CHAPTER - II

REVIEW OF RELATED LITERATURE

2.1. INTRODUCTION

This chapter describes the source of review of related literature. The researcher finds out some of the review of related literature which could be very supportive and strengthen this study. After going through the available literature, the investigator presented some of the observations and findings of the experts in this area.

The literature in any field forms the foundation upon which all future work will be built. If there is failure to build up on the foundation of knowledge provided by the review of literature, the researcher might miss some works already done on the same topic. The reviews are discussed under the following topics to have a better perspective about the selected independent variables.

2.2. Studies on SAQ Training

2.3. Studies on Speed Training

2.4. Studies on Jump Training

2.2. STUDIES ON SAQ TRAINING

Milanović, et. al., (2014) Studies on SAQ training were determined the effects of a 12 week speed, agility and quickness (SAQ) training program on speed and flexibility in young soccer players. One hundred and thirty-two soccer players were
randomly assigned to experiment (EG; n=66, mean±SD: age: 18.5±0.4 years (range 17-19 years); body mass: 71.30±5.93 kg; stature: 177.2±6.5 cm) and control groups (CG; n=66, mean±SD: age: 18.6±0.6 years (range 17-19 years); body mass: 70.63±4.87 kg; stature: 175.9±5.7 cm). The experimental group performed SAQ training whilst the control group undertook straight-line sprint training matched for volume and duration. Sprint performance was assessed using 5 and 10 m sprints and a further test including maximal speed, a 20 m sprint. Flexibility was assessed using sit and reach, V-sit and reach, leg lift from supine position and lateral leg lift while lying on the side tests. Sprints over 5, 10 and 20 m did not differ between groups at baseline, but by week 12, the 5m sprint had significantly improved (P<.05) in the SAQ training group compared to the control group (1.40±0.13 vs. 1.46±0.12s, respectively) although this improvement had a trivial effect size (ES=0.15). The 10 m sprint time had improved by 3.3% (P<.01) in the SAQ group with a moderate effect size (ES=0.66). No significant differences (P>.05) for all flexibility tests were found between experimental and control group at baseline and after the training programs. Consequently SAQ training was found to be an effective way of improving sprint time for short distances over 5 and 10 m but not over 20 m (where maximum speed was achieved) or flexibility. These results indicate that SAQ training may be more effective for improving sprint performance for some soccer players but more research is required to determine ideal training methods for improving acceleration and flexibility in young soccer players.

Milanović, et. al., (2013) determined the effects of a 12 week conditioning programme which involve speed, agility and quickness (SAQ) training and its effect on agility performance in young soccer players. Soccer players were randomly assigned to two groups: experimental group (EG; n = 66, body mass: 71.3 ± 5.9 kg; body height: 1.77 ± 0.07 m) and control group (CG; n = 66, body mass: 70.6 ± 4.9 kg; body height:
Agility performance was assessed using field tests: Slalom; Slalom with ball; Sprint with 90° turns; Sprint with 90° turns with ball; Sprint with 180° turns; Sprint with backward and forward running; Sprint 4 x 5 m. Statistically significant improvements (p < 0.05) between pre and post training were evident for almost all measures of agility, with and without the ball, with the exception being the Sprint with backward and forward running. This suggests that SAQ training is an effective way of improving agility, with and without the ball, for young soccer players it can be included in physical conditioning programmes. Key points SAQ training appears to be an effective way of improving agility with and without the ball in young soccer players. Soccer coaches could use this training during pre-season and in-season training. Compared with pre-training, there was a statistically significant improvement in all but one measure of agility, both with and without the ball after SAQ training.

Jovanovic, et. al., (2011) evaluated the effects of the speed, agility, quickness (SAQ) training method on power performance in soccer players. Soccer players were assigned randomly to 2 groups: experimental group (EG; n = 50) and control group (n = 50). Power performance was assessed by a test of quickness--the 5-m sprint, a test of acceleration--the 10-m sprint, tests of maximal speed--the 20- and the 30-m sprint along with Bosco jump tests--squat jump, counter movement jump (CMJ), maximal CMJ, and continuous jumps performed with legs extended. The initial testing procedure took place at the beginning of the in-season period. The 8-week specific SAQ training program was implemented after which final testing took place. The results of the 2-way analysis of variance indicated that the EG improved significantly (p < 0.05) in 5-m (1.43 vs. 1.39 seconds) and in 10-m (2.15 vs. 2.07 seconds) sprints, and they also improved their jumping performance in countermovement (44.04 vs. 4.48 cm) and continuous jumps (41.08 vs. 41.39 cm) performed with legs extended (p < 0.05). The
SAQ training program appears to be an effective way of improving some segments of power performance in young soccer players during the in-season period. Soccer coaches could use this information in the process of planning in-season training. Without proper planning of the SAQ training, soccer players will likely be confronted with decrease in power performance during in-season period.

Polman, et. al., (2009) investigated 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, increase 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.

