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Effect of Aerobic Loading on Static Balance in Young Athletes

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Abstract

The fact that balances can also be a factor in performance distinction between athletes in athletic skills, and is considered to provide positive acceleration for physical development in which motor skills are exhibited. Human's skill to ensure balance can be defined as a determinant factor in development of other motor skills. From this point of view, the purpose of the study is to investigate the effects of Aerobic Loading on Proprioception in Young Athletes. The research was composed of 18 young athletes registered in Ağrı Provincial Directorate of Youth and Sports Athletics Club. Tests of the participant athletes of the research were conducted in the Performance Laboratory of Ağrı ibrahim Çeçen University Department of Physical Training and Sports. After the data were collected, comparisons were made using percentage distributions, medians, and t-test. As a result of the research, it was seen that no effect at desired level occurred in static balances of athletes. It was detected that there was no significant difference between the static balance values taken prior to loading and the static balance values taken after loading ($p > 0,05$). In lactate measurements performed in order to detect fatigue conditions, differences at significant level ($p \le 0.05$) were detected when the data taken before and after the study were compared. When the general characteristics of the participants are considered, the fact that they are elite athletes reminds that they may carry a high level of motor learning process along with them. This skill may be effective in the fact that static balance values remained unchanged following maximal loading.

Keywords: Balance, athletes, lactate

1. Introduction

With the level the sport has reached today, increase of competitive conditions, and further specification of qualifications desired in athletes in parallel to that, profile of the athlete at elite level is changing, significant developments are occurring in performance, and development is continuing (Akyüz M, Uzaldı, Akyüz & Doğru, 2016). "There is a direct interrelation between the physiological capacity mechanisms and the practice level of physical exercise, which is influenced by a series of factors, of which environment and its characteristics are the most important" (Badau, Ungur, & Badau, 2015). Balance is the skill of controlling the body with the least muscular activity in static and dynamic positions against changes in the centre of gravity of body (Vernazza-Martin, Martin, Le Pellec-Muller, Tricon & Massion, 2006; Hall, Mockett & Doherty, 2006). In this regard, balance is ensured and centre of gravity of body is kept at support level through the coordination between proper neural mechanisms and musculoskeletal system (Cote, 2005; Bennell & Hinman, 2005; Yim-Chiplis & Talbot, 2000). Movement is the most important need of individuals (Akyüz M, Ağar, Akyüz & Doğru, 2016); however, one of the major problems in control of movement is the time, which lapses in order for signals concerning the speed of positions and movements from various sections of the body to reach the brain. As in the spinocerebellar afferent system, a delay of 15-20 milliseconds occurs in neural transmission from foot to brain even in sensory paths that transmit the fastest (120 m a second). Feet of person who is running fast can move by 25 cm within this period. Thus, when movements are made, it is impossible for signals, which arise from the peripheral part of the body to reach the brain simultaneously. Signals from periphery tell the brain not only the positions of different parts of the body (Berthoz, 2000) but also how fast and in which direction they are moving. It is believed that it is the function of the vestibular cerebellum calculating in terms of this speed and directions where different parts of the body will be located within the next few milliseconds. Results of these calculations are the key to the brain process for the next sequential movement. Thus, while the balance is regulated, it is thought that the information coming from the vestibular system to correct in advance the postural motor signals, which are required for maintaining the balance even in very fast movements including very rapid change of direction of movement, are used in a feedback control circuit (Guyton & Hall, 2001).

