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 lead in to the problem. It will bring out a deep and clear perspective of overall field.

2.1 Studies on SAQ Training

Gains GL, Swedenhjelm AN, et.al., (2010) Conducted a study on to determine the difference in 40-yd dash and proagility times performed on field turf (FT) and natural grass (NG). Red-shirt freshmen National Collegiate Athletic Association Division II college Soccer players (n = 24) performed 2 trials each of a 40-yd dash and proagility run on each surface. Sprints were timed by an electronic timing system (ET) and by 2 hand timers (HTs). Agility was timed on each surface by 2 HTs. There was no significant difference in 40-yd dash times between FT and NG using ET (FT: 5.34 ± 0.30 seconds, NG: 5.33 ± 0.33 seconds) or HT (FT: 5.06 ± 0.31 seconds, NG: 5.11 ± 0.29 seconds). Hand timer 40-yd dashes were significantly faster than ET 40-yd dashes on both surfaces, with the difference between HT and ET on FT (-0.28 ± 0.11 seconds) significantly greater than the difference on NG (-0.22 ± 0.06 seconds). The time differences between surfaces were significantly correlated (r = 0.12, p = 0.56). Proagility times were significantly faster on FT (4.49 ± 0.28 seconds) than on grass (4.64 ± 0.33 seconds). Thus, it appears that straight-ahead sprint speed

is similar between FT and NG, but change-of-direction speed may be significantly faster on FT.

Munro AG, Herrington LC. (2010) Conducted a study on to investigate whether learning affects were present in the administration of 4 hop tests and the Agility T-test and secondly to assess the between-session reliability of these tests. Twenty-two recreational athletes (11 women: age 22.3 ± 3.7 years, height 167.7 ± 6.2 cm, weight 59.2 ± 6.9 kg and 11 men: age 22.8 ± 3.1 years, height 179.8 ± 4 cm, weight 79.6 ± 10 kg) took part in the study. The subjects performed 6 repetitions of each hop test and 4 repetitions of the Agility T-test once a week over a period of 3 weeks. Distances were normalized to leg length and presented as a percentage value for the single, triple and crossover hop. Results showed that there were significant differences in scores between genders and that learning affects were present in all tests. Intraclass correlation coefficients ranged from 0.76 to 0.92 for the hop tests and 0.82 to 0.96 for the Agility T-test. The results indicated that the hop and Agility T-tests are reliable tests for use with subjects in a clinical or team sport environment. The error measurement statistics presented could be of help to practitioners to determine whether changes in individuals' scores in the hop and Agility T-tests are because of a true change in performance or measurement error. Of most importance was the fact that all subjects achieved at least 90% limb symmetry index on all 4 hop tests. Therefore, we recommend that a minimum limb symmetry value of 90%, rather than previously recommended 85%, should be adopted during rehabilitation and conditioning.

Polman R, Bloomfield J, et.al., (2009) Conducted a study to investigate the efficacy of both programmed (speed, agility, and quickness; SAQ) and random (small-sided games; SSG) conditioning methods on selected neuromuscular and physical performance variables. Twenty volunteers (21.1 +/- 4.0 y, 1.71 +/- 0.09 m,

66.7 +/- 9.9 kg; mean +/- SD) completed the study. The study design used two physically challenging periodized experimental conditions (SAQ and SSG conditions) and a nonexercise control condition (CON). Participants engaged in 12.2 +/- 2.1 h of directed physical conditioning. All participants had at least 24 h of recovery between conditioning sessions, and each 1-h session included 15 min of general warm-up and a 45-min exercise session. Participants completed a battery of tests (15-m sprint, isokinetic flexion/extension, depth jump) before and following the training program. There was a 6.9% (95% CI: -4.4 to 18.3) greater improvement in 5-m acceleration time and 4.3% (95% CI: -0.9 to 9.5) in 15-m mean running velocity time for the SAQ group compared with the SSG group. In addition, increases in maximal isokinetic concentric strength for both the flexor and extensor muscles, with the exception of 180 degrees /s flexion, were greater in the SAQ than SSG condition. The SAQ group also showed 19.5% (95% CI: -11.2 to 50.2) greater gain in reactive strength (contact time depth jump) and 53.8% (95% CI: 11.2 to 98.6) in mean gastrocnemius medialis activity in comparison with SSG. SAQ training should benefit the physical conditioning programs of novice players performing invasion games.

Bloomfield J, Polman R, et.al., (2007) Conducted a study on the effectiveness of 2 methodologies for speed and agility conditioning for random, intermittent, and dynamic activity sports (e.g., soccer, tennis, hockey, basketball, rugby, and netball) and the necessity for specialized coaching equipment. Two groups were delivered either a programmed method (PC) or a random method (RC) of conditioning with a third group receiving no conditioning (NC). PC participants used the speed, agility, quickness (SAQ) conditioning method, and RC participants played supervised small-sided soccer games. PC was also subdivided into 2 groups where participants either used specialized SAQ equipment or no equipment. A total of 46 (25 males and 21 females) untrained participants received (mean +/- SD) 12.2 +/- 2.1 hours of physical

conditioning over 6 weeks between a battery of speed and agility parameter field tests. Two-way analysis of variance results indicated that both conditioning groups showed a significant decrease in body mass and body mass index, although PC achieved significantly greater improvements on acceleration, deceleration, leg power, dynamic balance, and the overall summation of % increases when compared to RC and NC ($p < 0.05$). PC in the form of SAQ exercises appears to be a superior method for improving speed and agility parameters; however, this study found that specialized SAQ equipment was not a requirement to observe significant improvements. Further research is required to establish whether these benefits transfer to sport-specific tasks as well as to the underlying mechanisms resulting in improved performance.

