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## Title The effect of muscular fatigue on the dynamic balance among the male students (11-15) in the secondary school.

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### ABSTRACT

**Background:** The aim of the present study is to determine the effect of muscular fatigue the dynamic balance among male students (11-15) in the secondary school. **Objective:** 30 secondary school students were selected in random cluster type, from bahman school, group 2, district 4, karaj city.. **Results:** 15 students for experiment group and 15 students for control group were selected in a way that all were relatively in an equal age, height and weight. The experiments were performed under 2 conditions before fatigue (31 repetition) and after fatigue (3 repetitions). It means after completion of the pre-test was taken from the subjects. It was similar to the pre-test but there was a difference **Conclusion:** the experiment group was affected by the dependent variable of the muscular fatigue. The subject was asked to run slowly on the treadmill, and then gradually we made the treadmill faster until he felt exhaustion. The treadmill speed was regulated based on symon fatigue protocol. The subject stood on Biodex system and was asked to do the dynamic balance test. He stood barefoot on system and did the test with open eyes. Then the replacement of the center of foot pressure (cop) was studied. For analyzing the data, the independent and dependent t-test 0/05 alpha was used on a significance level. For homogeneity of the variance, Levin test was used. Then to compare the fluctuation index in 2 studied group, co-variance analysis was done. Based on the gained results, after fatigue, in replacement distance of the foot pressure center, in experiment group there was a significance difference in the dynamic balance as compared with the control group. In the final conclusion, the results of the present study showed that the fatigue has the significance effect on controlling of the dynamic balance in the experiment group.

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## INTRODUCTION

The foot as the only contact part with the ground, while doing the sport activities and the weight tolerance in firmness protection share the following actions with the sole. Preparing mechanical support for body by bony-ligamentary structure of the foot, the harmonious function of the muscles in the lower organs and preparing the sense in formation based on the physical condition via depth and mechanical recipients of the pressure. It is likely that the defect in posture, the foot sense flexibility and strength damages this supportive function and exposes the person to lose the balance. Lytinen *et al* (2011), - Hertel *et al* (2002), Gribble *et al* (2004), Root (1979). On the other hand, the anatomical structure of the foot and the distribution of the ground reaction power which is suitable to it, affects the foot functions while tolerating weight and advancing Lytinen *et al* (2011). The physical fitness is discussed as muscular skeleton health index and the lack of physical fitness can alter the pressure degree on the joint and lead to the joint cartilage damage and serious postural abnormality Stroebel *et al* (2009). It is necessary to maintain the physical balance while doing routine activities and sport skills. the balance is surely one of the inseparable components of all routine activities and is the vital factor of athletes and non-athletes' success Rabiee *et al* (2011). On the other hand, the lack of a suitable physical condition is one of the reasons of more fatigue. Since the more the body remains aloof from the balance and fitness, the more it needs energy to maintain its straight. Because the muscles which are related to the body posture, have less mechanical score to keep the balance. Instead they should be involved in the movement which might result in the fatigue. Totally inequality of the strength in antagonist and agonist muscles of an organ and inadequacy of muscle flexibility could have negative body influences. Although extensive studies recently have

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been carried out to assess the fatigue and control posture by balance test. But there are slight studies in the field of studying fatigue process related the exercise and physical movement and its effects on controlling the dynamic posture. In these studies, in different age group with having postur abnormality, the fatigue often affected the balance. Also considering studies related to the balance, it has been proved that probably the fatigue affects the physical balance and there's a significant relationship between the fatigue and the balance. That is the fatigue affects the balance. Hoseini mehr *et al* (2010) has discussed the effects of fatigue on the athletes' dynamic posture control, having ankle injuries. He argued that the fatigue especially accompanied by the injuries or disorders is one of the balance decreasing factors. In a research which was carried out by Anbarian *et al* (2010), postural deviations on Biodex system in 3 following indexes were used to study the mechanical balance function of the studied groups: the anterior-posterior firmness index, the interior-exterior part, the total firmness. When the subject in both groups stood on a relatively firm surface with eyes open, there wasn't any difference in their postural deviations in the entire 3 firmness index. In another research which have been carried out by Rabiee *et al* (2011) on 16 cases having knee valgus trouble and 16 normal cases to restore the balance after exerting disorder, the results revealed that the people with knee valgus in comparison to the normal cases in the balance restore had a weaker function after exerting the external disorder. Rozzi *et al* (2011) studying the fatigue effect on the balance conclude that there wasn't any increase in body fluctuation after the fatigue. It means the fatigue didn't affect the balance. Gribble *et al* (2004) in a research studied the compound effects of fatigue and the chronic unfairness of the ankle on controlling the dynamic stature. They discussed that the unhealthy group's unfair foot in comparison to the healthy group's food had a weak function after the fatigue. In another research which has been done by Simoeau *et al* (2006) to study the effects of the average fatigue on controlling the dynamic balance, the subject's balance after the fatigue was decreased. In this study the number of the subjects for controlling the dynamic balance was 10.6 males and 4 females with the average age of 22 +1.7. Their main task was the balance regulation and COP maintenance during the fast walking on the treadmill which at last led to the fatigue and their balance was challenged. Aydog *et al* (2006) discussed the dynamic balance condition of patients with spondylitis disorder and the control group using the Biodex system. They reported that there's no difference between the patients with spondylitis disorder and the control group in the dynamic balance function. And there isn't any significant difference between the postural fluctuation and the center of foot pressure in both groups. Lytinen *et al* (2010) reported the lack of a significant difference in people's balance amount having knee osteoarthritis and normal people. In the field of reformative and rehabilitative movements the muscular-endurance is less focused than the muscle strength and the flexibility. Naturally the exercise protocols are less described in the field of muscular-endurance improvement and promotion. There are several ways to measure the muscular-endurance. One of these ways is to study the muscular fatigue. The muscular fatigue is described as disability of the muscles to maintain a specified strength in long term (Edwards, 1981). The function and the structure of the body are in a way that can prepare a potential by itself to gain fitness. Nevertheless, the unpleasant habits, the wrong lifestyles and its relevant activities can cause the stress on this mechanism that leads to the physical structure disorders. Since the fatigue effect on the lower organ the students in this range of age have been ambiguous, and also it has been rarely studied in this area, besides there isn't any special agreement about it, in the present study we've concentrated on the effect of muscular fatigue on the dynamic balance the male students Lytinen *et al* (2010), Guo *et al* (2006) in the secondary school.

