Strength and Conditioning for Soccer Players

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ABSTRACT

SOCCER IS CHARACTERIZED AS A HIGH-INTENSITY, INTERMITTENT, CONTACT TEAM SPORT THAT REQUIRES A NUMBER OF PROFICIENT PHYSICAL AND PHYSIOLOGICAL CAPABILITIES TO PERFORM SUCCESSFULLY. APART FROM THE NECESSARY TECHNICAL AND TACTICAL SKILLS REQUIRED, SOCCER PLAYERS MUST ALSO DEVELOP AND RETAIN A HIGH LEVEL OF AEROBIC AND ANAEROBIC CONDITIONING, SPEED, AGILITY, STRENGTH, AND POWER. THESE ARE BEST DEVELOPED THROUGH HIGH-INTENSITY INTERVAL TRAINING, SMALL-SIDED GAMES, REPEATED SPRINTS, COACHED SPEED AND AGILITY SESSIONS AND STRENGTH AND POWER-BASED GYM SESSIONS. SOCCER COACHES AND STRENGTH AND CONDITIONING COACHES MUST WORK COHESIVELY TO ENSURE A STRUCTURED AND EFFECTIVE PROGRAM IS ADHERED TO.

INTRODUCTION

Soccer is the world's most popular sport with the Federation of the International Football Association (FIFA) estimating that more than 270 million people are actively involved in the sport worldwide. The US Soccer Federation (USA) has the second highest number of registered players of all countries and participation continues to grow. In recent years, there has been a remarkable expansion in and acceptance of sport science, and specifically strength and conditioning (S&C), within soccer. This discipline is recognized as a valid area of scientific and professional practice, with S&C practitioners becoming key members of the now multidisciplinary coaching team.

In addition to the necessary technical and tactical skills required, soccer players must develop and retain a high level of athleticism to be successful. Previous research has identified that aerobic endurance (4,15,17,44,62), ability to repeatedly execute high-intensity actions (58), speed (58,64), agility (32,58), and strength and power (89) are all determinants of superior performance. However, it is worth noting that physiological and physical characteristics vary between different positions. The aim of this article is to review the physiological demands of soccer to provide S&C coaches with critically appraised evidence-based interventions for elite male soccer players.

METABOLIC CONDITIONING

The level of metabolic conditioning of a soccer player is crucial in defining and ultimately limiting their contribution to the game (41). It has been shown repeatedly that maximal aerobic capacity is positively related to soccer performance parameters such as distance covered, time on the ball, and number of sprints during a match (15,17,44,62). Specifically, Helgerud et al. (41) reported that using specific aerobic interval training (4 periods of 4 minutes at 90–95% of maximum heart rate, HRmax, with a 3-minute jog in between) twice a week for 8 weeks with elite male soccer players (n = 19; 18.1 ± 0.8 years) achieved:

- Enhanced aerobic capacity, $\dot{V}O_2max$, from 58.1 ± 4.5 to 64.3 ± 3.9 mL/kg/min ($P < 0.01$).
- Increased the distance covered by 20% ($P < 0.01$).
- Average work intensity up from 82.7 ± 3.4% to 85.6 ± 3.1% ($P < 0.05$).
- Increased the number of sprints by 100% ($P < 0.01$).
- Lactate threshold up from 47.8 ± 5.3 to 55.4 ± 4.1 mL/kg/min ($P < 0.01$).
- Improved running economy by 6.7% ($P < 0.05$).
- Increased the number of involvements with the ball by 24% ($P < 0.05$).

Aerobic capacity also corresponds to a higher league position (89), the level of competition (5,72), and more starting players compared with nonstarting players (37,81). Accordingly, the aerobic capacity of soccer players must be developed, and Tables 1 and 2 identify position-specific values for aerobic

KEY WORDS:
soccer; program design; metabolic conditioning; speed; resistance training