Polman, et. al., (2004) compared the efficacy of three physical conditioning programmes provided over a 12 week period (24 h in total) on selected anthropometric
and physical fitness parameters in female soccer players. Two of the groups received physical conditioning training in accordance with speed, agility and quickness (SAQ); one group used specialized resistance and speed development SAQ equipment (equipment group; n = 12), while the other group used traditional soccer coaching equipment (non-equipment group; n = 12). A third group received their regular fitness sessions (active control group; n = 12).

All three interventions decreased (P < 0.001) the participants' body mass index (-3.7%) and fat percentage (-1.7%), and increased their flexibility (+14.7%) and maximal aerobic capacity (VO2max) (+18.4%). The participants in the equipment and non-equipment conditioning groups showed significantly (P < 0.005) greater benefits from their training programme than those in the active control group by performing significantly better on the sprint to fatigue (-11.6% for both the equipment and non-equipment groups versus -6.2% for the active control group), 25 m sprint (-4.4% vs -0.7%), left (-4.5% vs -1.0%) and right (-4.0% vs -1.4%) side agility, and vertical (+18.5% vs +4.8%) and horizontal (+7.7% vs +1.6%) power tests. Some of these differences in improvements in physical fitness between the equipment and non-equipment conditioning groups on the one hand and the active control group on the other hand were probably due to the specificity of the training programmes. It was concluded that SAQ training principles appear to be effective in the physical conditioning of female soccer players. Moreover, these principles can be implemented during whole team training sessions without the need for specialized SAQ equipment. Finally, more research is required to establish the relationship between physical fitness and soccer performance and principles underlying the improvements seen through the implementation of SAQ training programmes.
2.3. STUDIES ON SPEED TRAINING

Campos-Vazquez, et. al., (2015) assessed the effect of combining repeated-sprint training with 2 different methods of muscle strength training on physical performance variables in young players. Twenty-one soccer players with mean (± SD) age of 18.1 (± 0.8) years, weight 69.9 (± 6.5) kg, and height 177.1 (± 5.7) cm, and competing in U-19 category, were randomly assigned to 2 experimental groups: squat group (SG: n = 10) and take-off group (TG: n = 11). Intervention in both groups consisted of the combination of a weekly session of repeated-sprint training (the same for both groups), with 2 weekly sessions of strength training (different for each group), for 8 weeks in the final period of the season. The strength sessions for the SG consisted of conducting a series of full squats executed at maximum velocity in the concentric phase. Intervention in the TG was the performance of 2 specific strength exercises (take-offs and change of direction), with measurements taken before and after consideration of the following variables: repeated-sprint ability (RSA), yo-yo intermittent recovery test level 1 (YYIRT1), countermovement jump (CMJ), and average velocity in full squat progressive loads test. The SG improved CMJ height in 5.28% (p ≤ 0.05) and FS37.5-47.5-67.5 (p ≤ 0.05), whereas the TG improved FS17.5-27.5-37.5-47.5-67.5 (p ≤ 0.05). There were no significant changes in the values of RSA or YYIRT1 in either group. The results seem to show that the combination of a weekly session of repeated-sprint training with 2 weekly sessions of strength training could be an insufficient stimulus to improve RSA in the final period of the season.

Luteberget, et. al., (2015) compared the effects of RST, by sled towing, against TST on sprint performance and muscle architecture. Participants (n = 18) were assigned to either RST or TST and completed 2 training sessions of RST or TST per week (10 wk), in addition to their normal team training. Sprint tests (10 and 30 m) and
measurements of muscle architecture were performed pre and post training. Beneficial effects were found in the 30-m-sprint test for both groups (mean; ±90% CL: TST = -0.31; ±0.19 s, RST = -0.16; ±0.13 s), with unclear differences between the groups. Only TST had a beneficial effect on 10-m time (-0.04; ±0.04 s), with a likely difference between the 2 groups (85%, ES = 0.60). Both groups had a decrease in pennation angle (-6.0; ±3.3% for TST and -2.8; ±2.0% for RST), which had a nearly perfect correlation with percentage change in 10-m-sprint performance (r = .92). A small increase in fascicle length (5.3; ±3.9% and 4.0; ±2.1% for TST and RST, respectively) was found, with unclear differences between groups. TST appears to be more effective than RST in enhancing 10-m-sprint time. Both groups showed similar effects in 30-m-sprint time. A similar, yet small, effect of sprint training on muscle architecture was observed in both groups.

