

The Effect of Fatigue on Dynamic Balance Performance in Elite Athletes

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ABSTRACT

Background: Fatigue is a complex concept that includes physiological and psychological factors that occur as a result of component movements in which the central nervous system and many muscle groups play a role, and it plays an active role in static and dynamic balance deterioration.

Aim: In this study, it was aimed to detect the balance abilities of elite athletes and to determine the effect of fatigue on balance performance.

Methods: Twenty elite national male wrestlers, who are studying at university and have international achievements in the adults category, have voluntarily participated in the study. Height, body weight measurements, fat percentages of the wrestlers, who have participated in the study, are taken with Tanita Body Composition Analyzer (BC-418). Bruce treadmill protocol and SEBT (Star Excursion Balance Test) dynamic balance test were applied to the wrestlers before and after the Bruce Protocol.

Results: According to the results of the study, when the SEBT pre-test and post-test results were compared, it was found that there is a significant difference between the anterior (A) and Posterolateral (PL) directions of the right leg, whereas it was found that there are differences in Anterolateral (AL), Anteromedial (AM), Lateral (L), Medial (M), Posterior (P) and Posteromedial (PM) directions and between all direction averages related to the left leg although it is not significant statistically.

Conclusion: In conclusion it was found that fatigue has a negative effect in all directions of non-dominant and dominant legs of elite wrestlers.

Keywords: Dynamic Balance, Fatigue, Wrestling

INTRODUCTION

Balance is an important motoric feature for success in daily life and sport activities³⁷. Balance is defined as the creation of the body's center of gravity by establishing the base contact with minimal swinging⁴⁰. Balance, in another definition, can be defined as the ability of the postural control to maintain a support base with a static minimum movement and the ability to perform a different task while performing a dynamic movement^{23,27}. The development of balance ability is defined as a determining factor in the development of other motor systems¹⁵. Balance centers of the athletes are continuously change place during sport movements. It is very important to control the changing center of balance in terms of high performance. In the studies made, it was stated that elite athletes perform balance controls well and that their dynamic balance performances are high^{37,42}. Wrestling; is a sport that requires high level of endurance, strength, flexibility, speed, agility, balance, reaction and strategy⁵⁰. In wrestling branch, the players are exposed to sudden pushing, pulling and falling down during the competition, and the fact that the wrestling mat is soft in addition to all these situations increases the importance of balance performance^{32,30}. Especially in sports branches, which include sudden movements, the balance performance constitutes the basis of movement².

Fatigue is one of the important factors that affect balance as well as it affects balance performance, age, strength, gender and anthropometric conditions^{45,20,5}. Fatigue is a very complex concept including both physiological and psychological factors. It is a physiological condition that contains many different components that have multiple roles in the central nervous system and

muscle system³⁷. In the studies made, it is reported that fatigue occurred during and after exercise adversely affects the performance and causes loss of balance and injury^{21,9,47,43}. Duration, intensity and type of exercise determines the level of fatigue^{36,4}. As the intensity of the exercise increases, the level of fatigue increases and consequently decreases occur in performance^{38,26,51}. Balance is affected by somatosensors, visual and vestibular systems, and coordination and joint range of motion (ROM) as well as as well as sensory information obtained from motoric responses^{39,4}. On the other hand, fatigue can affect the sensorimotor system both directly and indirectly, and can inhibit neuromuscular control and cause functional instability^{7,44}. The aim of this study was to examine the effect of fatigue on dynamic balance performance of elite athletes.

MATERIAL AND METHOD

Participants: The research sample comprised 20 national male wrestlers, who are in adults category having national and international achievements and they were students studying at the university. Besides, they have participated in the study as volunteers. The research model was created as Uncontrolled Pre&Post Test Model. The national wrestlers, aged 23,2±1,98 years, and height of 172,2±6,38 cm, weight of 72,47±9,72 kg. and 24,36±2,45 BMI, and has a mean training experience of 9,6±1,54 years.

Ethical Considerations: The male wrestlers were informed about the experimental design, procedures, methods, benefits and possible risks, and written informed consent was obtained from all. All measurements were taken according to the World Helsinki Declaration. The research was explained in detail in the Ethical application

form and presented to the ethical committee. All the procedures of this article had been approved by the Social and Humanities Research and Publication Ethics Committee at Necmettin Erbakan University in Konya and the protocol number was 18/2020.

Data Collection Tools: Height and body weight measurements of the subjects were taken with Tanita Body Composition Analyzer (BC-418). The subjects were wearing short and t-shirts and were measured with bare feet. Leg lengths of the subjects were measured with measuring tape from waist to heel in upright posture.

Balance Test: The subjects were tested with SEBT (Star Excursion Balance Test) balance test before and after Bruce Protocol.

