

The Comparison of the Pre-Game and Post-Game Reaction Times of the Handball Teams According to Their Seeds in the Standings

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Abstract: This study aimed to compare the pre-game (PRG) as rested and post-game (POG) as fatigued reaction times of handball teams according to their seeds in the standings. 48 male athletes playing for handball teams of universities and having trained at least for five years or more voluntarily partook in the study. The measurements were performed by the Nelson Reaction Scale in the pre and post games for the handball games that were ongoing on one-leg basis. The analysis of the data was carried out with a packaged programme. The mean (M) and standard deviation (S_D) of the data scores were presented as the student t was the test performed in the dependant and independent groups for the comparison of PRG and POG, hand reaction time (HRT), two-hand reaction time (THRT) and foot reaction time (FRT). $p < 0,05$ was adopted as the level of significance. When the *PRG* (HRT: 0.232, THRT: 0.249, FRT: 0.228) and *POG winner* (HRT: 0.212, THRT: 0.227, FRT: 0.206) reaction time of the Team 1 taking the first place and the *PRG* (HRT: 0.258, THRT: 0.265, FRT: 0.244) and *POG defeated* (HRT: 0.274, THRT: 0.277, FRT: 0.265) reaction time of the Team 4 taking the last place were compared, it was observed that the POG winner scores of the Team 2 taking the second place and the Team 3 taking the third place were shorter (good) than they were in the PRG and the POG defeated scores were longer than they were in PRG. This differences were statistically significant ($p < 0.05$). The Team 1 taking the first place turned out to have the shortest (good) reaction time as the Team 4 taking the last place recorded the longest reaction time. When the reaction time of the winner and defeated teams in POG as fatigued was analyzed, it turned out to be short for the winner but long for the defeated. It is safe to say that the fatigue has an impact on the reaction time as winning or losing is more influential in that regard.

Key words: Handball Player • Reaction Time • Fatigue

INTRODUCTION

In view of the size of the ball, the duration of the game and the requisite to play it fast and accurately, then the basic motor qualities such as strength, speed, stamina and coordination come into prominence. It was also observed, however, that the complex motor qualities such as speedy strength and persistence in the strength are in the foreground for attacking plays [1, 2]. The athletes equipped with excellent technique and tactics can succeed only when the basic motor qualities are developed in a systematical fashion. The technical moves against the ball in an individual attack and defense are directly proportionate to how good the reaction time is [3, 4]. The

most important element for the road to success in sports is the reaction time. There are lots of definitions concerning the reaction time. What these definitions have in common is a stimulus and the reaction to that stimulus [4-7].

The reaction time is defined as the elapsed time between the starting time of the stimulus and the starting time of the reaction [6]. This time is an inherited characteristic defining the elapsed time between first muscular reaction of the person and the action time [8]. In other words, the reaction time is the elapsed time between the transmission of a non-prioritized signal coming out of nowhere and the response to this signal. It is, therefore, a decisive motor quality for the result of the game in sports.

Studies with regard to the discovery of a sports talent have proven that the sports talent is a set of resultants. The reaction time and hand-eye coordination that we have performed in our study are a part of these resultants as well [9].

The fatigue is defined as feeling exhausted, slow and weak and sometimes pain in muscles. When the studies related to the fatigue are analyzed, the poor performance turns out to result from changes in any stage of a neural pathway arc or in the neuromuscular junction which are defined as an element of the central nervous system. In addition, it can originate in a negative development having an impact on the contractile process of the musculoskeletal cell. The fatigue as a result of the developments in the neural pathway arc is called central fatigue as the loss of performance as a result of developments in the muscle cell is named peripheral fatigue [10-13].

Spiritual, mental and physical instruments are influential on the fatigue. The load the muscle shoulders depends on a coordinated function. Coordinated functioning of the muscle is associated with the central fatigue. The fatigue in the central nervous system as a result of an action leads to a decrease in the number and severity of the motor orders transmitted to muscles [4]. The effect of all the motor qualities particularly the reaction time would go down. The mental fatigue and especially the sleepiness have the most impact on the prolongation of the reaction time.

Studies have proven that the fatigue does prolong the reaction time. Our study aimed to ascertain the differences between the pre-game (PRG) and post-game (POG) reaction times of the handball teams participating in a tournament that were ongoing for five days on one-leg basis and to research into the relation between the reaction time and the fatigue.

