Effects of Speed, Agility, Quickness Training Method on Power Performance in Elite Soccer Players

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Abstract

Jovanovic, M, Sporis, G, Omrcen, D, and Fiorentini, F. Effects of speed, agility, quickness training method on power performance in elite soccer players. *J Strength Cond Res* 25(5): 1285–1292, 2011—The purpose of this study was to evaluate 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, countermovement 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 most likely be confronted with decrease in power performance during in-season period.

Key Words SAQ, power performance, soccer

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Introduction

Today, soccer is a highly demanding game in which the participants are subjected to numerous actions that require overall strength and power production, speed, agility, balance, stability, flexibility, and the adequate level of endurance (4,10,11,16), thus making the conditioning of players a complex process. One of the goals is to minimize the unknown variables to the least possible number. Recently, acceleration, speed, and agility have been found to be independent, unrelated qualities that produce a limited transfer to each other (17). The next step is to investigate methods that produce the integral effects that can be used in the conditioning of soccer players. But, we found that few studies have investigated the training methods that produce the integral effects on various abilities. One of the most popular training methods that produce the mentioned results is the SAQ (speed, agility, quickness) method (22). Within the context of randomized intermittent, dynamic and skilled movement type sports (randomized intermittent, dynamic type sports [RIDS]), to which soccer undoubtedly belongs, the integrated effects are wanted. The problem is to decide which type of conditioning should be implemented (programmed or random conditioning) to improve SAQ in soccer. A study that has investigated this problem (4) leads to the conclusion that programmed conditioning enhances power performance to a greater extent. However, random conditioning is not rejected, yet it comes as an advisable addition to programmed conditioning (15). That kind of conditioning uses randomized intermittent patterns seen in match performance. Both types follow the basic principles of conditioning and thus deliberately produce effects that can be in some way planned. The downside of random conditioning is that it has the inability to achieve the desired level of volume and intensity depending on motivation and effort, but on the other hand, the use of open skills produces specific demands that are used in a real match. Although the authors (4) found that programmed conditioning is more preferred when it comes to speed and agility, when it comes to endurance, it is speculated that random conditioning can have more effect. Thereby, both conditioning methods are valid in overall performance enhancing.

The SAQ training method more frequently uses the programmed than random type conditioning after the SAQ continuum. One SAQ session is composed of 7 components, where the main part of the session, explosion and expression of potential, are combinations of programmed and random conditioning. Integral planning and programming is required to progress from fundamental movement patterns to highly positional specific movements (31). A logical sequence in the learning process must not be neglected because it develops neural structures that are a prerequisite for elite-level upgrade. Consequently, elite players manipulate with their bodies without the loss of speed, balance, strength, and control. Also, with correct movement patterns (technique) and greater muscle power, they accelerate faster. Some studies (2,6,8,18,32) found that leg muscle power is a poor predictor of agility performance that emphasizes even more the integral influence within the vast range of capabilities.

Furthermore, the SAQ training method consolidates speed, agility, and quickness through the range of soccer specialized exercises. All exercises are performed with optimal biomechanical movement structures, and consequently, energy and time savings are made. Power performance aside from major abilities has the need for optimal joint mobility, dynamic balance, appropriate locomotor system, and energy production among others.

It is well known that soccer players rarely achieve maximal speed during play, but the initial starting phase and acceleration phase have a higher value in a soccer performance. Also, elite soccer players have greater values of high-intensity running when compared with total distance covered during a game. This results in the necessity for methods that enhance power performance in soccer players. A recent study (7) showed that faster athletes have higher test values in squat jump (SJ) and countermovement jump (CMJ) tests. These results associate sports with the emphasized need for maximal speed values that correlate with muscle power values as in sprinters.

Agility is very important when it comes to soccer players (21,24,29). Not only do they use it to outmaneuver the opposition but it also helps in preventing injuries. Optimal activation and inhibition of muscle fibers can prevent muscle tears and even more prevent the joints from injuries. Jullien et al. (13) stress that short-term agility training of not more than a 3-week duration can improve values in agility tests in soccer players. Also, it is important to notice that agility training forms a long lasting response from motor memory. Pearson (22) mentions 4 elements of agility such as balance, coordination, programmed and random agility all of which are used on the SAQ continuum with appropriate volume and intensity with regard to athletes' age and level of motor readiness. The purpose of this study, in agreement with the previously referred, was to determine how much the SAQ training actually influences the power performance parameters of elite soccer players during in-season period. The second purpose was to determine, whether the SAQ training method during the in-season period causes overtraining of elite athletes.