SEBT is such a test performed by stepping to 8 directions including front (A), front-right (AM), right (M), rear-right (MP), rear (P), rear-left (PL), left (L), front-left (AL) respectively with 45° angles on the center of the device placed on the floor. The participant, as hands on hips, breaks one leg at the waist (for example, the left foot) at the center by 45° degree and lifts the heel and reaches the farthest point that he/she can reach with the other foot (for example, the right foot) and tries to touch it after waiting 5 seconds. After a successful touch, he/she was allowed to rest for 5 seconds and then correct his/her balance and touch again. The participant touched all directions starting from the front (A) and clockwise respectively. When the fixed foot changed and he/she tried to touch with the left foot as right foot was fixed, he/she was asked to touch counterclockwise respectively. In cases where the participant's touch is canceled;

1. When the fixed foot is completely lifted off the ground or changes direction,
2. When he/she puts the center of gravity onto the touching foot while trying to touch the farthest point,
3. When the participant loses his/her balance and steps on another place,
4. When any other organ other than the fixed foot contacts with the ground.

Exercise Protocol: Bruce treadmill protocol was applied to the subjects. The Bruce protocol is a test consisting of 2-minute of periods in which speed and incline change. The test consists of detect the time the subject runs at the specified speed and incline. After 3 minutes of warming at an incline of 0% and the speed of 1/mile/hour (1,61km/hour), and the exercise was started with the first level of the protocol, which is 1.7 miles/hour and at an incline of 10%. The speed was increased by 2% at 2-minute intervals and measurement was made generally at levels of 9 or 10 up to 26% and in some cases up to 28%.

Table.1: Test protocol

01. Level	10%	1.7 mile/hour(2.7 km/hour)
02. Level	12%	2.5 mile/hour(4.0 km/hour)
03. Level	14%	3.4 mile/hour(5.5 km/hour)
04. Level	16%	4.2 mile/hour(6.8 km/hour)
05. Level	18%	5.0 mile/hour(8.0 km/hour)
06. Level	20%	5.5 mile/hour(8.8 km/hour)
07. Level	22%	6.0 mile/hour(9.6 km/hour)
08. Level	24%	6.5 mile/hour(10.5 km/hour)
09. Level	26%	7.0 mile/hour(11.3 km/hour)
10. Level	28%	7.5 mile/hour(12.1 km/hour)

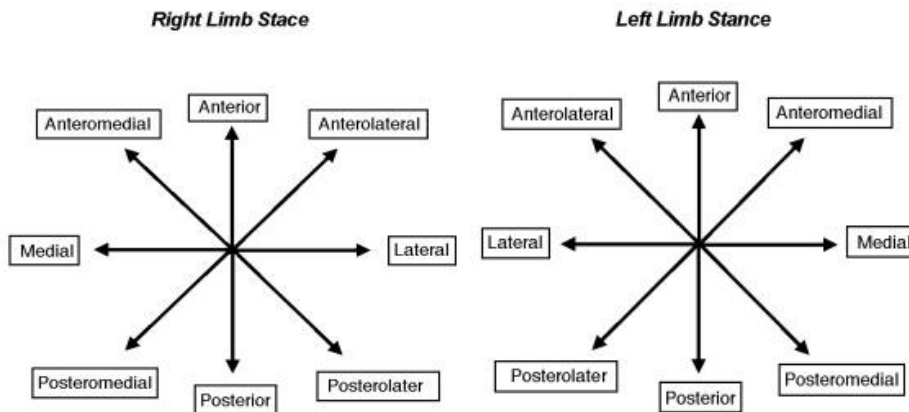


Figure.1: SEBT (Star Excursion Balance Test) balance test

Measurement of the Perceived Difficulty Degree: The difficulty degree values perceived during the tests were recorded by using the 15-part (RPE) scale of Borg.

STATISTICAL ANALYSIS

Table.2: Demographic characteristics of the wrestlers participating in the research

Variables	N	Minimum	Maximum	Mean	Sd
Year (year)	20	20,00	28,00	23,150	1,98
Height (cm)	20	160,00	183,00	172,150	6,38
Weight (kg)	20	61,70	92,50	72,47	9,72
Sport age (year)	20	7,00	14,00	9,60	1,54
BMI (%)	20	20,30	29,00	24,36	2,45

Arithmetic average in statistics, standard deviation, minimum and maximum values were calculated. IBM SPSS 21 statistics package program was used in the analysis of the obtained data. At the end of the experiment, "t test for dependent groups" was used to compare the averages of pretest and posttest scores to determine whether the results were significant or not. A significance level of 0.050 was accepted for accepting differences.

Findings

Figure 2: Wrestlers' right leg sebt pre-test-post-test values

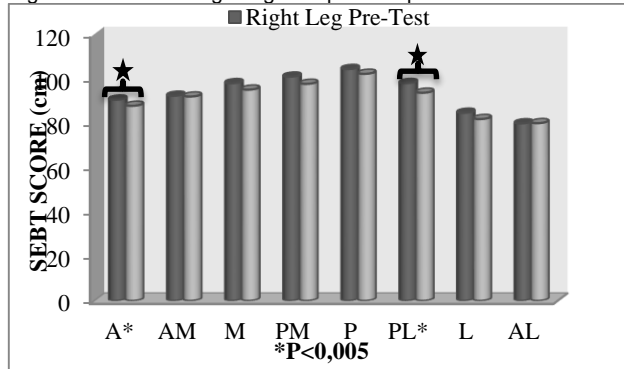
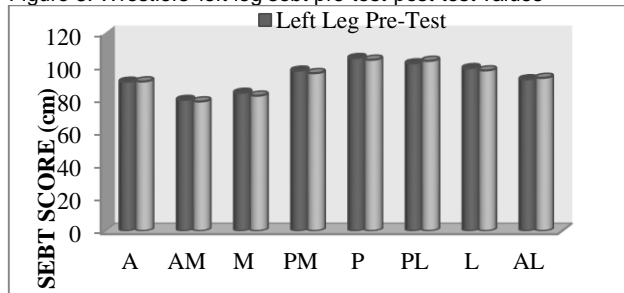