Sáez, et. al., (2015) determined the influence of a short-term combined plyometric and sprint training (9 weeks) within regular soccer practice on explosive and technical actions of pubertal soccer players during the in-season. Twenty-six players were randomly assigned to 2 groups: control group (CG) (soccer training only) and combined group (CombG) (plyometric + acceleration + dribbling + shooting). All players trained soccer 4 times per week and the experimental groups supplemented the soccer training with a proposed plyometric-sprint training program for 40 minutes (2 days per weeks). Ten-meter sprint, 10-m agility with and without ball, CMJ and Abalakov vertical jump, ball-shooting speed, and Yo-Yo intermittent endurance test were measured before and after training. The experimental group followed a 9-week plyometric and sprint program (i.e., jumping, hurdling, bouncing, skipping, and footwork) implemented before the soccer training. Baseline-training results showed no significant differences between the groups in any of the variables tested. No
improvement was found in the CG; however, meaningful improvement was found in all variables in the experimental group: CMJ (effect size [ES] = 0.9), Abalakov vertical jump (ES = 1.3), 10-m sprint (ES = 0.7-0.9), 10-m agility (ES = 0.8-1.2), and ball-shooting speed (ES = 0.7-0.8). A specific combination of plyometric and sprint training within regular soccer practice improved explosive actions compared with conventional soccer training only. Therefore, the short-term combined program had a beneficial impact on explosive actions, such as sprinting, change of direction, jumping, and ball-shooting speed which are important determinants of match-winning actions in soccer performance. Therefore, we propose modifications to current training methodology for pubertal soccer players to include combined plyometric and speed training for athlete preparation in this sport.

Bachero-Mena and González-Badillo, (2014) evaluated the effects of a 7-week, 14-session, sled-resisted sprint training on acceleration with 3 different loads according to a % of body mass (BM): low load (LL: 5% BM, n = 7), medium load (ML: 12.5% BM, n = 6), and high load (HL: 20% BM, n = 6), in young male students. Besides, the effects on untrained exercises: countermovement jump (CMJ), loaded vertical jump squat (JS), and full squat (SQ) were analyzed. The 3 groups followed the same training program consisting in maximal effort sprint accelerations with the respective loads assigned. Significant differences between groups only occurred between LL and ML in CMJ (p ≤ 0.05), favoring ML. Paired t-tests demonstrated statistical improvements in 0-40 m sprint times for the 3 groups (p ≤ 0.05), and in 0-20 m (p ≤ 0.05) and 0-30 m (p < 0.01) sprint times for HL. Sprint times in 10-40 m (p < 0.01) and 20-40 m (p ≤ 0.05) were improved in LL. Time intervals in 20-30 m and 20-40 m (p ≤ 0.05) were statistically reduced in ML. As regards, the untrained exercises, CMJ and SQ for ML and HL (p ≤ 0.05) and JS for HL were improved. The results
show that depending on the magnitude of load used, the related effects will be attained in different phases of the 40 m. It would seem that to improve the initial phase of acceleration up to 30 m, loads around 20% of BM should be used, whereas to improve high-speed acceleration phases, loads around 5-12.5% of BM should be preferred. Moreover, sprint-resisted training with ML and HL would enhance vertical jump and leg strength in moderately trained subjects.

**Haugen, et. al., (2014)** investigated the effect of training at an intensity eliciting 90% of maximal sprinting speed on maximal and repeated-sprint performance in soccer. It was hypothesised that sprint training at 90% of maximal velocity would improve soccer-related sprinting. Twenty-two junior club-level male and female soccer players (age 17 ± 1 year, body mass 64 ± 8 kg, body height 174 ± 8 cm) completed an intervention study where the training group (TG) replaced one of their weekly soccer training sessions with a repeated-sprint training session performed at 90% of maximal sprint speed, while the control group (CG) completed regular soccer training according to their teams’ original training plans. Counter movement jump, 12 × 20-m repeated-sprint, VO2max and the Yo-Yo Intermittent Recovery Level 1 test was performed prior to and after a 9-week intervention period. No significance between-group differences were observed for any of the performance indices and effect magnitudes were trivial or small. Before rejecting the hypothesis, we recommend that future studies should perform intervention programmes with either stronger stimulus or at other times during the season where total training load is reduced.

**Marques, et. al., (2013)** examined the effect of a six-week combined jump and sprint training program on strength-speed abilities in a large sample of youth competitive soccer players. It was hypothesized that the experimental training group would enhance their jumping and sprinting abilities. Enhancement of kicking
performance was also hypothesized due to an expected increase in explosive strength established by a plyometric and sprinting regimen. Fifty-two young male soccer players playing at the national level (aged $13.4 \pm 1.4$ years, body mass $53.4 \pm 11.7$ kg, body height $1.66 \pm 0.11$ m) took part in the study. Half of the group underwent the plyometric and sprint training program in addition to their normal soccer training, while the other half was involved in soccer training only. The plyometric training group enhanced their running (+1.7 and +3.2%) and jumping performance (+7.7%) significantly over the short period of time, while the control group did not. Furthermore, both groups increased their kicking velocity after just six weeks of training (+3.3 vs. 6.6%). The findings suggest that a short in-season 6-week sprint and jump training regimen can significantly improve explosive strength in soccer-specific skills and that these improvements can be transferred to soccer kicking performance in terms of ball speed.

