Health & Fitness Journal

of Canada

Volume 9 May 30, 2016 Number 2

NARRATIVE REVIEW

Evidence-based strength and conditioning in soccer.

Sam Orange[1] and Andy Smith[2]

Abstract

Background: Competitive soccer is complex and acyclical in nature. In addition to the necessary technical and tactical skills, a number of well-developed physiological characteristics are required to perform successfully. Soccer is not a science, but evidence-based practice based on scientific literature can improve performance. Strength and conditioning (S&C) practitioners are now emerging as essential members of a multidisciplinary coaching team. *Purpose:* To review the physiological demands of soccer and provide S&C coaches with evidence-based training recommendations for full-time professional male soccer players. *Methods:* To gather information on soccer match-play and effective training prescriptions, a narrative review of literature was conducted using Ovid/Medline, Pub-Med and Google Scholar data-bases. This was supplemented by a review of relevant reference lists. *Results:* During a 90 min match, professional soccer players cover 10-12 km mostly by walking or jogging. High-intensity actions occur during important periods of play and are critical to the result of the match. The professional soccer player is required to complete almost 3000 actions during a match, including sprinting, jumping, turning, and decelerating. These activities are dynamic and occur in an unpredictable pattern. *Conclusion:* Wherever possible, S&C in soccer must replicate match-play so that specific movement patterns can be developed. Small-sided games should be manipulated to improve aerobic endurance, repeated sprint ability and agility, while also promoting a direct transfer to the competitive environment. Strength and power sessions must prescribe varying loads to develop the full strength-power continuum. Coaches should consider the scientific evidence when implementing S&C programs in soccer. **Health & Fitness Journal of Canada 2016;9(2):21-37.**

Keywords: Fitness, Sports Science, Applied Practice, Specificity

From [1]Department of Sport, Health and Exercise Science, University of Hull, Hull, UK; [2]The Strength and Conditioning Research Group, Faculty of Health and Life Sciences, York St. John University, York UK.
Email: s.orange@2015.hull.ac.uk

Introduction

Soccer is the most popular sport in the world (Bangsbo, 1994). The Federation of the International Football Association (FIFA) estimate that more than 2.6 million people play soccer in Canada alone (FIFA, 2006), and participation continues to expand. It is now accepted that sport science can improve soccer performance. In particular, strength and conditioning (S&C) practitioners have emerged as key members of multidisciplinary coaching teams within Major League Soccer. This paper aims to i) briefly review the physiological demands of soccer and ii) provide S&C coaches with evidence-based training recommendations for adult male soccer players competing in full-time professional leagues. The need for sport specific training and its transfer to the competitive environment is emphasized.

Methods

To gather information on the demands of soccer match-play and effective training prescriptions, a narrative search was conducted using Ovid/Medline, Pub-Med and Google Scholar data-bases from January 1996 to June 2016. This was supplemented by a review of reference lists. Findings are presented within the brief review of literature, and embedded within our evidence-based training ideas. Due to the broad and heterogeneous nature of the search, a narrative review was deemed most appropriate.

Narrative review of literature

The physiological demands of soccer are complex. This is partly a consequence of the acyclical and intermittent nature of the exercise pattern (Mohr et al., 2016). Energy production in soccer is mainly dependent on aerobic metabolism (Manari et al., 2016). The majority of the 10-12km covered during a match is done by walking or jogging (Bradley et al., 2013). Exercise intensity and player load is reduced during the latter stages of each half (Barrett et al., 2016), and players typically cover 5-10% less distance in the second half compared to the first (Russell et al., 2015). The average distance covered at high-intensity is 10% (Carling et al., 2008). With emerging evidence, it has become clear that physical and technical performances have undergone substantial change as soccer has evolved (Bush et al., 2015); large increases in sprint distance and number of passes have been observed over the last decade (Bradley et al., 2016). Different playing formations and positions also influence the physiological demands required. The 3-5-2 formation elicits the highest total and high-speed running distance, with 4-2-3-1 evoking the most accelerations and decelerations (Tierney et al., 2016).

