetheless, locomotor activities, heart rate, blood lactate levels, and perceived exertion differ between surfaces.

Dellal A, et.al. (2012) compared the effects of common rule changes on technical and physical demands for elite soccer players in five playing positions during various 4-min small-sided games (SSGs) in comparison to 11-a-side matches. Forty international players classified into five positional roles participated in the study (25.3±2.4 years, 182.4±2.3 cm, 77.3±4.1 kg; M±SD). Players completed three different conditioned small-sided 4 vs. 4 games (1 ball touch=1T, 2 ball touches=2T and Free Play=FP) as well as two friendly matches. Heart rate (HR), blood lactate ([La]), ratings of perceived exertion (RPE) as well as physical and technical performance were analyzed. Compared to match-play, total distance covered per minute of play, high-intensity running activities (sprinting and high-intensity runs), total numbers of duels and lost ball possessions were significantly greater within SSGs for all playing positions (p<.05). In contrast, [La], percentage of successful passes and number of ball possessions were lower (p<.05) within SSGs, particularly with 1T and 2T rules, in comparison with match-play. HR was higher in SSGs compared to match-play for all playing positions, and RPE values were lower (p<.05) during the FP SSG for defensive midfielders, wide midfielders and forwards. In conclusion, this study revealed that 4 vs. 4 SSGs played with 1 or 2 ball touches increased
the high-intensity running and the difficulty to perform technical actions, being more specific to match demands. Subsequently, it is of importance for coaches to understand the different physiological demands imposed upon players by varying the rules of SSGs and to understand the differences between positional roles.

Casamichana D, et.al. (2012) compared the physical demands of friendly matches (FMs) and small-sided games (SGs) in semiprofessional soccer players by means of global positioning system technology. Twenty-seven semiprofessional soccer players were monitored during 7 FMs and 9 sessions involving different SGs. Their physical profile was described on the basis of 20 variables related to distances and frequencies at different running speeds, the number of accelerations, and through global indicators of workload such as the work:rest ratio, player workload, and the exertion index. Results showed significant differences (p < 0.01) between SGs and FMs for the following variables: overall workload (SG > FM); the distribution of the distance covered in the speed zones 7.0-12.9 km·h(-1) (SG > FM) and >21 km·h(-1) (FM > SG); the distribution of time spent in certain speed zones (FM > SG: 0.0-6.9 and >21 km·h(-1); FM > SG: 7.0-12.9 km·h(-1)). More sprints per hour of play were performed during FMs, with greater mean durations and distances, greater maximum durations and distances, and a greater frequency per hour of play for sprints of 10-40 and >40 m (p < 0.01). The frequency of repeated high-intensity efforts was higher during FM (p < 0.01). The results show that coaches and
strength and conditioning professionals should consider FMs during their training routine to foster specific adaptations in the domain of high-intensity effort.

Dellal A, et.al. (2012) compared the effects of small-sided games (SSGs) in soccer versus high-intensity intermittent training (HIT) on a continuous aerobic test (Vameval) and the performance in an intermittent test with changes of direction (CODs; 30-15 intermittent fitness test [30-15(IFT)]). Twenty-two amateur soccer players (mean age ± SD: 26.3 ± 4.7 years) were assigned to 3 different groups for 6 weeks: SSG group (n = 8), HIT group (n = 8), and control group (CG; n = 6). In addition to the usual technical and tactical sessions and competitive games, the SSG group performed 9 sessions of 2 versus 2 and 1 versus 1 SSGs, whereas the HIT group performed 9 sessions of intermittent runs in the form of 30 seconds of effort interspersed with 30 seconds of passive recovery (30s-30s), 15s-15s, and 10s-10s. The HIT and SSG groups showed performance improvements in the Vameval test (5.1 and 6.6%, respectively) and the 30-15(IFT) intermittent test with CODs (5.1 and 5.8%, respectively), whereas there was no change in the performance of the CG. Players from HIT and SSG groups showed similar increase in their performance in the 30-15(IFT) and the Vameval tests during the 6-week training period, especially with an increase significantly different to that in a traditional training as in the CG (p < 0.05). This investigation demonstrates that both SSG and HIT interventions are equally effective in developing the aerobic capacity and the
ability to perform intermittent exercises with CODs in male amateur soccer players. Furthermore, these 2 methods of training applied during the 6 weeks induce similar effect on the recovery capacity and on the ability to repeat directional changes of 180°. Coaches will now be able to choose between these two methods according to the objective of the training and to optimize the training.

Brandes M, et.al. (2012) hypothesize that the SSG formats of 2 vs. 2, 3 vs. 3, and 4 vs. 4 players reveal game-like intensities and therefore are most adequate to increase game-specific aerobic fitness. Heart rate (HR), percentage of maximum heart rate (HRmax), blood lactate concentration (La), and time-motion characteristics of 17 elite male youth soccer players (aged 14.9 ± 0.7 years, V\(\text{[Combining Dot Above]}\)O₂max 61.4 ± 4.5 ml·kg·min, HRmax 199.6 ± 7.3 b·min) were collected by global positioning systems while performing the SSG formats. Repeated-measures analysis of variance and effect sizes were calculated to demonstrate the differences between SSG formats. Highest physiological responses were obtained in 2 vs. 2 (HR: 186 ± 7 b·min, HRmax: 93.3 ± 4.2%, La: 5.5 ± 2.4 mmol·L) followed by 3 vs. 3 (HR: 184 ± 8 b·min, HRmax: 91.5 ± 3.3%, La: 4.3 ± 1.7 mmol·L) and 4 vs. 4 (HR: 179 ± 7 b·min, HRmax 89.7 ± 3.4%, La: 4.4 ± 1.9 mmol·L). Pronounced differences were found for most physiological parameters and for time spent in the speed zones "walking" (<5.3 km·h), "moderate-speed running" (10.3-13.9 km·h), and "maximum sprinting" (≥26.8 km·h). The findings suggest that all the formats
reveal game-like intensities and are suitable for aerobic fitness improvements. However, we found pronounced demands on the anaerobic energy supply in 2 vs. 2, whereas 3 vs. 3 and 4 vs. 4 remain predominantly on an aerobic level and differ mainly in the HR response. We suggest using 3 vs. 3 for soccer-specific aerobic fitness training.