2.2 Studies on Circuit Resistance Training

Castagna C, Castellini E (2012) conducted a study to examine the validity of vertical jump (VJ) performance variables in elite-standard male and female Italian soccer players. One-hundred-eighteen National teams soccer players (n=56 male and n=62 female) were tested for countermovement (CMJ) and squatting jump (SJ) heights. The stretch-shortening cycle efficiency (SSCE) was assessed as % of CMJ gain over SJ ([INCREMENT]CMJ-SJ), difference (CMJ-SJ) and ratio (CMJ/SJ). Results showed significant sex difference in SJ and CMJ. Difference in SSCE were mainly in the absolutevariables between sexes. Cut-off values for CMJ and SJ using sex as construct were 34.4 and 32.9 cm respectively. No competitive-level differences in VJ performance were detected in the male players. Female National team players showed VJ performance higher than the under 17 counterpart. The results of this study showed that VJ performance cannot discriminate between competitive levels in male national-teams selected soccer players. However the use of CMJ and SJ normative data may help strength and conditioning coaches in prescribing lower-

limbs explosive strength training in elite soccer players. In this variations in VJ performance in the range of ∼1 cm may be regarded as of interest in tracking non casual variation in elite-standard soccer players.

Massidda M, Corrias L et .al., (2012) conducted a study on The aim of the present paper was to investigate the relationships between polymorphisms in ACTN3, ACE and BDKRB2 genes, soccer performance, and explosive leg-muscle strength in Italian soccer players. We examined 42 top-level Italian soccer players (S) and 106 sedentary healthly Italians, as a control group (C). $\chi 2$ test was used to look for the difference in genotype distribution of ACTN3, ACE and BDKRB2 between groups. The data were evaluated by forward stepwise multiple regression analysis with the Squat Jump (SJ) and Counter Movement Jump (CMJ) as dependent variables, as well as competition level (CL), ACTN-3, ACE and BDKRB2 genotypes as independent variables. No significant difference was found between groups for ACE, ACTN-3 and BDKRB2 genotype distributions. Forward stepwise multiple regression analysis suggests a significant relationship between a) SJ vs. CL, ACE, and ACTN-3 and b) CMJ vs. CL. For SJ, the multivariate model combining genotypic data and competition level significantly predicted explosive leg-muscle strength in soccer players and variance explained by the function was 23.92%.An interaction of two polymorphisms (ACE and ACTN-3) might be able to discriminate quantitative traits crucial for the elite soccer performance, however the contribution of genetic factors to soccer performance is not so high.

Wells CM, Edwards AM, et.al., (2012) conducted a study to identify if sport-specific and cardiopulmonary exercise testing differentiated professional from amateur soccer players. Thirty six men comprising 18 professional (mean±s: age 23.2±2.4 years) and 18 amateur (mean±SD: age 21.1±1.6 years) soccer players

participated and performed four tests on separate occasions: 1) a graded exercise test to determine VO2max; 2) four exercise transients from walking to 80%Δ for the determination of VO2 kinetics; 3) the Yo-Yo Intermittent Recovery Test level 2 (Yo-Yo IR2) and 4) a repeated sprint test (RST).The players did not differ in VO2max (professional 56.5±2.9 mL.kg-1.min-1; amateur 55.7±3.5 mL.kg-1.min-1: P=0.484) or VO2 kinetic fundamental measures (τ1 onset, professional 24.5±3.2 s; amateur 24.0±1.8 s: τ1 cessation, professional 28.7±2.8 s; amateur 29.3±3.5 s: P=0.923). However, the amateurs were outperformed in the Yo-Yo IR2 (Professional 966±153 m; Amateur 840±156 m) (P=0.034) and RST (best time, professional 6.46±0.27 s; amateur 6.84±0.24 s, P=0.012).Performance indices derived from field-based sport-specific performance tests identified significant differences between professional and amateur players (P<0.05). However, neither tests of VO2 kinetics nor VO2max differentiated between groups, suggesting laboratory tests of cardiorespiratory parameters are probably less consequential to soccer than sport-specific field-based observations.

Vincenzo M, Antonio B, et.al., (2012) conducted a study on The aim of this study was to examine the association between individual measures of internal training load (TRIMPi) and aerobic-fitness and performance variables in premiership male soccer players. Eighteen Premiership soccer players (age 28.4±3.2 years, height 182±5.3 cm, body mass 79.9±5.5 kg) performed treadmill tests for VO2max and Ventilatory Threshold (VT) and Speed at blood-lactate concentration of 4 mmol·l (S4) on separate days pre and post 8 weeks of training (pre-season). The Yo-Yo Intermittent recovery test (Yo-Yo IR1) performance was assessed pre and post pre-season training as well. The TRIMPi was calculated using individual lactate and heart-rate profiles and assessed in each training session (n=900). Results showed that TRIMPi was large to very-large associated with percentage changes in VO2max

(r=0.77, p=0.002), VT (r=0.78, p=0.002) S4 (r=0.64, p=0.004) and Yo-Yo IR1 performance (r=0.69, p=0.009). Regression analyses showed that a weekly TRIMPi exceeding 500 AU were necessary to warrant improvements in aerobic fitness and performance in premiership male soccer-players during the pre-competitive season. It is concluded that TRIMPi is a valid and viable tool to guide training prescription in male premiership soccer players during the pre-season.

Noyes FR, Barber-Westin SD et.al., (2012) conducted a study to determine if a sports-specific anterior cruciate ligament injury prevention training program could improve neuromuscular and performance indices in female high school soccer players. We combined components from a published knee ligament intervention program for jump and strength training with other exercises and drills to improve speed, agility, overall strength, and aerobic fitness. We hypothesized that this program would significantly improve neuromuscular and athletic performance indices in high school female soccer players. The supervised 6-week program was done 3 d-wk for 90-120 minutes per session on the soccer fields and weight room facilities in area high schools. In phase one, 62 athletes underwent a video drop-jump test, t-test, 2 vertical jump tests, and a 37-m sprint test before and upon completion of the training program. In phase two, 62 other athletes underwent a multistage fitness test before and after training. There were significant improvements in the mean absolute knee separation distance ($p < 0.0001$), mean absolute ankle separation distance ($p < 0.0001$), and mean normalized knee separation distance ($p < 0.0001$) on the drop-jump, indicating a more neutral lower limb alignment on landing. Significant improvements were found in the t-test ($p < .0001$), estimated maximal aerobic power ($p < 0.0001$), 37-m sprint test ($p = 0.02$), and in the 2-step approach vertical jump test ($p = 0.04$). This is the first study we are aware of that demonstrated the effectiveness of a knee ligament injury prevention training program in improving athletic

performance indices in high school female soccer players. Future studies will determine if these findings improve athlete compliance and team participation in knee ligament injury intervention training.

