Original Article

Correlation Between Reaction Time and Speed in Elite Soccer Players

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The aim of this study was to determine the relationship between reaction time (auditory and visual) and speed (20-m sprint time) in elite male soccer players. A total of 104 elite male soccer players with an average age, height and weight of 21.44 ± 3.32 years, 174.88 ± 6.82 cm and 69.39 ± 7.61 kg, respectively, volunteered to participate in this study. Each subject's reaction time and speed were measured, and the data analyzed using Pearson's correlation and paired *t* tests. There were no meaningful correlations between reaction time and speed in the subjects. However, their auditory reaction times were significantly better than their visual reaction times, and there was a negative correlation between body weight and speed ($p < 0.01$).

Keywords: reaction time, soccer, speed

Introduction

Reaction time is the interval between the onset of a signal (stimulus) and the initiation of a movement response (Magill 1998). The reaction time for an auditory stimulus is about 170 ms, and for a visual stimulus is about 250 ms (Magill 1998).

Reaction time can be broken down into three parts. The first is perception time: the time for the application and perception of the stimulus and giving the necessary reaction to it. The second is decision time, which signifies the time for giving an appropriate response to the stimulus. The third is motor time, which is the time for compliance to the order received (Tripo 1965; Teichner 1954). Singer et al. (1993) defined reaction time as being composed of four stages, namely: the start of eye movements, eye movement time, decision time and muscle contraction time. Reaction time is affected by factors such as age, gender, number of simultaneous stimuli, nutrition, physical activity, training and physical fitness and fatigue (Morehouse & Miller 1976; Spirdiso 1975; Tripo 1965). It is known that athletes have better reaction times than non-athletes (Moka et al. 1992). Reaction time is a decisive factor affecting success in sporting competitions. The reaction times of athletes in different sports show variations (Moka et al. 1992).

The reaction times of high performance sprinters were found to be shorter than those of low performance sprinters. Reaction time can be improved to a certain extent by warm-up and exercise. Exercise induces arousal that supports alertness to external environmental stimuli in highly trained athletes (Mouelhi et al. 2006). These have the effect of shortening the response time of the whole body. Explosive power, together with reaction time, decides the results of competitions in the first 2–3 meters (Akgün 1996). Since soccer requires 1–3-second explosive sprints, the importance of this feature becomes much more obvious in the performance of players. Research has shown that speed can be improved by strengthening the muscles (Akgün 1996). One of the most important biomotor abilities required in sports is speed, or capacity to travel or move very

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quickly. From a mechanical point of view, speed is expressed through a ratio between space and time. The term *speed* incorporates three elements: (1) reaction time; (2) frequency of movement per time unit; and (3) speed of travel over a given distance (Bompa 1994). Studies have revealed that reaction time is independent of speed (Paradis et al. 2004; Yakut 2004).

Although it is also known that physical training has positive effects on both reaction time (Davranche et al. 2006) and speed (Little & Williams 2005), the relationship between reaction time and speed has not been extensively investigated in the literature. The aim of this study was, therefore, to examine the correlation between reaction time and speed in elite soccer players.

Methods

Subjects

The subjects in this study were 104 soccer players from different professional football clubs in the second and third division of the Turkish Football League.

Procedure

Data were collected in the laboratories of the Gazi University School of Physical Education and Sport. The body weights and heights of the subjects were measured with Holtain scales (Holtain Ltd., Croswell, Crymych, UK) and a Tera brand steel meter. The 20-meter speed test was carried out and visual and auditory reaction times were measured using the Newtest 2000 Sprint Timing System (Newtest Oy, Oulu, Finland).

Data analysis

Data were statistically evaluated with the paired *t* test and Pearson's test using SPSS version 12.0 (SPSS Inc., Chicago, IL, USA) for Windows. Significance was set at the $p < 0.05$ level.

