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ACUTE EFFECTS OF ANAEROBIC EXERCISE WITH DIFFERENT INTENSITIES ON DYNAMIC BALANCE PERFORMANCE

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Abstract:
The purpose of this study was to investigate of acute effects of anaerobic exercise at different intensities on dynamic balance performance. Twenty sedentary men who were 23.70 ± 1.45 years old, were voluntarily participated in the study. Single-blind, randomized controlled crossover design was used as experimental design. For determining dynamic balance, dynamic balance test on isokinetic balance device with dominant-single-leg test procedure was used. To create anaerobic exercise effect, Wingate anaerobic power test was used with different loads. Dynamic balance performance was measured one time before anaerobic exercise trials. During the following four days, anaerobic exercise trials with different intensities were applied in order to create anaerobic acute effect. Dynamic balance test procedure immediately applied after all anaerobic trials. For analyzing obtained data, repeated measures analysis of variance and LSD correction tests were applied. In terms of other trials, 10.0% and 7.5% anaerobic exercise trials showed significant decrement in overall and anterior-posterior balance points ($p < 0.05$). In terms of other trials, 10.0%, 7.5%, and 5.0% anaerobic exercise trials showed significant decrement in medial-lateral balance point ($p < 0.05$). Besides, balance points increased in 10.0% trial, while the balance points gradually decreased to 7.5% trial from control. In summary, it could be said that dynamic balance positively influenced from anaerobic exercise when it low intensity, and negatively influenced from anaerobic exercise when it high intensity.

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1. Introduction

The balance can defined the ability to maintain a base of support with minimal movement and the ability to perform a task while maintaining a stable position, as dynamic (Grigg, 1994; Palmieri et al., 2003; Palmieri et al., 2002). The balance is appointed at performing sportive skills, initial movements, locomotor moves, and multidimensional moves of subjects, trunk stabilization, and sportive performance (James et al., 2001). These highlighted features show importance of balance for athletic performance.

The balance can be affected from some factors as byomechanic and physicological. The others are dominant leg, exercise history, age, height, weight, physical activity level, injuries and fatigue (Rozzi et al., 1999). The fatigue is one of important factors on the balance (Sato and Mokha, 2009). Researches well-clearly presented the balance could be negatively affected from the fatigue (Johnston et al, 1998; Yaggie and McGregor, 2002; Nardone et al., 1997; Wilkins et al., 2004; Gosselin et al., 2004; Frzovic et al., 2000; Adlerton and Moritz, 1996; Bellew and Fenter, 2006). But it is not known how the effects of the intensity level of anaerobic physical activity on dynamic balance.

There are no studies about of effects of the different loads of anaerobic physical activity on dynamic balance. It could be hypothesized that the increased anaeobic intensity affects the dynamic balance. The present study aimed to investigate the effect of the anaerobic exercise intensities on the dynamic balance performance.

2. Method

2.1 Experimental Design

The present study was designed as single-blind, randomized, trial-controlled repeated measures design. The subjects visited laboratory six times. During the first visit, they were familiarized with the dynamic balance test and anaerobic exercise protocol, and were sign the written consent. During the second visit, the descriptive data were recorded and the “control trial” that included only dynamic balance test without anaerobic exercise. The third, fourth, fifth, and sixth visits included dynamic balance test after anaerobic exercises with 2.5%, 5.0%, 7.5%, 10.0% loads, randomly. The trials performed at the same time (10:00-12:00), with 24 hour rest bouts.

2.2 Subjects

Twenty sedanter males participated in the study volunteerly (Table 1). The mean age of subjects is 23.70 ± 1.45 year. The inclusion criterias are having without sportive history, non-participant in regular physical activity, and no have diagnosed disease. Written consent from subjects and ethical approval from Gaziantep Clinical Research Ethical Committee were received (2016-283).