The methodology: this research is a semi-experimental one. 30 secondary students were selected in random cluster type from Bahman school, group 2, district 4 of karaj city. 15 students in the experiment group and 15 students in the control group were selected in a way that all were relatively in on equal age, weight and height. None of the subjects had any kind of regular of exercise experience and any involvement in a certain sport field. After they've been informed about the research process, they announced their willingness to participate in the experiment in the written form. The lack of the surgery antecedent, breakage, burn, serious injuries or strokes in the upper or lower organs and the absence of the artificial organ in the leg, the knee and the ankle, were the subjects' general conditions. The independent and dependent variables of this research respectively were the muscular fatigue and the dynamic balance.

#### *Methodology:*

At the beginning of each section, the subject's started 6 minutes to warm up. The first 3 minutes was the slow walking and the next 3 minutes was the tensional movements. Both groups took a pre-test, in a way that at first they have been informed about all the research processes, and then they've been asked to do the test with the aim of familiarity. After ending of the pre-test, the subjects have been asked to take a post-test-a test similar to the pre-test- but it had a difference with the pre-test. We exposed the experimented group into the independent variable of the muscular fatigue. The control groups don't affected by the independent variable. We led the subject to the treadmill. He was asked to run slowly on the treadmill then gradually the treadmill speed increased until he felt fatigue. The intensity and the scale of the treadmill speed were regulated based on Symon fatigue protocol. The subject's main task was the balance regulation and COP protection during the fast walking

on the treadmill that finally led to the fatigue and the people's balance was challenged. The average speed 1/86 kilometers per second which was variable among the people from 0/85 to 3/6. The experiment involved 3 sets of jogging on the treadmill until he couldn't maintain his speed and it caused the imbalance. The experiment time was 1 hour (20). After the muscular fatigue the subject was led to the Biodex system and he was asked to do the dynamic balance test. The subject stood barefoot on the system and did the dynamic balance test with the open eyes. When the subject's heel separated from Biodex plate or when he bended his knees, the test was stopped and reported. The amount of fluctuation in the foot pressure center is considered as the balance measuring variable. The subject did each of the above stages 3 times. At last, the average of 3 repetitions was considered to assess the balance.

#### The statistical method:

To analyze the data, the descriptive and inferential statistics were used. In the descriptive statistics section the mean and the standard deviation were used and in the inferential statistics section Kulmogruf-Smirnof was utilized to determine the normality of data distribution. To test the research hypothesizes the independent and dependent t-test with a significance level of alpha 0/05 was applied. For homogeneity of both tests, Levin test was applied. Then to compare the fluctuation index in both research groups co-variance analysis has been used. All of the statistical analyses were carried out by SPSS 16 and Excel (2010) software.

#### Results:

Table (1) shows the descriptive statistics. It demonstrates the posture fluctuation index under two conditions ; the open eyes and the close eyes , the soft surface and the hard surface, for both the experiment group and the control group in the pre-test and the post-test. To determine the normality of the data distribution Kulmogruf-Smirnof was applied. Considering the research results in table 2, the result for each variable proves the normality of the data distribution and there wasn't any significant difference. Concentrating on the results of Levin index test which is bigger than 0/05 for the both test, it can be said that they are homogeneous. So, there's no prevention to use the co-variance test.

