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The effect of fatigue in elite young female wrestlers upon balance performance and reaction time.

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Abstract

The purpose of the study was to investigate the effect of fatigue in Turkish National Team Young Female Wrestlers upon balance performance and reaction time. Totally 17 female wrestlers with 18.58 ± 2.26 years age average, 165.65 ± 6.88 cm height average, 62.55 ± 9.35 kg weight average, and 22.53 ± 2.03 kg/m^2 body mass index were included into the study voluntarily.

The wrestlers participated into the research were asked to make a match in accordance with the real conditions. Static-dynamic balance performance and reaction time tests were performed to the female wrestlers as rested before and as fatigue after the match. Static-dynamic balance measurements of the wrestlers were determined using Biodex Balance System, visual reaction time measurements were determined using MOART Lafayette Reaction Measurement Device, and fatigue levels were determined using handheld Lactate analyser.

Whereas negative relationship ($p<0.005$, $r=-0.577$) was found between after match (fatigue) lactate level and after match static balance ($p<0.005$, $r=-0.505$) and dynamic balance, after match lactate level was determined not to have a significant relationship with after match reaction time ($p>0.005$, $r=0.395$).

Consequently, the balance skill as one of the most important requirements of high performance in wrestling was determined to deteriorate through the increase at fatigue level. Moreover, although no significant relationship was found between fatigue and reaction time, the time for fatigue reaction time was noticed to be higher rather than rested reaction time.

Keywords: Wrestling, Balance, Reaction time, Fatigue.

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Introduction

Balance is one of the most important key words of success in daily life and sportive activities [1]. During the sports activities, balance point of the sportsmen constantly changes its place. Good control of changing balance point is one of the requirements of high performance. The studies carried out before stated that elite sportsmen performed their balance point control well, and their dynamic balance performances were at a high level as result of this [2-4]. Balance performance is affected from pathologic conditions, age, strength, gender, anthropometric structure and points of support [5-7]. Moreover, one of the factors affecting the balance is fatigue. The duration, severity, and type of the exercise determine the level of fatigue [8,9]. Fatigue decreases the balance skill, and causes decreases in performance, as well [6,10-14]. As the severity of the exercise increases, the level of fatigue increases, as well; and decreases at performance happen as result of the fatigue [15-17].

Reaction is access of a stimulant in muscle to the central nervous system via the neurons, decision's given in the central nervous system transfer to the muscles via the neurons again and muscles behaving via spasms and relaxations according to this decision [18,19]. And reaction time is defined as the period between individuals' receiving this stimulant and responding to this same stimulant [20]. Reaction time is one of the most important factors affecting the success in sports. It is known that reaction time is affected from gender, age, motivation, doping, sleep, training, alcohol, smoking and various diseases. Moreover, one of the factors affecting the reaction time is fatigue [21,22].

The purpose of the study was to investigate effects of fatigue in elite young female wrestlers upon dynamic-static balance performance and reaction time.

Materials and Methods

Totally 17 volunteer female wrestlers in Turkey's female Young National Team participated into the study. Height

measurement of the female wrestlers participated into the research was performed using standard steel stadiotmeter as bare foot and with 0.1 cm sensitivity; the weight measurement was performed using BC-418 Segmental Body Analysis System (Tanita Corporation, Tokyo, Japan) without having any metals on. First measurements of female wrestlers were determined before the match as rested, and the second measurements were determined soon after the 3-minute match held in accordance with the real conditions.

Balance measurement

Static and dynamic balance performances of female wrestlers in the study were measured using Biodex Balance System (Biodex, Inc. Shirley, New York) for twice as rested before the match and as fatigue soon after the match. Biodex balance device includes a moveable platform enabling participants to stand still, and move towards back and front and two sides. Among the balance indexes taken, general balance index (OA) talent is accepted as the best indicator. High OA index value indicates too much loss of balance. Balance scores as "0 degree" indicate the possible maximum balance. The platform has movability level between 0 and 12. Whereas 12 is the most stable platform, 1 is the most moveable one. The tests were performed on two feet and at a straight position as standing. Two feet balance tests were performed for three times in 30-second periods with 10 second resting breaks. Before the tests, 10-second experiment tests were performed in order to provide sportsmen introduce and adapt into static and dynamic tests. The participants were asked not to move and talk during the tests. Test of the participants who lost their balance were restarted.

Reaction time measurement

Visual reaction time measurements of the sportsmen in the study were carried out twice as rested before the match and as fatigue soon after the match using MOART Lafayette Reaction Time device. In simple reaction time test, light stimulus was given to the sportsmen at different time intervals. The sportsmen were asked to respond at the shortest time pressing to the button at the lower panel of the device against the stimulus through their index finger of their dominant hand. Before the test, 3 repetitive practice tests were performed. Visual simple reaction time measurements of the experiments were carried out for 5 times successively. Excluding the best and worst values, arithmetic averages of the rest three (3) values were recorded as the simple reaction time.

Blood lactate analyser

Lactic acid analysis in blood lactate samples was performed using a Lactate Scout (+) brand (LSP, SensLab GmbH, Germany) movable lactate analyser determining the lactic acid analysis at a 10-second period through enzymatic-amperometric method from 0.5 L capillary blood. This measurement was carried out twice as before the match and soon after the match.

Statistical Analysis

Wilcoxon Signed Ranks test was used to compare the values of female wrestlers before and after the matches, and Spearman Correlation Analysis test as a non-parametric test was used in order to determine the relationship between dynamic-static balance, reaction time and lactate values. All analyses were carried out benefiting from SPSS 21.0 (SPSS Inc., Chicago, IL); and significance level of the study was determined as 0.001 and 0.005.