Soccer players are required to repeatedly produce maximal or near maximal actions amid relatively short recovery periods. During a soccer game, a sprint bout occurs every 90 seconds (Ingebrigtsen et al., 2015), each lasting an average of 6-20 m (Di Salvo et al., 2010). Total sprint distance (>25.2 km/h) is reported to be 100-300 m depending on playing position (Carling et al., 2016). Soccer players are frequently required to change direction in response to a stimulus with or without the ball (Young et al., 2015). An elite soccer player performs ≈2700 actions during a 90 min match (Di Salvo et al., 2013), which necessitate sustained forceful contractions to maintain balance and control of the ball against defensive pressure (Bangsbo et al., 2006). Furthermore, elite players complete 26 and 43 high-intensity accelerations and decelerations, respectively (Russell et al., 2015). Recent data show that accelerations contribute 7-10% of the total player load for all player positions, whereas decelerations contribute 5-7% (Dalen et al., 2016). Approximately 3.3% of total distance is covered whilst accelerating or decelerating at a speed greater than 3 $m \cdot s^{-2}$, and these actions are transiently reduced following periods of peak activity (Akenhead et al., 2013).

In addition to sprinting, the ability to rapidly produce high amounts of force is an essential physiological characteristic of the soccer player. Players make approximately 120 high-intensity impacts (Russell et al., 2015), including 30-40 jumps and 15 tackles (Mohr et al., 2003). Soccer involves a variety of motor actions that require both propulsive and breaking forces, as well as the entire strength-power capabilities of the neuromuscular system (Silva et al., 2015). This makes strength and power logical determinants of successful soccer performance. Importantly, superior technical skills are only consistently shown throughout a 90 min match by players with high levels of endurance and strength (Stølen et al., 2005).

Evidence-based training

Based on the review of literature and additional evidence referenced in the rest of this paper, the authors are able to present evidence-based training ideas for professional male soccer players. These are for illustrative purposes only, and are not designed to be ideal for all situations. In particular, these recommendations are directed for adults (≥ 18 yr), and other considerations should be made when training youth athletes. A wealth of research has identified aerobic endurance (Ingebrigtsen et al., 2012), repeated sprint ability (RSA; Rampinini et al., 2009), speed (Ferro et al., 2014), agility (Paul et al., 2016), and strength and power (Maly et al., 2014) to predict soccer performance. As a result, this paper focuses on these components of fitness.

We encourage S&C coaches to draw their own conclusions based from the evidence we present, and to take into account the individual player's health and exercise history, personality, motivation, playing position, and targets. The title and content of this paper inherently raises the question how does one translate the evidence on S&C in soccer in to training? The approach used here is based on the following definition of evidence-based practice taken from health care.

'the practice of health care in which the practitioner systematically finds, appraises, and uses the most current and valid research findings as the basis for clinical decisions […].' (Keane, 2003).

Aerobic endurance

Maximal aerobic power (VO_2max) is positively related to league position (Wisløff et al., 1998), the standard of competition (Ingebrigtsen et al., 2012), and match performance (Hoff, 2005). Seminal work by Hoff and Helgerud (2004) suggested that endurance training should aim to improve VO_2max by increasing maximal stroke volume and cardiac output. This led to a series of studies showing that specific aerobic interval training (4 periods of 4 min at 90-95% of maximum heart rate, maximal heart rate (HR_{max}), interspersed with a 3 min jog at 65% HR_{max}) improves aerobic capacity and several parameters of soccer performance (Impellizzeri et al., 2006; Kelly et al., 2013; Sporis et al., 2008).