**Table 1:** the subjects' mean and standard deviation of the posture fluctuation

The index	The test	The mean of standard deviation			
		The experiment		The control	
		The pre-test	The post-test	The pre-test	The post-test
The posture fluctuation	The open eyes The rigid surface	1.89±0.922	0.98±0.39	2.01±0.672	1.81±0.39
	The closed eyes The rigid surface	2.07±0.813	1.14±0.42	2.13±0.908	2.14±0.42
	The open eyes The soft surface	1.98±0.633	1.19±0.30	2.1±0.663	2.19±0.30
	The closed eyes The soft surface	2.11±0.507	1.35±0.66	2±0.728	1.820±.66

**Table 2:** the result of Kulmogruf- Smirnof test-the measured index

The test		The group							
		The experiment				The control			
		The pre-test		The post-test		The pre-test		The post-test	
		z	sig	z	sig	z	sig	z	sig
The posture Fluctuation	The open eyes The rigid surface	0.515	0.954	0.614	0.845	0.719	0.416	0.751	0.626
	The closed eyes The rigid surface	0.722	0.674	0.574	0.897	0.812	0.391	0.619	0.838
	The open eyes The soft surface	0.529	0.942	0.626	0.828	0.391	0.811	0.943	0.291
	The closed eyes The soft surface	0.545	0.928	0.681	0.743	0.478	0.728	0.809	0.529

Based on the gained results from co-variance analysis test (table 4), the effects of group differences and the measurement stages ( $f = 343.035$ ,  $sig = 0.001$ ,  $p = 0.05$ ) show that the muscular fatigue affects the secondary school male students' (11-15) postur stableness in comparison to the control group on the soft surface with closed eyes. Furthermore the result of the independent and dependent t-test reveal that the muscular fatigue affects the experiment group's balance on the rigid surface with the eyes closed and open. While there wasn't any change in the control group. Nevertheless there was a significant difference between the dynamic balance of the control and the experiment group with the eyes open and closed on the rigid surface in the post-test.

**Table 4:** the effect of fatigue on the postural stability on the soft surface with the closed eyes, based on co-variance analysis test.

The change source	The sum of the mean deviation squares	The optional scale	The average of the sum of the mean deviation squares	The optional level (f)	The significance level (p)
The effect of the measurement stages	1012/367	2	63/273	5/918	P<0/001
The group differences effects	3667/840	1	3667/840	343/035	0/001
The effect of group differences and the measurement stages	1012/367	2	63/273	5/918	0/001
The effects of the intra-group errors	139/000	57	10/692		
The effects of the inter-group errors	1151/367	59	8/001		

### Discussion and Conclusion:

The research findings proved that the fatigue could affect the dynamic balance. So the fatigue as an important factor in the balance controlling should be assessed more. Furthermore the results revealed that the replacement distance of the pressure center before applying the fatigue protocol, statistically showed a significant difference. But the pressure center replacement in the experiment group showed a significant difference after applying the fatigue. In comparison to applying the fatigue and also in comparison with the control group. When the subjects in both groups stood on a relatively stable with open eyes, there wasn't any difference in their postural deviations in the entire 3 firmness index. In other words, when the muscles felt the fatigue, it caused the balance restore disorder and postural fluctuation in the standing posture increased and led to COP after applying the fatigue in the standing posture that was statistically significance. The after momentary fluctuation (the maximum speed) in the anterior-posterior side, was observed, which showed that the fatigue is suggestion of some changes in the control condition. The faster momentary fluctuations could compensate for the movement and the sense deficiency caused by the circumferential muscular fatigue that is accompanied by the separate control of the required posture fluctuations. The result of the present study doesn't match with the result of the following researchers: Khanna *et al* (2008), Bot *et al* (1999), Rozzi *et al* (1999), Lytinen *et al* (2010). But if parallels that of under mentioned researchers; Gue *et al* (2006), Durmus *et al* (2010), Tetsuhiko *et al*(2007), Anbarian *et al*(2010–2011), Sinaki *et al*(2005), Hoseini mehr *et al*(2010) and Symon *et al* (2006). In justifying the homogeneity of the present study with the prior studies and the muscular fatigue influence on the dynamic balance in two groups, it can be said it's likely that the quality of the anterior element and the articular surface of the spinal column structure be different from one person to another or from one group to another. So it isn't important to acquire different results in the different groups. And also it isn't likely that influencing the fatigue on the balance among the subjects in the present study be due to such factors. In justifying the research results can be mentioned it is probable that when there's more in stability due to the fatigue in the learning part, the students use the compensatory mechanism more to keep their balance. These compensatory mechanisms often appear in the anterior-posterior sides. In a study undertaken by Symon *et al* (2006), the subjects' balance decreased after the fatigue process. This paralleled the present study. Totally the findings reveals that the muscular fatigue of the sense system in fluencies the posture fluctuations as compared with the moveable output. It's likely that the heterogeneity of some results with the prior study results is due to the different balance assessment methods. Therefore the present study results could be utilized in teaching posture fluctuation to the people in the aforesaid age group. Nevertheless there's still a need to greater studies in this area to determine how the adopted ways are useful to restore the posture fluctuation.

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