Shalfawi, et. al., (2013) compared the effects of in-season combined resisted agility and repeated sprint training with strength training on soccer players' agility, linear single sprint speed, vertical jump, repeated sprint ability (RSA), and aerobic capacity. Twenty well-trained elite female soccer players of age $\pm$ SD $19.4 \pm 4.4$ years volunteered to participate in this study. The participants were randomly assigned to either the agility or repeated sprint training group or to the strength training group. All the participants were tested before and after a 10-week specific conditioning program. The pretest and posttest were conducted on 3 separate days with 1 day of low-intensity training in between. Test day 1 consisted of squat jump (SJ), counter movement jump (CMJ), and RSA. Test day 2 consisted of a 40-m maximal linear sprint and an agility test, whereas a Beep test was conducted on test day 3 to assess aerobic capacity. The agility and repeated sprint training implemented in this study did not have a significant
effect on agility, although there was a tendency for moderate improvements from 8.23 ± 0.32 to 8.06 ± 0.21 seconds (d = 0.8). There was a significant (p < 0.01) and moderate-positive effect on Beep-test performance from level 9.6 ± 1.4 to level 10.8 ± 1.0, and only a trivial small effect on all other physical variables measured in this study. The strength training group had a positive, moderate, and significant (p < 0.01) effect on Beep-test performance from level 9.7 ± 1.3 to level 10.9 ± 1.2 (d = 1.0) and a significant (p < 0.05) but small effect (d = 0.5) on SJ performance (25.9 ± 2.7 to 27.5 ± 4.1 cm). Furthermore, the strength training implemented in this study had a trivial and negative effect on agility performance (d = -0.1). No between-group differences were observed. The outcome of this study indicates the importance of a well-planned program of conditioning that does not result in a decreased performance of the players, the great importance of strength and conditioning specialist in implementing the training program, and the importance of choosing the time of the year to implement such conditioning training programs. However, the fact that the present training program did not cause any decline in performance indicates that it is useful in maintaining the soccer players' physical performance during the competition period.

**Cherif, et. al. (2012)** investigated the effect of a combined program including sprint repetitions and drop jump training in the same session on male handball players. Twenty-two male handball players aged more than 20 years were assigned into 2 groups: experimental group (n=11) and control group (n=11). Selection was based on variables "axis" and "lines", goalkeepers were not included. The experimental group was subjected to 2 testing periods (test and retest) separated by 12 weeks of an additional combined plyometric and running speed training program. The control group performed the usual handball training. The testing period comprised, at the first day, a medical checking, anthropometric measurements and an incremental exercise test
called yo-yo intermittent recovery test. 2 days later, participants performed the Repeated Sprint Ability test (RSA), and performed the Jumping Performance using 3 different events: Squat jump (SJ), Counter movement jump without (CMJ) and with arms (CMJA), and Drop jump (DJ). At the end of the training period, participants performed again the repeated sprint ability test, and the jumping performance. The conventional combined program improved the explosive force ability of handball players in CMJ (P=0.01), CMJA (P=0.01) and DJR (P=0.03). The change was 2.78, 2.42 and 2.62% respectively. No significant changes were noted in performances of the experimental group at the squat jump test and the drop jump with the left leg test. The training intervention also improved the running speed ability of the experimental group (P=0.003). No statistical differences were observed between lines and axes. Additional combined training program between sprint repetition and vertical jump in the same training session positively influence the jumping ability and the sprint ability of handball players.

Lockie, 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 ≤ 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.

Meckel, et. al., (2012) compared the effect of Short-Sprint repetition Training and Long-Sprint repetition Training (SST, LST), matched for total distance, on selected fitness components in young soccer players. Thirty young (14-15 years) soccer players were randomly assigned to either the short-sprint training group or long-sprint training group and completed 2 similar sets of fitness tests before and after 7 weeks of training. The 2 training programs consisted of SST (4-6 sets of 4 × 50-m all-out sprint) and LST (4-6 sets of 200-m run at 85% of maximum speed), each performed 3 times a week. Before training, there were no baseline between-group differences in predicted VO2max, standing long jump, 30-m sprint time, 4 × 10-m shuttle running time, and 250-m running time. Both training programs led to a significant improvement in VO2max (predicted from the 20-m 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 30-m sprint time (p < 0.01), 4 × 10-m shuttle running time (p < 0.01), and 250-m 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, to maintain a player's training interest and enthusiasm, coaches may alternate between these methods during the busy soccer.

Tønnessen, et. al., (2011) examined 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, counter movement 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 top speed (-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 sprint speed (-0.06 seconds). Between-group differences showed a statistically marked improvement for the TG over the CG in 10 × 40-m repeated sprint speed (-0.07 seconds) and 20- to 40-m top speed (-0.05 seconds), but the effect of the improvement was moderate. The results further indicate that a weekly training with
repeated sprint gave a moderate but not statistically marked improvement in 40-m sprinting, CMJ, and beep test. The results of this study indicate that the repeated sprint program had a positive effect on several of the parameters tested. However, because the sample size in this study 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.