Table 1: Descriptive parameters of subjects (N = 20)

	Mean	**S.D.**
Age (year)	23.70	1.45
Height (cm)	178.40	6.98
Weight (kg)	74.50	9.65
BMI (kg/m^2)	23.33	1.95
BFP (%)	15.75	4.30
Overall balance (point)	2.14	0.76
Anterior-posterior balance (point)	1.55	0.63
Medial-lateral balance (point)	1.54	0.73

SD, standard deviation; BMI, body mass index; BFP, body fat percentage (note that, BFP was calculated with Yuhasz formula)

2.3 Procedures

2.3.1 Dynamic Balance Measurement

A mechanized balance system (Biodex Balance SD, Biodex Inc., NY, USA) used for measuring ODB. Tha platform setting set at fourth level. The testing protocol consisted of three 20-second (between 10-second rest) with dominant one-legged on dynamic unstable surface. Subjects stood on their dominant leg on the balance platform. The platform was then unlocked to allow motion. Subjects were instructed to adjust the position of the supporting foot until they found a position where they could maintain platform stability. Then, the platform was locked and testing began as the platform was released for a 20-sec trial and participants were asked to maintain an upright standing position on their dominant limb. The unsupported leg was in a comfortable knee-flexed position. For the trial to be complete, balance needed to be maintained for 20 sec. The handrails to the BBS were up only between trials and participants were permitted to move their arms to assist in maintaining balance. Testing was repeated for three trials between 10-sec rest (Cachupe et al., 2001). Overall balance, anterior-posterior balance, medial-lateral balance values were obtained via the test. The value is the better the closer to zero.

2.3.2 Anaerobic Exercise Procedures

Anaerobic exercise for lower extremities was applied with cycle ergometer (894E Peak Bike, Monark Exercise AB, Vansbro, Sweden) and Wingate test procedure. Before exercise, cycle seat and handle bar was adjusted for each subject. Resistance load was set at 2.5%, 5.0%, 7.5%, 10.0%, randomly for trials, of subject's body weight. The subjects performed warm-up approximately 5-10 minutes. When subject felt warming up, seated to cycle and pressed to cycle button for drop load. After than subject pedaled as fast as possible while seated for 30 seconds. During 30 seconds exercise time, operator provided verbal encouragement to maximal effort of subject (Bar-Or, 1987; Taşmektepligil et al., 2012).

2.3.3 Statistical Method

For statistical analysis, SPSS 22.0 (SPSS Inc., Chicago, Il) was used. Data are presented as mean, standard deviation, and the mean percent of difference. The Shapiro–Wilk test was used for normality. In order to determine the significant effects of the anaerobic exercise trials on the dynamic balance, repeated measures one woy ANOVA and LSD tests were performed. Significance was defined as $p \leq 0.05$.

3. Results

There were significant differences between trials in the overall balance (Table 2). LSD test showed that significant differences were found between 10.0% trial and control trial; 7.5% trial and 2.5%, control trials; 5.0% trial and 2.5%, control trials ($p < 0.05$).

Table 2: Overall balance analysis

Trial	Mean (point)	S.D.	f	p	Significant difference
A. Control	2.14	0.76			
B. 2.5%	2.07	0.80			E-A
C. 5.0%	1.50	0.55	13.892	0.001	D-A; D-B
D. 7.5%	1.47	0.71			C-A; C-B
E. 10.0%	1.59	0.63			

Note: The value is the better the closer to zero.

Table 3 shows anterior-posterior balance alteration between the trials. There were significant differences between the trials in the anterior-posterior balance. LSD test showed that significant differences were found between 10.0% trial and control trial; 7.5% trial and 2.5%, control trials; 5.0% trial and 2.5%, control trials ($p < 0.05$).

Table 3: Anterior-posterior balance analysis

Trial	Mean (point)	S.D.	f	p	Significant difference
A. Control	1.55	0.63	3.787	0.007	E-A D-A; D-B C-A; C-B
B. 2.5%	1.38	0.65			
C. 5.0%	1.16	0.66			
D. 7.5%	1.06	0.50			
E. 10.0%	1.29	0.49			

Note: The value is the better the closer to zero.

Table 4 shows medial-lateral balance change between the trials. There were significant differences between the trials in the medial-lateral balance. LSD test showed that significant differences were found between 10.0% trial and 2.5%, control trials; 7.5% trial and 2.5%, control trials; 5.0% trial and 2.5%, control trials ($p < 0.05$).

Table 4: Medial-lateral balance analysis

Trial	Mean (point)	S.D.	f	p	Significant difference
A. Control	1.54	0.73	4.271	0.001	E-A; E-B D-A; D-B C-A; C-B B-A
B. 2.5%	1.35	0.76			
C. 5.0%	0.84	0.31			
D. 7.5%	0.79	0.39			
E. 10.0%	0.93	0.53			

Note: The value is the better the closer to zero.