The higher the O_2 amount usable by person within unit time, the higher the aerobic capacity of that person is. Aerobic strength is the most important physiological factor affecting performance in endurance sports. There is a high dependency between maximal aerobic capacity and the skill to sustain a severe effort. An athlete cannot show high performance in resistance sports without having a high maximal VO_2 value. Use of maximal VO_2 consumption (VO2max) was first mentioned by A.V Hill. According to Hill (1913), O_2 taken in unit time reaches a particular maximum due to restriction of the circulatory and respiratory systems, and stays at that level even if the work performed increases. It is this point where the O_2 person uses is maximal; it takes the name VO2max or maximal aerobic capacity, and is accepted as the cardiorespiratory endurance capacity of individual or the best criterion of condition. Aerobic energy consumption is expressed as the oxidation of nutritive in mitochondria in order to provide energy. Energy is obtained by release of water and carbon dioxide as a result of decomposition of carbohydrate and fats in oxygen environments. In long-term moderate endurance trainings increase occurs in aerobic capacity, myoglobin level at high degree, in mitochondria enzymes, glycogen stores, and oxidative capacity. Increasing respiratory capacity and respiratory rate, increase in oxygen transfer, increase of heart output, and expansion of the muscular mitochondria scope are in question in aerobic exercise (Bompa, 1994).

Lactide acid (LA) causes fatigue if it reaches high density in muscle and blood. Acid environment reduces pH and can reduce the destruction rate (speed) of carbohydrates by preventing several enzyme activities in mitochondria. When compared to oxygen reaction, only several moles of ATP can be renewed during anaerobic glycolysis. For example, only 3 moles of ATP are obtained from glycogen during anaerobic glycolysis. However, when glycose enters into reaction in oxygen environment, 39 moles of ATP are obtained from the same glycogen. In fact, the amount of ATP obtained through anaerobic glycolysis is less than 3 moles. The reason for this is that maximum 60 to 70 gr of lactic acid is tolerated in muscles and blood before fatigue appears during exhaustive training. If all of the 180 gr of glycogen had entered into reaction, 180 gr of lactic acid would have occurred. Therefore, it is seen that only 1 mole to 1.2 mole of ATP is renewed during application when the lactic acid in blood and muscles reaches the level that causes fatigue. ATP production takes place very rapidly in anaerobic glycolysis system. In order to reduce lactic acid fatigue, lactic acid must be removed from the body. Recovery rate is determined by the rate of removal of lactic acid from the body. This event generally takes place in a half-time of 20-30 minutes. A full recovery in metabolic means cannot be expected even at the end of the training program in which the lactic acid system is used at the highest point. Energy for severe exercises, which last approximately for 40 seconds (200-400 m run etc.), is met from the ATP-PC system first. Glycogen, which is found stored in muscular tissues and liver, is decomposed. Since 02 is not used during glycogen decomposition and LA formation occurs as a result, this system is called Lactic acid system. In the event that severe exercises at a high rate are continued, LC accumulation in muscle and blood will increase and this will first cause fatigue and later termination of the exercise. Fatigue in sports can be defined as gradual decrease of strength along with maximal loading of muscles. Fatigue starts upon depletion of energy sources and accumulation of metabolic wastes (Günay, 1999). Oxygen usage determines the foundation of aerobic energy. Amount of oxygen carried to tissues is the determinant factor of aerobic energy production. These factors are as follows: Maximal oxygen consumption is the highest amount of oxygen sent to functioning muscles. Maximal oxygen consumption is defined as max VO2. Max VO2 is the amount of oxygen consumed per one kilogram of body weight within unit time (Doğru, Büyükyazı, Ulman, Taneli, Tıkız, Göral, & Esen, 2016). This value is the indicator of the aerobic path that participates in formation of energy in endurance sports. It is synonymous with aerobic strength. Relation between the maximal oxygen consumption and lactic acid production; fatigue depending on lactic acid accumulation along with max VO2 plays a limiting role in endurance trainings. Athletes with high max VO2 capacity have higher and later tolerance against lactic acid production. Athletes with high anaerobic threshold value have higher effort time and resistance to effort in aerobic exercises. Productivity; the relation between muscular functioning and the amount of oxygen used reveals the productivity. There is a certain oxygen consumption for every effort during running. Marathon runners consume less oxygen at the same running pace compared to middle distance runners and sedenteries (Dündar, 1998).