Brandes M, Heitmann A, Müller L (2012) conducted a study on A major use of small-sided games (SSGs) in soccer training is the concomitant development of game-specific aerobic fitness. We 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-specificaerobic 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[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 speedzones "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.

Bogdanis, Gregory C; et.al., (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 ergo meter 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 liter 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.

Tønnessen E, Shalfawi SA, et.al., (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 precompetition phase of the training program for the participants and ended 13 weeks before the start of the season; the duration of the precompetition 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 posttest in 40-m maximum sprint (-0.06 seconds), 10 × 40-m repeated sprint speed (-0.12 seconds), 20- to 40-m topspeed (-0.05 seconds), and CMJ (2.7 cm). The CG showed only a statistically notable improvement from pre to posttest in 10 × 40-m repeated sprintspeed (-0.06 seconds). Between-group differences showed a statistically marked improvement for the TG over the CG in 10 × 40-m repeated sprintspeed (-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 is 20 participants, 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 should probably trained strength, however, benefits were observed even without strength training is most likely to be caused by the training specificity.

Jastrzębski Z, Rompa P et.al., (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 soccerseason. 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.

Ingebrigtsen J, Dillern T, et.al., (2011) conducted a study on investigated aerobic capacities and anthropometric characteristics within a group of 29 elite female soccerplayers. The purpose was to identify and establish aerobic capacities and anthropometric characteristics for these players and to look for possible positional differences between keepers, defenders, midfielders, and attackers. We did this by measuring standard anthropometrical variables and maximal oxygen (VO(2)max) and anaerobic threshold (AT). One-way analysis of variance revealed no significant differences among anthropometric or physiological variables. However, a trend ($p =$

0.062) toward positional differences was found within running speed at AT. A subsequent Tukey post hoc test showed differences ($p = 0.04$) between keepers and defenders, with the latter running faster (~1.7 km·h) at AT. The present results suggest that few anthropometric and physiological differences exist between playing positions in elite female soccer players. Furthermore, the current results indicate that present elite players' physiological characteristics are similar to those previously shown, despite the rapid changes of the female soccergame. Based on well-established knowledge that different playing positions within a soccer team ought to have distinct capacities, we recommend regular testing programs to be able to construct and implement tailored training programs for players' physical capacities with respect to the demands of their playing positions.

Meckel Y, Gefen Y et.al., (2011) conducted a study to compare the effect of short sprint repetition and long sprint repetition training, matched for total distance, on selected fitness components in young soccer players. Thirty young (14-15 y) soccer players were randomly assigned to either the short sprinttraining group or long sprint training group, and completed two similar sets of fitness tests before and after seven weeks of training. The two trainingprograms consisted of short (4-6 sets of 4X50m all out sprint) sprint repetition training, and long (4-6 sets of 200m run at 85% of max speed) sprint repetition training, each performed three times a week. Prior to training, there were no baseline between group differences in predicted VO2 max, standing long jump, 30m sprint time, 4x10m shuttle running time and 250m running time. Both training programs led to a significant improvement in VO2 max (predicted from the 20m shuttle run, $p<0.01$), with no between-group difference ($p=0.14$). Both training programs also led to a significant improvement in the anaerobic fitness variables of 30m sprint time ($p<0.01$), 4x10m shuttle running time ($p<0.01$) and 250m

running time ($p<0.01$), with no between-group differences. Neither of the training programs had a significant effect on standing long jump ($p=0.21$). The study showed that long, near maximal sprints, and short, all-out sprint training, matched for total distance, are equally effective in enhancing both the aerobic and anaerobic fitness of young soccer players. Therefore, in order to maintain players training interest and enthusiasm, coaches may alternate between these methods during the busy soccer season.

Wong, Pui-lam; et.al., (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 submaximal 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 PL, Chaouachi A, et.al., (2010) conducted a study on 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 trainingtwice 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 maximalaerobic 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.

Wong PL, Chamari K, et.al., (2010) conducted a study on examined 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 submaximal 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.

Hoffman, Jay R; et.al., (2009) Conducted a study on to examine the efficacy of periodization and to compare different periodization models in resistance trained American Soccer players. Fifty-one experienced resistance trained American Soccer players of an NCAA Division III Soccer team (after 10 weeks of active rest) were randomly assigned to 1 of 3 groups that differed only in the manipulation of the intensity and volume of training during a 15-week off-season resistance training program. Group 1 participated in a nonperiodized (NP) training program, group 2 participated in a traditional periodized linear (PL) training program, and group 3 participated in a planned nonlinear periodized (PNL) training program. Strength and power testing occurred before training (PRE), after 7 weeks of training (MID), and at the end of the training program (POST). Significant increases in maximal (1-repetition maximum [1RM]) squat, 1RM bench press, and vertical jump were observed from PRE to MID for all groups; these increases were still significantly greater at POST; however, no MID to POST changes were seen. Significant PRE to POST improvements in the medicine ball throw (MBT) were seen for PL group only. The results do not provide a clear indication as to the most effective training program for strength and power enhancements in already trained Soccer players. Interestingly, recovery of training-related performances was achieved after only 7 weeks of training, yet further gains were not observed. These data indicate that longer periods of training may be needed after a long-term active recovery period and that active recovery may

need to be dramatically shortened to better optimize strength and power in previously trained Soccer players.