Methods

Experimental Approach to the Problem

During the last decade, soccer has gradually changed pace; play has become faster, players cover more distances, high-intensity running has changed (3,5,9,11,16,27). All these facts mentioned lead to a logical conclusion that power performance plays a significant role in overall soccer performance (14). Therefore, it does not come as a surprise that the SAQ training method is growing in popularity, and thus, it is being used as a method of improving power performance. This study was a randomized controlled trial where the subjects were randomly assigned to experimental and control groups (EG and CG). After conducting 8 weeks of the SAQ program, power performance was assessed using standard sprint tests for parameters of speed and Bosco Jump tests for leg muscle power. We hypothesized that, because of the nature of the SAQ training, power performance in soccer players would improve after 8 weeks of a planned SAQ program. The study was conducted during the in-season for 1 purpose only, that is, to see whether power performance could be improved during the in-season period using the SAQ training method. In the summer of 2008, the preseason training program was administrated for a duration of 8 weeks (Table 1).

Technical, tactical, and strength training was performed. During the preparation period, the subjects were trained 8–10 sessions per week for 90–105 minutes per session. Strength training was conducted in a gymnasium twice a week, each session lasting 90 minutes (30 minutes of warm-up; 40 minutes of circular training; 20 minutes of stretching exercises). Endurance training was done 3 times a week during a preparation period. The intensity of training was monitored using the polar heart rate monitors (Polar S-610; Polar Electro, Kempele, Finland). All workouts were supervised by team coaches. The in-season strength training program targeting the major muscle groups was done twice a week (i.e., legs, back, chest) and consisted of varied workouts with exercises focusing on muscular power development (e.g., jump squats, back squats, bench throws) using loads of up to 75–85% of 1 repetition maximum (1RM). Endurance training was performed once a week. The high-intensity intervention consisted of a 4 × 4-minute maximal running with different drills, at an exercise intensity of 90–95% of the maximal heart rate, separated by 'rest' periods of 3-minute technical drills done at 55–65% of the maximal heart rate. During the 3-minute technical drills, the subjects were required to work in pairs and perform inside-of-the-foot passes (first drill), receive the passed ball with the chest (second drill), and perform head kicks and head receiving (third drill) (Tables 2 and 3).

Intensity and volume of the SAQ training are presented in Table 4. Distribution of SAQ components is presented in Figure 1. During SAQ training work, the rest ratio was 3:2, for example, 5 minutes: 2 minutes.

TABLE 1. General conditioning program overview for preseason and first competitive period in season 2008–2009.*

Mesocycle	Introductory	Multilateral	Basic	Specific	Competition experimental program	Total
Calendar duration	First and second week of July	Third and fourth week of July	First and second week of August	Third and fourth week of August	From fourth week in august to fourth week in October	
Conditioning vs. technical–tactical training (%)	50: 50	60: 40	70: 30	40: 60	30: 70	
Duration (d)	14	14	14	14	56	98
Days of training and matches	6	6	12	12	49	85
Number of training sessions	10	10	20	18	38	96
Number of matches		1	2	4	8	15
Hours of practice	18	20	44	38	70	190
Number of the days of rest	1	1	2	2	8	14
Extensity of training	1.28	1.42	3.66	2.85	1.25	1.93
Intensity (% HRmax)	80	85	85	95	90–100	90
Dates of testing	T1(initial) 1 wk before preseason training began (lasted 1 d) T2 (final) 2 wks after the experimental program (lasted 1 d)					

*Volume of training was calculated as the ratio of training hours and training days.

Subjects

All subjects were members of the teams playing in the First Croatian Junior League. In this league, there are 12 clubs, and each club has about 25 players in the team. Because this study was financed by the Croatian Football Federation, all players were at our disposal. Only 8 clubs had all the necessary facilities and equipment to participate in this study. We then divided these 8 clubs randomly into 2 groups–the EG and the CG, each consisting of 100 players. But, for the players to be tested at the end of the study (final testing), they had to have completed 75% of the entire training process and they ought to have played 85% of all official matches. Only 100 players (50 from the experimental and 50 from CG) were able to match these criteria. All the subjects were familiar with the SAQ training.