Dellal A, et.al. (2011) examined the influence of the number of ball touches authorized per possession on the physical demands, technical performances and physiological responses throughout the bouts within 4 vs. 4 soccer small-sided games (SSGs). Twenty international soccer players (27.4 ± 1.5 y, 180.6 ± 2.3 cm, 79.2 ± 4.2 kg, body fat 12.7 ± 1.2%) performed three different 4 vs. 4 SSGs (4 × 4 min) in which the number of ball touches authorized per possession was manipulated (1 touch = 1T; 2 touches = 2T; Free Play = FP). The SSGs were divided in 4 bouts (B1, B2, B3 and B4) separated by 3 min of passive recovery. The physical performances, technical activities, heart rate responses, blood lactate and RPE were analyzed. The FP rule presented greater number of duels, induced the lowest decreases of the sprint and high-intensity performances, and affected less the technical actions (successful passes and number of ball losses) from B1 to B4 as compared with 1T and 2T forms. Moreover, the SSG played in 1T form led to reach higher solicitation of the high-intensity actions while players presented more difficulty to perform a correct technical action. The modification of the number of ball touches authorized per possession affects the soccer player activity from the
first to the last bout of SSG, indicating that the determination of this rule has to be precisely planned by the coach according to the objectives of the training.

Casamichana D. and Castellano J. (2010) examined physical, physiological, and motor responses and perceived exertion during different soccer drills. In small-sided games, the individual playing area (275 m², 175 m², and 75 m²) was varied while the number of players per team was kept constant: 5 vs. 5 plus goalkeeper. Participants were ten male youth soccer players. Each session comprised three small-sided game formats, which lasted 8 min each with a 5-min passive rest period between them. A range of variables was recorded and analysed for the three drills performed over three training sessions: (a) physiological, measured using Polar Team devices; (b) physical, using GPS SPI elite devices; (c) perceived exertion, rated using the CR-10 scale; and (d) motor response, evaluated using an observational tool that was specially designed for this study. Significant differences were observed for most of the variables studied. When the individual playing area was larger, the effective playing time, the physical (total distance covered; distances covered in low-intensity running, medium-intensity running, and high-intensity running; distance covered per minute; maximum speed; work-to-rest ratio; sprint frequency) and physiological workload (percent maximum heart rate; percent mean heart rate; time spent above 90% maximum heart rate), and the rating of perceived exertion were all higher, while certain motor behaviours were observed less frequently (interception, control and dribble, control and shoot,
clearance, and putting the ball in play). The results show that the size of the pitch should be taken into account when planning training drills, as it influences the intensity of the task and the motor response of players.

Krstrup P, et.al. (2010) documented that the present special issue of Scandinavian Journal of Medicine & Science in Sports deals with health and fitness benefits of regular participation in small-sided football games. One review article and 13 original articles were the result of a 2-year multi-center study in Copenhagen and Zurich and include studies of different age groups analyzed from a physiological, medical, social and psychological perspective. The main groups investigated were middle-aged, former untrained, healthy men and women who were followed for up to 16 months. In addition, elderly, children and hypertensive patients were studied. A summary and interpretations of the main findings divided into an analysis of the physical demands during training of various groups and the effect of a period of training on performance, muscle adaptations and health profile follow. In addition, social and psychological effects on participation in recreational football are considered, the comparison of football training and endurance running is summarized and the effects of football practice on the elderly and children and youngsters are presented.

Henry G, et.al. (2012) compared reactive agility between higher-standard (n = 14) and lower-standard (n = 14) Australian footballers using a
reactive agility test incorporating a life-size video image of another player changing direction, including and excluding a feint. Mean agility time in the feint trials was 34% (509 ± 243 ms; p < 0.001; effect size 3.06) longer than non-feint trials. In higher-standard players, agility time was shorter than for lower-standard players in both feint (114 ± 140 ms; p = 0.18; effect size 0.52; likely beneficial) and non-feint (32 ± 44 ms; p = 0.22; effect size 0.47; possibly beneficial) trials. Additionally, the inclusion of a feint resulted in movement time increasing over three times more in the lower-standard group (197 ± 91 ms; p = 0.001; effect size 1.07; almost certainly detrimental) than the higher-standard group (62 ± 86 ms; p = 0.23; effect size 0.66; likely detrimental). There were weak correlations between the feint and non-feint trials (r = -0.13-0.14; p > 0.05), suggesting that reactive agility involving a feint is a unique skill. Also, higher-standard players are more agile than their lower-standard peers, whose movement speed deteriorates more as task complexity increases with the inclusion of a feint. These results support the need for specific training in multi-turn reactive agility tasks.