Núñez VM, Da Silva-Grigoletto ME, et.al., (2008) conducted a study on designed to increase strength and aerobic endurance in 1 season was tested on 16 professional soccer players from Spain with a mean age of 28 +/- 3.37 years. The schedule comprised 4 macrocycles of 12 weeks of aerobic endurance and strength training. As much for the strength training as for the aerobic endurance, the program used a sequence of general, special, and specific exercises. Assessments were made with routine tests (i.e., squat jumps [SJs], countermovement jumps [CMJs], and countermovement jumps with arm swing [CMJas]) at the end of each macrocycle, and the Probst test was used to assess aerobic endurance as a function of running speed and distance, at the start and end of thetraining schedule and at the start of the third macrocycle. Jumps were performed on an infrared platform fitted to the MuscleLab system. The Probst test showed differences between the first evaluation and the second and third evaluations: 3,550 +/- 411.59 m vs. 2,006 +/- 207.20 m ($P < 0.01$). For 2 of the 3 jumps analyzed, the results were better in the last 2 than in the first 2 evaluations (SJ, 43.13 +/- 3.77 vs. 39.47 +/- 3.4 [$P < 0.05$]; CMJ, 49.80 +/- 3.77 vs. 46.67 +/- 3.76 [$P < 0.05$]; CMJas, 56.24 +/- 5.2 vs. 52.98 +/- 4.54 [$P > 0.05$]). Improvement of aerobic endurance was produced on the first phase of the season as a consequence of the training. To increase strength, it is necessary to augment the number of training sessions of this type. It is convenient to separate aerobic endurance and strength training to create more ample blocks during the last 2 macrocycles.

Jullien, Hugues; et.al., (2008) Conducted a study on assessed the effects of specific leg strength training (as part of a broader exercise program) on running speed and agility in young professional soccer players. Twenty-six male players (ages 17 to 19 years) were divided into 3 groups. The reference group (Re) performed individual

technical work only, the coordination group (Co) performed a circuit designed to promote agility, coordination, and balance control (together with some technical work) and the Squat group (Sq) underwent 3 series of 3 squat repetitions (at 90% of the individual maximum value) and a sprint, before competition of the agility circuit and some technical work. These specific training programs were performed 5 times a week for 3 weeks. Before the experimental session and at the end of each week, all players were assessed using 4 types of tests, (agility, a shuttle test with changes of direction, and 2 sprints over 10 and 7.32 meters, respectively), with completion time being the only performance parameter recorded. Our results indicate that in the short sprints or shuttle sprint with changes in direction, lower limb strengthening did not improve performance. Performance improved in all 3 groups in the agility test but more so in the reference and coordination groups. It appears that soccer-specific training composed of exercise circuits specifically adapted to the different types of effort actually used in match play can enhance agility and coordination.

Santos-Silva PR, Fonseca AJ et.al., (2007) conducted a study to determine the degree of reproducibility of maximum oxygen consumption (VO2max) among soccer players, using a modified Heck protocol.2 evaluations with an interval of 15 days between them were performed on 11 male soccer players. All the players were at a high performance level; they were training for an average of 10 hours per week, totaling 5 times a week. When they were evaluated, they were in the middle of the competitive season, playing 1 match per week. The soccer players were evaluated on an ergometric treadmill with velocity increments of 1.2 km.h-1 every 2 minutes and a fixed inclination of 3% during the test. VO2max was measured directly using a breath-by-breath metabolic gas analyzer. The maximum running speed and VO2max attained in the 2 tests were, respectively: (15.6 +/- 1.1 vs. 15.7 +/- 1.2 km.h-1; [P = .78]) and (54.5 +/- 3.9 vs. 55.2 +/- 4.4 ml.kg-1.min-1; [P = .88]). There was

high and significant correlation of VO2max between the 2 tests with a 15-day interval between them [r = 0.97; P < .001].The modified Heck protocol was reproducible, and the 15-day interval between the ergospirometric testing was insufficient to significantly modify the soccer players' VO2max values.

Dupont G, Akakpo K, et.al., (2004) conducted a study on the effects of in-season, high-intensity interval training on professional male soccer players' running performances were investigated. Twenty-two subjects participated in 2 consecutive training periods of 10 weeks. The first period was considered a control period and was compared with a period where 2 high-intensity interval training exercises were included in the usual training program. Intermittent runs consisted of 12-15 runs lasting 15 seconds at 120% of maximal aerobic speed alternated with 15 seconds of rest. Sprint repetitions consisted of 12-15 all-out 40-m runs alternated with 30 seconds of rest. Results from the high-intensity interval training have shown that maximal aerobic speed was improved (+8.1 +/- 3.1%; p < 0.001) and that the time of the 40-m sprint was decreased (-3.5 +/- 1.5%; p < 0.001), whereas no change in either parameters were observed during the control period. This study shows that improvements in physical qualities can be made during the in-season period.

Chin MK, So RC, Yuan YW, et.al., (1994) conducted a study to evaluate the cardiorespiratory fitness and isokinetic muscle strength of elite junior soccer players in Hong Kong. It was conducted in conjunction with the selection of the Hong Kong team to the 1989 Gothia Cup held in Sweden. Twenty-one top junior soccer players were selected as subjects for the study. The following means (+/- SD) were observed: age 17.3 +/- 1.1 years; height 172.5 +/- 6.2 cm; weight 62.8 +/- 7.0 kg; body fat 5.2 +/- 1.8%; forced vital capacity (FVC) 4.6 +/- 0.6 L; maximum oxygen uptake (VO2max) 58.6 +/- 2.9 ml.kg-1.min-1; anaerobic threshold (AT) 76.7 +/- 10.2% of VO2max; peak isokinetic dominant knee extensor and flexor

strengths 3.28 +/- 0.37 Nm.kg-1 and 1.84 +/- 0.24 Nm.kg-1; hamstring to quadriceps peak torque ratio (H/Q) 56 +/- 0.6% measured at 60 degrees s-1. Hong Kong players appeared to have comparable aerobic power, light body weight, poor flexibility and above average isokinetic muscle strength compared to other international junior soccer players. Training programs to improve the contra lateral knee muscle imbalance and to increase the fast speed movement capability of the non-dominant knee flexors are recommended.