The study was approved by the Ethics Committee of the Faculty of Kinesiology, University of Zagreb. To be included in the investigation, each subject provided a written informed consent in accordance with the Helsinki Declaration. The participants were aware that they could withdraw from the study at any time.

Goalkeepers were excluded from the investigation following their morphological characteristics and motor ability differences (5,28). For field players to be included in this

TABLE 2. Conditioning program–overview for in-season training (8-week SAQ intervention).*

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Morning session (from 9 to 11 AM)	SAQ	Technical–tactical training	SAQ	SAQ	Technical–tactical training		Day of rest
Afternoon session (from 6 to 8 PM)	Strength training	Endurance training	Strength training	Endurance training	Prevention training	Official game	

*SAQ = speed, agility, quickness.

TABLE 3. Framework of SAQ program.*

Dynamic flexibility	Mechanics	Innervations
Toe walk	*Arm mechanics-arm drive*	Single walk
Heel walk	Partner drills	Single run
Jogging and hug	Arm drive for jumping	Single lateral steps
Small skip	Buttocks bounce	Up and back
Wide skip	*Leg mechanics*	Lateral step in-out
Single knee dead-leg lift	Knee-lift development	Small dead-leg run
Knee-across skip	Dead-leg run	Icky shuffle
Lateral running	Leading leg run	Double run
Preturn	Preturn	Hopscotch
Carioca	Quick sidestep	Two step forward and 1 step backward
Hurdle walk	Sidestep	Single space jumps
Russian walk	1–2–3 Lift	Two jumps forwards and 1 jump backward
Walking lunges	Single jumps	Twist again
	Single jump over and back	Hop in and out
	Single jump with 180° twist	Carioca
	Lateral single jumps	Spotty dogs
	Forward multiple jumps	Line drills
	Lateral multiple jumps	Line drills (spit steps)
	Multiple hops	Two-footed jumps
	180° twist jumps	Box drills
		Split step
		Two-footed jumps
Accumulation of potential	Explosion	Expression of potential
Agility disc	*Vision and reaction*	Robbing the nest
Seated agility disc	Fast hand games	Shadow
Swerve development runs	Reaction ball	Cone game
Fast feet zigzag run	Get-ups	Fielding drill–specific
Four turn, four angle run	Chair get-ups	
Combination runs	Let-goes	
Team combination runs	Parachute running	
	Ball drops	
	Buggy runs	
	Flexy cord–overspeed	
	Flexy cord–out and back	
	Side-stepper–resisted lateral runs	
	Side-stepper–jockeying throw and catch drill	

*SAQ = speed, agility, quickness.

study, the following requirements were set–minimal number of games played during the past season was set at 20 (friendly or championship games), minimal attendance of 75% of training sessions in the past season, minimum of 7 years of soccer experience, minimum of 6 weeks of preseason period, and a similar beginning of the preseason training in all 8 clubs. The training regimen was composed of minimum 3 SAQ training sessions a week in compliance with the SAQ program (Figure 1, Table 4) for the EG. Each training session had the strength training and the conditioning part and the technical–tactical part. Also, a game was played each week as a part of the in-season period schedule. The mean (*SD*) age, height and body mass for the EG was 19 years, 174.78 (5.74) cm and 67.83 (3.37) kg, respectively, vs. 19 years, 175.09 (5.29) cm, and 68.18 (4.08) kg, respectively, for the CG.

Procedures

The initial testing took place before the beginning of the in-season period (end of preseason), whereas the final testing was performed after 8 weeks of intervention with the SAQ training method. To prevent unnecessary fatigue accumulation, the players and coaches were instructed to avoid intense exercise for a 24-hour period before each testing session. Also, before each testing, the subjects performed a standard 25-minute warm-up. During testing, the air temperature ranged from 22 to 27°C. The testing always commenced at 10 AM and was completed by 1 PM. The physical load at given intensities was monitored by heart rate monitors. All sprint tests were performed on a grass sports field, and the players wore soccer shoes to replicate the playing conditions.