Hill-Haas SV, et al. (2011) documented that Small-sided games (SSGs) are played on reduced pitch areas, often using modified rules and involving a smaller number of players than traditional football. These games are less structured than traditional fitness training methods but are very popular training drills for players of all ages and levels. At present, there is relatively little information regarding how SSGs can best be used to improve
physical capacities and technical or tactical skills in footballers. However, many prescriptive variables controlled by the coach can influence the exercise intensity during SSGs. Coaches usually attempt to change the training stimulus in SSGs through altering the pitch area, player number, coach encouragement, training regimen (continuous vs interval training), rules and the use of goalkeepers. In general, it appears that SSG exercise intensity is increased with the concurrent reduction in player number and increase in relative pitch area per player. However, the inverse relationship between the number of players in each SSG and exercise intensity does not apply to the time-motion characteristics. Consistent coach encouragement can also increase training intensity, but most rule changes do not appear to strongly affect exercise intensity. The variation of exercise intensity measures are lower in smaller game formats (e.g. three vs three) and have acceptable reproducibility when the same game is repeated between different training sessions or within the same session. The variation in exercise intensity during SSGs can also be improved with consistent coach encouragement but it is still more variable than traditional generic training methods. Other studies have also shown that SSGs containing fewer players can exceed match intensity and elicit similar intensities to both long- and short-duration high-intensity interval running. It also appears that fitness and football-specific performance can be improved equally with SSG and generic training drills. Future research is required to examine the
optimal periodization strategies of SSGs training for the long-term development of physiological capacity, technical skill and tactical proficiency.

West DJ, et.al. (2012) compared the effects of combined weighted sled towing and sprint training against traditional sprint training on 10 and 30 m speed in professional rugby union players (n=20). After baseline testing of 10 and 30 m speed, participants were assigned to either the combined sled and sprint training (SLED) or traditional sprint training (TRAD) groups, matched for 10 msprint times. Each group completed 2 training sessions per week for 6 weeks, with performance re-assessed post-training. Both trainingprogrammes improved participants’ 10 and 30 m speed (P<0.001), but the performance changes (from pre-to post) in 10 (SLED -0.04±0.01 vs. TRAD -0.02±0.01 s; P<0.001) and 30 m (SLED -0.10±0.03 vs. TRAD -0.05±0.03 s; P=0.003) sprint times were significantly greater in the SLED training group. Similarly, the % change within the SLED group for the 10 (SLED -2.43±0.67 vs. TRAD -1.06±0.80 s; P=0.003) and 30 m (SLED -2.46±0.63 vs. TRAD -1.15±0.72 s; P=0.003) tests were greater than the TRAD group. In conclusion, sprint training alone or combined with weighted sled towing can improve 10 and 30 m sprint times; however, the latter training method promoted greater improvements in a group of professional rugby players.
Hrysomallis C. (2012) collated information on resisted training studies for sprinting and vertical jumping, ascertain whether resisted movement training was superior to normal unresisted movement training, and identify areas for future research. The review was based on peer-reviewed journal articles identified from electronic literature searches using MEDLINE and SPORTDiscus databases from 1970 to 2010. Resisted sprint training was found to increase sprint speed but, in most cases, was no more effective than normal sprint training. There was some evidence that resisted sprint training was superior in increasing speed in the initial acceleration phase of sprinting. Resisted jump training in the form of weighted jump squats was shown to increase vertical jump height, but it was no more effective than plyometric depth jump training. Direct comparisons between resisted jump training and unresisted normal jump training were limited, but loaded eccentric countermovement jump squat training with unloaded concentric phase and eccentric landing was shown to generate superior results for elite jumpers. More prospective studies on resisted sprint training are required along with monitoring both kinematic and kinetic adaptations to fully determine any underlying mechanisms for any improvements in sprint speed. Based on the available data, the benefits and superiority of resisted sprint training have not been fully established. As for resisted jump training, although there are some promising findings, these results need to be duplicated by other researchers.
before resisted jump training can be claimed to be more effective than other forms of jump training.

Lockie RG, et.al. (2012) assessed 4 common protocols (free sprint training [FST], weight training [WT], plyometric training [PT], and resisted sprint training [RST]) for changes in acceleration kinematics, power, and strength in field sport athletes. Thirty-five men were divided into 4 groups (FST: n = 9; WT: n = 8; PT: n = 9; RST: n = 9) matched for 10-m velocity. Training involved two 60-minute sessions per week for 6 weeks. After the interventions, paired-sample t-tests identified significant ($p \leq 0.05$) within-group changes. All the groups increased the 0- to 5-m and 0- to 10-m velocity by 9-10%. The WT and PT groups increased the 5- to 10-m velocity by approximately 10%. All the groups increased step length for all distance intervals. The FST group decreased 0- to 5-m flight time and step frequency in all intervals and increased 0- to 5-m and 0- to 10-m contact time. Power and strength adaptations were protocol specific. The FST group improved horizontal power as measured by a 5-bound test. The FST, PT, and RST groups all improved reactive strength index derived from a 40-cm drop jump, indicating enhanced muscle stretch-shortening capacity during rebound from impacts. The WT group increased absolute and relative strength measured by a 3-repetition maximum squat by approximately 15%. Step length was the major limiting sprint performance factor for the athletes in this study. Correctly administered, each training protocol can be effective in improving acceleration.
To increase step length and improve acceleration, field sport athletes should develop specific horizontal and reactive power.

2.2 STUDIES ON FUNCTIONAL TRAINING

Kiesel KB, Butler RJ, and Plisky PJ. (2013) determined if the motor control of fundamental movement patterns and pattern asymmetry have a relationship with time-loss injury over the course of the pre-season in professional football. In order to measure the motor control of 1x body weight fundamental movement patterns, Functional Movement Screen™ (FMS) scores were obtained prior to the start of training camp. The previously established cut-off score of ≤14 and the presence of any asymmetries on the FMS were examined using relative risk to determine if a relationship exists with time-loss injury. Players who scored ≤14 exhibited a relative risk of 1.87 (CI95 1.20-2.96). Similarly, players with at least one asymmetry displayed a relative risk of 1.80 (CI95 1.11-2.74). The combination of scoring below the threshold and exhibiting a movement asymmetry was highly specific for injury 0.87 (CI95 0.84-0.90). The results of this study suggest fundamental movement patterns and pattern asymmetry are identifiable risk factors for time-loss injury during the preseason in professional football players.