2.3 Studies on Plyometric Training

Pietraszewski B, Rutkowska-Kucharska A.(2011) conducted a study to determine the power produced by the lower limbs in the take-off phase in drop jumps (DJ) and the correlation between the power and load measured by dropping height after take-off. The research group (N = 17) contained students practicing football, volleyball, basketball, athletics, high jump, swimming and fencing. The individual characteristics 'power-load' of the players and the observation of the changes during the training process enable the coaches to choose precise loads and at the same time to improve the training. The criterion of choosing loads in the plyometric training may be relative power output of lower limbs referred to the DJ height. While the condition allowing player to perform this type of training may depend on obtaining greater power in drop jump than in counter movement jump.

Chelly MS, Ghenem MA, Abid K, Hermassi S, Tabka Z, Shephard RJ. (2010) conducted a study on 8-week lower limb plyometric training program (hurdle and depth jumping) to normal in-season conditioning would enhance measures of competitive potential (peak power output [PP], jump force, jump height, and lower limb muscle volume) in junior soccer players. The subjects (23 men, age 19 ± 0.7 years, body mass 70.5 ± 4.7 kg, height 1.75 ± 0.06 m, body fat 14.7 ± 2.6%) were randomly assigned to a control (normal training) group (GM; n = 11) and an

experimental group (Gex, n = 12) that also performed biweekly plyometric training. A force-velocity ergometer test determined PP. Characteristics of the squat jump (SJ) and the countermovement jump (CMJ) (jump height, maximal force and velocity before take-off, and average power) were determined by force platform. Video-camera kinematic analyses over a 40-m sprint yielded running velocities for the first step (VS), the first 5 m (V5m) and between 35 and 40 m (Vmax). Leg muscle volume was estimated using a standard anthropometric kit. Gex showed gains relative to controls in PP ($p < 0.01$); SJ (height $p < 0.01$; velocity $p < 0.001$), CMJ (height $p < 0.001$; velocity $p < 0.001$, average power $p < 0.01$) and all sprint velocities ($p < 0.001$ for V5m and Vmax, $p < 0.01$ for VS). There was also a significant increase ($p < 0.05$) in thigh muscle volume, but leg muscle volume and mean thigh cross-sectional area remain unchanged. We conclude that biweekly plyometric training of junior soccer players (including adapted hurdle and depth jumps) improved important components of athletic performance relative to standard in-season training. Accordingly, such exercises are highly recommended as part of an annual soccer-training program.

Ronnestad BR, Kvamme NH, Sunde A, Raastad T.(2008) conducted a studyon the effects of combined strength and plyometric training with strength training alone on power-related measurements in professional soccer players. Subjects in the intervention team were randomly divided into 2 groups. Group ST (n = 6) performed heavy strength training twice a week for 7 weeks in addition to 6 to 8 soccer sessions a week. Group ST+P (n = 8) performed a plyometric training program in addition to the same training as the ST group.

The control group (n = 7) performed 6 to 8 soccer sessions a week. Pretests and posttests were 1 repetition maximum (1RM) half squat, countermovement jump (CMJ), squat jump (SJ), 4-bounce test (4BT), peak power in half squat with 20 kg, 35 kg, and 50 kg (PP20, PP35, and PP50, respectively), sprint acceleration, peak sprint

velocity, and total time on 40-m sprint. There were no significant differences between the ST+P group and ST group. Thus, the groups were pooled into 1 intervention group. The intervention group significantly improved in all measurements except CMJ, while the control group showed significant improvements only in PP20. There was a significant difference in relative improvement between the intervention group and control group in 1RM half squat, 4BT, and SJ. However, a significant difference between groups was not observed in PP20, PP35, sprint acceleration, peak sprinting velocity, and total time on 40-m sprint. The results suggest that there are no significant performance-enhancing effects of combining strength and plyometric training in professional soccer players concurrently performing 6 to 8 soccer sessions a week compared to strength training alone. However, heavy strength training leads to significant gains in strength and power-related measurements in professional soccer players.

Impellizzeri FM, Rampinini E, Castagna C, Martino F, Fiorini S, Wisloff U.(2008) conducted a study on aim of this study was to compare the effects of plyometric training on sand versus a grass surface on muscle soreness, vertical jump height and sprinting ability. Parallel two-group, randomized, longitudinal (pretest-post-test) study. After random allocation, 18 soccer players completed 4 weeks of plyometric training on grass (grass group) and 19 players on sand (sand group). Before and after plyometric training, 10 m and 20 m sprint time, squat jump (SJ), countermovement jump (CMJ), and eccentric utilization ratio (CMJ/SJ) were determined.Muscle soreness was measured using a Likert scale. No training surface x time interactions were found for sprint time ($p>0.87$), whereas a trend was found for SJ ($p = 0.08$), with both groups showing similar improvements ($p<0.001$). On the other hand, the grass group improved their CMJ ($p = 0.033$) and CMJ/SJ ($p = 0.005$) significantly ($p<0.001$) more than players in the sand group. In contrast, players in the

sand group experienced less muscle soreness than those in the grass group ($p<0.001$).Plyometric training on sand improved both jumping and sprinting ability and induced less muscle soreness. A grass surface seems to be superior in enhancing CMJ performance while the sand surface showed a greater improvement in SJ. Therefore, plyometric training on different surfaces may be associated with different training-induced effects on some neuromuscular factors related to the efficiency of the stretch-shortening cycle.

