JOURNAL OF ATHLETIC PERFORMANCE AND NUTRITION

e-ISSN:2148-7488

Original Article

Journal of Athletic Performance and Nutrition
Volume: 3 Issue: 2 pp:11-22 2016

Effect of Balance Training on Throw Hit Accuracy Rate and Proprioception Sense in Land Pentathletes

Serdar COŞKUN[1], Atilla PULUR[2], Murat ERDOĞAN[3], Ahmet UZUN[4]

Abstract

Objectives: Purpose of this study is investigating the effect of balance training on throw hit accuracy and body awareness (proprioception) in land pentathletes.

Methods: The study group consisted of 20 male (military) Pentathlon athletes (age: 22.50 ± 3.8) and 20 university students (age: 20.10 ±.71) who exercised regularly in total the control group consists of 40 subjects who participated voluntarily. In the study, the tests were conducted before and after the 8 week balance training of the sportsmen. Balance trainings were applied after 3 days and 20 minutes and warm-up period per week. All statistical analyzes, significance and distribution tests, Mann Whitney U test and Wilcoxon signed rank test were used to test the significance of the difference between the difference scores of two related measurement sets.

Results: There was no statistically significant difference between the groups in pre-test results applied in the study and in the final test results, the difference between the groups in the values of dual foot dynamic balance, dominant leg balance, hit shot position, dynamic balance and hit scores of 20-25 meters were statistically significant ($p<0.01$).

Conclusion: As a result; it can be said that equilibrium training applied to the land pentathletes positively improved the proprioception scores of the ankle and knee joints, and balance and accurate bombing exercises have positive effects on the performance of the Olympic bomb throwing hit accuracy.

Key words: Land pentathlon, bomb, hit

[1]K.K.K.Personel Bşk.lığı, TSK, Ankara. Turkey
[2]Gazi University, Physical Education and Sports College, Ankara 06330, Turkey, atillapulur38@gmail.com
[3]Spor Okl.ve Eğt.Mrk.K.lığı, TSK, Ankara. Turkey
[4]Akdeniz University, Physical Education and Sports College, Antalya 07058, Turkey

Introduction

Balance system forms as a result of the stimulation from the vestibular, visual, and somatosensory system is processed in the central nervous system (CNS) to create replies suitable for musculoskeletal system. Balance is one of the critical elements that make up the basis of movement that makes performance in functional skills favorable. The basic functions of the balance system are to keep the field of view constant during head movements and to control the posture in the field of gravity (Irrgang and Neri, 2000).

The relationship between balance ability and athletic performance is less clear. The importance of balance to activities such as gymnastics, rifle shooting and ice hockey may appear apparent but the relationship to performance in many sports and motor skills hasn't been fully elucidated (Hrysomallıs, 2010). There is also evidence that the higher balance of the athlete is a result of the ability to pay attention to proprioceptive and visual cues (Ashton-Miller et al., 2001). The development of the proprioceptive is important for ensuring coordinated muscle contraction. (Jerosch and Prymka, 1996). It is stated that each sport branch's specific motor skills require a different level of sensor-motor process. In particular, we see that the dynamic balance in the fencing sport has a great deal of importance, while the static balance in the sport of shooting has a bigger proposition (Mononen et al., 2007)

Most of the visual surveys on aiming at far-off targets assume that the previously programmed motor control and visualization and information reappears just before the last shot and launch.. Eye movement data indirectly support this claim in constant shooting. Motor training, which consists of voluntary movements, leads to performance improvement and results in changes in the characteristic cognitive reorganization of the motor cortex (Walker et al., 2000)

Land (Military) Pentathlon is a military sport that allows the military personnel combine five different sports branches to develop their morale abilities with physical strength in reaching foresight and success, improving their morale skills, making bombs and throwing bombs and fighting all kinds of obstacles with minimum power. The Land (Military) Pentathlon is a sporting competition held by the International Military Sports Council (CISM) and made by distinguished soldiers of superior physical characteristics from various armies of the world (MPGR, 2011).