Findings

Table 1. *Comparison of female wrestlers values before and after the matches.*

Variables	PreEx.	Post Ex.	Z	p
Pulse	72 ± 6.20	190 ± 16.13	-3.625	0.000
Lactate	1.22 ± 0.17	9.43 ± 2.33	-3.622	0.000
StaticBalance	0.33 ± 0.12	0.62 ± 0.22	-3.424	0.001
DynamicBalance	0.85 ± 0.20	1.13 ± 0.26	-3.360	0.001
Reaction Time	227.62 ± 6471	280.37 ± 6471	-3.621	0.000
The study is significant at 0.001 and 0.005 (p<0.01)				

When Table 1 was analysed, a significant difference was determined between pulse, lactate level, static balance, dynamic balance and reaction time values before and after matches (p<0.001).

Table 2. *The relationship between female wrestlers dynamic-static balance, reaction time and lactate values.*

Variables	[1]Static Balance	[2]Static Balance	[1]Dynamic Balance	[2]Dynamic Balance	[1]Lactate	[2]Lactate	[1]Reaction Time
[2]Static Balance	0.511†						
Correlation Coefficient †	0.036						
P value							
[1]Dynamic Balance	0.222	0.530†					
Correlation Coefficient †	0.392	0.029					
P value							

[2]Dynamic Balance	0.275	0.634††	0.615††				
Correlation Coefficient †	0.285	0.006	0.009				
P value							
[1]Lactate	-0.202	-0.211	-0.006	-0.133			
Correlation	0.437	0.416	0.980	0.612			
Coefficient †							
P value							
[2]Lactate	-0.123	-0.505†	-0.495†	-0.577†	0.531†		
Correlation	0.638	0.039	0.043	0.015	0.028		
Coefficient †							
P value							
[1]Reaction Time	-0.448	-0.366	-0.280	-0.205	0.447	0.222	
Correlation Coefficient †	0.071	0.148	0.276	0.430	0.072	0.392	
P value							
[2]Reaction Time	-0.419	-0.644††	-0.333	-0.414	0.410	0.395	0.788††
Correlation Coefficient †	0.094	0.005	0.191	0.099	0.102	0.117	0.000
P value							

††Correlation is significant at (p<0.01) level, †Correlation is significant at (p<0.05) level.

†Non-parametric Spearman correlation analysis.

[1]Measurements before the match

[2]Measurements after the match

Whereas in Table 2, a negative relationship was determined between after match (fatigue) lactate level and after match static balance (p<0,005 r=-,505) and dynamic balance (p<0,005, r=-,577), no significant relationship was found between after match lactate level and after match reaction time (p>0,005 r=,395).

Discussion

High level of anaerobic strength-capacity, muscular and cardiovascular endurance, speed, force, agility, flexibility, coordination and a good balance performance are needed to have the intended performance in wrestling [23,24]. Balance, one of the requirements of high performance, is affected from several factors including fatigue [6, 10-14]

In our study, static and dynamic balance performances of wrestlers were observed to significantly decrease as a result of fatigue. Ishızuka et al. (2011) conducted a study on football players and concluded that deteriorations in balance performance occurred in the first 10 minutes after 20-minute activity [25]. Similarly, Gribble and Hertel (2004) determined that knee and hip flexor and extensor muscle fatigue after isokinetic exercise caused significant level of postural control disorder in both frontal and sagittal plane [6]. In another study upon 20 male university students, it was found that the fatigue in muscles negatively affected balance performance [26,27]. Surenkok et al. (2006) also determined a significant decrease in static balance ability after the isokinetic fatigue [28] and Erkmen et al. (2009) proved that there was an inverse proportion between fatigue and balance performance [29]. It was also determined that isokinetic ankle fatigue significantly increased postural swing while decreasing postural control limits [30]. The results of the aforementioned studies are parallel with the results of our study.

In previous studies, while Walsh et al. (2004) explained the decreases at balance performance that occurred at the end of high severity exercises with kinaesthetic awareness in fatigue and decreases at motor control, McKenna (2003) related them to the decrease in the efficiency of muscular system. On the other hand, according to Gauchard et al. (2002) and Zemkova et al. (2010) those decreases resulted from the fact that joints couldn't catch the same angle after exhausting exercises whereas Bizid et al. (2009) claimed that the reason of the decreases was that type III and type IV muscle afferents' decreased motor-neuron outputs and sensitivity [8,12,17,31-33].

Reaction time is a hereditary property determining the duration between the first muscular reaction and movement of individuals against a stimulus [34]. Reaction time as one of the determinative features of performance in sports is negatively affected from fatigue [21,22].

Although no significant relationship was found between fatigue and reaction time performances in female wrestlers participated into our study, it was determined that after match reaction time (280, 37 ± 64.71 ms) was higher than the before match reaction time (227, 62 ± 64.71 ms). In literature, there are several studies with similar results. For example, in their study they carried out upon, Delignieres et al. (1994) found in their study on sportsmen playing tennis, boxing, table tennis and escrime that reaction time extended in each severity after loadings at 40%, 60%, and 80% severity in table tennis players

and boxers [35]. Similarly, Duvan et al. (2010) found that fatigue extended reaction time in both genders and determined pre-exercise reaction time period as 204, 11 ± 16.04 ms and post-exercise reaction time as 285, 02 ± 44.27 ms [36]. Okkesim and Coskun (2015) revealed that reaction time was negatively affected from fatigue after isometric and isotonic dumbbell exercises [37]. In another study upon the doctors, Aydın et al. (2013) proved that fatigue extended audio and visual reaction time [38].

Consequently, it could be noticed that reaction time and balance were negatively affected from fatigue. Furthermore, as a result of the literature review, it was seen that there were limited number of studies investigating the effects of fatigue upon reaction time. Therefore, further studies investigating exercises performed in different branches at different severities upon the reaction time could be suggested.

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