2. Method

2.1 Participants Selection

A total of 18 voluntary athletes in Athletics U18, whose median age is 14.1 ±1.26 years, median height is 169.3±3.87 cm, body weight is 55.3±5.47 kg, and sport ages are 3.2±0.83 years, participated in the research. Information on tests to be applied was given to athletes and documents, which specified the voluntary participation, were asked before the experiment. The study was conducted in accordance with the principles of Helsinki Declaration.

2.2 Study Design

Research was conducted in the Performance Laboratory of Ağrı İbrahim Çeçen University Department of Physical Training and Sports. All volunteers were informed of the applications to be made prior to test. Pre-fatigue eyes open and eyes closed static balance measurements were performed in technobody ProKin PK 252 model balance device on the participant to be included in the exercise protocol. Athletes were brought to fatigue level by performing astrand test with monark 839 E computerized aerobic ergonomics and MaxVo2 was determined at the same time with fitmate Pro cardio device.

2.3 Lactic Acid Measurement

Pre-aerobic loading and post-aerobic loading blood lactate levels of subjects were detected with "Accusport Lactate Analyser”. Before starting the test, finger tips of the subjects were pierced with lancet and a blood sample of approximately 50 microliters (approximately 1 drop) was taken into "Boehringer Mannheim" lactate kit, and fatigue blood samples of the subjects, who left the test right after it, were taken in the same manner and analysed. Before taking blood, the person who took blood wore sterile gloves and blood was taken after the fingertip was cleaned with alcohol (Tamer, 2000).

2.4 Data Analysis

Statistical evaluation of data was performed using SPSS 15.0 statistical package program. Eyes open and eyes closed as well as pre-fatigue and post-fatigue values of the subjects were compared, percentile averages were taken, and standard and t-tests were performed. Results were evaluated at a significance level of $p \leq 0.05$.

3. Results

Definitive statistics of the participants are shown in Table 1. Pre-exercise arithmetic mean, standard deviation, and minimum and maximum values of all parameters are provided. Data of 18 volunteers were used in analyses.

Table 1. General characteristics of participants at baseline

Parameters	N	Min-Max	X	SD
Age (yr)	18	12-16	14.1	1.26
Height (cm)	18	162-173	169.3	3.87
Body weight (kg)	18	45-62	55.3	5.47
Sport Age (yr)	18	2-4	3.2	0.83
Max VO2	18	42.6-64.2	51.22	6.84
Heart Rate	18	159-173	163.33	4.21
Fatigue (Mets)	18	12-18	14.66	1.87

When the results of the t-test are examined for pre and post-aerobic loading lactate values of the athletes, rest lactate average is 2.47 ± 0.81 and fatigue lactate average is 3.75 ± 1.45, and there is a significant difference at a level of $p \leq 0.05$.

Table 2. T-test results for pre and post-aerobic loading lactate values

Parameters	X	SD	t	p
Lactate (rest) Lactate (fatigue)	2.47 25.3	0.81 1.45	-3,707	0,006

$p \leq 0.05$

Table 3. Rested eye open and fatigued eye open static balance comparison

		X	SD	t	P
Eye Open	Pressure exerted on rested x axis Pressure exerted on fatigued x axis	1.11 1.22	1.69 1.85	-.316	.760
Eye Open	Pressure exerted on rested y axis Pressure exerted on fatigued y axis	1.22 .66	3.03 1.73	-1,380	.205
Eye Open	Rested forward-backward deviations (FB) Fatigued forward-backward deviations (FB)	4.11 3.00	2.66 1.00	1,048	.325
Eye Open	Rested right-left deviations (ML) Fatigued right-left deviations (ML)	2.66 1.55	1.73 .52	1,644	.139
Eye Open	Rested forward-backward accelerations (FB) Fatigued forward-backward accelerations (FB)	9.88 8.88	4.98 2.14	.495	.634
Eye Open	Rested right-left accelerations (ML) Fatigued right-left accelerations (ML)	7.11 5.22	2.84 1.30	1,931	.090
Eye Open	Rested circumference made Fatigued circumference made	347.77 294.00	140.24 54.95	.975	.358
Eye Open	Rested area made Fatigued area made	118.00 105.75	40.67 44.07	.594	.571