Hides JA, and Stanton WR. (2013) reported by the Australian Football League (AFL), lower limb injuries have shown the highest incidence and prevalence rates. Deficits in the muscles of the lumbo-pelvic
region, such as a smaller size of multifidus (MF) muscle, have been related to occurrence of lower limb injuries in the pre-season in AFL players. Motor control training programs have been effective in restoring the size and control of the MF muscle, but the relationship between motor control training and the occurrence of injuries has not been extensively examined. This pre-post intervention trial was delivered over the playing season as a panel design with 3 groups. The motor control program involved voluntary contractions of the MF, transversus abdominis (TrA), and pelvic floor muscles while receiving feedback from ultrasound imaging, and progressed into a functional rehabilitation program. Assessments of muscle size and function were performed using magnetic resonance imaging (MRI), and included measurement of cross-sectional areas (CSAs) of MF, psoas (PS), and quadratus lumborum (QL) muscles, and change in trunk CSA due to voluntarily contracting the TrA muscle. Injury data were obtained from club records. Informed consent was obtained from all study participants. A smaller size of the MF muscle (OR=2.38) or QL muscle (OR=2.17) was predictive of lower limb injury in the playing season. At the time point when one group of players had not received the intervention (n=14), comparisons were made with the combined groups who had received the intervention (n=32). The risk of sustaining a severe injury was lower for those players who received the motor control intervention (OR=0.09). While there are many factors associated with
injuries in AFL, motor control training may provide a useful addition to strategies aimed at reducing lower limb injuries.

Steffen K et.al. (2013) examined the effect of player adherence on performance and injury risk. During the 2011 football season (May-August), coaches of 31 tiers 1-3 level teams were introduced to the 11+ through either an unsupervised website or a coach-focused workshop with and without additional on-field supervisions. Playing exposure, adherence to the 11+, and injuries were recorded for female 13-year-old to 18-year-old players. Performance testing included the Star Excursion Balance Test (SEBT), single-leg balance, triple hop and jumping-over-a-bar tests. Complete preseason and postseason performance tests were available for 226 players (66.5%). Compared to the unsupervised group, single-leg balance (OR=2.8; 95% CI 1.1 to 4.6) and the anterior direction of the SEBT improved significantly in the onfield supervised group of players (OR=4.7; 95% CI 2.2 to 7.1), while 2-leg jumping performance decreased (OR=-5.1; 95% CI -9.9 to -0.2). However, significant improvements in 5 of 6 reach distances in the SEBT were found, favouring players who highly adhered to the 11+. Also, injury risk was lower for those players (injury rate ratio, IRR=0.28, 95% CI 0.10 to 0.79). Different delivery methods of the FIFA 11+ to coaches influenced players' physical performance minimally. However, high player adherence to the 11+ resulted in significant improvements in functional balance and reduced injury risk.
Kiesel K, Plisky P, and Butler R. (2011) determined if an off-season intervention program was effective in improving Functional Movement Screen™ (FMS) scores in professional American football players. Pre- and post-intervention FMS scores were obtained on 62 subjects who completed a 7-week off-season intervention program. A repeated measures ANOVA was conducted to determine the effectiveness of the training program on FMS scores. A chi-square was performed to determine if there were a greater number of players who met the injury threshold and if asymmetries were reduced following intervention. Logistic regression was used to predict what factors were associated with failure (post-test score of <14). There was a positive main effect for time (P<0.01) and a greater number of individuals with a score >14 following the intervention. At post-test, 41 players were free of asymmetry as compared with 31 at the pre-test. The strongest predictor of program failure was a low squat score at pre-test. This study demonstrated that fundamental movement characteristics do change with a standardized intervention. Further research is required to determine if injury risk is reduced when a player's score improves beyond the established cut-off of 14 and/or asymmetry is resolved.

Palmer TG et.al. (2013) investigated self-perceptions before and after experiencing an activity that dynamically and statically challenges proximal stability of the pelvis, spine, and trunk. Twenty-eight, healthy Division II female soccer and volleyball collegiate players (17 soccer, 11 volleyball) completed a self-reported Tegner activity scale, pretest questionnaire and
posttest interview. A self-perceived numeric rating of the athletes' proximal stability and performance on a functional movement screen (FMS) were recorded. A guided interview was used to examine the self-perceptions of proximal stability after the FMS testing session. Differences and correlations between the pretest and posttest ratings of proximal stability and FMS scores were analyzed using a 1-sample Kolmogorov-Smirnov test and Spearman's rank order correlation test, respectively. Residual standard error from a 1-way analysis of variance was used to explore the association between variables. Qualitative data were recorded and transcribed. There were significant differences between the pretest (3.4 ± 0.63) and posttest ratings (3.1 ± 0.49) of proximal stability (p = 0.01). The relationship between the pretest proximal stability ratings and the FMS scores was low (r = 0.19, p = 0.33), whereas posttest rating and FMS scores had a moderately high (r = 0.68, p = 0.00) correlation. There was a smaller residual standard error for the posttest ratings (1.7) when compared with the pretest ratings (3.2) with the FMS. Four qualitative themes emerged: (a) wanting to do well, (b) expectations of performance, (c) focused mental mindset, and (d) body control. Self-perceptions of proximal stability in female athletes were influenced by undergoing a test that stressed the proximal stabilizers. Combining assessments of self-perceptions and proximal stability may assist clinicians and athletes in targeting components of training.
Oliver GD, and Di Brezzo R. (2009) examined the effects of functional balance training implemented in addition to regular season practice, competition, and strength and conditioning training for collegiate women athletes. Twenty-six members of National Collegiate Athletic Association (NCAA) Division I collegiate women's volleyball and soccer teams volunteered. A pre-test, post-test group design was used for the study. Pre- and post-test measures were the following: Skindex, body mass index (BMI), single-leg squat, prone quadra-ped core test, Biodex balance test, and a 1-minute sit-up test. The intervention consisted of 10 minutes of Indo Board (a dynamic balance board) training 4 days a week throughout the entire season. The volleyball team served as the intervention group, whereas the soccer team had no intervention. A dependent t-test demonstrated a statistically significant (p <or= 0.05) improvement on the single-leg squat and 1-minute sit-up test for the volleyball team, whereas the soccer team (no intervention) demonstrated a statistically significant (p <or= 0.05) improvement on the 1-minute sit-up test. It was concluded that by training on an unstable surface, the individual is conditioning the core while simultaneously performing balance activities. It was also noted that, although improvements were seen, each participant (both volleyball and soccer) was also active in regular season practice, competition, and strength and conditioning training over the course of the season. Functional balance activities are cost effective and should be added to any form of strength and conditioning program in an attempt to enhance program effectiveness and to
develop functional postural activation. Functional postural activation will not only assist with functional performance, but also in the prevention of injury.