Table 1
Physiological characteristics of elite Croatian soccer players

Variable	Defenders (n = 80)	Midfielders (n = 80)	Attackers (n = 80)	Goalkeepers (n = 30)	Total (n = 270)	Range
Body fat, %	12.2 ± 0.7	8.4 ± 2.9	10.2 ± 2.1	14.2 ± 1.9	11.9 ± 3.1	6.3–19.5
5 m, s	1.43 ± 0.5	1.47 ± 0.6	1.39 ± 0.4	1.45 ± 0.7	1.44 ± 0.5	1.39–0.47
10 m, s	2.14 ± 0.7	2.23 ± 0.5	2.03 ± 0.9	2.35 ± 0.8	2.27 ± 0.4	2.13–2.36
SJ, cm	42.3 ± 2.1	41.49 ± 4.0	44.2 ± 3.2	46.8 ± 1.4	44.1 ± 1.3	40.9–48.3
CMJ, cm	44.2 ± 1.9	44.26 ± 2.1	45.3 ± 3.2	48.5 ± 1.5	45.1 ± 1.7	41.4–50.1
$\dot{V}O_2$max, mL/kg/min	59.2 ± 1.5	62.3 ± 3.1	58.9 ± 2.1	50.5 ± 2.7	60.1 ± 2.3	50.3–65.3
HRmax, bpm	187.2 ± 2.3	191.1 ± 2.1	188.1 ± 2.1	188.5 ± 1.9	189.1 ± 1.9	185.4–193.3

Sporis et al. (78) collected physiological measurements of 270 professional Croatian soccer players (mean age 28.3 ± 65.9 years, range 19.4–34.5 years) over 2 years to evaluate whether positional roles have different physical and physiological profiles.

bpm = beats per minute; CMJ = countermovement jump; HRmax = maximum heart rate; SJ = squat jump.

capacity in elite male soccer players (5,78).

HIGH-INTENSITY INTERVAL TRAINING

Soccer is characterized as an intermittent sport with repeated bouts of high-intensity activity. Therefore, for training to suit the physical demands of the game, emphasis should focus upon the ability to repeatedly execute high-intensity activities with short rest periods. High-intensity interval training (HIIT) has been reported to induce greater improvements in both aerobic and anaerobic capacity compared with continuous training involving the same mechanical work and duration (36). In addition to this, HIIT training modalities require approximately half the time of traditional continuous methods and are more likely to enhance player motivation and adherence and increase the time for technical and tactical practices. Fundamentally, they are not likely to be detrimental to strength and power (because of Type 2 muscle fiber recruitment), the significance of which will be described later. Helgerud et al. (41) and Hoff et al. (45) recommend a high-intensity endurance training modality aimed specifically at increasing $\dot{V}O_2$max; for this, the athletes complete 4 intervals of 4 minutes at 90–95% HRmax, separated by 3 minutes of recovery performed at 70% HRmax. Helgerud et al. (42) have compared 4 endurance training interventions designed to improve $\dot{V}O_2$max in professional soccer players (Table 3).

SMALL-SIDED GAMES

In high performance sports, it is generally accepted that the benefits of exercise are maximized when the

Table 2
Physical characteristics of elite Icelandic soccer players with reference to position

Test variable	Strikers N	Strikers Mean ± SD	Midfielders N	Midfielders Mean ± SD	Defenders N	Defenders Mean ± SD	Goalkeepers N	Goalkeepers Mean ± SD	All players N	All players Mean ± SD
Body fat, fat %	47	9.6 ± 5.1	76	10.7 ± 4.2	89	10.6 ± 3.6	15	12.3 ± 5.3	227	10.5 ± 4.3
CMJ, cm	49	39.4 ± 4.2	70	39.3 ± 4.9	79	39.3 ± 5.5	16	38.0 ± 5.6	214	39.2 ± 5.0
SJ, cm	49	37.8 ± 4.4	70	37.6 ± 4.8	79	37.7 ± 4.9	16	35.8 ± 5.3	214	37.6 ± 4.8
Peak $\dot{V}O_2$, mL/kg/min	47	62.9 ± 5.5	76	63.0 ± 4.3	87	62.8 ± 4.4	15	57.3 ± 4.7	225	62.5 ± 4.8
Injury days per player, d	64	10.1 ± 9.6	96	11.9 ± 0.7	114	10.0 ± 19.0	24	2.8 ± 5.5	298	10.1 ± 19.1

Arnason et al. (5) investigated the relationship between physical fitness and team success in 306 elite male soccer players (mean age 24 years, range 16–38 years), from 17 Icelandic teams in the top 2 divisions in the 1999 soccer season.

CMJ = countermovement jump; SJ = squat jump.