Mujika, et. al., (2009) examined the effects of 2 in-season short-term sprint and power training protocols on vertical counter movement jump height (with or without arms), sprint (Sprint-15m) speed, and agility (Agility-15m) speed in male elite junior soccer players. Twenty highly trained soccer players (age 18.3 +/- 0.6 years, height 177 +/- 4 cm, body mass 71.4 +/- 6.9 kg, sum skinfolds 48.1 +/- 11.4 mm), members of a professional soccer academy, were randomly allocated to either a CONTRAST (n = 10) or SPRINT (n = 10) group. The training intervention consisted of 6 supervised training sessions over 7 weeks, targeting the improvement of the players' speed and power. CONTRAST protocol consisted of alternating heavy-light resistance (15-50% body mass) with soccer-specific drills (small-sided games or technical skills). SPRINT training protocol used line 30-m sprints (2-4 sets of 4 x 30 m with 180 and 90 seconds of recovery, respectively). At baseline no difference between physical test performance was evident between the 2 groups (p > 0.05). No time x training group effect was found for any of the vertical jump and Agility-15m variables (p > 0.05). A time x training group effect was found for Sprint-15m performance with the CONTRAST group showing significantly better scores than the SPRINT group (7.23 +/- 0.18 vs. 7.09 +/- 0.18).
0.20 m.s, p < 0.01). In accordance to these findings CONTRAST training should be preferred to line sprint training in the short term in young elite soccer players when the aim is to improve soccer-specific sprint performance (15 m) during the competitive season.

**Harrison and Bourke, (2009)** investigated whether an RS training intervention would enhance the running speed and dynamic strength measures in male rugby players. Fifteen male rugby players aged 20.5 (+/- 2.8) years who were proficient in resisted sledge training took part in the study. The subjects were randomly assigned to control or RS groups. The RS group performed two sessions per week of RS training for 6 weeks, and the control group did no RS training. Pre- and post intervention tests were carried out for 30-m sprint, drop, squat, and rebound jumps on a force sledge system. A laser measurement device was used to obtain velocities and distance measures during all running trials. The results show a statistically significant decrease in time to 5 m for the 30-m sprint for the RS group (p = 0.02). The squat jump and drop jump variables also showed significant increase 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.

**Venturelli, et. al., (2008)** investigated whether coordination or repeated-sprint training better improved speed over 20 m, with and without the ball. Sixteen soccer players (mean age 11+/-0.5 y) were randomly assigned to a sprint-training group (STG=7) or a coordination-training group (CTG=9). The STG trained twice a week for 12 wk and performed 20 repetitions of 20- and 10-m sprints; the CTG performed coordination training (eg, speed ladder running) for the same training duration. Maximal jump height, anthropometric measures, and 20-m sprint time, with and
without ball, were evaluated before and after the training period. Statistical significance was determined using two-way ANOVA with repeated measure and Pearson test for correlation. Both groups improved speed without the ball: STG=3.75+/−0.10 s to 3.66+/−0.09 s (P<.05); CTG=3.64+/−0.13 s to 3.56+/−0.13 s (P<.05), with no difference between groups. Sprint time with the ball pre- and post training was 4.06+/−0.11 s and 4.05+/−0.19 s (P>.05) for STG and 4.04+/−0.12 s and 3.82+/−0.15 s (P<.05) for CTG, with a significant difference between groups post training (P<.05). There were significant correlations between sprint time without ball, CMJ, and SJ. These data suggest that coordination training increase the speed with the ball more than typical repeated-sprint training. It can be hypothesized that running speed with ball improved more in CTG because this particular action requires improvements in coordination.

Markovic, et. al., (2007) evaluated the effects of sprint training on muscle function and dynamic athletic performance and to compare them with the training effects induced by standard plyometric training. Male physical education students were assigned randomly to 1 of 3 groups: sprint group (SG; n = 30), plyometric group (PG; n = 30), or control group (CG; n = 33). Maximal isometric squat strength, squat- and counter movement jump (SJ and CMJ) height and power, drop jump performance from 30-cm height, and 3 athletic performance tests (standing long jump, 20-m sprint, and 20-yard shuttle run) were measured prior to and for 10 weeks of training. Both experimental groups trained 3 days a week; SG performed maximal sprints over distances of 10-50 m, whereas PG performed bounce-type hurdle jumps and drop jumps. Participants in the CG group maintained their daily physical activities for the duration of the study. Both SG and PG significantly improved drop jump performance (15.6 and 14.2%), SJ and CMJ height (approximately 10 and 6%), and standing long jump distance (3.2 and 2.8%), whereas the respective effect sizes (ES) were moderate
to high and ranged between 0.4 and 1.1. In addition, SG also improved isometric squat strength (10%; ES = 0.4) and SJ and CMJ power (4%; ES = 0.4, and 7%; ES = 0.4), as well as sprint (3.1%; ES = 0.9) and agility (4.3%; ES = 1.1) performance. We conclude that short-term sprint training produces similar or even greater training effects in muscle function and athletic performance than does conventional plyometric training. This study provides support for the use of sprint training as an applicable training method of improving explosive performance of athletes in general.