The balance performance showed increment from the control trial to 7.5% trial in all the balance parameters. The performence increment understood from decrement the balance values as numerical. But after 10.0% trial balance performance started to impairment (Figure 1). The performence decrement understood from increment the balance values as numerical.

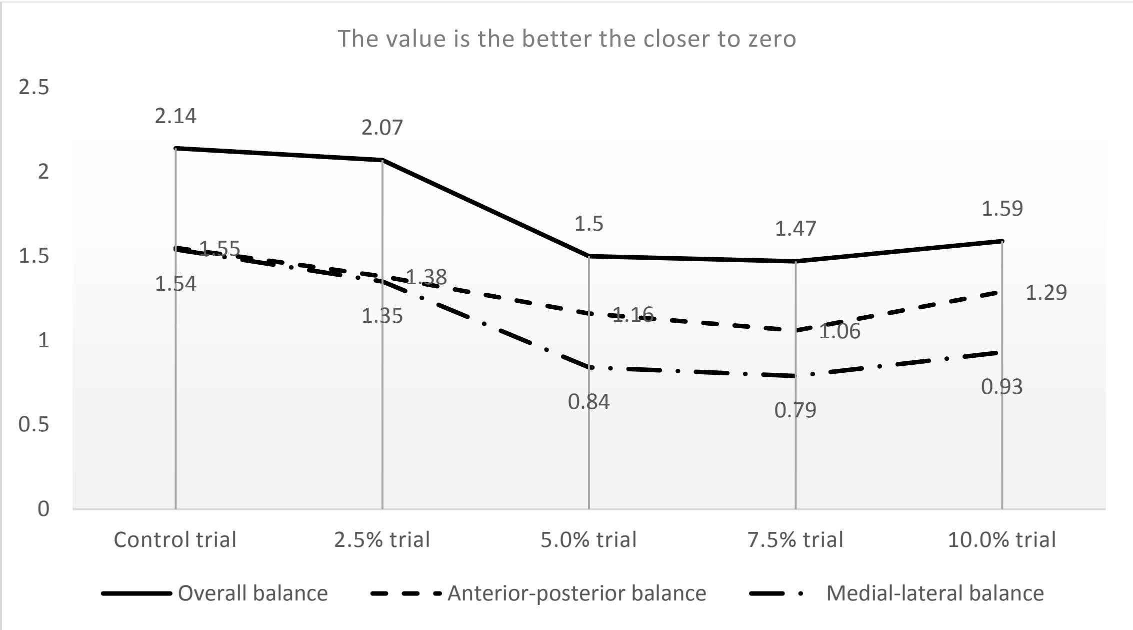

Figure 1: Difference of balance performance between trials

4. Discussion

Different intensities of anaerobic exercise were performed before dynamic balance test in the present study. According to obtained data, significant differences were found between 10.0% trial and control trial; 7.5% trial and 2.5%, control trials; 5.0% trial and 2.5%, control trials in the overall and anterior-posterior balance values ($p < 0.05$). Also, significant differences between the trials in the anterior-posterior balance. LSD test showed that significant differences were found between 10.0% trial and 2.5%, control trials; 7.5% trial and 2.5%, control trials; 5.0% trial and 2.5%, control trials in the medial-lateral balance ($p < 0.05$).

The overall balance was measured in the control trial by 2.14 ± 0.76 point, in the 2.5% trial by 2.07 ± 0.80 point, in the 5.0% trial by 1.50 ± 0.55 point, in the 7.5% trial by 1.47 ± 0.71 point, in the 10.0% trial by 1.59 ± 0.63 point. The anterior-posterior balance was observed in the control, 2.5%, 5.0%, 7.5%, and 10.0% trials by 1.55 ± 0.63 point, 1.38 ± 0.65 point, 1.16 ± 0.66 point, 1.06 ± 0.50 point, 1.29 ± 0.49 point, respectively. The medial-lateral balance was measured in the control, 2.5%, 5.0%, 7.5%, and 10.0% trials by 1.54 ± 0.73 point, 1.35 ± 0.76 point, 0.84 ± 0.31 point, 0.79 ± 0.39 point, 0.93 ± 0.53 point, respectively.