Results

Subjects' mean age, height and body weight were 21.44 ± 3.32 years, 174.88 ± 6.82 cm and 69.39 ± 7.61 kg, respectively (Table 1). There were significant differences between the auditory and visual reaction times of both the right and left hands ($p < 0.01$) (Figure). Subjects' scores for visual reaction time of the right hand (VRTRH), visual reaction time of the left hand (VRTLH), auditory reaction time of the right hand (ARTRH), and auditory reaction time of the left hand (ARTLH) were 210.26 ms, 209.98 ms, 175.93 ms, and 179.32 ms, respectively.

There were no significant correlations between the reaction time and speed of the subjects (Table 2). However, there was a negative correlation between the body weights and sprint values of the soccer players ($p < 0.01$). In other words, the greater the body weight, the shorter the 20-meter sprint time. Moreover, there was a statistically significant positive correlation between the auditory and visual reaction times ($p < 0.01$).

Table 1. Physical profiles and 20-meter sprint speed of the 104 elite male soccer players*

Age (yr)	21.44 ± 3.32
Height (cm)	174.88 ± 6.82
Body weight (kg)	69.39 ± 7.61
Time playing (yr)	8.42 ± 2.43
20-m sprint speed (s)	3.02 ± 0.53

*Data are presented as mean ± standard deviation.

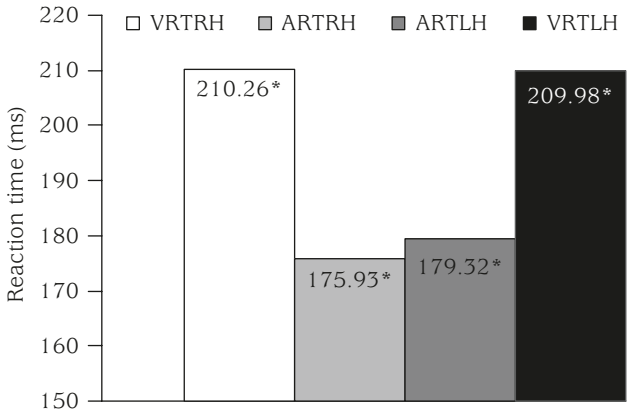

Fig. Visual and auditory reaction times of the 104 elite male soccer players. *Significant difference ($p < 0.01$). VRTRH = visual reaction time of the right hand; ARTRH = auditory reaction time of the right hand; ARTLH = auditory reaction time of the left hand; VRTLH = visual reaction time of the left hand.

Discussion

Reaction time and speed have been used in the evaluation of the motor skills of humans for a considerable

Table 2. Pearson's correlations among the parameters in the 104 elite male soccer players

	Body weight	Age	VRTRH	VRTLH	ARTRH	ARTLH	Speed (20-m)
Body weight		0.405*	−0.063	0.119	0.085	−0.036	−0.311*
Age	0.405*		0.057	0.202†	0.200†	0.232†	−0.513*
VRTRH	−0.063	0.057		0.604*	0.463*	0.479*	0.034
VRTLH	0.119	0.202†	0.604*		0.547*	0.546*	−0.007
ARTRH	0.085	0.200†	0.463*	0.547*		0.650*	0.020
ARTLH	−0.036	0.232†	0.479*	0.546*	0.650*		−0.147
Speed (20-m)	−0.311*	−0.513*	0.034	−0.007	0.020	−0.147	

*$p < 0.01$; †$p < 0.05$. VRTRH = visual reaction time of the right hand; VRTLH = visual reaction time of the left hand; ARTRH = auditory reaction time of the right hand; ARTLH = auditory reaction time of the left hand.

time. Although reaction time is a measure of performance, researchers generally use it to evaluate motor skills (Magill 1998). The right and left hand auditory (ARTRH, ARTLH) and visual (VRTRH, VRTLH) reaction times of the elite soccer players who participated in this study examining the correlation between reaction times and speed were 175.93 ms, 179.32 ms, 210.26 ms, and 209.98 ms, respectively.