2.3 STUDIES ON SKILL PERFORMANCES

Draganidis D, et.al. (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
Almeida CH, 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.

Vaz L, et.al. (2012) compared physical exertion and game performance indicators of experienced and novice Rugby Union players when playing small-sided games. Forty male players (M age = 21.6 yr., SD = 3.6; M Height = 177.7cm, SD = 7.4; M body mass 81.2 kg, SD = 10.2) participated in eight 6 vs 6 small-sided games over a 4-wk. period, with 12 min. continuous duration in a 60 x 40 m playing area. All players wore GPS units and heart rate belts. No statistically significant differences in the physical exertion measures between experienced and novice players were found. However, the manual notational analysis revealed substantial differences between players in all game performance indicators, with better performance by the experienced players (Passes made ES = 0.5; Tackles made ES = 1.0; Tries ES = 0.5). These results suggest the possibility that specific physical conditioning might be achieved without also achieving technical and tactical excellence.

Fradua L, et.al. (2013) examined the (1) individual playing area, (2) length and width of the rectangle encompassing the individual playing area and (3) distance between the goalkeepers and their nearest team-mates during
professional soccer matches and compare these to previously reported pitch sizes for small-sided games (SSGs). Data were collected from four Spanish La Liga matches of the 2002-03 season, and notated post-event using the Amisco system. The pitch sizes obtained from real matches were smaller and different from those used previously for SSGs. In addition, the current pitch sizes show significant \( (P < 0.001) \) effect of ball location in all variables examined. For example, overall individual playing area \( (F [5, 2562] = 19.99, P < 0.001, \eta^2 = 0.04) \) varied significantly across six different zones of the pitch. Based on these empirical results, pitch sizes with individual playing areas ranging from 65 m\(^2\) to 110 m\(^2\) and length to width ratio of 1:1 and 1:1.3 are generally recommended for training tactical aspects according to different phases of play. It is possible to design SSGs with a more valid representation of the tactical conditions experienced in full-size matches and their use may improve the training effect of tactical aspects of match performance in soccer.

Vickery W, et.al. (2013) investigated the physiological responses and movement demands associated with modified versions of small-sided games for cricket training, termed 'Battlezone'. Eleven (22.2 ± 3.6 years; 1.80 ± 0.06 m; 81.7 ± 11.4 kg) male, cricket players volunteered to perform each of four modified 8-over scenarios of Battlezone. Modifications to Battlezone included reducing the field size, removal of a fielder, a combination of these modifications and additional rule changes. Heart rate, blood lactate concentration, rating of perceived exertion (RPE) and the movement patterns of
participants were measured during each scenario. The total distances covered per 8-over bout ranged from 626 ± 335 m for wicketkeepers to 1795 ± 457 m for medium-fast bowlers; although similar distances (P > 0.05) were covered within positions between the four different scenarios. Between scenarios, the greatest mean speed, heart rate and blood lactate responses occurred when the rules were changed, resulting in increased movement patterns (P < 0.05), most notably for batsmen and wicketkeepers. In contrast, altering the playing field size or player number did not significantly influence (P > 0.05) these responses. These results suggest that the physical demands of cricket-specific training can be increased via rule variations including hit-and-run activities, more so than field size or player number.

Aguiar MV, et.al. (2013) identified the acute physiological responses and activity profiles of football small-sided games (SSG) formats. Ten professional football players participated in 4 variations of SSG (2-, 3-, 4-, and 5-a-side) with an intermittent regime involving 3 × 6-minute bouts with 1 minute of passive planned rest in which the heart rate (HR), rating of perceived exertion (RPE), activity profile, and body load were recorded. The higher percentage of maximum HR values were found in 2- and 3-a-side formats (p ≤ 0.05). The lowest RPE value was found at the 5-a-side, and the highest was found at the 2-a-side (13.48 ± 2.67 and 17.01 ± 1.80, respectively, p ≤ 0.05). The distance covered in the 2-a-side format (598.97 ± 78.91 m) was smaller than in all other formats. The 2-a-side format presented the lowest number of
sprints (0.71 ± 0.86) and the 3-a-side the highest (2.50 ± 1.65). Statistically significant differences were found across SSG in the total body load. The 4-a-side presented the highest and the 5-a-side the lowest values (95.18 ± 17.54 and 86.43 ± 14.47, respectively). The body load per minute declined each 2 minutes of play. Maintaining a constant area:player ratio, coaches can use lower number of players (2- and 3-a-side) to increase cardiovascular effects but use higher number of players (4- and 5-a-side) to increase variability and specificity according to the competition demands.