$p \leq 0.05$

When the results in Table 3 are examined, no significant difference was observed ($p > 0.05$) in static balance states between the pressure on the x axis while the rested eye is open and the pressure on the x axis while the fatigued eye is open; between the pressure on the y axis while the rested eye is open and the pressure on the y axis while the fatigued eye is open; between the rested eye open forward-backward deviations and fatigued eye open forward-backward deviations; between the rested eye open right-left deviations and fatigued eye open right-left deviations; between the rested eye open forward-backward accelerations and fatigued eye open forward-backward accelerations; between the rested eye open right-left accelerations and fatigued eye open right-left accelerations, and between the rested eye area made and the fatigued eye area made.

4. Discussion

In this research the effect of aerobic loading on static balance performance in elite athletes was investigated. In a research in which they investigated the effect of local and generic fatigue on knee proprioception, Miura et al. (2004) applied five-minutes running exercise on treadmill. As a result of the research, no change in post-fatigue knee proprioception scores was seen, while generic post-fatigue values reduced. In the study conducted by Vuillerme & Nougier (2004), the test group composed of gymnasts was compared with a control group composed of football and handball players. No difference between the two groups was reported in balance measurements they performed on single feet, double feet, and single feet on foam surface. In another research, Stemm, Gren, & Royer (2001) classified golf players according to 3 different handicap levels and examined postural release levels. At the end of this study, it was reported that there was no difference in basic balance measurements between the initial level and high handicap level. No differences were observed in postural control performances of 2 judoist groups competing in different groups in the study performed by Paillard, Costes-Salon, Lafont & Dupui (2002). Ageberg, Roberts, Holmström & Fridén (2003) examined in healthy individuals the reliability of a strength platform used in balance measurements as well as the change of balance parameters in frontal and sagittal planes following short-term sub-maximal exercise. While significant difference was found between average speed and DEV 10 (number of times centres of pressures exceeded 10mm) in frontal plane (FP), no difference could be found between width and DEV5 (number of times centres of pressures exceeded 10mm). Gribble, Hertel & Piegaro (2003) reported that there was no significant difference in release distance between right and left extremities in healthy subjects. In the study they conducted, Bressel, Yonker, Kras & Heath (2007), evaluated the dynamic and static balances of university athletes dealing with the branches of football, basketball and gymnastics. As a result, no difference was observed in values of gymnasts and football players while it was detected that basketball players had lower dynamic balance scores. This study also shows us that different sport branches can require different motoric properties. It was seen in this study that no effect at desired level occurred in static balances of athletes. It was detected that there was no significant difference between the static balance values taken prior to loading and the static balance values taken after loading ($p > 0,05$).