Notwithstanding the importance of a well-developed aerobic capacity, the acyclical nature and distinct characteristics of soccer should be taken into considerations when designing a training program to improve performance. Physiological adaptations to exercise are specific to the training being performed (Balshaw et al., 2016). As a consequence, it is suggested that endurance training should be soccer related and performed with the ball. Small-sided games (SSG) represent an effective method of achieving this objective. SSG replicate match activities so that specific movement patterns are developed concurrently with aerobic endurance. This promotes a direct transfer to the competitive environment. SSG also facilitate the improvement of coordination, technical and tactical skills under fatigue, which are essential determinants for success in soccer (Iaia et al., 2009). Furthermore, SSG have been shown to provide the same training stimulus and adaptation as traditional running, are more enjoyable, and are perceived as less intense (Jastrzebski et al., 2014; Los Arcos et al., 2015; Zouhal et al., 2013).

Similar to any type of soccer training, there are a number of variables that S&C coaches can manipulate during SSG depending on the stage of the season, the team's game plan, and the players' physical capabilities. For example, the number of players can alter the physiological and technical demands of SSG. In general, fewer players on each team increases the intensity and engenders a training stimulus that is optimal for endurance training (Aşçı, 2016). A reduction in player number also increases the number of individual ball contacts (Joo et al., 2016). In contrast, SSG involving more players can augment position-specific capabilities relating to the team's strategy (Hill-Haas et al., 2011). The size of the pitch can also have a similar effect. Exercise intensity and perceived exertion appear to increase as the pitch size is made relatively larger (Rampinini et al., 2007), and players have more time and space to make a decision.

In addition, soccer coaches often modify playing rules during SSGs to change the physiological workload (Halouani et al., 2014; Köklü et al., 2015). Greater total distances, player loads, and work:rest ratios have been observed when man-marking was employed during SSG (Casamichana et al., 2015). SSG played with one-touch also induce greater distance covered in sprinting (Dellal et al., 2011). Conversely, maintaining possession of the ball reduces the distance of high-intensity efforts and maximum sprinting velocity (Belozo et al., 2016). The inclusion of goalkeepers causes players to exercise at a lower intensity, cover less distance, and become more tactically defensive (Köklü et al., 2015; Mallo and Navarro, 2008). See Hill-Hass et al., (2011) and Clemente (2016) for a more comprehensive review on the physiology of SSG.

Repeated Sprint Ability

The ability to perform repeated bouts of high-intensity sprints is important for soccer performance (Bangsbo, 1994). S&C coaches commonly employ work:rest ratios to quantify and manipulate the training workload during intermittent activity. Little and Williams (2007) suggest a work:rest ratio of 1:4 to replicate soccer match-play for highly trained athletes. In match-play however, players do not perform bouts of high-intensity exercises in a regimented, strict, work:rest ratio. Rather, players may have to work at a high-intensity in several short periods in the game, and spend longer periods at low intensity. For example, a team losing by a narrow margin would be more likely to work constantly at a higher intensity trying to score, in comparison to if they were winning easily and in possession of the ball. It is important to simulate the intrinsic characteristics of soccer movement patterns in training (de Villarreal et al., 2013). Therefore, is it suggested that S&C coaches use SSG to improve RSA in soccer. Four weeks of progressive SSG have been shown to augment repeated sprint time (Owen et al., 2012). Increasing player number during SSG is a simple modification to increase the quantity of very-high-intensity activities and sprints (Rebelo et al., 2016). S&C coaches may combine SSG with soccer-related drills, such as the Hoff track (see Hoff et al., 2002), to improve the players' ability to repeatedly perform high-intensity actions.

It is evident that SSG are able to facilitate various training objectives, and S&C coaches should periodize SSG throughout the season depending on the training aim. Tables 1-3 present potential SSG for aerobic endurance, RSA, and

Table 1: Illustrative small-sided games focusing on aerobic endurance.

Match Design	Rule	Pitch Size	Sets x Reps	Rest	Main Objective
3 vs. 3 + GK	Normal	30 x 20m	4 x 4 min @ 85-95% HR_{max}	3 min @ 65% HR_{max}	Aerobic endurance
4 vs. 4	Maximum of 3 consecutive touches	40 x 30m	4 x 4 min @ 85-95% HR_{max}	3 min @ 65% HR_{max}	Aerobic endurance

GK = including goalkeepers; HR_{max}= maximum heart rate

Table 2: Illustrative small-sided games focusing on sprint ability.

