International Journal of Physical Education, Sports and Health 2020; 7(1): 111-113

P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (ISRA): 5.38
IJPESH 2020; 7(1): 111-113

www.kheljournal.com
Received: 05-11-2019
Accepted: 16-12-2019

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An analytical study of reaction time and speed in hockey players

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Abstract
The purpose of the present study was to determine the relationship between reaction time (auditory & visual) and speed (20 meter sprint time) in male hockey players. A total of 45 male hockey players with an average age, height and weight of 21.38 ± 3.15 years, 170.34 ± 5.79 cm and 64.17 ± 6.45 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, hockey, speed, height, weight etc.

Introduction
Reaction time is the intermission between the onset of a stimulus and the commencement of a movement response (Magill 1998) [12]. The reaction time for a visual stimulus is about 250 ms and for an auditory stimulus is about 170ms (Magill 1998) [12]. Reaction time can be further broken down into three parts. The first part is perception time - the time for the application and perception of the stimulus and giving the essential reaction to it. The second part is decision time, which signifies the time for giving a suitable response to the stimulus. The third part is motor time, which is the time for compliance to the order received (Tripo 1965). 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 various factors such as age, gender, number of simultaneous stimuli, nutrition, physical activity, training and physical fitness and fatigue (Morehouse & Miller 1976 and Spirdiso 1975). The athletes have better reaction times than non-athletes (Moka *et al*. 1992). Reaction time is a crucial factor affecting success in many sporting competitions. The reaction times of athletes in different sports and even in the same sports but playing in different positions show variations (Moka *et al*. 1992). The reaction times of high performance sprinters were found to be shorter than those of low performance sprinters. Exercise induces arousal that supports alertness to external environmental stimuli in highly trained athletes (Mouelhi *et al*. 2006). Explosive power, together with reaction time, decides the results of competitions in the first 2–3 meters.
Research has shown that speed can be enhanced by strengthening the muscles (Akgün 1996) [1]. One of the most significant bio-motor abilities required in sports is speed, or capacity to travel or move very quickly. From a mechanical point of view, speed is expressed through a ratio between space and time. The term speed incorporates three elements: (i) reaction time; (ii) frequency of movement per time unit & (iii) speed of travel over a given distance (Bompa 1994) [3].
Research Studies have revealed that reaction time is independent of speed (Paradis *et al*. 2004 and Yakut 2004). Although it is also known that physical training has positive effects on both reaction time (Davranche *et al*. 2006) [5] and speed (Little & Williams 2005) [11], the relationship between reaction time and speed has not been extensively investigated in the literature. The aim of this study was, therefore, to observe the relationship between reaction time (auditory & visual) and speed (20 meter sprint time) in male hockey players.

Methods

Subjects: The subjects in this study were 45 male Hockey players from different professional Hockey Academies/or teams of Maharashtra.

Data were collected in the Department of Sports Science, R.T.M. Nagpur University, Nagpur, Maharashtra India. The body heights and weights of the subjects were measured with anthropometric rod and spring based weigh machine. The 20-meter speed test was carried out in the field and visual and auditory reaction times were measured using the audio & visual reaction time instrument.

Statistical analysis

Data were statistically evaluated with the paired t test and Pearson's test using SPSS version 10.0 (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 21.38 ± 3.15 years, 170.34 ± 5.79 cm and 64.17 ±6.45 kg, respectively (Table 1).

Table 1: Mean ± SD of physical profiles and 20 meter sprint speed of the hockey players

Age (Years)	**21.33±**	**3.15**
Body height (cm)	170.34 ±	5.79
Body weight (kg)	64.17 ±	6.45
Time playing (years)	7.65 ± 2.53	
Visual Reaction Time of the Right Hand [VRTRH] (ms)	225.37	
Visual Reaction Time of the Left Hand [VRTLI-1] (ms)	224.63	
Auditory Reaction Time of the Right Hand [ARTRH] (ms) 189.13		
Auditory Reaction Time of the Left Hand [ARTLI-1] (ms) 20-ra Sprint Speed (s) 5.08 ± 0.55	192.70	

There were significant differences between the auditory and visual reaction times of both the right and left hands ($p<$ 0.01). The 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 225.37 ms, 224.63 ms, 189.13 ms, and 192.70 ms, respectively. There were no significant relationships between the reaction time and speed of the subjects (Table 2). However, there was a negative relationship between the body weights and sprint values of the hockey 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 relationship between the auditory and visual reaction times ($p<$ 0.01) of the players.

Table 2: Correlation (Pearson's) among the parameters in the male hockey players

	Body Weight	**Age**	**VRTRH**	**VRTLH**	**ARTRH**	**ARTLH**
Body weight	-					
Age	0.405**	-				
VRTRH	-0.063	0.057	-			
VRTLH	0.119	0.202*	0.604**	-		
ARTRH	0.085	0.200*	0.463**	0.547**	-	
ARTLH	-0.036	0.232*	0.479**	0.546**	0.650**	-
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.

Discussion

Reaction time and speed variables have been used in the evaluation of the motor skills of athletes for a considerable time. Although reaction time is a measure of performance, researchers usually use it to evaluate motor skills (Magill 1998) [12]. The right and left hand auditory (ARTRH, ARTLH) and visual (VRTRH, VRTLH) reaction times of the male hockey players who participated in this study examining the relationship between reaction times and speed were 189.13 ms, 192.70 ms, 225.37 ms, and 224.63 ms, respectively. Imamoglu *et al*. (2000) [8] found the auditory and visual reaction times of professional hockey players to be160.0 ± 19.0 ms and 175.0 ± 14.0 ms, respectively, and of amateur hockey players to be 163.0±20.0 and 177.0± 18.0 ms, respectively. Hasçelik *et al*. (1989) [7] found 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 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. Erog?lu & Senel (2002) found the following mean reaction times in their study of wrestlers: ARTRH of 182.09 ms, ARTLH of 179.54ms, VRTRH of 206.09ms, and VRTLH of 212.91ms. The reaction times obtained in the current study are in good compliance with the values reported in all of these previous studies. Imamoglu *et al*. (2000) [8] reported the 20-meter sprint values of professional and amateur hockey players as 2.95±0.17 s and 3.07±0.27 s, respectively. The 20-meter sprint values of hockey 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 hockey players, 2.89 ± 0.07 s for second league hockey players, 2.94 ± 0.07 s for division 3 players, and 2.96 ± 0.08 s for amateur hockey players. Ziyagil *et al*. (1997) reported values of 2.99 ± 0.1 s for professional hockey players, and 3.24 ± 0.11 s for reserve team players. Alpay (1999) [2] reported values of 2.84 ± 0.9 s for professional hockey players, and 2.97 ± 0.1 s for amateur hockey players. Çebi (1999) [4] reported values of 3.01 ± 0.1 s for professional hockey players, and 3.24 ± 0.1 s for amateur hockey players. The mean 20-meter sprint result of 5.08 ± 0.55 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 hockey 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 60m, 60m 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) [12] 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) [9]. Linford *et al*. (2006) [10] 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 (audio & visual) and sprint times.

Conclusion

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

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