Table 4. Intensity and volume for each SAQ component, during an 8-week intervention.*

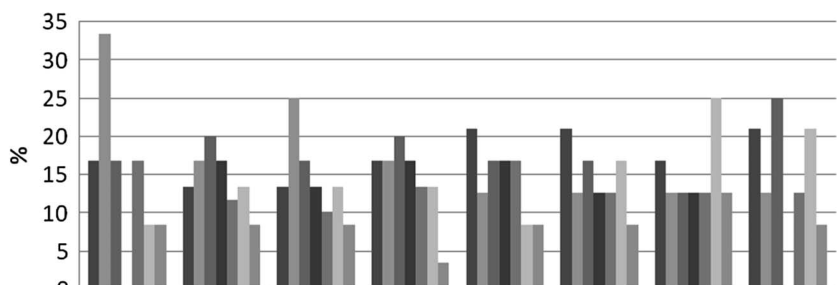
	Weeks	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth
Dynamic flex	Intensity	50	50	50	50	50	50	50	50
	Volume	20	16	16	20	25	25	20	25
Mechanics	Intensity	60	70	70	70	60	60	60	60
	Volume	40	20	30	20	15	15	15	15
Innervation	Intensity	100	100	100	100	100	100	100	100
	Volume	20	24	20	24	20	20	15	30
Accumulation of potential	Intensity	0	70	80	80	70	70	70	0
	Volume	0	20	16	20	20	15	15	0
Explosion	Intensity	100	100	100	100	100	100	100	100
	Volume	20	14	12	16	20	15	15	15
Expression of potential	Intensity	70	75	80	75	70	70	70	70
	Volume	10	16	16	16	10	20	30	25
Warm-down	Intensity	30	30	30	30	30	30	30	30
	Volume	10	10	10	4	10	10	15	10

*SAQ = speed, agility, quickness.

The sprints over 5, 10, 20, and 30 m (SP5, SP10, SP20, and SP30, respectively) were performed from a standing start and measured by means of infrared photocells using a telemetric system (RS Sport, Zagreb, Croatia). Time was recorded in 100ths of a second, and the average value from 3 sprint attempts was taken into consideration as a final result.

Four Bosco Jump tests were used to assess muscle power of leg extensor muscles (Kistler, Quattro Jump force platform, Winterthur, Switzerland). The players had 2 preparatory measurements. An average of 3 measurements was used to represent the final result in the SJ, CMJ, maximal CMJ (MAX), and continuous jumps with legs extended (CJS).

During the investigation (8 weeks of the in-season period), the CG performed the traditional in-season training regimen, whereas the EG had an intervention with the SAQ training program. Also, the EG was required to perform 3 SAQ



WEEKS	1.	2.	3.	4.	5.	6.	7.	8.
Dynamic Flex	16.67	13.33	13.33	16.67	20.83	20.83	16.67	20.83
Mechanics	33.33	16.67	25	16.67	12.5	12.5	12.5	12.5
Innervation	16.67	20	16.67	20	16.67	16.67	12.5	25
Accumulation of potential	0	16.67	13.33	16.67	16.67	12.5	12.5	0
Explosion	16.67	11.67	10	13.33	16.67	12.5	12.5	12.5
Expression of potential	8.33	13.33	13.33	13.33	8.33	16.67	25	20.83
Warm-down	8.33	8.33	8.33	3.33	8.33	8.33	12.5	8.33

Figure 1. Distribution of speed, agility, quickness components (in %) during an 8-week in-season period.