Match Design	Rule	Pitch Size	Sets x Reps	Rest	Main Objective
5 vs. 5 + GK	Player-to-player marking	30 x 20m	5 x 3 min @ 90-95% HR_{max}	2 min @ 65% HR_{max}	Aerobic endurance and repeated sprint ability
5 vs. 5	Offside rule in effect (front one-third zone of the pitch)	40 x 30m	6 x 2 min @ 90-95% HR_{max}	90s @ 65% HR_{max}	Aerobic endurance and repeated sprint ability

Table 3: Illustrative small-sided games focusing on position-specific demands.

Match Design	Rule	Pitch Size	Sets x Reps	Rest	Main Objective
6 vs. 6	Keep possession	50 x 40m	3 x 8 min @ 80-90% HR_{max}	90s @ 65% HR_{max}	Maintain aerobic capacity and position-specific demands
8 vs. 8	Normal	3/4 pitch	24 min continuous @ 80% HR_{max}	-	Maintain aerobic capacity and position-specific demands

position-specific capabilities, respectively. The tables illustrate the versatility of SSG and how S&C coaches may manipulate rules, pitch dimension, number of players, and training prescription to provide particular stimuli. The practitioner must be cognizant of the training adaptation being specific to the explicit design of the SSG.

Agility, speed, and change of direction

Agility and change of direction speed (CODS) are independent qualities and should be trained as such (Fiorilli et al., 2016). Agility can be defined as "a rapid whole-body movement with change of velocity or direction in response to a stimulus" (Sheppard and Young, 2006) whereas CODS relates to a pre-planned change of direction task. Evidence exists demonstrating that agility tests are better able to discriminate between higher- and lower-standard soccer players, and therefore reactive agility drills should be the main focus of training (Paul et al., 2016). In addition, the decision-making element in agility training is more appropriate for soccer given that, whether attacking or defending, a player must discern relevant information and react quickly to the movement of the opposition. However, CODS has been identified as one of the main contributors to agility performance (Young et al., 2002) and incorporating pre-planned COD tasks is relevant within a holistic training program. Speed, acceleration, and deceleration can all be trained in concomitance with CODS. In addition, training fundamental movement skills can help reinforce the correct movement mechanics that transfer over to agility performance. Lloyd et al., (2013) propose that 40% of agility training for young adults should comprise of fundamental movement skills and CODS, with the remaining 60% involving reactive agility drills. Holmberg (2009) also suggests that agility should be developed by progressing through technical drills, pattern running, and then reactive agility training. While this premise is well founded, movement skills and CODS can be efficiently trained as part of an extended warm-up, prior to the main session of relative agility drills (see FIFA 11+ below). Professional soccer players usually have a high level of technical proficiency. Therefore, agility sessions that simulate match-like situations while causing athletes to respond to external stimuli are a more beneficial method of training (Turner and Stewart, 2014).

S&C coaches can implement SSG to foster the ability to provide a sudden motor response to an external stimulus. Reducing player number during SSG increases the number of accelerations and decelerations a player makes (Rebelo et al., 2016). In an analogous fashion, players are likely to make more accelerations, decelerations, and changes of direction as the relative pitch size decreases (Casamichana and Castellano, 2010). A recent review has shown that these motor actions, coupled with the decision-making element in SSG, provide a stimulus to improve agile dexterity (Paul et al., 2016). For example, SSG consisting of 1 vs. 1 to 3 vs. 3 with modified dimensions according to player number (100 m^2 per player) have demonstrated superior improvements in agility performance compared to pre-planned COD training (Chaouachi et al., 2014).