Table 3 Training systems used by Helgerud et al. (42) to enhance aerobic capacity			
Training group	**Protocol**	**Pretraining $\dot{V}O_2$max, mL/kg/min**	**Posttraining $\dot{V}O_2$max, mL/kg/min**
Long slow distance running	Continuous run at 70% HRmax (137 ± 7 bpm) for 45 min	55.8 ± 6.6	56.8 ± 6.3
Lactate threshold running	Continuous run at lactate threshold (85% HRmax, 171 ± 10 bpm) for 24.25 min	59.6 ± 7.6	60.8 ± 7.1
15/15 interval running (15/15)	47 reps of 15-s intervals at 90–95% HRmax (180–190 ± 6 bpm) with 15-s of active resting periods at warm-up velocity, corresponding to 70% HRmax (140 ± 6 bpm) between	60.5 ± 5.4	64.4 ± 4.4; 5.5% increase
4 × 4-min interval running (4 × 4 min)	4 × 4-min interval training at 90–95% HRmax (180–190 ± 5 bpm) with 3 min of active resting periods at 70% HRmax (140 ± 6 bpm) between each interval	55.5 ± 7.4	60.4 ± 7.3 (mL/kg/min) 7.3% increase

Using the 4 × 4 intervention twice a week for 8 weeks increased the $\dot{V}O_2$max of soccer players by 11%, resulted in a 20% increase in the distance covered, a 23% increase in involvements with the ball and a 100% increase in the number of sprints (41).

training stimuli are similar to competitive demands. Small-sided games (SSG) are soccer-specific training protocols designed to develop technical, tactical, and physical capabilities (69). These games are typically completed in the form of several intervals, with varying numbers of players, different pitch dimensions, and modified rules. It has been reported that SSG expose players to significant aerobic and anaerobic loads, with a mean relative intensity of 82% $\dot{V}O_2$max and mean blood lactate levels of 4.5–4.9 mmol for a 4 versus 4 game (60); additionally, the number of high-intensity activities (43) and time in possession of the ball (60) are higher than that found in match play (11 versus 11 game). Reilly and White (70) reported no significant difference between HIIT and SSG in relation to heart rate or lactate concentrations:

- HIIT: six 4-minute runs at 85–90% HRmax, 3-minute rest between runs.
- SSG: 5 versus 5 games; six 4-minute games, 3-minute rest between games.

There are a number of factors the S&C coach must consider before designing and implementing SSG, for example, the condition capabilities of the players, the stage in the soccer season, the technical level of the players, the time of SSG application in relation to the match schedule and the team's strategic objectives (18). The number of players in SSG can influence the physiological and tactical element of the exercise. Rampinini et al. (69) suggest that as the number of players decreases the intensity increases, and results in players having more touches of the ball (9). However, although the frequency of technical actions is increased with fewer players, the tactical component of the drill is more limited as players are not restricted to specific positions and tasks.

Field dimensions can impact the kinematics of the players. The larger the playing area, the more time and space the player has to make a decision and carry out his actions. Conversely, smaller spaces reduce the time for decision making and actions and are likely to induce more accelerations, decelerations, and changes of direction. Also, physiological workloads and ratings of perceived exertion are higher when the playing areas are bigger (14,69).

In addition, the number of players and field dimensions, game rules can also impact the intensity of SSG. Mallo and Navarro (61) compared the demands of 3 exercises with different constraints and found that the inclusion of goalkeepers modified the physical and tactical behavior of the players; the exercises that included the goalkeepers reported that the players covered less distance, worked at a lower intensity, and tactically became more defensive.

It is evident that SSG provides an effective physiological stimulus to enhance and maintain aerobic and anaerobic capacity and allow for concomitant improvements of technical and tactical skills. However, S&C coaches should consider the pitch dimensions, number of players, rules of the game and timings as variables that can impact upon the intensity of the games. Table 4 provides examples of different formats for SSG.

REPEAT SPRINT ABILITY

Sprinting ability is an integral component of successful game play (58,64), with the ability to perform sprints repeatedly being a predictor of superior

Table 4
Examples of small-sided game formats

Number of players	Pitch dimensions, m	Timings	Notes
3v3–4v4	25 × 20–30 × 25	2 × 6 × 1 min (1.5-min rest)–3 × 6 × 2 min (1-min rest)	Limited tactical component
			High number of actions per player
			High intensity
			Increased acceleration/deceleration and change of direction
5v5–7v7	40 × 30–60 × 35	4 × 4 min (2-min rest)–5 × 8 min (2-min rest)	Moderate tactical component
			Moderate to high number of actions
			Moderate to high intensity
			Accelerations/decelerations and high speed running
8v8–11v11	70 × 40–90 × 45	3 × 12 min (2-min rest)–4 × 15 min (2-min rest)	High tactical component
			Low number of actions per player
			Lower intensity (increased recovery between actions)
			Increased high speed running
			Larger aerobic emphasis

performance (58). Repeat sprint ability (RSA) has been described as the ability to produce the best possible sprint performance over a series of sprints (≤10 seconds), separated by short recovery periods (≤60 seconds) (12). Plisk and Gambetta (68) advocate using tactical metabolic training as an extension to repeated sprint training. This approach uses position and match-specific movement and intensities observed during actual competition. Advantages include greater time efficiency, with skill components being integrated into metabolic conditioning, and enhanced motivation and compliancy among players.