The effect of balance training shots on hit rate has a great prospect especially for soccer, basketball, handball, archery, shooting, dart, bowling and so on. The most important factor determining the athletes' performance in the mentioned sports branches is the high hit

rate. This is one of the most important characteristics that determines the success rate. Therefore, determining the effect of balance training on the goals of sports is very important for the performance of athletes. It is believed that balance training in sport branches, combined with different types of training, can contribute to shot accuracy and can directly affect success.

The purpose of this study is to investigate the effect of 8-week balance training on land pentathletes on accuracy rate and body awareness (proprioception) in throwing.

Methods

The study group consisted of 20 male (military) Pentathlon athletes (age: 22.50 ± 3.8) and 20 university students (age: 20.10 ± .71) who exercised regularly in total the control group consists of 40 subjects who participated voluntarily. The right foot and arms of all subjects are dominant. Also, the Olympic bomb throwing (throwing) distances of all subjects are 40 meters and above.

The research was conducted in the performance labs of the Military Academy's Sports Health Center and in the Olympic bombing area. In the study, the tests were conducted before and after the 8 week balance training of the sportsmen. Balance trainings were applied after 3 days and 20 minutes and warm-up period per week. For the control group, Olympic bomb throwing exercises were applied only once a week. In addition to this group, no balance exercise was applied.

Exercise protocol

In addition to the routine weekly bombing exercises, equilibration exercises were applied to the experimental group for 3 weeks 20 minutes during 8 weeks.

Exercises of Week 1-4

- Eyes open, one foot on the base, the hand is crossed on the shoulders, the knee is bent (right-left) towards the hips,
- Eyes open, one foot on the claw, the hand crossed on the shoulders, the knee bent to the halter (right-left)
- Eyes open, 90 feet in front of the knee (right-left)
- Eyes open, on single-footed claw, arms open parallel to each other, 90 degree stranded stop (right-left)
- On the equilibrium, the eyes are open, on the single foot base, the arms are parallel to the open standing (right-left)

- Eyes open on the balance board, on the double foot base

  Eyes open on the balance board, on the double foot base
- Rope on one foot (right-left)

  Exercises of Week 5-8
- Eyes open on the balance board, on the double foot base
- Rope on one foot (right-left)
- Circular movement (right-left) on the single foot base, with eyes open on the balance board
- Moving forward (right-left) on the single-foot base with the eyes open on the balance board
- The eyes are open on the balance board, constantly on the single foot base. Standing study (right-left)
- Eyes open on the balance board, move back forward on the double footwell
- Eyes open on the balance board, moving right and left on the double foot base
- Eyes open on the balance board, circular motion on the double foot base
- Glider movement (right-left)

Collection of Data

Measurements of body composition of the athletes were determined by means of TANITA BC-418 Bioelectrical Impedance device. The dynamic equilibrium test was performed with Biodex Balance System SD. In this study, overall stability was measured in left-right one-leg, double-leg, and shot positions.

Eight Olympic bombs were put on the subjects, four of which were aimed at throwing 20-meter and 25-meter standard Olympic bombs, and the shots were scored according to the CISM Military Pentathlon bombing scoring chart.

Statistical analysis

All statistical analyzes were performed in SPSS 16.0 statistical package program running under Windows. Significance and distribution tests The Wilcoxon signed rank test was used to test the significance of the difference between the Mann Whitney U test and the difference scores of the two related measurement sets.

Results

Findings of the measurement results of the groups participating in the study are given in the following tables.

Table 1. General Physical Properties of Experiment and Control Groups that Participate to the Study

	Experiment (n=20)				Control (n=20)			
Variables	$\bar{X}$	SS	Min	Max	$\bar{X}$	Ss	Min	Max
Age (year)	22.5	3.81	20.7	24.2	20.1	0.7	19.7	20.4
Height (cm)	178.4	4.61	176.2	180.6	180.3	5.0	177.9	182.7
Weight (kg)	70.5	6.50	67.4	73.5	68.8	6.5	65.7	71.9
BMI (kg/m^2)	22.1	1.62	21.3	22.8	21.1	1.8	20.3	22.0
KK (kg)	66.1	5.98	63.3	68.3	63.5	6.2	60.6	66.4

Experiment groups; Mean age was found to be 22.50 ± 3.81, height average was found to be 178.4 ± 4.61 cm, weight average was found to be70.60 ± 6.50 kg, mean BMI was found to be 22.12 ± 1.62, mean weight of MM was found to be 66.19 ± 5.98 kg; Control groups; Mean age was found to be 20,10 ± 1,71, mean height was found to be 180,33 ± 5,06 cm, weight average was found to be 68,85 ± 6,55 kg, mean BMI was found to be 21,17 ± 1,81, mean weight of muscle mass was found to be 63,58 ± 6,22 kg (Table 1).