Impellizzeri FM, Maffiuletti NA. (2007) conducted a study on aim of this study was to examine the construct validity of the 7-point Linker scale of muscle soreness, assessing its relationship with Visual Analogue Scale (VAS). An additional aim was to examine its sensitivity as measure of symptom of eccentric-contraction muscle damage. Correlation study. Self-administered questionnaires collected in field setting. Twenty-six soccer players.4-week preseason training camp, which included high-intensity plyometric training sessions. Players self-reported the perceived muscle soreness of the lower limbs using the VAS (criterion measure) and the 7-point Linker scale of muscle soreness. Significant individual correlations were found between the two muscle soreness scales (mean r=0.80+/-0.07; range, 0.65 to 0.94). The correlation using the pooled data was 0.81. No significant muscle soreness scale x time interaction was found for standardized measures of muscle soreness (P=0.98). The main factor for time (24, 48, 72, and 96 hours after the first plyometric training session) was significant (P=0.0001). Effect sizes for the changes in the Linker and VAS absolute scores during the first 96 hours were similar (partial eta=0.13).The results of this study provide further convergent evidence for the construct validity of the 7-point Linker scale of muscle soreness. The 2 scales showed similar sensitivity to muscle soreness caused by eccentric contractions during the first 96 hours after plyometric exercises.

Diallo O, Dore E, Duche P, Van Praagh E.(2001)conducted a study to examine the effectiveness of plyometric training and maintenance training on physical performances in prepubescent soccer players. Twenty boys aged 12-13 years were divided in two groups (10 in each): jump group (JG) and control group (CG). JG trained 3 days/week during 10 weeks, and performed various plyometric exercises including jumping, hurdling and skipping. The subsequent reduced training period lasted 8 weeks. However, all subjects continued their soccer training. Maximal cycling power (Pmax) was calculated using a force-velocity cycling test. Jumping power was assessed by using the following tests: countermovement jump (CMJ), squat jump (SJ), drop jump (DJ), multiple 5 bounds (MB5) and repeated rebound jump for 15 seconds (RRJ15). Running velocities included 20, 30 and 40 m (V20, V30, V40 m). Body fat percentage (BF percent) and lean leg volume were estimated by anthropometry. Before training, except for BF percent, all baseline anthropometric characteristics were similar between JG and CG. After the training programme, Pmax ($p<0.01$), CMJ ($p<0.01$), SJ ($p<0.05$), MB5 ($p<0.01$), RRJ15 ($p<0.01$) and V20 m ($p<0.05$), performances increased in the JG. During this period, no significant performance increase was obtained in the CG. After the 8-week of reduced training, except Pmax ($p<0.05$) for CG, any increase was observed in both groups. These results demonstrate that short-term plyometric training programmes increase athletic performances in prepubescent boys. These improvements were maintained after a period of reduced training.

Tan D, Dawson B, Peeling P. (2012) Conducted a study on quantify the hemolytic responses of elite female football (soccer) players during a typical weekly training session. Ten elite female football players' (7 field players (FP) and 3 goalkeepers (GK)) were recruited from the Australian National Women's Premier

League, and were asked to provide a venous blood sample 30 min prior to, and at the immediate conclusion of a typical weekly training session. During this training session, the player's movement patterns were monitored via a 5 Hz global positioning system (GPS). The blood samples collected during the training session were analyzed for iron status via serum ferritin (SF) analysis; and the hemolytic response to training via serum free hemoglobin (Hb) and hemoglobin (Hp) measurement.50% of the participants screened were found to have a compromised iron stores (SF <35ug.L-1). Furthermore, the post-training serum free Hb levels were significantly elevated (p=0.011), and the serum Hp levels were significantly decreased (p=0.005), with no significant differences recorded between the FP and the GK. However, the overall distance covered and the movement speed was significantly greater in the FP.The increases in free Hb and decreases in Hp levels provide evidence that a typical team-sport training session may result in significant degree of hemolysis. This hemolysis may primarily be a result of running-based movements in FP, and/or theplyometric movements in GK such as diving and tackling.

Wong DP, Chaouachi A, Dellal A, Smith AW.(2012)Conducted a study on aimed to compare ground reaction forces (GRF) and contact times (GCT) between 2 lateral plyometric exercises: lateral alternative leg hopping (HOP), and speed lateral footwork (SPEED). 16 professional male soccer players (age: 24.6±5.5 years; and BMI: 21.7±2.2 kg.m - 2) participated in this within-participant repeated measures study. 3-dimensional GRF data were measured by force platform. Our study revealed significant differences between the 2 lateral plyometric exercises in all kinetics parameters (F=573.7, P<0.01). HOP produced significantly longer GCT (0.45 s vs. 0.23 s, P<0.01, large effect), significantly higher values (P<0.05, large effect) in peak force (3.31 vs. 2.47 Body Weight [BW]), peak rate of force development (0.94 vs. 0.29 BW/s), and impulse (0.76 vs. 0.31 BW.s) except for peak force in the medial-

lateral (P<0.05, medium effect) and impulse in the anterio-posterior direction (not significant, small effect). Therefore, SPEED is an exercise that aims to increase step frequency because of its short GCT (< 0.25 s) while HOP increases leg strength and power.

Michailidis Y, Fatouros IG et.al., (2012) conducted a study on aimed to determine whether pre-adolescent boys exhibit plyometric trainability or not. Forty-five children were randomly assigned to either a control (CG, N=21, 10.6±0.5 yrs; participated only in regular soccer practice) or a plyometric training group (PTG, N=24, 10.6±0.6 yrs; participated in regular soccer practice plus a plyometric exercise protocol). Both groups trained for 12 weeks during the in-season period. PT exercises (forward hopping, lateral hopping, shuffles, skipping, ladder drills, skipping, box jumps, and low-intensity depth jumps) were performed twice a week. Pre-adolescence was verified by measuring Tanner stages, bone age, and serum testosterone. Speed(0-10 m, 10-20 m, 20-30 m), leg muscle power [static jumping (SJ), countermovement jumping (CMJ), depth jumping (DJ), standing long jump (SLJ), multiple 5-bound hopping (MB5)], leg strength (10RM), anaerobic power (Wingate testing), and soccer specific performance (agility, kicking distance) were measured at baseline, mid- and post-training. CG caused only a modest (1.2%-1.8percentage) increase in speed post-training. PTG induced a marked (p<0.05) improvement in all speed tests (1.9%-3.1% at mid-training and 3-5% at post-training) and vertical jump tests (10%-18.5% at mid-training and 16-23% at post-training), SLJ (2.6% at mid-training and 4.2% at post-training), MB5 (14.6% at mid-training and 23% at post-training), leg strength (15% at mid-training and 28% at post-training), agility(5% at mid-training and 23% at post-training), and kicking distance (13.6% at mid-training and 22.5% at post-training). Anaerobic power remained unaffected in both groups. These data indicate that: a) pre-pubertal boys exhibit

considerable plyometric trainability, and b) when soccer practice is supplemented with a plyometric training protocol it leads to greater performance gains.