The authors have presented an illustrative agility training session for soccer players (Table 4). This session moves sequentially through fundamental movement skills, CODS, and reactive agility. The main focus of this session is changing direction in response to stimuli. However, S&C coaches must manipulate the content of the session depending on the training objective and stage of the season. Movements should be monitored during SSG, and if necessary, rehearsed in a subsequent closed environment.

Table 4: Illustrative agility training for soccer.

Focus of training	Exercise	Sets x Reps	Rest(s)	Main objective	Approximate total time
Warm-up/fundamental movement skills	FIFA 11+	-	-	Hip mobility, body kinaesthetic awareness, neuromuscular control, knee stability, multidirectional force production	15 min
CODS	10m sprint into 5m backwards run into 5m acceleration	4 x 4	60	Straight line speed, deceleration, acceleration	10 min
	Sprints with 90° turns with ball	4 x 10s	60	COD ability with ball	
	Pre-planned multi-directional ball passes	3 x 15s	60	Multidirectional COD ability	
Agility	Follow the leader agility drill with ball	6 x 20s	90	Sport specific agility	40 min
	SSG 1 vs. 1	4 x 60s	90	Agility in game situation	
	SSG 2 vs. 2	4 x 90s	90		
	SSG 3 vs. 3	3 x 120s	90		

CODS = change of direction speed; SSG = small-sided games

Strength and power

Research concerning the activity pattern of soccer suggest that a high performance level necessitates adequate amounts of strength and power (Dalen et al., 2016). Indeed, the ability to produce high amounts of force in short periods of time manifests within the majority of soccer activities. There are several studies demonstrating the beneficial impact that strength and/or power training exerts on soccer performance (Karsten et al., 2016; van der Horst et al., 2015; Zouita et al., 2016), which has been confirmed in a recent review with highly trained players (Silva et al., 2015).

Complex training has received considerable attention, and represents a potent method of improving both strength and power in a time efficient manner.

This training strategy combines biomechanical similar high-load weight training with plyometric exercises, set for set, in the same workout. The implementation of complex training has consistently been shown to improve soccer-related motor skills and technical performance (Brito et al., 2014; Cavaco et al., 2014). Including plyometric exercises also exerts a beneficial impact on speed-power abilities, COD performance, and ball shooting speed in soccer players (de Hoyo et al., 2016; de Villarreal et al., 2015; Hammami et al., 2016). It is important for S&C coaches to consider the plyometric training-axis for the desired neuromuscular training response. It appears that horizontal jumps are superior for increasing acceleration (e.g. up to 10 m), whereas vertical jumps should be employed to enhance speed over longer distances (e.g. 10 – 20 m) and jump height (Loturco et al., 2015). Plyometric drills should be multidirectional, unilateral, and bilateral in nature to provide the optimal jumping stimulus that is relevant to soccer motor actions (Ramírez-Campillo et al., 2015a, b).

Another approach S&C coaches can take is alternating a strength exercise with a 'prehabilitation' movement. Prehabilitation refers to exercises that aim to reduce the risk of soccer-related injuries. The case for incorporating prehabilitation within an S&C context is supported by the notion that these ancillary exercises will not increase fatigue in between sets of strength exercises. Therefore, physiological adaption to the primary exercise will not be affected. Prehabilitation should aim to develop injury resilience by improving, amongst others; hip mobility, knee stability, proprioception, inter-joint coordination, single leg strength, landing mechanics, and glute and hamstring strength (Meir et al., 2007).

Weightlifting involves the snatch and clean and jerk, and primarily features concentric force production. These exercises have been shown to improve power development in sportspeople (Hackett et al., 2015), and in turn are commonly recommended for soccer strength training (Turner and Stewart, 2014). However, weightlifting requires a high level of skill to execute the movements correctly. S&C practitioners must be mindful that weightlifting is a means to an end, and must emphasize the completion of the lower-body triple extension movement that translates to athletic performance. The aim is to improve force production for soccer performance, not to augment the soccer player's weightlifting ability. Therefore, it is suggested that S&C coaches employ derivatives of weightlifting, such as the power hang clean, mid-thigh pull, jump shrug, and jump squat. Previous research suggests that these simpler exercises may provide a more effective training stimulus than full weightlifting movements (Suchomel et al., 2015). In fact, the jump squat exercise is superior to the Olympic push-press for improving speed-power abilities in professional soccer players (Loturco et al., 2016). Derivatives of weightlifting maximise power output while requiring less technical ability compared to the snatch or clean and jerk.