Table 2. Test Results According to the First and Last Measurements of the Overall Stability Index (OsI) Balance Values of the Experimental and Control Groups' Dual Leg, Dominant and Nondominant Leg and Accuracy Positions

			INITIAL TEST						FINAL TEST					
Variables	Group	N	Order Ave.	Ranks Total	$\bar{X}$	Ss	U	p	Order Ave.	Ranks Total	$\bar{X}$	Ss	U	p
Double Feet Dynamic Balance	Exp.	20	18.0	360.0	4.1	2.3	150	0.18	14.3	287.0	3.2	2.0	77	0.00*
	Con.	20	23.0	460.0					26.6	533.0				
Nondominant Leg Dynamic Balance	Exp.	20	21.8	437.5	4.0	2.3	172	0.46	17.8	357.0	3.0	2.0	147	0.15
	Con.	20	19.2	382.5					23.1	463.0				
Dominant Leg Balance	Exp.	20	19.5	395.0	4.1	2.0	185	0.69	15.1	302.0	3.1	1.6	92	0.00*
	Con.	20	21.5	425.0					25.9	518.0				
Hitting Position Dynamic Balance	Exp.	20	18.8	363.5	3.9	1.8	153	0.21	15.5	311.0	3.0	1.3	101	0.00*
	Con.	20	22.2	456.5					25.4	509.0				

(*: $p<0.01$);

It was determined that there was no significant difference between the groups in pre-test results applied to the study, and in the final test results, the difference between experimental and control groups was found to be statistically significant in dynamic balance values of dual foot dynamic balance, dominant leg balance and hit shot position (Table 2).

Table 3. Wilcoxon signed rank test results of overall stability index (OSI) equilibrium values of the two legs, dominant and nondominant legs and hit position before and after application

Variable		N	$\bar{x}$	Ss	Ave Difference	Z	p
Double Fee Dynamic Balance	First Exp.	20	3.65	2.08	-1.39	3.922	0.00**
	Final Exp.	20	2.26	1.07			
NonDominant leg Dynamic Balance	First Exp.	20	4.14	2.08	-1.78	3.920	0.00**
	Final Exp.	20	2.31	0.85			
Dominant Leg Balance	First Exp.	20	4.09	2.10	-1.68	3.921	0.00**
	Final Exp.	20	2.41	1.06			
Hitting Position Dynamic Balance	First Exp.	20	3.76	2.20	-1.28	3.772	0.00**
	Final Exp.	20	2.48	1.09			
Double Fee Dynamic Balance	First Con.	20	4.64	2.49	-0.35	3.950	0.00**
	Final Con.	20	4.29	2.37			
NonDominant leg Dynamic Balance	First Con.	20	4.01	2.66	-0.31	3.927	0.00**
	Final Con.	20	3.71	2.58			
Dominant Leg Balance	First Con.	20	4.29	2.02	-0.44	3.924	0.00**
	Final Con.	20	3.85	1.87			
Hitting Position Dynamic Balance	First Con.	20	4.09	1.46	-0.50	3.924	0.00**
	Final Con.	20	3.60	1.38			

(Exp: Experimental; Con: Control; *:p<0.01)

According to the first and last measurements of the experimental and control groups, it was determined that the difference between the values of Dual Leg, Dominant and Nondominant Leg and Hit Fire Position Overall Stability Index (OSI) was significant.

Table 4. U test result of test and control groups according to pre-test measurements of hit shots to 20 and 25 meters target

Variables	Groups	N	Order Ave.	Ranks Total	$\bar{x}$	SS	U	p
20 Meter Hit Score (n=40)	Experiment	20	24.75	495.0	18.35	2.99	115	0.02*
	Control	20	16.25	325.5				
25 Meter Hit Score (n=40)	Experiment	20	27.15	543.0	19.10	4.19	67	0.00**
	Control	20	13.85	277.0				

(*: p<0.01)

There was no significant difference (p <0,01) in the 20-meter hit-shooting scores, indicating that there was a significant difference (p <0,01) between the initial measurements of 25-meter hit-shooting scores (table 4).