MATERIALS AND METHODS

A total number of 48 male handball players - with a training age over five years or more, 21.25 ± 2.21 year in age, 179.04 ± 5.93 cm in height and 82.12 ± 15.63 kg in weight - playing for four teams participating in the 2nd division games for the lead in the group voluntarily took part in the study. The teams were named in accordance with their seeds in the standings (Team 1, Team 2, Team 3 and Team 4). The Team 1 taking the first place in the end had no defeat as the Team 4 taking the last place had no win.

The athletes taking part in the study provided their demographic information. Their height was measured by a measuring apparatus in cm as their weight was measured by an electronic bascule in kg. The reaction time calculation in the pre-game (PRG) and the post-game (POG) of the handball games that were ongoing on one-leg basis for five days was performed within the first 15 minutes as the winner (W) and the defeated (D). Nelson Hand Reaction Test and the reaction time of the dominant hand (HRT), the Nelson Foot Reaction Test and the reaction time of the dominant foot (FRT) as well as the Nelson Motion Speed Test and two-hand reaction time (THRT) were measured [14]. In Nelson hand reaction test, the experimental subject sat on a chair as his forearm and hand were on the table in a comfortable fashion. The thumb and index finger tips were 8-10 cm off the table as the upper side of the thumb and index finger was parallel to each other. The test supervisor put the scale between the thumb and index finger of the experimental subject and asked him to directly look at the central point of the scale. The experimental subject was requested to catch the scale when it was released. The figure on the top edge of the thumb where he caught the scale was read and registered. For Nelson foot test, the experimental subject sat against a wall as his tiptoe and heel were 2,5 and 5 cm off the wall, respectively. The test supervisor held the reaction scale between the wall and the foot of the experimental subject and released it when the experimental subject was ready. The experimental subject caught the scale jamming it to the wall with his tiptoe. For Nelson motion speed test, the experimental subject leaned his hands against the edge of the balancing beam at a height of a table. The little fingers were on the ground and they were 30 cm far from each other as the palms were facing each other as well. The test supervisor held the scale between the central point of the experimental subject's two hands and released it after the experimental subject concentrated on it. The experimental subject caught and jammed the scale between his two hands as fast as possible. The results for three measurements were obtained for five times and the best and the worst scores were excluded as the average of three remaining measurements was registered as the scale range. The score was calculated with the following formula thus allowing for us to ascertain the reaction times of the experimental subjects [6].

Reaction Time = $\sqrt{2 \times \text{Scale Range} / \text{Speed Varying on the Gravity}}$
Reaction Time = $\sqrt{2 \times \text{Range (cm)} / 980 \text{ sec}}$

The analysis of the data was performed with a package program of statistics Statistical Package for the Social Sciences. One-Sample Kolmogorov-Smirnov test was referred to test whether the data shown a normal indication of dispersion and the data turned out to show a normal indication of dispersion. The results of the measurements were presented in mean (M) and standard deviation (S_D). The comparison for the pre-game and post-game measurements of the groups was performed by the Student t test in dependant and independent groups. p<0,05 was considered as the level of significance.

RESULTS

When the PRG and POG reaction times were compared, the hand and two-hand reaction times as winners turned out to be shorter than they were in the PRG and this difference was regarded significant (p<0.01).

The hand, two-hand and foot reaction times as the defeated, however, were longer than they were in the PRG and these differences were statistically significant (p<0.01).

The hand, two-hand and foot reaction times of the Team 1 taking the first place were shorter than they were in the PRG as these differences were statistically significant (p<0.05). Since the Team 1 had no defeat, it was not possible to compare the reaction times of the team as the pre-game (PRG) and the defeated (D). The reaction times of the Team 4 taking the last place as the defeated (D) were longer than they were in the PRG as these differences were statistically significant (p<0.05).

The hand, two-hand and foot reaction times of the Team 2 taking the second place as the winner (W) were shorter than they were in the PRG as the difference was significant (p<0.05). The reaction time scores as the defeated (D), however, was longer than they were in the

Table 1: Statistical scores for the physical qualities of all the athletes participating in the games (n=48)

Variables	Minimum	Maximum	Mean	S _D
Age (year)	18.00	28.00	21.25	2.21
Height (cm)	165.00	195.00	179.04	5.93
Body weight (kg)	63.00	112.00	82.12	15.63

Table 2: The measurement results for the (PRG) and (W-D) reaction times of all the athletes participating in the games