A common method of quantifying intermittent activity is often described by specific work:rest ratios. However, within soccer, there should be consideration for such ratios being heavily influenced by playing position and level of competition. It is suggested that repeated sprint training should aim to increase phosphocreatine (PCr) recovery. This is achieved by implementing rest periods long enough to replenish the majority of PCr but short enough to induce gradual fatigue to stimulate an appropriate training adaptation. A work:rest ratio of 1:6 has been suggested to develop the phosphagen system and resemble the demands of soccer in males (59); highly trained athletes may be able to train at a slightly lower work:rest ratio of 1:4 to provoke appropriate training adaptations (59). Anecdotally, the maximum effort duration should not exceed 6 seconds, and multidirectional as well as linear movements are beneficial.

In summary, it can be suggested that a combination of HIIT, SSG, and RSA training is used to develop aerobic and anaerobic capabilities within soccer players. It may also be prudent to recommend using predominantly aerobic and anaerobic intervals during the off-season, and a combination of SSG and RSA training within the competitive period due to the time efficacy and sport-specific nature of the drills.

ACCELERATION AND SPEED

Bangsbo (11) found that players sprint between 1.5 m and the length of the pitch during a match, but average 17 m. Around 96% of sprints are less than 30 m, with an average duration of less than 6 seconds and an occurrence of every 90 seconds on average (11). Other authors have reported that almost half of the total sprints are less than 10 m (63,79) and typically commence when the player is already in motion; therefore, maximal velocity is achievable in a reduced period of time and distance compared with sprints from a static start (58,74,92). This suggests the necessity to develop speed following a flying or rolling start.

Although there is growing consensus that the components that comprise speed performance are trainable, it is less clear what the optimal approach to training might be (34). What is known is that speed consists of a multitude of factors and that it requires dedicated training. To develop soccer-specific speed, it is necessary to incorporate perception-action coupling and account for the development of perceptual and decision-making aspects (76). Gamble (34) identifies the trainable determinants of speed performance as neuromuscular skill and coordination, postural control and stability, strength qualities, mechanical, and morphological qualities of locomotor muscles, and stretch-shortening cycle.

AGILITY

A soccer player changes direction every 2–4 seconds (82) and makes 1,200–1,400 changes of direction (10) during a game. Rapid activity occurs in the crucial seconds of the game and can make the difference in determining the outcome of the game. It is suggested that superior male and female athletes from a range of sports demonstrate better visual search strategies and produce more accurate and faster responses (2,26,31,73,86). The ability to produce fast-paced variable actions can impact soccer performance (32,58); so, a soccer player's agility must be developed.

For most athletes, a progression from closed to open agility drills is required. For example, Holmberg (49) suggests that agility is best developed by progressing through the following phases: technical drills, pattern running, and then reactive agility training. Technical drills involve focusing and developing specific movement patterns. Pattern running typically involves several preplanned change-of-direction movements sequenced in a sport-specific pattern and are generally considered very effective for novice athletes. However, once a high level of technical proficiency is attained, agility sessions that reinforce game-like situations while compelling athletes to respond to random stimuli are a more beneficial method of training. Therefore, SSGs are further advocated as they provide the opportunity to develop reactive agility. Moves that deteriorate under pressure can be rehearsed in a closed environment, with progress monitored in subsequent SSGs.

STRENGTH AND POWER

Soccer involves repeated powerful movements like kicking, sprinting, tackling, and jumping. Measures of power generation including sprinting ability (51,54,58,71,77) and jumping height and distance (16,71) have been shown to positively correlate with performance in soccer. Specific to soccer, jump height (r = 0.78), 10 m (r = 0.94) and 30 m (r = 0.71) sprint performances, and aerobic endurance are highly correlated with maximal strength in professional male soccer players (46,88). Table 1 (78) and Table 2 (5) identify position-specific values for countermovement jump (CMJ) and squat jump (SJ); CMJ is largely regarded as a valid test of lower-body power and SJ is largely regarded as a valid test of lower-body strength. The rationale for improving a player's strength and power can be noted when reading the research of Wisløff et al. (89). Here, the champions in the Norwegian elite soccer league, Rossenburg, were compared with Strindheim who finished in last place (Table 5). The authors suggested that the higher strength, power, and endurance capacity gave Rosenborg a better foundation for on-field performance.