Kotzamanidis, et. al., (2005) investigated the effect of a combined heavy-resistance and running-speed training program performed in the same training session on strength, running velocity (RV), and vertical-jump performance (VJ) of soccer players. Thirty-five individuals were divided into 3 groups. The first group (n = 12, COM group) performed a combined resistance and speed training program at the same training session, and the second one (n = 11, STR group) performed the same resistance training without speed training. The third group was the control group (n = 12, CON group). Three jump tests were used for the evaluation of vertical jump performance: squat jump, countermovement jump, and drop jump. The 30-m dash and 1 repetition maximum (1RM) tests were used for running speed and strength evaluation, respectively. After training, both experimental groups significantly improved their 1RM of all tested exercises. Furthermore, the COM group performed significantly better than the STR and the CON groups in the 30-m dash, squat jump, and countermovement jump. It is concluded that the combined resistance and running-speed program provides better results than the conventional resistance training, regarding the power performance of soccer players.
2.4. STUDIES ON JUMP TRAINING

Reiger and Yingling, (2015) determined the effect of oral contraceptive use on bone serum markers following a 3-week jumping protocol. Twenty-three females (18-25 years) were grouped as oral contraceptive users (OC+) or non-users (OC-). Following a 3-week observation period, participants completed a 3-week (15-day) jump protocol. Jump sessions consisting of ten 42 cm drop jumps with a 30 s rest interval between jumps were completed each day, 5 days per week. Peak vertical ground reaction force and loading rate were measured and the osteogenic index was calculated. Serum markers for bone formation, bone alkaline phosphatase (BAP) and bone resorption, C-terminal telopeptides of type I collagen (CTX) were measured at three time points (pre-, mid-, post-jump). BAP and CTX increased significantly (P = 0.0017, 0.0488) in both groups post-jump; however, bone metabolic markers were not different between the OC+ and OC- groups. Osteogenic index, ground reaction force and vertical jump height were similar between groups. Correlations between markers of bone metabolism and participants' age at menarche, weight, loading rate and years on OC were not significant. A 3-week jumping protocol was found to be effective in stimulating bone metabolism in both OC+ and OC- groups.

Rebutini, et. al., (2014) determined the effects of a plyometric long jump training program on torque around the lower limb joints and swimming jump start kinetic and kinematic. Ten swimmers performed three identical assessment sessions, measuring hip and knee muscle extensors during maximal voluntary isometric contraction and, kinetic and kinematics parameters during the swimming jump start, at three instants: INI (two weeks prior to the training program, control period), PRE (two weeks after INI measurements) and POST (24-48h after 9 weeks of training). There were no significant changes from INI to PRE measurements. However, the peak torque
and rate of torque development increased significantly from PRE to POST measurements for both hip (47% and 108%) and knee (24% and 41%) joints. There were significant improvements to the horizontal force (7%), impulse (9%) and angle of resultant force (19%). In addition, there were significant improvements to the center of mass displacement (5%), horizontal takeoff velocity (16%), horizontal velocity at water entrance (22%), and peak angle velocity for the knee (15%) and hip joints (16%). Therefore, the plyometric long jump training protocol was effective to enhance torque around the lower limb joints and to control the resultant vector direction, in order to increase swimming jump start performance. These findings suggest that coaches should use long jump.

Dal Pupo, et. al., (2014) determined the test-retest reliability and concurrent validity of the 30-s continuous jump (CJ30) test using the Wingate test as a reference. Twenty-one male volleyball players (23.8 ± 3.8 years; 82.5 ± 9.1 kg; 185 ± 4.7 cm) were tested in three separate sessions. The first and second sessions were used to assess the reliability of the CJ30 while in the third session the Wingate test was performed. In the continuous jump test, consisting of maximal continuous jumps performed for 30s, jump height was determined by video kinematic analysis. Blood samples were collected after each test to determine lactate concentration. The CJ30 showed excellent test-retest reliability for the maximal jump height (ICC = 0.94), mean vertical jump height (ICC = 0.98) and fatigue index (ICC = 0.87). Peak lactate showed moderate reliability (ICC = 0.45). Large correlations were found between the mean height of the first four jumps of CJ30 and the peak power of the Wingate (r = 0.57), between the mean vertical jump height of CJ30 and the mean power of the Wingate (r = 0.70) and between the lactate peak of CJ30 and Wingate (r = 0.51). A moderate correlation of fatigue index between CJ30 and the Wingate was found (r = 0.43). The
continuous jump is a reliable test and measures some of the same anaerobic properties as WAnT. The correlations observed in terms of anaerobic indices between the tests provide evidence that the CJ30 may adequately assess anaerobic performance level.

**Wang, et. al., (2014)** investigated the effects of an eight-week program of whole body vibration combined with counter-movement jumping (WBV + CMJ) or counter-movement jumping (CMJ) alone on players. Twenty-four men's volleyball players of league A or B were randomized to the WBV + CMJ or CMJ groups (n = 12 and 12; mean [SD] age of 21.4 [2.2] and 21.7 [2.2] y; height of 175.6 [4.6] and 177.6 [3.9] cm; and weight, 69.9 [12.8] and 70.5 [10.7] kg, respectively). The pre- and post-training values of the following measurements were compared: H-reflex, first volitional (V)-wave, rate of electromyography rise (RER) in the triceps surae and absolute rate of force development (RFD) in plantarflexion and vertical jump height. After training, the WBV + CMJ group exhibited increases in H reflexes (p = 0.029 and <0.001); V-wave (p < 0.001); RER (p = 0.003 and <0.001); jump height (p < 0.001); and RFD (p = 0.006 and <0.001). The post-training values of V wave (p = 0.006) and RFD at 0-50 (p = 0.009) and 0-200 ms (p = 0.008) in the WBV + CMJ group were greater than that of in the CMJ group. This study shows that a combination of WBV and power exercise could impact neural adaptation and leads to greater fast force capacity than power exercise alone in male players.