Greska EK, Cortes N, Van Lunen BL, Oñate JA. (2011) conducted a study to evaluate the effects of a 10-week off-season neuromuscular training program on lower extremity kinematics. Twelve Division I female soccer players (19.2±0.8 years, 1.67±0.1m, 60.2±6.5Kg) performed unanticipated dynamic trials of a running stop-jump task pre- and post-training. Data collection was performed utilizing an 8-camera VICON system and two Bertec force plates. The 10-week training program consisted of resistance training two times per week and field training, consisting of plyometric, agility, and speed drills, two times per week. Repeated measures ANOVA's were utilized to assess differences between pre- and post-training kinetics and kinematics of the hip, knee, and ankle at initial contact, peak knee flexion and peak stance. Repeated measures ANOVA's were also utilized to assess isometric strength differences pre- and post-training. The alpha level was set at .05 a priori. The training program demonstrated significant increases in left hip extension, left and right hip flexion, and right hip adduction isometric strength. At initial contact, knee abduction angle moved from an abducted to an adducted position (-1.48±3.65° to 1.46±3.86°, p=0.007), and hip abduction angle increased (-6.05±4.63° to -10.34±6.83°, p=0.007). Hip abduction angle at peak knee flexion increased (-2.23±3.40° to 6.01±3.82°, (p=0.002). Maximum knee extension moment achieved at peak stance increased from pre-training to post-training (2.02±0.32 Nm/kg to 2.38±0.75 Nm/kg, p=0.027). The neuromuscular training program demonstrated a potential positive effect in altering mechanics that influence the risk of incurring an ACL injury.

Grieco C, Cortes N, Greska E, Lucci S, Onate J. (2011) conducted a study to investigate the effect of a 10-week combined resistance/plyometric training program on RE and VO_2max in female soccer players. Fifteen Division 1A female soccer players (19.0 yr ± 0.7; 1.67 m ± 0.1; 61.7 kg ± 8.1) performed a treadmill test for VO_2max and RE at the end of a competitive season (PRE) and following a 10-week training program (POST). Isometric strength was measured in knee flexion and extension. Resistance training was conducted 2 days per week on nonconsecutive days; plyometric training was conducted separately on different non-consecutive days. Eleven subjects were included in PRE/POST analysis (19.0 yr ± 0.8; 1.67 m ± 0.5; 59.9 kg ± 6.7). Descriptive statistics were compared using ANOVA with repeated measures with a Bonferroni adjustment and significance was set at $p < .05$. A significant increase occurred following training in VO2peak (10.5%; p = .008), time-to-fatigue (6.9%; p = .017) and interpolated maximal speed (3.6%; p = .016), despite a decrease in maximal respiratory exchange ratio (2.9%; p = .001). There was no significant change in RE at 9 km*h-1, however, there was a significant decrease in percentage of VO2peak at 9 km*h-1 (-5.6%; p = .02). Maximal isometric strength of knee flexors/extensors did not change. The results suggest a plyometric/agility trainingprogram may increase VO2peak in female soccer players, however, the effect on RE was equivocal.

Sedano S, Matheu A, Redondo JC, Cuadrado G.(2011) The main aim of this study was to determine the effects of a 10-week plyometric training program on explosive strength, acceleration capacity and kicking speed in young elite soccer players. Twenty-two players participated in the study: control group (CG), (N.=11; 18.2 ± 0.9 years) and treatment group (TG) (N.=11; 18.4 ± 1.1 years). Both groups performed technical and tactical training exercises and matches together. However, the CG players followed the regular physical conditioning program, which was

replaced by a plyometric program for TG. Plyometric training took place three days a week and included jumps over hurdles, horizontal jumps and lateral jumps over hurdles. Jumping ability, 10 m sprint and kicking speed were measured on five separate occasions. Two-way analysis of variance (ANOVA) with repeated measures reflected that the TG demonstrated significant increases ($P<0.05$) in jumping ability and acceleration capacity after six weeks of training and in kicking speed with dominant and non-dominant leg after eight and ten weeks respectively. On the other hand there were no significant changes in CG players throughout the study. The main findings revealed that a 10-week plyometric program might be an effective training stimulus to improve explosive strength compared to a more conventional physical training program. The improvements in explosive strength can be transferred to acceleration capacity and kicking speed but players need time to transfer these increases.

Nakamura D, Suzuki T, Yasumatsu M, Akimoto T. (2011)Conducted a study on reported the effects of reduced training and/or interrupted training on athletic performance, but few reports are available for soccer players. The purpose of this study was to examine, using the Yo-Yo intermittent recovery level 2 (YoYoIR2) test and sprint performance, the effects on soccer players of a reduced training program consisting of either moderate running training, plyometric training. After the completion of a competitive season, 29 male soccer players were divided into three groups: the running group (R, n = 13), the plyometric group (P, n = 11), and the control group (C, n = 5). Both training groups completed either running or plyometric training sessions two days a week for three weeks, whereas the C group was not allowed to perform any training. The subjects performed YoYoIR2 and 20 m sprint tests before (pre) and after (post) the experimental period. Neither training group showed any significant training effects on the YoYoIR2 performance or 20 m sprint

times compared with the control group. This study suggests that neither endurance running nor plyometric training two days a week for three weeks has a significant effect on high-intensity performance compared with a non-training regimen. However, our results do not support complete inactivity. These results may have important implications for the management of training cessation for a few weeks.