Strength training, as developed by means of heavy resistance training, has been shown to improve initial acceleration and change-of-direction activities, H^+ (hydrogen ion) regulation and buffering capacity, and repeated sprint ability; it subsequently delays the fatigue experienced in match play (22). Dependent on the

Table 5
Comparison of results between Rosenborg, who finished champions of the Norwegian elite soccer league (89), and Strindheim, who finished last

Team	Height, cm	Mass, cm	$\dot{V}O_2$max, mL/kg/min	Squats, kg	Squats, kg/mass	Vertical jump, cm	Bench press, kg	Bench press, kg/mass
Rosenburg	182.1 ± 4.8	79.6 ± 6.3	67.6 ± 4.0*	164.6 ± 21.8†	2.1 ± 0.3†	56.7 ± 6.6*	82.7 ± 12.8	1.1 ± 0.3
Strindheim	180.8 ± 4.9	76.8 ± 6.4	59.9 ± 4.1	135.0 ± 16.2	1.7 ± 0.2	53.1 ± 4.0	77.1 ± 16.5	1.0 ± 0.2

Squats performed to 90° joint angles at the knee; Jump height determined using a force platform.

*Significantly higher than Strindheim ($P < 0.05$).

†Significantly higher than Strindheim ($P < 0.01$).

Table 6 Most effective strategies for maximal strength gains		
Novice	**Amateur**	**Professional**
Untrained individuals	**Trained individuals**	**Highly trained individuals (athletes)**
Intensity: 60% of 1RM	Intensity: 80% of 1RM	Intensity: 85% of 1RM
Volume: up to 4 sets per exercise	Volume: up to 4 sets per exercise	Volume: up to 8 sets per exercise
Frequency: 3 d per week	Frequency: 2 d per week	Frequency: 2 d per week

RM = repetition maximum. Table created based on data from Peterson et al. (67).

player's training age, the most effective strategies for enhancing strength are summarized by Peterson et al. (67) in Table 6. The high and positive correlation that exists between maximum strength and peak power (r = 0.77–0.94) (6), further advocates heavy resistance training as a precursor for power development. Notably, strength training that involves high loads (>80% 1 repetition maximum [RM]) leads to greater increases in maximum muscle power compared with low resistance strength training (1).

Factors that influence power include both intramuscular and intermuscular coordination, maximal strength, and the various structural and neural elements that comprise the stretch-shortening cycle (SSC) (34). Therefore, the multidimensional nature of power requires a multifaceted approach to training (65,75,94). These can broadly be categorized into 3 modes of training: ballistic resistance training, Olympic-style weightlifting, and plyometrics.

BALLISTIC RESISTANCE TRAINING

This training mode is characterized by an external resistance being unloaded (projected or released) at the termination of the concentric movement (19), for example, a throw or jump. This results in the load being accelerated for longer, allowing higher velocities to be achieved (65). Both concentric-only and eccentric-concentric variations of ballistic resistance training can be performed. However, exercises that exhibit a rapid eccentric-concentric coupling appear to be integral to the improvement of power. It has been hypothesized that each repetition should achieve ≥90% of peak power output or velocity (29); however, Cronin and Sleivert (20) reported that training at a range of loads, irrespective of which load constitutes peak power output, is in fact likely to produce superior results.

WEIGHTLIFTING

Weightlifting (snatch and clean and jerk) primarily features concentric force development. They enable relatively high loads to be controlled in an explosive manner in the vertical plane. Consequently, power output is maximized at much greater relative external loads than ballistic resistance training modes. In fact, Olympic-style weightlifting has been reported to produce some of the highest power outputs of any exercise modality (35).

PLYOMETRICS

Improvements made with regard to the utilization of the SSC through plyometric training result in an increase in jump and hopping height (4,24,25), reduced ground contact time (GCT) at all running speeds (4), increased rate of force development (13,87) and contributes to an athlete's ability to change direction (31,53,93). In addition, Voigt et al. (84) and Verkhoshansky (83) reported that economical sprinting (i.e., efficient usage of the stretch-shortening mechanism) can recover approximately 60% of the total mechanical energy, thereby increasing running economy. Although these findings were not limited to soccer, it is assumed that the results are directly transferable to many sporting movements specific to soccer.