**Aerts, et. al., (2013)** provided an overview of the kinematic variables and malalignments during jump-landing, which could be attributed to overuse or acute injury occurrence. We searched ISI Web of Knowledge, SPORTDiscus, PubMed, EMBASE and SCOPUS for all studies, published before October 2012, which looked at the relation between kinematic risk factors and malalignments of jump-landing and injuries. An article was included 1) if the article was an observational, retrospective or
A prospective study; 2) if the article investigated the relationship between injuries and the visible and easily measurable kinematic variables or malalignments of the jump-landing technique; 3) if the article met a predefined quality cut-off score. Ten studies met all inclusion criteria. Literature shows that several kinematic factors are related to lower acute and overuse injuries. A stiffer jump-landing technique is a risk factor in the development of overuse injuries and acute injuries. This is caused by less active motion in the lower extremity joints and by the increased valgus position of the knee during the jump-landing maneuver which creates an unfavorable alignment of the lower extremity. A valgus position of the knee during landing was also a predictor of acute lower extremity injuries. Future intervention programs should focus on the jump-landing technique and the performance of the athlete. Training instead of vertical jump one to improve swimming start performance.

Markovic, et. al., (2013) investigated the selective effects of different types of external loads applied in vertical jump training on both the performance and muscle power output of the squat (SJ) and countermovement jump (CMJ). Physically active males practiced maximum unconstrained vertical jumps over an 8-week period with no load, with either a negative or positive load exerted by a nearly constant external force that altered their body weight, and with a loaded vest that increased both the body weight and inertia. The magnitude of all applied loads corresponded to 30% of body weight. A similar training-associated increase in jump height was observed in all experimental groups in both CMJ (7.4-11.8%) and SJ (6.4-14.1%). The relative increase in power output was comparable to the increase in jump height in SJ (7.4-11.5%), while the power increase in CMJ was relatively small and load-specific (0.5-9.5%). The observed differences could originate from the changes in the CMJ pattern, reflected through the depth of the counter movement that particularly increased after
the training with negative load (42 %) and no load (21 %). The same participants also revealed increased CMJ duration, reduced ground reaction forces, as well as reduced maximum and average power output when compared with other training groups. Jump training with the applied loads could lead to a comparable improvement in jumping performance. However, the observed load-specific adaptations of CMJ pattern could decouple the training-associated increase in jump height from the increase in muscle power output.

**Markovic, et. al., (2011)** examined the effects of jump training with negative (-30% of the subject's body weight (BW)) VS. positive loading (+30% BW) on the mechanical behaviour of leg extensor muscles. 32 men were divided into control (CG), negative loading (NLG), or positive loading training group (PLG). Both training groups performed maximal effort countermovement jumps (CMJ) over a 7-week training period. The impact of training on the mechanical behaviour of leg extensor muscles were assessed through CMJ performed with external loads ranging from -30% BW to +30% BW. Both training groups showed significant (P ≤ 0.013) increase in BW CMJ height (NLG: 9%, effect size (ES)=0.85, VS. PLG: 3.4%, ES=0.31), peak jumping velocity (V(peak); NLG: 4.1%; ES=0.80, P=0.011, VS. PLG: 1.4%, ES=0.24; P=0.017), and depth of the countermovement (Δ H(ecc); NLG: 20%; ES=-1.64, P=0.004, VS. PLG: 11.4%; ES=-0.86, P=0.015). Although the increase in both the V(peak) and H(ecc) were expected to reduce the recorded ground reaction force, the indices of force- and power-production characteristics of CMJ remained unchanged. Finally, NLG (but not PLG) suggested load-specific improvement in the movement kinematic and kinetic patterns. Overall, the observed results revealed a rather novel finding regarding the effectiveness of negative loading in enhancing CMJ performance which could be of potential importance for further development of routine training.
protocols. Although the involved biomechanical and neuromuscular mechanisms yet need further exploration, the improved performance could be partly based on an altered jumping pattern that utilizes an enhanced ability of leg extensors to provide kinetic and power output during the concentric jump phase.