Figure 3: Wrestlers' left leg sebt pre-test-post-test values



When the pretest and posttest results were compared, there was a significant difference in the anterior and postlateral directions of the right leg. There were not any significant difference in other directions and left leg.

DISCUSSION AND CONCLUSION

Wrestling is not only a struggle consisting of sidesteps to defeat the opponent, but also a sport branch that requires high levels of endurance, strength, flexibility, speed, agility, balance, reaction and strategy⁵⁰. It was proved by studies made that dynamic balance and postural control are essential for success in all performance sports^{15,43,3,45}. In this study, it was aimed to determine the balance abilities of elite athletes and to determine the effect of fatigue on balance performance.

As a result of the findings obtained, it was observed that the averages in anterior and postlateral directions of the right leg decreased in the posttest and that there was also a statistically significant difference. ($p < 0,005$). It was seen that there was a decrease in posttest averages other directions but it was not statistically significant. In Kurt's (2015) study, in which the differences between balance and

force values in freestyle wrestlers was examined, supports the result of our research in this direction. In many studies made, it was seen that it was focused on triggering of the fatigue especially during short-term exercises. In fatigue protocols commonly used in posture and balance studies, the submaximal and maximal muscular contractions³¹ or submaximal and maximal aerobic exercises are repeated^{31,11,20}. Ishizuka *et al.* (2011) concluded that in college athletes, descension occurred in balance performance in the first 10 minutes after a 20-minute activity, In parallel with these, it was seen that fatigue occurred after the Bruce protocol applied in the study affected the balance performance of elite wrestlers negatively. Erkmen *et al.* (2009) reported that there is an inverse proportion between fatigue and balance performance. It was found that similar results were obtained in the studies that examined the effects of different protocols in athletes on balance^{6,21,47,48}. Although, it was found that the right leg, in other words, the dominant leg balance performances and reach distances of the wrestlers were better than those of the left leg, and there is not any statistically significant difference. Flexibility being in the first place, high level of anaerobic power capacity, muscle and cardiovascular endurance, speed, strength, agility, flexibility, coordination and the balance performance are quite important to achieve the desired performance in wrestling^{1,19}. It is thought that the reason for the wrestlers' reach distances is long in the dominant leg because of using the right leg more frequently or because their flexibility gains have increased due to one-sidedly weighing upon it. The results of Güler's study (2015), which examines the effect of fatigue on balance performance in elite male karate athletes, supports our research. When the left leg balance findings of our study were examined; it was found that the average anterior and postlateral directions increased in the posttest; it was observed that the posttest averages of the other directions have decreased and there was not any statistically significant difference ($p > 0,005$). As a result of their study made with elite freestyle wrestlers, Bulgay and Polat (2017) reported that the strength and balance performance may be related to each other and that this relationship may be on the left leg, which is the stronger one.

It is seen that Bruce protocol has increased the fatigue on both legs and negatively affected the balance performances. In a study they made, İri *et al.* (2016) reported that balance skill, which is one of the most important requirements of high performance in wrestling, was negatively affected from the increase in fatigue level. In a study made previously, there was not any significant difference in swinging distance between the right and left extremities²² (Gribble *et al.*, 2001). In the study made by Gioftsidou *et al.* (2006) on football players, it was found that there was not any significant difference in balance ability and knee-joint mobility before and after football training. As a result of the study made by Can (2007), it was seen that there was not any difference between test measurements of the groups made before the six-week balance training; pre- and post-fatigue; and the dominant, nondominant, double-leg static and dynamic balance scores did not show a significant difference between the two groups ($p < 0,05$). It

is seen that the study made does not support the findings of the research. It is thought that the reason for this may be the balance training program applied before the fatigue protocol. In their study, in which they examined the effect of pliometric studies on balance and strength in wrestlers¹², reported that there was increase in balance and strength values. Therefore, trainings diversified with balance and proprioceptive studies using unstable soils should be performed instead of a uniform training method such as pliometric training or similar ones. In their studies, Erdem and Akyüz (2017) found that the development of the dominant leg swinging parameters of the study group athletes doing balance and core exercises was significant compared to the athletes included in the control group. ($p < 0.05$).

CONCLUSION

In conclusion; It was seen that the fatigue occurred after the Bruce protocol negatively affect the balance performance of athletes. It is thought that the application of exercises intended for increasing the balance performance will increase the balance performance in addition to the daily training programs of the athletes in order to eliminate this negative situation.

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