Variables	Pre-game - Post-game winner				Pre-game - Post-game defeated					
	M	S _D	t	p	M	S _D	t	p		
HRT	Pre-game	0.235	0.025	4.622	0.000**	Pre-game	0.245	0.023	-4.891	0.000**
	Post-game winner	0.214	0.017			Post-game defeated	0.263	0.018		
THRT	Pre-game	0.253	0.021	7.141	0.000**	Pre-game	0.259	0.020	-3.922	0.000**
	Post-game winner	0.226	0.027			Post-game defeated	0.274	0.012		
FRT	Pre-game	0.214	0.017	0.816	0.420	Pre-game	0.245	0.019	-3.344	0.002**
	Post-game winner	0.210	0.019			Post-game defeated	0.261	0.020		

Table 3: The measurement results for the (PRG) and (W-D) reaction times of Team 1 and Team 4

Variables (n=26)		M	S _D	t	P	
HRT	Team 1	Pre-game	0.232	0.029	2.636	0.023*
		Post-game winner	0.212	0.020		
THRT		Pre-game	0.249	0.018	3.952	0.002**
		Post-game winner	0.227	0.014		
FRT		Pre-game	0.228	0.017	2.399	0.035*
		Post-game winner	0.206	0.023		
HRT	Team 4	Pre-game	0.257	0.015	-3.452	0.004**
		Post-game defeated	0.274	0.011		
THRT		Pre-game	0.265	0.016	-2.342	0.036*
		Post-game defeated	0.277	0.009		
FRT		Pre-game	0.244	0.026	-2.728	0.017*
		Post-game defeated	0.265	0.014		

Table 4: The measurement results for the (PRG) and (W-D) reaction times of Team 2 and Team 3

Variables n=22			M	S _D	t	p		M	S _D	t	p
HRT	Team 2	Pre-game	0.236	0.025	2.792	0.021*	Pre-game	0.236	0.025	-2.055	0.070
		Post-game winner	0.215	0.014			Post-game defeated	0.255	0.020		
THRT		Pre-game	0.251	0.031	4.417	0.002**	Pre-game	0.251	0.031	-2.467	0.036*
		Post-game winner	0.216	0.004			Post-game defeated	0.273	0.018		
FRT		Pre-game	0.243	0.015	2.400	0.040*	Pre-game	0.243	0.015	-1.032	0.329
		Post-game winner	0.221	0.016			Post-game defeated	0.255	0.027		
HRT	Team 3	Pre-game	0.237	0.023	2.485	0.030*	Pre-game	0.237	0.023	-3.017	0.012*
		Post-game winner	0.215	0.017			Post-game defeated	0.257	0.016		
THRT		Pre-game	0.260	0.012	4.000	0.002**	Pre-game	0.260	0.012	-1.915	0.082
		Post-game winner	0.234	0.019			Post-game defeated	0.270	0.009		
FRT		Pre-game	0.248	0.011	8.878	0.000**	Pre-game	0.248	0.011	-2.085	0.061
		Post-game winner	0.205	0.013			Post-game defeated	0.262	0.019		

Table 5: The measurements for PRG rested and POG fatigued reaction times of the teams

Teams	Pre-game			Post-game winner			Post-game defeated		
	HRT	FRT	THRT	HRT	FRT	THRT	HRT	FRT	THRT
Team 1	0.232	0.249	0.228	0.212	0.227	0.206	The Team 1 taking the first place in the end had no defeat		
Team 2	0.236	0.251	0.243	0.215	0.216	0.221	0.255	0.273	0.255
Team 3	0.237	0.260	0.248	0.215	0.234	0.205	0.257	0.270	0.262
Team 4	0.258	0.265	0.244	Team 4 taking the last place had no win		0.274	0.277	0.265	

Table 6: The measurements for the PRG and POG fatigued reaction times of all the teams

Pre-game			Post-game			
HRT	FRT	THRT	Winner	HRT	FRT	THRT
0.241	0.256	0.241	Winner	0.214	0.226	0.211
			Defeated	0.262	0.273	0.261

PRG. The difference in two-hand reaction time was statistically significant ($p < 0.05$). The scores for the hand, two-hand and foot reaction times of the Team 3 taking the third place were shorter than they were in the PRG as the difference was significant ($p < 0.01$). The scores for the reaction times as the defeated (D), however, were longer than they were in the PRG. Only the difference in the hand reaction time was statistically significant ($p < 0.05$).

The Team 1 taking the first place recorded the shortest reaction time as it was shorter as the winner than it was in the PRG. The Team 4 taking the last place recorded the longest reaction time as it was longer as the defeated than it was in the PRG. The reaction times of all the teams as the winner (W) in the measurements when they were fatigued were shorter than they were in the measurements as PRG and the defeated (D). It was ascertained that the post-game sense to win and lose was more influential.