Additionally, the balance performance showed increment from the control trial to 7.5% trial in all the balance parameters. But after 10.0% trial balance performance started to decrement. This result important to explain importance of the study.

A previous study presented the moderate intensity of exercise may has positively effect on the balance performance (Schneiders et al, 2012). However the high intensity of exercise can be reason of the decrement in balance performance (Schneiders et al, 2012; Erkmen et al., 2009; Bove et al., 2005; Susco et al., 2004; Wilkins et al., 2004; Waterman et al., 2004; Erkmen et al., 2009). Researches showed that the most important factor of the reason on decrement in balance performance is fatigue in lower extremity (Yaggie and McGregor, 2002; Surenkok et al, 2006), rather than fatigue in upper extremity (Surenkok et al, 2008).

In the present study, 10.0% trial caused a marked decrement in balance performance, and the it can be concluded that fatigue is reason of this result. It is known that fatigue in lower extremity can be caused increased swing level in anterior-posterior direction. As a result of this, it may be considered that production of efferent signal which required for body stability may be reduced, because transmission of afferent signal may be declined by fatigue (Gribble and Hertel, 2004; Gribble et al, 2004; Nardone et al., 1997; Johnston et al., 1998). Additionally, muscle fatigue can be caused decrement in proprioceptive and kinesthetic properties in joints. Due to reduced afferent signal transmission following fatigue, the muscle spindle discharge treshold could increase, resulting in a change in joint sensitivity (Rozzi et al., 1999).

In the present study, fatigue in the 10.0% trial may be peripheral/muscular (Holtzhausen and Noakes, 1995; Douglas et al., 1987; Doglas et al, 1998; Lomax et al., 2015; Lomax et al., 2014). During exercise alteration in cardiovascular (Holtzhausen and Noakes, 1995; Douglas et al., 1987;), endocrinal (Doglas et al, 1998) that occured in muscle glycogen stores after high intensity exercise (Çinar et al., 2010), energy metabolism (Laursen et al., 2002; Mendeş, 2016; Akcan and Biçer, 2015), and related with homeostasis (Çinar et al., 2008) could be occured by fatigue, and the reasons above may be affect the body swing (Ledin et al., 2004; Vuillerme et al., 2002; Caron, 2003; Vuillerme et al., 2006; Vuillerme and Demetz, 2007). Proprioceptive and extroceptive information system and their entegration may be affected by high intensity exercise, and muscular activity may be decrease. After that motor-neuron output of type III and IV muscular afferents reduce, thus the ability to catch the same angle of lower extremity could be negatively affect (Nardone et al., 1997; Lepers et al., 1997; Gauchard et al., 2002). As a result of these factors, kinesthetic awareness and motor control could be decrease (Walsh et al., 2004).

In addition to the above information, high intensity exercise caused to acidosis and deep ventilation, and this result caused to increased body swing (Hunter and Kearney, 1981; Jeong, 1991; Bouisset and Duchêne, 1994; Sakellari et al., 1997). Besides, the situation of fatigue is not only occured on muscular level, it also occurs at central nervous system and caused deficiency motor-drive. Therefore the reduction and deterioration of the expected return from the sense of joint position are the main effects (Gandevia, 2001; Lepers et al., 1997; Seliga et al., 1991; Forestier et al., 2002).

In the present study, 5.0% and 7.5% trials show improve in balance performance. This result cannot be explain with fatigue effect, but can be explain with warm-up effect. Muscular temperature and contractional ability-strength of muscle can be increase with warming up (McConnell et al., 1997). Warm up caused to decrement in joint and muscle stiffness (Wright and Johns, 1961; Proske et al., 1993), increased nerve signal speed (Karvonen and Lemon, 1992), improved power-acceleration relation (Ranatunga et al., 1987), and increased glycolysis-phosphate degradation (Febbraio et al., 1996), improved coordination of inter-intramuscular (Özdal, 2015; Özdal, 2016a; 2016b; 2016c; Özdal et al., 2016).

As a result, it could be said that moderate anaerobic exercise may positively affect the dynamic balance performance due to warm-up effect; however high intensity may negatively affect the dynamic balance ability due to fatigue effect.

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