Kelly DM, 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 CI, 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; HRmax 199.1 ± 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 A, 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.
Gabbett TJ, et.al. (2012) investigated the effect of changes in field size on the physiological and skill demands of small-sided games in elite junior and senior rugby league players. Sixteen elite senior rugby league players ([mean ± SE] age, 23.6 ± 0.5 years) and 16 elite junior rugby league players ([mean ± SE] age, 17.3 ± 0.3 years) participated in this study. On day 1, 2 teams played an 8-minute small-sided game on a small field (10-m width × 40-m length), whereas the remaining 2 teams played the small-sided game on a larger sized field (40-m width × 70-m length). On day 2, the groups were crossed over. Movement was recorded by a global positioning system unit sampling at 5 Hz. Games were filmed to count the number of possessions and the number and quality of disposals. The games played on a larger field resulted in a greater (p < 0.05) total distance covered, and distances covered in moderate, high, and very-high velocity movement intensities. Senior players covered more distance at moderate, high, and very-high intensities, and less distance at low and very-low intensities during small-sided games than junior players. Although increasing field size had no significant influence (p > 0.05) over the duration of recovery periods for junior players, larger field size significantly reduced (p < 0.05) the amount of short-, moderate-, and long-duration recovery periods in senior players. No significant between-group differences (p > 0.05) were detected for games played on a small or large field for the number or quality of skill involvements. These results suggest that increases in field size serve to increase
the physiological demands of small-sided games but have minimal influence over the volume or quality of skill executions in elite rugby league players.

Da Silva CD, 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%MHR). 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 A, 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 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 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 %HRmax and %HRreserve. 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).

Fanchini M, et.al. (2011) examined whether the increase in bout duration would affect the exercise intensity and technical actions, we manipulated bout duration during a typical small-sided game drill (SSG) in male soccer players. Nineteen players (mean ± SD: age 24 ± 4 years, body mass 74 ± 4 kg, and height 180 ± 5 cm) completed three bouts of a 3-a-side drill at three different bout durations: 2, 4, and 6 minutes. Exercise intensity was quantified using heart rate (HR) and rating of perceived exertion (RPE). A nonsignificant duration × bout interaction was found for HR (p = 0.757). Heart rates of bout 1 were significantly lower than bout 2 (p = 0.004) and bout 3 (p = 0.049). The effect of duration was close to significance for HR (p = 0.057) with 6-minute SSG significantly lower than 4-minute SSG (p = 0.004). Duration × bout interaction did not reach the significance for RPE (p = 0.096). The RPE significantly increased along the bouts (p < 0.001) but was not affected by duration (p = 0.763). No effect of duration was found for number of technical actions per minute (p > 0.111). A significant effect of bout was only found for successful passes (p = 0.018). Partially confirming our hypothesis, the increase in bout duration from 2 to 6 minutes resulted in a decrease in intensity only between the 4- and 6-min SSG. However, duration did not influence the technical actions and proficiency. The magnitude of changes in HR (89.5 vs.
87.8 of maximum) is probably not enough to induce different training adaptations. Therefore, coaches can use different bout durations with minimal impact on exercise intensity and without compromising technical proficiency.

Young WB, and Rath DA. (2011) identified training programs that can increase foot velocity. The purpose of this review is 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 football training, especially in nonelite
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.

Upton DE. (2011) evaluated the effects of a 4-week, 12-session training program using resisted sprint training (RST), assisted sprint training (AST), and traditional sprint training (TST) on maximal velocity and acceleration in National Collegiate Athletic Association (NCAA) Division IA female soccer athletes (n = 27). The subjects, using their respective training modality, completed 10 maximal effort sprints of 20 yd (18.3 m) followed by a 20-yd (18.3 m) deceleration to jog. Repeated measures multivariate analyses of variance and analyses of variance demonstrated significant (p < 0.001) 3-way interactions (time × distance × group) and 2-way interactions (time × group), respectively, for both velocity and acceleration. Paired t-tests demonstrated that maximum 40-yd (36.6-m) velocity increased significantly in both the AST (p < 0.001) and RST (p < 0.05) groups, with no change in the TST group. Five-yard (4.6-m), 15-yd (13.7 m), 5- to 15-yd (4.6- to 13.7-m) acceleration increased significantly (p < 0.01) in the AST group and did not change in the RST and TST groups. Fifteen- to 25-yd (13.7- to 22.9-m) acceleration increased significantly (p < 0.01) in the RST group, decreased significantly (p < 0.01) in the AST group, and was unchanged in the TST group. Twenty-five to 40-yd (22.9- to 36.6-m) acceleration increased significantly (p < 0.05) in the RST
group and remained unchanged in the AST and TST groups. It is purposed that the increased 5-yd (4.6-m) and 15-yd (13.7-m) accelerations were the result of enhanced neuromuscular facilitation in response to the 12-session supramaximal training protocol. Accordingly, it is suggested that athletes participating in short distance acceleration events (i.e., $\leq$ 15 yd; $\leq$ 13.7 m) use AST protocols, whereas athletes participating in events that require greater maximum velocity (i.e., $>$ 15 yd; $>$ 13.7 m) should use resisted sprint training protocols.

Alcaraz PE, et.al. (2009) documented that an excessive load in resisted sprint training can produce changes in running patterns. Therefore, load control is essential to ensure the specificity of these training methods. The most common way to control it is through the percentage of velocity lost in relation to maximum velocity. The present paper describes a study that aimed to establish the load for sprint training with sled towing. The study developed a regression equation for calculating the load in the maximum velocity phase. The calculation was done with 26 athletes from the Spanish and French national levels on a synthetic track surface and with spikes. The regression equation obtained was % body mass = (-0.8674 x % velocity) + 87.99. The equation, although specific for type of surface used and sled towing characteristics, is useful in establishing the optimal load for acceleration and maximum velocity training with sled towing.
Harrison AJ, and Bourke G. (2009) investigated whether a resistance sprint 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 postintervention 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.