DISCUSSION AND CONCLUSION

An athlete, in each and every game, must perform and concurrently try to deal with anxiety. The major factors causing to anxiety are related to fear of failure, loss of prestige and arrogance [15]. Spielberger [16] defined the anxiety as the emotional responses including the combination of a sense of stress, fear, bad temper, unpleasant sentiments (concerns) and physiological changes. A high level of anxiety, according to Spielberger, disrupts the performance. Those who have a low level of anxiety, on the other hand, show indications for lack of motivation. The sports performance is thought not only to be associated with physiological, biomechanical and technical factors but also with psychological factors such as anxiety, stress and motivation [16].

When the PRG and POG reaction times of the handball players in Team 1, Team 2, Team 3 and Team 4 were compared, the Team 1 taking the first place had HRT: 0.232, THRT: 0.249, FRT: 0.228 in PRG and HRT: 0.212, THRT: 0.227, FRT: 0.206 as the winner (W) (Table 3). The Team 4 taking the last place had HRT: 0.258, THRT: 0.265, FRT: 0.244 in PRG and HRT: 0.274, THRT: 0.277, FRT: 0.265 (Table 3) as the defeated (D). The Team 1 proved to have the shortest (good) reaction time as the Team 4 recorded the longest reaction time. When the reaction

times of all the teams when they were fatigued in POG were analyzed, the winners were observed to shorter reaction times than the defeated ones.

When the impact of the fatigue on the reaction time was analyzed, the winners of the games turned out to have shorter reaction times as the winners than they were in the PRG. The reaction times as the defeated were longer than they were in the PRG. This proves the impact of the reaction time on the result of the game. Winning positively affect the reaction time as being defeated affects it negatively. Our study, therefore, proves that the positive impact of the winning on the reaction time and that the fatigue has no impact on the reaction time.

It was observed that winning or losing at the end of the game was influential on the reaction times. The athletes in all the teams participating in the game were expected to be fatigued following the game and thus differing in prolongation of the reaction time. The athletes when they were the winners, however, turned out to have a shorter reaction time than they were in PRG as it depended on the motivation. For the defeated ones at the end of the game, the reaction time turned out to be longer due to the negative impact of the motivation. Athletes in both teams, however, were fatigued at the end of the game. It was observed, however, that the motivation left no room for the fatigue and positively affected the reaction time. The factors paving the way for the fatigue do not come out of nowhere but continue to kick in as physiological processes during an exercise or a game. It is known that the action potentials and impact on the spread of the factors such as pH decline in muscle fibers, an increase in lactate, an increase in the metabolic byproducts and the lack of blood in the medium starting with a muscular contraction and limiting and putting a stop to the exercise are the changes in the signal frequency content [17].

This proves the impact of the game results on the reaction times. Winning positively affects the reaction time whereas losing has a negative impact on it. It is safe to say, based on this result, that winning has a positive impact on the reaction time. Van den Berg *et al.* [18] in their study suggest that the insomnia leads to the prolongation of the reaction time. Takahashi *et al.* [19] in their study in Japan suggest that a short-time rest on the desk has a positive impact on reaction time.

When the studies researching into the relation between the reaction time and the performance were analyzed, the regularly-taken physical activities turned

out to have a positive impact on this relation. More *et al.* [20] put emphasis on the fact that better athletes are shorter in reaction speed than the others. Ağaoğlu *et al.* [21] suggest putting more work on the studies shortening the reaction time in order to enhance the success. The reaction time can be improved with regular trainings [8, 22, 23]. Fox *et al.* [24] suggested that the athletes with high performances seem to have a better reaction time. Koç *et al.* [7] pointed out that the reaction speed, one of the major motor qualities of an athlete, is the most important criterion on road to success in handball. Karakuş *et al.* [25] suggested that the success as a result of their study and the reaction time is directly proportionate. The findings obtained as a result of this study are supportive of our study as well.

As a conclusion, this study - aiming to ascertain the impact of the fatigue and morale on the reaction time in the pre-game (PRG) and the winner (W) and the defeated (D) measurements - proves that the Team 1 taking the first place has the shortest (good) reaction time as the Team 4 taking the last place has the longest reaction time. When the fatigued reaction times of the winning and defeated teams in POG were analyzed, the winners turned out to have a shorter reaction time than the defeated ones. It is safe to say that the fatigue has no impact on the reaction time but whether the team has won or lost is more influential.

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