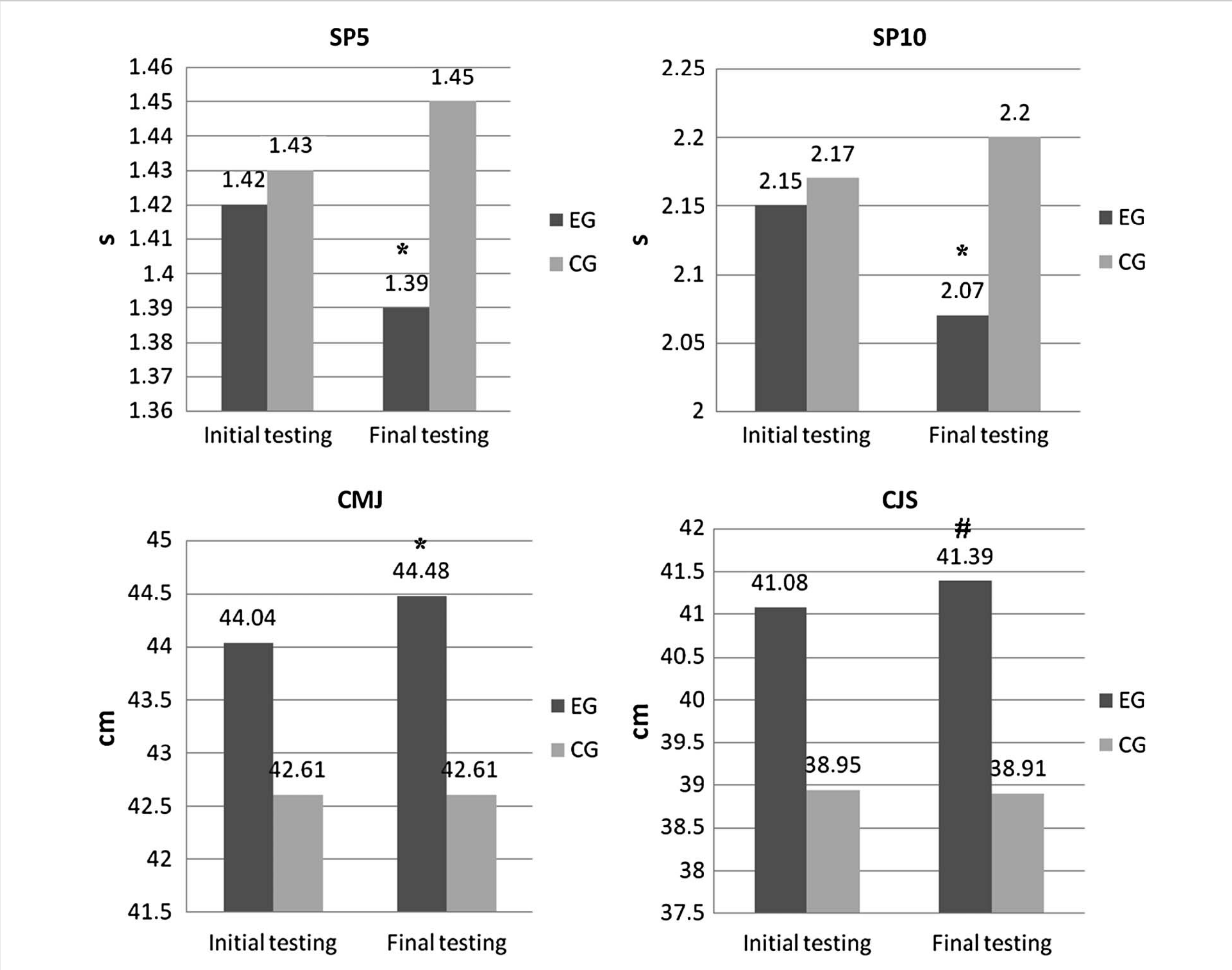


Figure 2. Changes of sprint and jump variables, from initial to final testing in both groups.

training sessions a week, on Monday, Wednesday, and Thursday. Thus, the program entailed, among others, 24 SAQ workouts, whereas the CG covered approximately the same volume of regular training. We considered that there was no difference in the training volume that would represent an important factor when comparing the effects of these 2 groups. Each SAQ session followed detailed components of training during the 8-week period (Figure 1).

Statistical Analyses

Data analysis was performed using the *Statistical Package for Social Sciences* (v13.0, SPSS Inc., Chicago, IL, USA). Descriptive statistics were calculated for all experimental data. In addition, the Kolmogorov–Smirnov test of the normality of distribution was calculated for all variables before the analysis. Statistical power and effect size were calculated using the G-power software. A 2-way analysis of variance with repeated measures was used to determine the pairwise differences between the EG and CG where appropriate. When a significant F value was achieved, appropriate Tukey post hoc tests procedures were used to locate the difference between the means. Test–retest reliabilities for the experimental tests demonstrated interclass correlations. Statistical significance was set at $p \leq 0.05$.

Results

The Kolmogorov–Smirnov test showed that data were normally distributed. The statistical power was 0.95, and the effect size was medium ($r = 0.52$). Interclass correlation coefficient (ICCRs) for all variables ranged from 0.66 to 0.85.

Results from other tests showed that the EG values improved compared with those of the CG but not enough for this improvement to be significant. The CG remained at the initial test result values or even aggravated their performance in the measured tests.

