ORIGINAL RESEARCH PAPER

THE EFFECT OF SPEED TRAINING ON SPRINT AND AGILITY PERFORMANCE IN 15-YEAR-OLD FEMALE SOCCER PLAYERS

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Abstract

The main aim of this study was to investigate the effects of short burst speed and change-of -direction exercises on sprint and agility performance in youth female soccer players 15.5 (± 0.7) years. One training group (n=10) followed an eight-week, once per week training program consisting of short-burst sprinting exercises in addition to two normal soccer training, while a control group (n=9) followed three traditional soccer training session. Pre-and post-tests assessed significant improvement in 10 m sprint, pre 1.99 s (± 0.08), post 1.91 s (± 0.09), 20 m sprint pre 3.53 s (± 0.15), post 3.42 s (± 0.15), and agility performance, pre 8.23 s (± 0.31), post 7.80 s (± 0.33). Control group (15.1 years (± 0.7) did not demonstrate significant change in performance during the intervention period. The results demonstrate that a training program of short burst high speed exercises improve linear sprint and agility performance in youth female soccer players, beyond the gain of traditional soccer training consisting of small-sided games.

Key words: *acceleration, sprint training, young female, agility testing, soccer*

Introduction

Soccer is one of the most popular sports among children and youth worldwide, with an increasing number of young female players (Vescovi et al., 2012). Among the different physical qualities needed are the ability to perform straight-line sprint and positive and negative acceleration with rapid changes of directions, often referred to as agility (Muijka et al., 2009). Previous studies have shown a difference in running speed between high-

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level and the non-elite youth players in those qualities (Mujika et al., 2009; Malina et al., 2007; Gissis et al., 2006), and sprint performance has been reported to be among the most important variables in predicting player selection (Vescovi, 2012; Gil et al., 2007).

It has been an increased focus on the trainability in the youth age, however, there is little empirical evidence regarding the efficacy of sprint training methods in youth females (Vescovi et al., 2011). Most experiments have been conducted on males, with programs combining strength and speed training (Rumpf et al., 2012; Maio Alves et al., 2010; Faigenbaum et al., 2007). Reports of male youth athletes aged 14 to 18 years, have showed an enhanced effect on sprint with high-intensity strength and speed training (Jovanovic et al. (2011; Mujika et al., 2009; Kotzaminidis et al., 2005). Buchheit et al. (2010) found that a 10 week training program, with one hour per week shuttle sprint and explosive strength training, produced significant improvement in 30m sprint, but no significant improvement in 10 meter sprint in adolescent male soccer players. Hughes et al. (2012) reported enhanced sprint performance in males aged 12 and 15 years, but not in 13 or 14 years, combining speed training and plyometric drills. A program consisting of high-speed and plyometric exercises in 13-year-old males, significantly improved both 20 m linear running speed, and agility performances (Mathisen, 2014).

Polman et al. (2007) found positive effects of a speed and quickness program on 25 m linear sprint and agility performance in 21.2 (± 3.1) year-old female soccer players. However, to our knowledge, there is only one study among youth female soccer players, high-speed exercises produced significant improvement in speed and agility in 13-year-old females (Mathisen & Danielsen, 2014). Furthermore, it is unsolved whether traditional soccer training, consisting of small-sided games, can provide enough stimuli to sufficiently increase sprint performance in young players (Jullien et al., 2008). Previous research has proposed high intensity up to maximal effort during exercises as a key factor in these abilities (Pettersen & Mathisen, 2012). Given the limited body of knowledge, the aim of the present study was to examine the effects of short burst speed exercises on straight-line sprint and agility in 15-year-old female soccer players.

Material and methods

Subjects. An initial sample of 14 regional female soccer players with a mean age of 15.5 (± 0.7) years was selected. However due to injury, and non-attendance at the testing sessions, the sample was reduced to 10 players. In addition to the intervention program, the participants in the training group (TG) undertook two one-hour organized regular soccer-training sessions consisting of technical drills and small-sided games. Nine female soccer players from the same league, and at similar performance level, mean age 15.1 (± 0.5) years, served as a control group (CG). The CG undertook three organized sessions of soccer training per week, consisting of technical drills and small-sided games. Written informed consent was obtained from both the participants and their superiors. The study was conducted according to the Declaration of Helsinki, and the study was given institutional ethical approval, and meets the ethical standards in sports and exercise science research (Harris & Atkinson, 2011).

Experimental Approach to the Problem. To compare the effects of speed training versus traditional soccer training we tested 10m (meter) and 20-m linear-sprint and agility performance, before and after an eight-week conditioning program. The intervention took place in the preseason period, and the training group (TG) replaced one of three ordinary soccer-training sessions consisting of technical drills and small-sided games, with a program of speed training. Pre- and post-tests assessed the 20m linear-sprint with a 10-m split time, while agility performance was tested using an agility course (Pettersen & Mathisen, 2012).