For highly trained soccer players, maximal strength gains are elicited from two weekly sessions of high-intensity resistance training (i.e. 85% of 1 repetition maximum [1RM]) (Silva et al., 2015). High-intensity strength programs involving multi-planar movements and a focus on soccer-specific actions are preferred over traditional moderate-intensity training due to the greater efficiency and ecological value (Silva et al., 2015). In contrast, S&C coaches should prescribe varying loads for optimal power development depending on the exercise. A recent meta-analysis (Soriano et al., 2015) found that loads of ≤30 % of 1RM appear to be optimal for the jump squat, whereas heavier loads (≥70 % of 1RM) result in greater peak power production in the power clean and hang power clean. Thus, a range of loads should be prescribed to stimulate the full strength-power continuum. Tables 5-7 present illustrative strength and power sessions for soccer players. The exercises shown are progressed between sessions in regards to technicality, load, and their transfer to the environment. For this reason, it is suggested that players would progress sequentially from session 1 to 3, based on individual competency, stage of the season, and training objective.

Injury prevention

Preventing injury is an important consideration for S&C practitioners. Professional male soccer players obtain up to 66 injuries per 1000 hr of match-play, leading to an average of 19.5 days lost to training and competition (Pfirrmann et al., 2016). Soccer injuries mostly affect the lower extremities, including the thigh, knee, and ankle (Stubbe et al., 2015). FIFA's Medical Assessment and Research Centre has developed a comprehensive injury-prevention program, referred to as FIFA 11+ (Owoeye et al., 2014). The FIFA 11+ also aims to improve, amongst others, speed, body kinaesthetic awareness, and neuromuscular control. Indeed, as well as reducing injury rate (Bizzini and Dvorak, 2015; Silvers-Granelli et al., 2015), FIFA 11+ has been shown to improve functional balance, neuromuscular control, and muscle activation in soccer players (Impellizzeri et al., 2013; Steffen et al., 2013; Takata et al., 2016). Therefore, the authors recommend that the FIFA 11+ is undertaken prior to agility sessions to engender fundamental movement skills and injury resilience. Additional CODS exercises to improve speed, acceleration, and deceleration can also be integrated into the session, after players have completed the FIFA 11+. Supplementary injury prevention strategies should also be embedded within all S&C programs. For example,

Table 5. Session 1: Illustrative strength and power training for soccer

Exercise	Sets x Reps	Load	Main objective
Deadlift	3 x 5	75% of 1RM	Maintain neutrality of spine and strength of posterior chain. Maximise force production.
Box Jump	3 x 5	BW	
DB split squat	3 x 10	65% of 1RM	Single leg force production in sagittal plane. Strength of hamstrings and core.
Swiss ball hamstring curl	3 x 6 EL	BW	
Military press	3 x 10	65% of 1RM	Upper body strength.
Rear flies	3 x 12	60&% of 1RM	
Close-grip pull up	3 x 10	BW	Upper back and core strength.
Sit-up with medicine ball throw	3 x 12	10% of BW	

DB = dumbbell; BW = body weight; EL = each leg; 1RM = 1 repetition maximum

Table 6. Session 2: Illustrative strength and power training for soccer.