Optimization of SSC mechanics through appropriate plyometric drills will improve a player's reactive strength. Flanagan and Comyns (27) suggest progressing through the following phases:

- Eccentric loading and correct landing mechanics (e.g., drop lands).
- Low-intensity fast plyometrics where a short GCT is encouraged (e.g., ankling).
- Hurdle and depth jumps upon which the focus is short GCT and optimum jump height (e.g., drop jumps).

It is evident that strength and power are determinants of successful soccer performance and also aid in preventing injury (discussed in a later section). The best method for improving these qualities is by combining heavy resistance training (using the protocols in Table 6) and power exercises in the form of ballistic resistance training, weightlifting, and plyometrics. For power training, it is suggested that training at a range of loads will optimize results, and these are anecdotally achieved while performing a maximum of 5 sets of 3 reps, with a minimum of 3-minute rest between sets (8,29). It may be wise to structure this type of training in blocks (traditional periodization, described in the next section), for example, strength endurance during the off-season with strength and power in the preseason.

PROGRAM DESIGN

PERIODIZATION

The traditional periodization strategies (e.g., implementing a particular component focus for approximately 4 weeks and utilizing a 3:1 loading paradigm whereby progressive loading is applied for weeks 1–3 and week 4 is used to de-load) are generally concerned with athletes who need to peak for a single or acute phase (<2 weeks) of competitions (e.g., track athletes and martial artists) and are therefore not necessarily suited to team-sport athletes. Soccer players must reach their peak as part of preseason training, and then maintain it for extended periods of up to 35 weeks. Therefore, it has been suggested that while the classical or traditional form of periodization is appropriate during the off-season and preseason, a nontraditional (nonlinear) form of periodization is more appropriate to team sports during the in-season (33,48,55–57). This form of periodization involves the variation in training prescription and volume loads on a session-by-session basis to concurrently account for multiple training goals. It is suggested that one of the merits of this system is the ease with which sessions can be quickly tailored and administered in response to the intense and variable competition schedule (38). It should be noted that maintaining peak performance for up to 35 weeks is considered a thankless task (47,56) and is somewhat dependent on maintaining strength (3,7).

Kraemer et al. (56) reported that both starting and nonstarting soccer players had decreased performance over an 11-week competitive season. This indicates that the drop was independent of total match play and the volume load of practices and conditioning. A catabolic environment (high cortisol, low testosterone) was induced in the preseason and is likely to have determined the metabolic status of the players as they entered the competitive period. This highlights the need for a restoration period, particularly as they enter the competitive phase; such a period is referred to as a taper. It is suggested that regular physiological monitoring is performed to identify the training status of the players and team. This information will allow the S&C coach to taper training volume and intensity appropriately to provide an effective training environment. Tables 7 and 8 provide examples of an annual plan and competition microcycle (with 1 match played per week), respectively, for elite soccer players.

GENERAL PREPARATORY PHASE OR ACCUMULATION PHASE

This block is typically 2–6 weeks in duration and involves relatively high volumes and lower intensities (specifically muscular endurance/hypertrophy). The primary objective of this non–sport-specific phase is to increase the player's tolerance to the continuously increasing training and competition demands and to address individual dysfunction. Exercises prescribed during this phase should focus on the individual needs of the player. See Table 9 for an example general preparatory phase mesocycle.

SPORT-SPECIFIC PREPARATORY PHASE

This block is typically 2–4 weeks in duration and involves high-intensity training with relatively lower volumes. The focus should be on sport-specific training modes to help facilitate greater transfer to training and matches (Table 10).

COMPETITION OR REALIZATION PHASE

This block may be up to 35 weeks in duration; training intensity and volume may vary and is easily adapted to the competition schedule. The objective of this phase is to maintain the player close to their physical peak, with some suggesting that you may even be able to increase strength levels throughout the season (7). For example, Hoffman and Kang (47) reported significant in-season improvements in strength (1RM squat and bench press) in American football players (n = 53; 2 d/wk during in-season resistance training at >80% 1RM). However, American football and soccer impose different physiological demands with the latter more aerobic in nature and associated with high levels of fatigue and cortisol concentrations (56). As such, the goal is likely to be to minimize loss of strength in elite players. For an example competition mesocycle, see Table 11.