These studies show parallelism with our study. However, there are also studies, which are similar to our study, but the results of which differ. In the study they performed, Yaggie & Armstrong (2004) applied pre-, post-wingate test and rest (10 minutes after test) balance tests, and saw that fatigue affects balance negatively. In the same study it was detected that recovery started ten minutes after exercise. In the study performed by Nardone, Tarantola, Giordano & Schieppati (1997), a significant change was found in release path following 25-minutes treadmill exercise and bicycle exercise. However, it was reported that the size of change was bigger in the treadmill exercise. In the same study it was reported that physical exercise caused various effects on postural release variants of young normal subjects during motionless posture, and these effects were dependent on the type of exercise, work density, and visual conditions. In addition, it was observed that all effects took place right after exercise and were short-term, and disappeared approximately 15 minutes after end of exercise. In the studies they performed on basketball players, McGuine, Greene, Best & Leverson (2000) emphasized that poor balance can be defined as a risk factor for ankle injury. Moreover, they reported that balance is a factor in sportive skills in making distinction between those performing well and those who do not, and motor skills provide a positive acceleration for the physical development they are exhibited in. It was pointed out in the studies performed that reduction in skill to sustain balance following exhausting training was seen both in double feet static posture and single foot static posture. Therefore, it was reported that individuals have higher risk of injury when fatigue occurs (Nardone, Tarantola, Giordano, & Schieppati, 1997; Nordahl, Aasen, Dyrkorn, Eidsvik, & Molvaer, 2000). In the studies performed, harmful effect of fatigue in static postural control was detected; however, it was emphasized that effects were unknown in dynamic postural control amount (Ramsdell, 2001). It was reported that fatigue could weaken the proprioceptive and kinaesthetic properties of joints, fatigue disrupting feedback increased muscle spindle discharge threshold, and improved joint sensitivity afterwards (Gribble, PHertel, Denegar, & Buckley, 2004). In this study in lactate measurements performed in order to detect fatigue conditions, differences at significant level ($p \leq 0.05$) were detected when the data taken before and after the study were compared. When the general characteristics of the subjects are considered, the fact that they are elite athletes reminds that they may carry a high level of motor learning process along with them. This skill may be effective in the fact that static balance values remained unchanged following maximal loading.

5. Conclusion

Balance is a very important and improvable motoric property in terms of sport. It is an essential element for showing good performance and improving performance. In addition, as it can be used in determining the balance level required by the sport branch and distinguishing talented athletes, it can be also beneficial in taking required measures in advance by ensuring that athletes with insufficient balance parameters are aware of the fact that they face with risk of injury. Balance is a very important and improvable motoric property in terms of sport. That subjects are elite athletes and the possibility that the athletes carry along them a high level of motor learning process can be effective in the fact that static balance values remain unchanged following maximal loading.

References

Ageberg, E., Roberts, D., Holmström, E., & Fridén, T. (2003). Balance in single-limb stance in healthy subjects–reliability of testing procedure and the effect of short-duration sub-maximal cycling. *BMC Musculoskeletal disorders*, *4*(1), 1.

Akyüz, M., Ağar, M., Akyüz, Ö., & Doğru, Y. (2016). Motivational Factors Affecting Athletes in Selecting the Sport Branches of Athletics, Ski and Tennis. *Journal of Education and Training Studies*, *4*(12), 160-165.

Akyüz, M., Uzaldi, B. B., Akyüz, Ö., & Doğru, Y. (2016). Comparison of Sprint Reaction and Visual Reaction Times of Athletes in Different Branches. *Journal of Education and Training Studies*, *5*(1), 94-100.

Badau, A., Ungur, R. N., & Badau, D. (2015). Influence of water gymnastics on strength development. *Palestrica of the Third Millennium Civilization & Sport*, *16*(3).

Bennell, K. L., & Hinman, R. S. (2005). Effect of experimentally induced knee pain on standing balance in healthy older individuals. *Rheumatology*, *44*(3), 378-381.

Berthoz, A. (2000). *The brain's sense of movement* (Vol. 10). Harvard University Press.

Bompa, T. O. (1994). Theory and methodology of training: the key to athletic performance. Kendall Hunt Publishing Company.

Bressel, E., Yonker, J. C., Kras, J., & Heath, E. M. (2007). Comparison of static and dynamic balance in female collegiate soccer, basketball, and gymnastics athletes. *Journal of athletic training*, *42*(1), 42.

Cote, K. P., Brunet II, M. E., Gansneder, B. M., & Shultz, S. J. (2005). Effects of pronated and supinated foot postures on static and dynamic postural stability. *Journal of athletic training*, *40*(1), 41.