Exercise	Sets x Reps	Load	Main objective
Jump squat	5 x 3	30% of 1RM	Maximise power and multi-planar force production.
Horizontal DL drop squat	5 x 4	BW	
Hip thruster	4 x 4	85% of 1RM	Glute activation and strength of posterior chain. Lateral force production and ability to land safely in frontal plane.
Lateral bounds	3 x 8 EL (2 in each direction)	BW	
Bulgarian DB split squat	3 x 8 EL	70% of 1RM	Single leg force production in sagittal plane. Eccentric strength of hamstrings
Assisted Nordic lower	3 x 4	BW	
DB bent over row	3 x 5 EA	85% of 1RM	Maintain neutrality of spine and upper back strength. Core strength and upper body power.
Medicine ball slam	3 x 8	10% of BW	

DB = dumbbell; BW = body weight; DL = double leg; EL = each leg; EA = each arm; 1RM = 1 repetition maximum

prehabilitation exercises can be integrated within strength and power sessions (Lauersen et al., 2014). It is suggested that S&C coaches should individually prescribe exercises focusing on strength, power, stability, and fundamental movement skills to help prevent injury, and these strategies should mainly focus on the lower body.

A note on periodization

Linear periodization is often prescribed during the off-season and pre-season for team sports, and involves the systematic progression from general fitness to sport specific training modalities (Bompa and Buzzichelli, 2015). In contrast, undulating periodization is considered to b more appropriate during the in-season (Gamble, 2006). This strategy involves the session-by-session variation of training stimuli and volume loads to account for all components of fitness (Kelly and Coutts, 2007).

The lack of randomized controlled trials involving professional soccer players make it difficult for S&C coaches to implement evidence-based periodization. However, recent data suggest undulating periodization during the soccer pre-season is efficient in promoting positive neuromuscular adaptations (Germano et al., 2015). Using

Table 7. Session 3: Illustrative strength and power training for soccer.

Exercise	Sets x Reps	Load	Main objective
Hang power clean	5 x 3	70% of 1RM	Power production and rate of force development. Single leg force production in frontal plane.
SL to DL horizontal drop jump	5 x 2 EL	BW	
Back squat	3 x 3	90% of 1RM	Maximise lower limb force production. Stability of knee joint and the ability to jump and land safely in all three planes of motion.
Multidirectional hop and holds	3 x 8 EL (2 in each direction)	BW	
Lateral step-up	3 x 4 EL	85% of 1RM	Single leg strength in frontal plane. Eccentric strength of hamstrings.
Nordic lower	3 x 4	BW	
SA DB push press	3 x 5 EA	60% of 1RM	Segmental sequential acceleration. Core strength and force production through transverse plane.
Medicine ball rotational throw	3 x 8 ES	15% of BW	

DB = dumbbell; BW = body weight; SA = single arm; DL = double leg; EL = each leg; EA = each arm; ES = each side; 1RM = 1 repetition maximum

this method throughout both the pre-season and in-season, training is sport specific from the beginning and multiple training goals are accounted for. The combined time of the off-season and pre-season can be extremely short for professional soccer teams (<6 weeks), particularly for international players, and thus spending a substantial amount of time on general, non-specific training is not optimal. Generic fitness training can be undertaken in the off-season before the team returns for intentional training. In addition, professional players with years of training experience are likely to possess adequate levels of general conditioning (Stølen et al., 2005). The main objective of the S&C practitioner is to enhance soccer-related physical and physiological parameters in the pre-season, and to maintain these improvements in the competitive season. It may be important to maintain some level of training specificity throughout the entire season.

Conclusion

In addition to the necessary technical and tactical skills, successful soccer players require a high level of aerobic endurance, RSA, speed, agility, strength and power. The authors have presented several illustrative training sessions to develop these physical qualities. Teams competing in a full-time professional environment should continually evolve their S&C practice informed by advances in scientific evidence. Wherever possible, training should replicate match activities so that specific movement patterns are developed concurrently with components of fitness. Therefore, the focus of training should be on its transfer to the competitive environment. This paper provides S&C coaches with evidence-based information to design training programs for improved soccer performance. More research is required to create models of evidence-based practice in S&C.

Authors' Qualifications

The authors' qualifications are: Sam Orange BSc. MRes., Prof. Andy Smith MBE. PhD. CSci. FBASES.

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