TRANSITION

After the competitive season, there is a transition period before structured training commences. This period of active rest is used to dissipate any muscular, neural, and psychological fatigue (85). Nonstructured, low-intensity, low-volume recreational activities are recommended during this time.

INJURY PREVENTION

It seems prudent to address injury incidence and potential preventative strategies within soccer. Soccer is classified as a contact sport with the majority of contact occurring between opposing players while contesting ball possession. In such a sport, injury of varying severity is inevitable. It is reported that elite male soccer players incur approximately 1 performance-limiting injury each year (21,39), with the average injury resulting in 24.2 days lost to training and competition (40). These inevitable injuries appear more likely to occur during competition rather than training (90). Arnason et al. (5) identified a trend between the high number of days lost to injury and the lack of team success in elite male soccer players.

The lower bodily extremities are most at risk from injury (90) with the knee, ankle, thigh, groin, and calf being the most injured regions (52,90), and sprains, strains and, contusions being the most common injury types (52). Furthermore, previous studies have shown that injuries caused by nonbody contact were more prevalent than injuries caused by body contact (39,40,91) and occur mainly during running and turning (39,40). Soccer players seem to be at particular risk for both hamstring (23) and adductor muscle injuries (5,66).

Table 7
Example of an annual macrocycle

Preparation			
General preparatory phase	**SSPP**	**Competition**	**Transition**
2–6 wk	3–4 wk	30–35 wk	3–4 wk
1–2 mesocycles	1 mesocycle	6–8 mesocycles lasting 4 wk	Rest
1–2 preseason matches	2–4 preseason matches	Nontraditional (undulating periodization)	Holiday
Traditional periodization	Traditional periodization		The last 15 d: active rest (2–3 sessions per week)
			Play other sports
			Swimming
			Cycling
			Jogging
			Flexibility exercises
Training objectives: cycle 1	Training objectives	Training objectives	
Strength-endurance/hypertrophy	Strength-speed	Competition	
Aerobic capacity (70–80% of MHR)	Speed-strength	Maintain strength	
Coordination	Maximum speed	Maintain power	
Mobility	Lactic and alactic development	Aerobic-anaerobic power and capacity	
	Reactive agility	Adequate recovery	
Training objectives: cycle 2			
Strength			
Aerobic power (80–100% of MHR)			
Running drills			
Coordination and change of direction			

MHR = maximum heart rate; SSPP = sport-specific preparatory phase

In a review of soccer injuries by Junge and Dvorak (52), several strategies for the prevention of soccer injuries were discussed. These included:

- Warm-up with more emphasis on stretching.
- Regular cool-down.
- Adequate rehabilitation with sufficient recovery time.
- Proprioceptive training.
- Protective equipment.
- Good playing conditions.
- Adherence to rules.

It is interesting to note that S&C training (or strength training in general) was not identified as a key factor. In addition to an increase in muscle strength, tendon, ligament, and cartilage strength would also increase along with bone mineral density (28,30,80), and therefore improve the structural integrity of all joints involved. Also, athletes who display an agonist-antagonist muscular imbalance may exhibit alterations in neural firing patterns, leading to increased braking times and inaccurate movement mechanics during rapid ballistic movements (50), which may expose soccer players to the aforementioned prevalent noncontact injuries during running and turning (39,40). In addition to addressing

Table 8
Example of an in-season microcycle

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
AM	Rest	Physical: strength/power soccer: technical/tactical game (8v8–11v11)	Physical: individualized injury prevention and SSG and RS	Physical: strength/power soccer: technical/tactical	Physical: individualized injury prevention and speed/reaction soccer: tactical work game (tactical)	Rest	Team recovery session technical/conditioning session for the players not involved in the match
PM	Rest	Soccer: technical/tactical	Soccer: technical/tactical	Rest	Rest	Match	Rest

RS = repeat sprint; SSG = small-sided games.