Training program. The exercises were completed with a one-hour training program per week, for a total of eight weeks. The training group (TG) replaced one of the three ordinary soccer-training sessions with the current program, and followed a strict organization with exercises and recovery periods. Each session started with 10 minutes warm-up consisting of jogging and sprint drills, and was followed by 45 minutes short burst high-speed running exercises. The program consisted of eight partner resisted sprints (15m), eight 20m straight sprints, eight change of direction sprints (20m) with 60° and 90° turns, and finished with relay race with 90° turns with eight race by each participant, thus, the session consisted of a total of 32 short sprints. The exercises lasted between three to six seconds, followed by 60 to 90 seconds of recovery with rest, depending on the length of work periods. The participants were instructed to complete the sprints at maximal speed.

Test Procedures. The sprint test consisted of a 20m track, with 10m split time recording. The photocells were placed at height of 20cm in the starting position, and at 100cm height at 10m and 20m in the straight-line test. All tests were completed from a standing start, with the front foot placed 20cm behind the photocells' start line. The agility test was a 20m standardized course used in previous experiment (Pettersen & Mathisen, 2012). The test started with a 5 m straight-sprint, followed by a 90° turn, a 2.5m sprint followed by a 180° turn, a 5m slightly curved sprint followed by a 180° turn, a 2.5m straight sprint followed by a 90° turn, and finished with a 5 m straight-sprint. Three 120cm-high coaching sticks were used to ensure correct passage in the turns. The tests were executed with the same starting procedure as the straight-line test, and with photocells placed at 100cm height at the finish line. Each participant performed two trials with minimum three minutes recovery between the tests, times were recorded to the nearest 0.01 second, and the better of the two trials was recorded. Familiarization test for the sprint and agility track were conducted during both the pre- and post-tests, with two sub-maximal trials prior to the start of the test.

Electronic photocells timing gates were used to record split and completion times (Brower Timing System, USA). The exercises and the tests were executed in a gym with a parquet floor, and with a temperature of 20°C. Prior to the testing, the participants followed the same supervised warm-up procedure with 10 minutes jogging and sprint drills. The tests have shown good reliability by calculating the intraclass correlation coefficient (ICC) (Pettersen & Mathisen, 2012).

Statistical Analyses

Data were checked for normality by histogram plot and by using the Shapiro-Wilk's normality distribution test. Descriptive statistics were then calculated and reported as mean ± standard deviations (SD) of the mean for each group of players on each variable. A two-way analysis of variance between-groups (ANOVA) was conducted regarding the mean difference between the training group and the control-group before and after the intervention. Turkey post hoc analyses were conducted to identify a training effect. The relationship between performances in linear sprints and agility tests was determined by using Pearson's correlation (*r*). The same procedure was used to detect any correlation among the linear sprint and agility.

The reliability of each test was assessed by the intraclass correlation coefficient. All calculations were carried out using SPSS v 21.0 (Inc., Chicago, Il., USA).

Results

Table 1 presents the anthropometric characteristics of the subjects. There was no significant difference between TG and CG.

Table 1

Anthropometric characteristic in the study (mean ± SD)

Test	TG (n = 10) Pre	Post	CG (n = 9) Pre	Post
Age (years)	15.5 (0.7)	15.7 (0.7)	15.1 (0.5)	15.3 (0.5)
Height (cm)	162.9 (3.8)	163.1 (3.7)	164.6 (2.6)	165.0 (2.4)
Weight (kg)	58.0 (7.0)	58.4 (7.1)	56.0 (4.7)	56.2 (4.6)

No significant difference between groups

Results of pre- and post-test are presented in Table 2.

Table 2

Pre- and post-test results for sprint and agility performances (mean ± SD) in the training group (TG) and the control group (CG) (mean ± SD)

	TG (n = 10) Pre	Post	CG (n = 9) Pre	Post
10 m sprint	1.99 (0.08)	1.91 (0.09) *	1.95 (0.06)	1.95 (0.07)
20 m sprint	3.53 (0.15)	3.42 (0.16) *	3.48 (0.10)	3.49 (0.13)
Agility	8.23 (0.31)	7.80 (0.33) *	8.04 (0.14)	8.01 (0.15)

*Significant change in performance between groups $p<0.05$

Results showed a significant improvement between TG and CG in 10m straight-line sprint; pre 1.99 (±0.8) to post 1.91 (±0.09), in 20 m straight-line sprint; pre 3.53 (±0.15) to post 3.42 (±0.16), and in agility; pre 8.23 (±0.31) to post 7.80 (±0.33).