Nagano, et. al., (2011) investigated the effects of anterior cruciate ligament (ACL) injury prevention programs on knee kinematics during landing tasks; however the results were different among the studies. Even though tibial rotation is usually observed at the time of ACL injury, the effects of training programs for knee kinematics in the horizontal plane have not yet been analyzed. The purpose of this study was to determine the effects of a jump and balance training program on knee kinematics including tibial rotation as well as on electromyography of the quadriceps and hamstrings in female athletes. Eight female basketball athletes participated in the experiment. All subjects performed a single limb landing at three different times: the initial test, five weeks later, and one week after completing training. The jump and balance training program lasted for five weeks. Knee kinematics and simultaneous electromyography of the rectus femoris and Hamstrings before training were compared with those measured after completing the training program. After training, regarding the position of the knee at foot contact, the knee flexion angle for the Post-training trial (mean (SE): 24.4 (2.1) deg) was significantly larger than that of the Pre-training trial (19.3 (2.5) deg) (p < 0.01). The absolute change during landing in knee flexion for the Post-training trial (40.2 (1.9) deg) was significantly larger than that of the Pre-training trial (34.3 (2.5) deg) (p < 0.001). Tibial rotation and the knee varus/valgus angle were not significantly different after training. A significant increase was also found in the activity of the hamstrings 50 ms before foot contact (p < 0.05). The jump and balance training program successfully increased knee flexion and hamstring activity of female
athletes during landing, and has the possibility of producing partial effects to avoid the characteristic knee position observed in ACL injury, thereby preventing injury. However, the expected changes in frontal and transverse kinematics of the knee were not observed.

Sheppard, et. al., (2011) evaluated the effects of assisted jump training on counter-movement vertical jump (CMVJ) and spike jump (SPJ) ability in a group of elite male volleyball players. Seven junior national team volleyball players (18.0±1.0 yrs, 200.4±6.7 cm, and 84.0±7.2 kg) participated in this within-subjects cross-over counter-balanced training study. Assisted training involved 3 sessions per week of CMVJ training with 10 kg of assistance, applied through use of a bungee system, whilst normal jump training involved equated volume of unassisted counter-movement vertical jumps. Training periods were 5 weeks duration, with a 3-week wash-out separating them. Prior to and at the conclusion of each training period jump testing for CMVJ and SPJ height was conducted. Assisted jump training resulted in gains of 2.7±0.7 cm (p<0.01, ES=0.21) and 4.6±2.6 cm (p<0.01, ES=0.32) for the CMVJ and SPJ respectively, whilst normal jump training did not result in significant gains for either CMVJ or SPJ (p=0.09 and p=0.51 respectively). The changes associated with normal jump training and assisted jump training revealed significant differences in both CMVJ and SPJ (p=<0.03) in favour of the assisted jump condition, with large effect (CMVJ, ES=1.22; SPJ, ES=1.31). Assisted jumping may promote the leg extensor musculature to undergo a more rapid rate of shortening, and chronic exposure appears to improve jumping ability.

Hilfiker, et. al., (2007) evaluated the immediate influence of eccentric muscle action on vertical jump performance in athletes performing sports with a high demand of explosive force development. In this randomized, controlled crossover trial, 13 Swiss
elite athletes (national team members in ski jump, ski alpine, snowboard freestyle and alpine, ski freestyle, and gymnastics) with a mean age of 22 years (range 20-28) were randomized into 2 groups. After a semi standardized warm-up, group 1 did 5 jumps from a height of 60 cm, landing with active stabilization in 90 degrees knee flexion. One minute after these modified drop jumps, they performed 3 single squat jumps (SJ) and 3 single counter movement jumps (CMJ) on a force platform. The athletes repeated the procedure after 1 hour without the modified drop jumps. In a crossover manner, group 2 did the first warm-up without and the second warm-up with the modified drop jumps. Differences of the performance (jump height and maximal power) between the different warm-ups were the main outcomes. The mean absolute power and absolute height (without drop jumps) were CMJ 54.9 W.kg(-1) (SD = 4.1), SJ 55.0 W.kg(-1) (SD = 5.1), CMJ 44.1 cm (SD = 4.1), and SJ 40.8 cm (SD = 4.1). A consistent tendency for improvement with added drop jumps to the warm-up routine was observed compared with warm-up without drop jumps: maximal power CMJ +1.02 W.kg(-1) (95% confidence interval [CI] = +0.03 to +2.38), p = 0.045; maximal power SJ +0.8 W.kg(-1) (95% CI = -0.34 to +2.02), p = 0.148; jump height CMJ +0.48 cm (95% CI = -0.26 to +1.2), p = 0.182; SJ +0.73 cm (95% CI = -0.36 to +1.18), p = 0.169. Athletes could add modified drop jumps to the warm-up before competitions to improve explosive force development.

2.5. SUMMARY OF THE LITERATURE

The reviews were presented in three section such as SAQ Training, jumping ABC Training and Speed Training. This section gives an insight into the number and range of how the trainings have been influenced the various types of dependent variables.
In summary, studies on SAQ training, jumping ABC training and speed training revealed much on various aspects of development through the usage of SAQ training, jumping ABC training and Speed training. The studies reviewed in this section mostly in the disciplines of Physical Education, Medical Science, Dental, Physics, Library, Mathematics, Plant Physiology, Medical Anatomy and Physiology, Radiology and so forth.

The research studies reviewed were from many journals available in the websites such as www.pubmed.gov, and ERIC websites and so on. All such websites employ SAQ Training, jumping ABC Training and Speed Training.