Doğru, Y., Büyükyazı, G., Ulman, C., Taneli, F., Tıkız, H., Göral, M., & Esen, H. (2016). Effects of two different eight-week walking programs on insulin resistance and ER stressrelated markers in pre-menopausal women, *Turkish Journal of Biochemistry, 41*(5), 322-330.

Dündar, U. (1998). Training Theory, 2nd Edition. Ankara.

Gribble, P. A., Hertel, J., & Piegaro, A. B. (2003). Predictors for performance of dynamic postural control using the Star Excursion Balance Test. *Measure Phys. Ed. Exerc. Sci.*, *7*, 89-100.

Gribble, P. A., Hertel, J., Denegar, C. R., & Buckley, W. E. (2004). The effects of fatigue and chronic ankle instability on dynamic postural control. *Journal of Athletic Training*, *39*(4), 321.

Günay, M. (1999). Exercise Physiology, Ankara.

Hall, J. E., & Guyton, A. C. (2006). *Textbook of medical physiology*. Elsevier Inc..

Hall, M. C., Mockett, S. P., & Doherty, M. (2006). Relative impact of radiographic osteoarthritis and pain on quadriceps strength, proprioception, static postural sway and lower limb function. *Annals of the rheumatic diseases*, *65*(7), 865-870.

Hill, A. V. (1913). The combinations of haemoglobin with oxygen and with carbon monoxide. I. *Biochemical Journal*, *7*(5), 471.

Konopka, P. (2003). *Sporternährung*. BLV Verlagsgesellschaft.

McGuine, T. A., Greene, J. J., Best, T., & Leverson, G. (2000). Balance as a predictor of ankle injuries in high school basketball players. *Clinical Journal of Sport Medicine*, *10*(4), 239-244.

Miura, K., Ishibashi, Y., Tsuda, E., Okamura, Y., Otsuka, H., & Toh, S. (2004). The effect of local and general fatigue on knee proprioception. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*, *20*(4), 414-418.

Nardone, A., Tarantola, J., Giordano, A., & Schieppati, M. (1997). Fatigue effects on body balance. *Electroencephalography and Clinical Neurophysiology/Electromyography and Motor Control*, *105*(4), 309-320.

Nordahl, S. H., Aasen, T., Dyrkorn, B. M., Eidsvik, S., & Molvaer, O. I. (2000). Static stabilometry and repeated testing in a normal population. *Aviation, space, and environmental medicine*, *71*(9), 889-893.

Paillard, T., Costes-Salon, C., Lafont, C., & Dupui, P. (2002). Are there differences in postural regulation according to the level of competition in judoists?. *British journal of sports medicine*, *36*(4), 304-305.

Ramsdell, K. M. (2001). *Effect of two ankle fatigue models on the duration of postural stability dysfunction*. publisher not identified.

Stemm, J., Gren, L. B., & Royer, T. (2001). An investigation of motor control: the static and dynamic balance of golfers. *Journal of Athletic Training*, *36*(2).

Tamer, K. (2000). Measurement and Evaluation of Physical-Physiological Performance in Sports, 2nd Edition. Ankara, Bağırgan Publisher, Ankara.

Vernazza-Martin, S., Martin, N., Le Pellec-Muller, A., Tricon, V., & Massion, J. (2006). Kinematic synergy adaptation to an unstable support surface and equilibrium maintenance during forward trunk movement. *Experimental brain research*, *173*(1), 62-78.

Vuillerme, N., & Nougier, V. (2004). Attentional demand for regulating postural sway: the effect of expertise in gymnastics. *Brain Research Bulletin*, *63*(2), 161-165.

Yaggie, J., & Armstrong, W. J. (2004). Effects of lower extremity fatigue on indices of balance. *Balance*, *312*(322), 2004.

Yim-Chiplis, P. K., & Talbot, L. A. (2000). Defining and measuring balance in adults. *Biological research for nursing*, *1*(4), 321-331.