Rhea MR, et.al. (2008) reported that resisted jumping devices and resisted plyometric training have become more common in recent years. The effectiveness of such training has yet to be determined among high school athletes. Sixty-four high school athletes (50 boys and 14 girls) from a variety of sports were divided into 2 groups and participated in a training intervention that differed only by the use of the VertiMax jump trainer in 1 group. Lower-body
power was tested before and after the intervention and compared statistically for differences between the groups. Athletes from both groups followed a periodized training program with resistance exercises performed 2 or 3 days per week, and sprint and plyometric training (i.e., training control group) or sprint, plyometric, and VertiMax training (i.e., VertiMax group) 1 or 2 days per week, for 12 total weeks. In addition to the traditional compound lower-body lifts and equated sprint work, the VertiMax group performed supplementary exercises on the VertiMax training apparatus. The average improvement in power observed in the training control group was 49.50 +/- 97.83 W, and the increase in power in the VertiMax group was 217.14 +/- 99.21 W. The differences in power after the test and improvements in power with training were found to differ between the groups (P < 0.05) and favored the VertiMax training group. Combined with previous research with college athletes, these data show the added effectiveness of resisted jump training on the VertiMax among athletes for the development of lower-body power.

Alcaraz PE, et.al. (2008) compared the kinematics of sprinting at maximum velocity to the kinematics of sprinting when using three of types of resisted sprint training devices (sled, parachute, and weight belt). Eleven men and 7 women participated in the study. Flying sprints greater than 30 m were recorded by video and digitized with the use of biomechanical analysis software. The test conditions were compared using a 2-way analysis of variance with a post-hoc Tukey test of honestly significant differences. We found that the
3 types of resisted sprint training devices are appropriate devices for training the maximum velocity phase in sprinting. These devices exerted a substantial overload on the athlete, as indicated by reductions in stride length and running velocity, but induced only minor changes in the athlete’s running technique. When training with resisted sprint training devices, the coach should use a high resistance so that the athlete experiences a large training stimulus, but not so high that the device induces substantial changes in sprinting technique. We recommend using a video overlay system to visually compare the movement patterns of the athlete in unloaded sprinting to sprinting with the training device. In particular, the coach should look for changes in the athlete’s forward lean and changes in the angles of the support leg during the ground contact phase of the stride.

Spinks CD, et.al. (2007) examined the effects of resisted sprint (RS) training (weighted sled towing) on acceleration performance (0-15 m), leg power (countermovement jump [CMJ], 5-bound test [5BT], and 50-cm drop jump [50DJ]), gait (foot contact time, stride length, stride frequency, step length, and flight time), and joint (shoulder, elbow, hip, and knee) kinematics in men (N = 30) currently playing soccer, rugby union, or Australian football. Gait and kinematic measurements were derived from the first and second strides of an acceleration effort. Participants were randomly assigned to 1 of 3 treatment conditions: (a) 8-week sprint training of two 1-h sessions x wk(-1) plus RS training (RS group, n = 10), (b) 8-week nonresisted sprint training program
of two 1-h sessions x wk(-1) (NRS group, n = 10), or (c) control (n = 10). The results indicated that an 8-week RS training program (a) significantly improves acceleration and leg power (CMJ and 5BT) performance but is no more effective than an 8-week NRS training program, (b) significantly improves reactive strength (50DJ), and (c) has minimal impact on gait and upper- and lower-body kinematics during acceleration performance compared to an 8-week NRS training program. These findings suggest that RS training will not adversely affect acceleration kinematics and gait. Although apparently no more effective than NRS training, this training modality provides an overload stimulus to acceleration mechanics and recruitment of the hip and knee extensors, resulting in greater application of horizontal power.

Paulson S, and Braun WA. (2011) compared the acute effects of parachute-resisted (PR) sprinting on selected kinematic variables. Twelve collegiate sprinters (mean age 19.58 ± 1.44 years, mass 69.32 ± 14.38 kg, height 1.71 ± 9.86 m) ran a 40-yd dash under 2 conditions: PR sprint and sprint without a parachute (NC) that were recorded on a video computer system (60 Hz). Sagittal plane kinematics of the right side of the body was digitized to calculate joint angles at initial ground contact (IGC) and end ground contact (EGC), ground contact (GC) time, stride rate (SR), stride length (SL), and the times of the 40-yd dashes. The NC 40-yd dash time was significantly faster than the PR trial (p < 0.05). The shoulder angle at EGC significantly increased from 34.10 to 42.10° during the PR trial (p < 0.05).
There were no significant differences in GC time, SR, SL, or the other joint angles between the 2 trials (p > 0.05). This study suggests that PR sprinting does not acutely affect GC time, SR, SL and upper extremity or lower extremity joint angles during weight acceptance (IGC) in collegiate sprinters. However, PR sprinting increased shoulder flexion by 23.5% at push-off and decreased speed by 4.4%. While sprinting with the parachute, the athlete's movement patterns resembled their mechanics during the unloaded condition. This indicates the external load caused by PR did not substantially overload the runner, and only caused a minor change in the shoulder during push-off. This sports-specific training apparatus may provide coaches with another method for training athletes in a sports-specific manner without causing acute changes to running mechanics.