Table 5. U test results according to the final test measurements of hit shots to 20 and 25 meter targets of the experimental and control groups,

Variables	Groups	N	Order Ave.	Ranks Total	$\bar{x}$	SS	U	p
20 Meter Hit Score (n=40)	Experiment	20	29.0	580.0	24.7	3.25	30	0.00**
	Control	20	12.0	240.0				
25 Meter Hit Score (n=40)	Experiment	20	30.0	601.0	23.7	5.75	9	0.00**
	Control	20	10.9	219.0				

(*: p<0.01)

In the study, it was found that there was a significant difference (p <0.01) between the second measurements of 20 and 25-meter shooting hit scores of the groups (Table 5).

Table 6. Wilcoxon Marked Ranks Test Results of 20- and 25-meter Target Hits Before and After Application

Variable		N	$\bar{x}$	SS	Ave Difference	Z	P
20 Meter Hit (Score)	First Exp.	20	19.60	3.56	7.60	3.856	0,00**
	Final Exp.	20	27.20	1.64			
25 Meter Hit (Score)	First Exp.	20	21.60	3.97	7.00	4.064	0,00**
	Final Exp.	20	28.60	3.25			
20 Meter Hit (Score)	First Con.	20	17.10	1.55	5.10	4.029	0,00**
	Final Con.	20	22.20	2.42			
25 Meter Hit (Score)	First Con.	20	16.60	2.68	2.20	3.317	0,00**
	Final Con.	20	18.80	2.63			

(Exp: Experimental; Con: Control; *:p<0.01)

It was found that there was a significant difference between experimental and control groups in 20 and 25 meter shot hits (table 6).

Discussion

In the light of many researches made, it is believed that the proprietorship can be obtained and it can be trained (Holm et al., 2004). In this study, the effect of the 8 week long balance training applied to the land pentathletes on accuracy rate and body awareness (proprioception) was investigated.

Table 1 shows that the age, height, weight and body mass index values are close to each other. These values can be regarded as indicative of a homogeneous distribution of the experimental and control group involved in the study.

The study showed that the Overall Stability Index values applied to the groups were similar and started with near balance scores (table 2). However, at the end of the 8-week balance training, the difference between the groups was significant (p>0.05). There are many studies investigating the effect of equilibrium training on static and dynamic equilibrium performance; (Aggarwal et al., 2010) that the balance training changes the dynamic balance statistically significantly and that the effect of the core stability training on the static balance is greater than the balance training (Aggarwal et al., 2010). Bressel et al. (2007) evaluated the dynamic and static balances of university athletes dealing with soccer, basketball and gymnastics. As a result, it was determined that basketball players had lower dynamic balance scores while gymnasts and soccer players had no difference in their values. He examined the relationship between regional training and dynamic balance on tennis athletes. In the study in which 13 athletes participating in the experimental group and 15 athletes participate in the

control group, the effect of 5-week regional training was investigated. As a result, it has been determined that the experimental group has a meaningful development in the dynamic equilibrium characteristic (Samson, 2005). In these studies it is evident that the balance exercises have a positive effect on the static and dynamic balance.

The overall Stability Index (OSI) balance values of both legs, dominant and nondominant leg and hit position positions before and after the application of the experimental and control groups were found to be significantly different according to Wilcoxon signed rank test results (Table 3) in both groups ($p<0.01$). Murray and colleagues demonstrated that body weight on the left and right limbs is independent of the dominant leg. Thus, if we consider that body oscillation is independent of the dominant lower extremity, and that this condition does not occur when the eyes are open and the eyes are closed, it is thought that the static balance problem in young people is mostly caused by the visual system (Murray et al., 1975). In their work, Granacher et al., (2012) have shown that static workouts on elderly individuals have a positive effect on dynamic balance. Tsang and Hui-Chan (2005) found that, in the study conducted by adults who regularly perform Tai Chi, they had stronger knee strength and better balance scores than the control group. Nelson et al.(2001) conducted a static stretching exercise on the knee extensors of the 15 subjects for 15 seconds. The isokinetic muscle strength measurements after stretching exercises showed a decrease of 7.2% in peak torque values and 4.5% in 90 degree / sec speeds at 60 degrees/sec. However, Cramer et al., (2004) reported that stretching exercises did not produce a significant difference in isokinetic muscle strength measurements performed on stretch exercises performed on 15 subjects on the knee extender muscle group. Bernier and Perrin (1998) studied the effect of proprioception on 6-week coordination and balance training given to persons with functional ankle instability. At the end of the study, it was found that this training improved postural oscillation but did not affect the sense of joint position in functional ankle instability. In other words, the dynamic balance was found to be at a better level than those who did not exercise regularly in regular exercise. This situation is in parallel with our research.