Table 9
Example of an off-season mesocycle

Off-season (general preparatory phase)		
Session 1 (10RM; 3 sets)	**Session 2 (12RM; 3 sets)**	**Session 3 (8RM; 3 sets)**
DB lateral lunge	BB overhead squat	DB split squat
BB RDL	Cable hip abduction	Assisted Nordic curls
SL calf raise	SL squat	Cable hip adduction
BB military press	Bench press	DB press up and rotate
Close grip pull up	Seated cable row	Inverted row
Cable trunk rotation	Cable antirotation	Plank variation
Metabolic conditioning: 4 × 4-min interval run at 90–95% MHR with 3-min active rest at 70% MHR		
Acceleration and speed: sprint technique/preparation and coordinative drills		
Plyometrics (emphasis on landing mechanics)		
Jump and stick (bilateral-unilateral)		
Box jump (bilateral-unilateral)		
Agility: various closed change-of-direction drills (emphasis on movement mechanics opposed to speed)		
Notes: 3:1 loading paradigm		

BB = barbell; DB = dumbbell; RDL = Romanian deadlift; RM = repetition maximum; SL = single leg.

Table 10
Example of a preseason mesocycle

Pre-Season (SSPP)					
Session 1	**Load**	**Sets/reps**	**Session 2**	**Load**	**Sets/reps**
Hang power clean	70% 1RM	5 × 2	Mid-thigh pull	85% 1RM	5 × 3
Jump squats	0% 1RM	5 × 3	Medicine ball throw	10% BW	5 × 3
Nordic curls	BW	3 × 6–8	Drop jump	BW	3 × 5
Bench throws	55% 1RM	3 × 5	Bent over row	75% 1RM	3 × 6
Metabolic conditioning: SSG and repeated sprints/TMT (work:rest ratio, 1:6)					
Acceleration and speed: maximum sprints—5, 10, and 15 m (rolling and static)					
Plyometrics: (emphasis on short GCT) multiple hops and jumps (bilateral and unilateral; multidirectional)					
Agility: complex patterned drills progressing into reactive drills					
Note: 3:1 loading paradigm individual corrective and core work to be completed between sets or at the end of the session					

BW = bodyweight; GCT = ground contact time; RM = repetition maximum; SSG = small-sided games; SSPP = sport-specific preparation phase; TMT = tactical metabolic training.

Table 11
Example of an in-season mesocycle

In-season (competition)					
Session 1	**Load**	**Sets/reps**	**Session 2**	**Load**	**Sets/reps**
Rack pull	70% 1RM	5 × 3	Power clean	80% 1RM	5 × 3
1/2 Back squat	90% 1RM	3 × 3	Box jump	BW	5 × 5
Straight-legged deadlift	75% 1RM	3 × 8	Step up	75% 1RM	3 × 6
Bench press	80% 1RM	3 × 6	Wide grip chins	BW	3 × 6
Metabolic conditioning: SSG and repeated sprints/TMT (work:rest ratio 1:6–1:4)					
Acceleration and speed: maximum sprints—5, 10, and 15 m (rolling and static)					
Plyometrics: (emphasis on short ground contact time and maximum jump height) depth jumps and bounds (bilateral and unilateral; multidirectional)					
Agility: reactive drills and SSG					
Individual corrective and core work to be completed between sets or at the end of the session.					

BW = bodyweight; RM = repetition maximum; SSG = small-sided games; TMT = tactical metabolic training.

muscle imbalances, implementing exercises/drills aimed at improving the neuromuscular skill, coordination, and movement mechanics of speed and change-of-direction actions may also be of value.

In addition to the strategies outlined by Junge and Dvorak (52), prevention strategies such as increasing muscle strength (and its concomitant benefits to connective tissue adaptations), addressing muscular imbalances (particularly of the thigh), and improving movement mechanics (e.g., during running, turning, and landing) are recommended. Significantly, these would be addressed by virtue of implementing any efficacious S&C program.

CONCLUSION

Soccer is characterized as a high-intensity, intermittent contact team sport that requires a number of proficient physical and physiological capabilities to perform successfully. Aside from the necessary technical and tactical skills required, soccer players must also develop and retain a high level of aerobic and anaerobic conditioning, speed, agility, strength, and power. The authors recommend that these qualities are developed using the following methods:

- Aerobic and anaerobic capacity–HIIT, SSG, and RSA.
- Speed and agility–neuromuscular skill and coordination, strength, postural control and stability, and plyometrics.
- Strength–heavy resistance training.
- Power–ballistic resistance training exercises, plyometric drills, and Olympic-style weightlifting.

When implementing the training program, it is recommended that a traditional periodized approach is applied during the off-season and preseason periods and a nontraditional approach is implemented in-season (the competition period). In addition to the physical development training, it is important to incorporate components of injury prevention. This article provides S&C coaches with the necessary scientific research to implement an evidence-based training program to enhance soccer performance.

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