Sedano Campo S, Vaeyens R, Philippaerts RM, Redondo JC, de Benito AM, Cuadrado G.(2009)Conducted a study to examine how explosive strength, kicking speed, and body composition are affected by a 12-weekplyometric training program in elite female soccer players. The hypothesis was that this program would increase the jumping ability and kicking speed and that these gains could be maintained by means of regular soccer training only. Twenty adult female players were divided into 2 groups: control group (CG, n = 10, age 23.0 +/- 3.2 yr) and plyometric group (PG, n = 10; age 22.8 +/- 2.1 yr). The intervention was carried out during the second part of the competitive season. Both groups performed technical and tactical training exercises and matches together. However, the CG followed the regular soccer physical conditioning program, which was replaced by a plyometric program for PG. Neither CG nor PG performed weight training. Plyometric training took place 3 days a week for 12 weeks including jumps over hurdles, drop jumps (DJ) in stands, or horizontal jumps. Body mass, body composition, countermovement jump height, DJ height, and kicking speed were measured on four separate occasions. The PG demonstrated significant increases ($p < 0.05$) in jumping ability after 6 weeks of training and in kicking speed after 12 weeks. There was no significant time x group interaction effects for body composition. It could be concluded that a 12-week plyometric program can improve explosive strength in female soccer players and that these improvements can be transferred to

soccer kick performance in terms of ball speed. However, players need time to transfer these improvements in strength to the specific task. Regular soccer training can maintain the improvements from a plyometric training program for several weeks.

Meylan C, Malatesta D (2009)Conducted a study to determine the influence of a short-term plyometric training within regular soccer practice on explosive actions of early pubertal soccer players during the in-season. Fourteen children (13.3 +/- 0.6 years) were selected as the training group (TG) and 11 children (13.1 +/- 0.6 years) were defined as the control group (CG). All children were playing in the same league and trained twice per week for 90 minutes with the same soccer drills. The TG followed an 8-week plyometric program (i.e., jumping, hurdling, bouncing, skipping, and footwork) implemented as a substitute for some soccer drills to obtain the same session duration as CG. At baseline and after training, explosive actions were assessed with the following 6 tests: 10-meter sprint, agility test, 3 vertical jump tests (squat jump [SJ], countermovement jump [CMJ], contact test [CT] and multiple 5 bounds test [MB5]). Plyometric training was associated with significant decreases in 10-m sprint time (-2.1%) and agility test time (-9.6%) and significant increases in jump height for the CMJ (+7.9%) and CT (+10.9%). No significant changes in explosive actions after the 8-week period were recorded for the CG. The current study demonstrated that a plyometric program within regular soccer practice improved explosive actions of young players compared to conventional soccer training only. Therefore, the short-term plyometric program had a beneficial impact on explosive actions, such as sprinting, change of direction, and jumping, which are important determinants of match-winning actions in soccer performance.

Thomas K, French D, Hayes PR.(2009)Conducted a study to compare the effects of two plyometric training techniques on power and agility in youth soccer

players. Twelve males from a semiprofessional football club's academy (age = 17.3 +/- 0.4 years, stature = 177.9 +/- 5.1 cm, mass = 68.7 +/- 5.6 kg) were randomly assigned to 6 weeks of depth jump (DJ) or countermovement jump (CMJ) training twice weekly. Participants in the DJ group performed drop jumps with instructions to minimize ground-contact time while maximizing height. Participants in the CMJ group performed jumps from a standing start position with instructions to gain maximum jump height. Post training, both groups experienced improvements in vertical jump height ($p < 0.05$) and agility time ($p < 0.05$) and no change in sprint performance ($p > 0.05$). There were no differences between the treatment groups ($p > 0.05$). The study concludes that both DJ and CMJ plyometrics are worthwhile training activities for improving power and agility in youth soccer players.

Siegler J, Gaskill S, Ruby B.(2003)conducted a study to evaluate changes in soccer-specific power endurance of 34 female high school soccer players throughout a season either with or without an intermittent, high-intensity exercise protocol. Thirty-four female high school soccer players were tested prior to the 2000 fall season and again 10 weeks later. The tests included an abridged 45-minute shuttle test (LIST), hydrostatic weighing, vertical jump, 20-m running-start sprint, and 30-second Wingate test. The experimental group (EG; n = 17, age 16.5 +/- 0.9 years) completed a 10-week in-season plyometric, resistive training, and high-intensity anaerobic program. The control group (n = 17, age 16.3 +/- 1.4 years) completed only traditional aerobic soccer conditioning. Statistical significance was set at alpha < 0.05. The experimental group showed significant improvements in the LIST (EG = delta 394 seconds +/- 124 seconds), 20-m sprint (EG = Delta-0.10 seconds +/- 0.10 seconds), increase in fat-free mass (EG = delta 1.14 kg +/- 1.22 kg), and decreases in fat mass (EG = Delta-1.40 kg +/- 1.47 kg) comparing pre- to postseason. This study indicates that a strength and plyometric program improved power endurance and

speed over aerobic training only. Soccer-specific power endurance training may improve match performance and decrease fatigue in young female soccer players.

Summary of Literature

The researcher had given forty one research studies which have been conducted recently in the area of SAQ training, circuit resistance training and plyometric training on motor fitness variables through journals, periodicals, abstracts, unpublished master and doctoral theses on Physical Education and Sports Sciences besides from various relevant books. The review summarized that the effects of SAQ training, circuit resistance training and plyometric training would be beneficial to better performance in sports. Hence, the present investigation assumes greater prove the concept on selected motor fitness variables due to SAQ training, circuit resistance training and plyometric training.