Table 3 shows the relationship between straight-line sprint and agility.

Table 3

The relationship between linear sprint and agility performance in TG and CG (n=19)

Relationship assessed	Pearson's r	p value
10 m linear sprint vs agility	0.60 *	<0.05
20 m linear sprint vs agility	0.58 *	<0.05

*Significant correlation between linear sprint and agility

The correlation between the performances in straight-line sprint and agility was $r = 0.60$, and between 20m straight-line sprint and agility performance $r = 0.58$ ($p<0.05$)

The reliability of each test was assessed by intraclass correlation in the control group, and was found to be 0.94 (10 m), 0.98 (20m) and 0.81 (agility). The statistical significance level was set at $p<0.05$.

Discussion

We tested the hypothesis that eight weeks, one hour per week of short burst high intensity exercises would lead to improvement in straight-line sprint and agility performance in youth female soccer players, aged 15.5 (±0.7) years. The main findings were an improvement in the 10 m straight-line sprint (4.1%), in the 20 m straight-line sprint (3.2%), and in agility performance (5.2%) (Tab. 2). In females, sprint performance up to 15 – 17 years of age is improved by growth and maturation (Vescovi et al., 2011), and maturity status plays a role in mediating the response to speed exercises (Malina et al., 2004), however, no significant change in any parameters was found in the CG. The results of the current study are in line with junior male soccer players following programs consisting of short-sprint training (Muijka et al., 2009; Markovic et al., 2007), and confirm to positive effect in female soccer players of similar age. Improvements have been reported in adult female soccer players following speed and quickness training program (Polman et al., 2007), and in youths with a program consisting of speed exercises in 13-year-old females (Mathisen & Danielsen, 2014).

This study incorporated exercises of straight-line running speed, change of directions runs, acceleration and deceleration, in bouts lasting from three to six seconds executed with maximal effort (Brown et al., 2005). A training-induced increase in the maximal firing frequency and action potential in the muscles appears to occur in young subjects executing maximal exercises as described above (Hughes et al., 2012; Aagaard, 2003). The improvements observed is supposed induced by enhanced coordination, motor unit recruitment, central nervous activation and improved technical skills (Milanovic et al., 2013; Myer et al., 2005; Aagaard, 2003). Furthermore, training programs that include movements that are biomechanically specific to the performance tests, may be likely to induce improvements in performance measures (Faigenbaum et al., 2007), thus, positive responses in speed and agility are supposed to be associated to specificity in the current program (Buttifant et al., 2002). Exercise protocols consisting of sport-specific drills have shown positive effect on sprint performance, while most methods consisting of strength and power training have failed to improve agility performance (Brughelli et al. (2008). Previous experiments resulting in no or small effect, may be due to ineffective training load or lack of specificity (Jovanovic et al. 2011; Muijka et al., 2009; Jullien et al., 2008; Steffen et al., 2007). Recovery periods in the present study was from 60 to 90 seconds, and is in line with previous programs for young soccer players (Ramirez-Campillo et al., 2014), however, two to five minutes are recommended among adults (Ramirez-Campillo et al., 2014).

Relationship between straight-line speed and change -of-direction speed in the present study is different compared to trained male athletes (Hennesy & Kilty, 2001). It is supposed that the relationship between linear speed and agility is higher during the early stages of athlete development (Jones et al., 2009), explained by common physiological underlying factors (Aagaard, 2003). The correlation between the 10 m and the 20 m linear sprint, and agility in this study was significant, $r = 0.60$ and $r = 0.58$, (Tab. 3). This is in line with previous reports in youth female athletes (Mujika et al., 2009; Vescovi et al., 2008), however, stronger than reported in 19-year-old female soccer players (Shalfawi et al., 2014). Results from adult male athletes, have showed a smaller transfer effect between these abilities, with low to moderate correlation, $r = 0.33$ to $r = 0.42$ (Young et al., 2001).

Limitations of this study are the small number of participants, and no assessment to determine any effects on the outcome to match-play. However, enhanced sprint performance is beneficial in match play (Polman et al., 2007), and both short linear speed, and agility is powerful discriminators between youths (Muijka et al., 2009, Reilly et al., 2000). Sprint bouts during games are mostly reported to be between 10-30 m, and high-speed actions are known to have an impact on match performance, as the faster player will have an advantage in match scenarios (Krustrup et al., 2005).

Conclusions

We indicate that a training program consisting of short-burst high-speed exercises, may be effective beyond the gain of traditional soccer training in youth female players. Results from this study shows that one training session per week (one hour) over eight weeks, is sufficient to enhance straight-line sprint up to 20m and agility performance in female youth soccer players in the preseason period, compared to traditional soccer training consisting of small-sided games and technical drills.

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