Matthews MJ, et.al. (2010) investigated the acute effect of a heavy resisted sprint when used as a preload exercise to enhance subsequent 25-m on-ice sprint performance. Eleven competitive ice-hockey players (mean ± SD: Age = 22.09 ± 3.05 years; Body Mass = 83.47 ± 11.7 kg; Height = 1.794 ± 0.060 m) from the English National League participated in a same-subject repeated-measures design, involving 2 experimental conditions. During condition 1, participants performed a 10-second heavy resisted sprint on ice. Condition 2 was a control, where participants rested. An electronically timed 25-m sprint on ice was performed before and 4 minutes after each condition. The results indicated no significant difference (p = 0.176) between pre (3.940 +
0.258 seconds) and post (3.954 + 0.261 seconds) sprint times in the control condition. The intervention condition, however, demonstrated a significant 2.6% decrease in times (p = 0.02) between pre (3.950 + 0.251 seconds) and post (3.859 + 0.288 seconds) test sprints. There was also a significant change (p = 0.002) when compared to the times of the control condition. These findings appear to suggest that the intensity and duration of a single resisted sprint in this study are sufficient to induce an acute (after 4 minutes of rest) improvement in 25-m sprint performance on ice. For those athletes wishing to improve skating speed, heavy resisted sprints on ice may provide a biomechanically suitable exercise for inducing potentiation before speed training drills.

Clark KP, et.al. (2010) determined the longitudinal effects of weighted sled (WS) and weighted vest (WV) sprint training on maximum velocity sprint performance and kinematics. Twenty male collegiate lacrosse players were randomly assigned to a WS group (n = 7) towing 10% body mass, a WV group (n = 6) loaded with 18.5% body mass, or an unresisted (UR) active control group (n = 7). All subjects completed 13 training sessions over 7 weeks. Pre- and post-test measures of sprint time and average velocity across the distance interval of 18.3 to 54.9 m were used to assess sprint performance, whereas high-speed video (300 Hz) and motion-analysis software were used to analyze stride length, stride rate, ground contact time, and flight time. A 3 × 2 repeated measures analysis of variance was performed for each dependent variable and revealed no significant between-group differences for any of
the sprint performance or kinematic stride cycle measures. Effect size statistics suggested small improvements in 18.3- to 54.9-m sprint time and average velocity for the UR group but only trivial improvements for the WS and WV groups. With regard to sprint performance, the results indicate that WS and WV training had no beneficial effect compared with UR training. In fact, for the loads used by WS and WV in this study, UR training may actually be superior for improving sprint performance in the 18.3- to 54.9-m interval.

Girold S, et.al. (2007) compared the effects of dry-land strength training with a combined in-water resisted- and assisted-sprint program in swimmer athletes. Twenty-one swimmers from regional to national level participated in this study. They were randomly assigned to 3 groups: the strength (S) group that was involved in a dry-land strength training program where barbells were used, the resisted- and assisted-sprint (RAS) group that got involved in a specific water training program where elastic tubes were used to generate resistance and assistance while swimming, and the control (C) group which was involved in an aerobic cycling program. During 12 weeks, the athletes performed 6 trainingsessions per week on separate days. All of them combined the same aerobic dominant work for their basic training in swimming and running with their specific training. Athletes were evaluated 3 times: before the training program started, after 6 weeks of training, and at the end of the training program. The outcome values were the strength of the elbow flexors and extensors evaluated using an isokinetic dynamometer, and the speed, stroke
rate, stroke length, and stroke depth observed during a 50-meter sprint. No changes were observed after 6 weeks of training. At the end of the training period, we observed significant increases in swimming velocity, and strength of elbow flexors and extensors both in the S and RAS groups. However, stroke depth decreased both in the S and RAS groups. Stroke rate increased in the RAS but not in the S group. However, no significant differences in the swimming performances between the S and RAS groups were observed. No significant changes occurred in C. Altogether, programs combining swimming with dry-land strength or with in-water resisted- and assisted-sprint exercises led to a similar gain in sprint performance and are more efficient than traditional swimming training methods alone.

Girold S, et.al. (2006) determined whether the resisted-sprint in overstrength (OST) or the assisted-sprint in overspeed (OSp) could be efficient training methods to increase 100-m front crawl performance. Thirty-seven (16 men, 21 women) competition-level swimmers (mean +/- SD: age 17.5 +/- 3.5 years, height 173 +/- 14 cm, weight 63 +/- 14 kg) were randomly divided into 3 groups: OST, OSp, and control (C). All swimmers trained 6 days per week for 3 weeks, including 3 resisted or assisted training sessions per week for the groups OST and OSp respectively. Elastic tubes were used to generate swimming overstrength and overspeed. Three 100-m events were performed before, during, and after the training period. Before each 100-m event, strength of the elbow flexors and extensors was measured with an isokinetic
dynamometer. Stroke rate and stroke length were evaluated using the video-recorded 100-m events. In the OSt group, elbow extensor strength, swimming velocity, and stroke rate significantly increased (p < 0.05), while stroke length remained unchanged after the 3-week training period. In the OSp group, stroke rate significantly increased (p < 0.05) and stroke length significantly decreased (p < 0.05) without changes in swimming velocity. No significant variations in the C group were observed. Both OSt and OSp proved to be more efficient than the traditional training program. However, the OSt training program had a larger impact on muscle strength, swimming performance, and stroke technique than the OSp program.

2.4 SUMMARY OF RELATED LITERATURE

The investigator has reviewed several journals, research articles and presented the above related studies in three broad areas, namely, studies pertaining to grid training including small sided games on selected performance related fitness components, studies on functional training and studies on effect of different trainings on skills and performances of games. From the reviewed studies it was inferred that in football there was scope for further research in determining effect of functional and grid training on selected performance related fitness and playing ability among inter school football players, hence this study was undertaken.