Discussion

The present study showed that an in-season SAQ training program intervention had a positive effect on power performance in young soccer players. The EG significantly ($p < 0.05$) improved as regards the time necessary to complete the SP5 and SP10 tests. Faster completion of SP10 (3.72%) and SP5 (2.11%) indicates that the 8-week intervention was successful as regards performance enhancement when it comes to quickness and acceleration. The improvements were also significant because of the shortening of the time necessary to cover the distances in sprint tests and the skill level of the participants involved in the study. Another confirmation that goes in hand with the importance of these findings is the fact that in soccer matches, 90% of all sprint activities are sprints from 5 to 15 m (3).

Furthermore, elite players are mostly characterized by reaction ability in the distances ranging from 5 to 10 m (25). Overall power performance is used in both attack and defense when goals are scored or defended. Similar studies found that a general distinction between the elite-level and less elite-level soccer performance is in the high-intensity running during a game, which in turn involves more sprints over shorter distances and faster reactions. Also, during a match, the overall distance covered ranging from 500 to 600 m comes from sprint actions (26), which happen every 90 seconds (27). The facts presented are in relation with this study and the results that show the improvement in tests that estimate quickness (SP5) and acceleration (SP10) of elite soccer players. Krustrup et al. (16) placed power performance parameters in direct dependency to soccer success and thus emphasized the importance of the SAQ training method as such. Furthermore, recent studies showed that jump test performance is also related to team success (1), whereas vertical jump height is related to short sprint performance (7,30).

Results from this study indicate that the SAQ intervention significantly improved ($p < 0.05$) the CMJ and the CJS ($p < 0.05$) in the EG (Figure 2). The players did not show any significant improvement in other jump tests (MAX and SJ) because the featured results present the above average test scores in all jump tests, keeping in mind the age of the participants. Countermovement jump is considered to be a slow stretch-shortening cycle (SSC) performance jump (>250 milliseconds). Moreover, it can be expected that slow SSC has more importance during the initial phases of sprinting because of the longer ground-contact phases during the first steps (7). Thus, team sports where quickness and acceleration are much more used than maximal speed, training programs that upgrade slow SSC performance are expected to have more impact on overall success. The CJS measures the elastic power of the lower leg muscles and can also be described as fast SSC (<250 milliseconds). The importance of that kind of muscle action can be seen when deceleration or acceleration actions are performed during a game. The subjects from this study showed approximately the same values as their Norwegian and Scottish colleagues in tests that assess power performance parameters (11,19). Moreover, it is important to emphasize the enhancement of ability in modern soccer and gradually discard the search for centimeters and seconds in the tests.

The SAQ training elements consist of exercises and equipment that evoke neural adaptations in programmed and random conditions with a gradual progression, and thus, both slow and fast SSC performance is enhanced. Although the athletes recorded positive changes in some explosive power tests, further research is needed when it comes to the effectiveness of the mentioned test in a match environment. However, the presented study indicates that the SAQ training method can be applied as a power performance enhancing method when it comes to elite soccer. Modern soccer game requirements can be met by maintaining a high level of endurance and power performance during the whole game (12,20). Taskin (28) found that sprint ability is similar in all field players' positions and speed dribbling. This is also a confirmation that power performance parameters, such as the ones tested in this paper, have a large impact on soccer accomplishment. Many coaches do not use the approach described in this article to the training process because they are afraid that overtraining can occur. One of the reasons why overtraining occurs in soccer is too much nonspecific endurance and power training. We tend to speculate the reason for this as precisely being the major difference between the protocols, meaning the improvement of anaerobic and aerobic mechanism through specific ball drills as conducted in the EG. With intensive SAQ, we can achieve improvement in the player's power performance during the competitive season without having any overtraining effects.

Practical Applications

This paper contains information about the SAQ training program largely used by many soccer experts. It also contains information on the possible effects that occur when the SAQ program is implemented in elite youth soccer population. Similar improvements are also confirmed in other studies (4,23), and they offer an insight to everyone that can take such information to the level of practical application. The presented SAQ program can and should be individually corrected and applied in practice. To conclude, the SAQ training appears to be an effective way of improving quickness and acceleration along with explosive and elastic jump power in young soccer players and would therefore be a good method for coaches to incorporate into their strength and conditioning programs. The results of this study can be considered important in terms of competitive soccer performance. Soccer coaches could use this information in the process of planning the in-season training. Without proper planning of the SAQ training, soccer players will most likely be confronted with decrease in power performance during in-season period. For proper soccer conditioning, coaches could make training more specific in such a way that the transfer of training effects to game efficiency will be faster.

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