İmamoğlu et al. (2000) found the auditory and visual reaction times of professional soccer players to be 160.0 ± 19.0 ms and 175.0 ± 14.0 ms, respectively, and of amateur soccer players to be 163.0 ± 20.0 and 177.0 ± 18.0 ms, respectively. Hasçelik et al. (1989) determined the visual and auditory reaction times of volleyball players before a training program to be 214.55 ms and 200.0 ms, respectively, and after a training program to be 191.3 ms and 175.05 ms, respectively. Ziyagil et al. (1994), in their study of Turkish wrestlers, determined the right and left hand auditory reaction times to be (1/100 s) 17.46 ± 1.46 and 16.87 ± 1.12, respectively, and the right and left hand visual reaction times to be (1/100 s) 17.38 ± 1.85 and 17.84 ± 1.27, respectively. Eroğlu & Şenel (2002) found the following mean reaction times in their study of wrestlers: ARTRH of 182.09 ms, ARTLH of 179.54 ms, VRTRH of 206.09 ms, and VRTLH of 212.91 ms. The reaction times obtained in the current study are in good compliance with the values reported in all of these previous studies.

İmamoğlu et al. (2000) reported the 20-meter sprint values of professional and amateur soccer players as 2.95 ± 0.17 s and 3.07 ± 0.27 s, respectively. The 20-meter sprint values of soccer players at different levels from other studies are as follows. Eniseler et al. (1996) reported values of 2.86 ± 0.10 s for premier league soccer players, 2.89 ± 0.07 s for second league soccer players, 2.94 ± 0.07 s for division 3 players, and 2.96 ± 0.08 s for amateur soccer players. Ziyagil et al. (1997) reported values of 2.99 ± 0.1 s for professional soccer players, and 3.24 ± 0.11 s for reserve team players. Alpay (1999) reported values of 2.84 ± 0.9 s for professional soccer players, and 2.97 ± 0.1 s for amateur soccer players. Çebi (1999) reported values of 3.01 ± 0.1 s for professional soccer players, and 3.24 ± 0.1 s for amateur soccer players. The mean 20-meter sprint result of 3.02 ± 0.53 s obtained in this study is in good concordance with the above previously reported values.

Table 2 shows that there was a negative correlation between body weight and sprint speed of the soccer players ($p < 0.01$). In other words, the greater the body weight, the shorter the 20-meter sprint time. There was a statistically significant positive correlation between the auditory and visual reaction times ($p < 0.01$). The decrease in the visual reaction times of the subjects is accompanied by a decrease in their auditory reaction times. The auditory reaction times of the subjects were significantly shorter than their visual reaction times ($p < 0.01$). This is also supported by data in the literature (Teichner 1954). In the present study, no significant correlation was observed between reaction time and sprint speed. Paradis et al. (2004), in their study of 209 male and female athletes who competed in the Greek, Balkan and European indoor championships in 2002, determined that there was no significant correlation between reaction times and the 60 m, 60 m hurdles and 200 m race results. Reaction time cannot be an indication of action time performance since these two variables represent different components of performance. In other words, reaction time and action time are not

dependent on each other (Yakut 2004). The most important characteristic of reaction and action times is that they are independent measures. This signifies that the correlation between reaction time and action time is typically low. Thus, one cannot use reaction time to determine or predict action time. Magill (1998) stated that reaction time and action time were independent of each other; he studied 402 subjects between 8 and 30 years of age and found almost zero correlation between reaction time and action time.

Action time can be improved by appropriate training. It is known that regular training also has a positive effect on reaction time. Although these two factors are independent of each other, they can both be improved by common strategies such as suitable physical training (Lemmink & Visscher 2005; Montes-Mico et al. 2000). Linford et al. (2006) reported that a 6-week training program significantly reduced reaction time of the peroneus longus muscle in healthy subjects.

The fact that the subjects in this study had similar performance levels may have resulted in the lack of a significant correlation between reaction times and sprint times.

Conclusion

No significant correlation was found between the audio and visual reaction times and the speed of the elite soccer players who participated in this study. However, there was a negative correlation between the body weights and sprint times of the soccer players. In addition, there were significant differences between the audio and visual reaction times of the subjects.

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