In this study, there is a significant difference between the two groups, both between themselves, as well as within themselves, according to Wilcoxon signed squares tests (Table 4), pre-test of hit shots to 20 and 25 meter targets of experimental and control groups. In this context, it is observed that both the balance and hit training applied to the experimental group and the hit group which the control group makes once a week positively reflect on the shooting scores.

In the study, the values of 20 and 25 meter shot hits between themselves and between each other are seen to be improved and significant difference according to the results of pre-test and post-test (Table 5 and Table 6). Moreover, when we look at the percentages of the group's development in the equilibrium values, it is determined that the developmental percentages in the experimental group are significant. Anderson and Behm (2004) reported that imbalance caused a lack of sufficient force output while performing a motion, and that this resulted from increased balance responsibility for the actual motion to take place. With the development of equilibrium ability, they have stated that the proportion of prime mover muscles in the circuit to reduce body stabilization can be reduced, so that these muscles can contribute as a driving force in activities such as jumping or running. 15-16 year old female basketball players 8 weeks Kangoo Jumps shoe shooting and the effect of balance on workout balance, leg strength and shot rate hit ratio in the study for 5 different areas (Corner 1, Striker 1, Guard, Corner 2, Striker 2) Before and after equilibration training measurements were taken. As a result, it has been pointed out that balance exercises increase the percentage of female basketball players' balance, jump and smash hits (Durmuş, 2014). Perrin and Courant (1991) suggest that basketball players have an association with postural stabilizers and sport performances, in relation to free throw accuracy, low horizontal mobility and high stability. These studies also show that there is a positive relationship between balance and shot accuracy and that the results are parallel to those in the literature.

When all the parameters were examined in this study, it was determined that there were statistically significant differences according to the test results between experimental and control groups. As we have mentioned in the equilibrium scores, this shows the differences in percentages of positive development observed in both groups. According to this; the development of 20 m target shot values in the experimental group was 38.77%; 29.82% of the control group; while the development gap is 8.95%. Experimental group 25m target shots value development is 32.40%; while the value is 13.25% in the control group; and the difference in development was determined as 19.15%. Especially with the increase in the score of the bomb throwing scores of the experimental group, it was found that the bombs that were thrown afterwards fell to each other and to the target at the 20 and 25 meter targets of 2 meters in all athletes. The same situation was not observed in the control group. It has been shown that bombs shot at targets of 20-25 meters and targets at longer distances will have a more consistent shot accuracy rate and that the scores of the works may be higher. This

can be said to be a result of the positive effects of balance training on the shooting accuracy rate.

Conclusion

As a result; it has been determined that equilibrium training applied to land pentathletes improves the proprioception scores of the ankle and knee joint positively, and balance and bomb hit shooting exercises have a positive effect on the performance of Olympic bomb throwing hits of athletes.

References

Aggarwal, A., Zutshi, K., Munjal, J., Kumar, S., Sharma, V. (2010). Comparing stabilization training with balance training in recreationally active individuals. *International Journal of Therapy and Rehabilitation*, 17(5),244–253.

Anderson, K.G., Behm, D.G. (2004). Maintenance of EMG Activity and Loss of Force Output with Stabil olmayanity. *The Journal of Strength & Conditioning Research*, 18(3), 637-640.

Ashton-Miller, J.A., Wojtys, E.M., Huston, LJ., Fry-Welch, D. (2001). Can proprioception really be improved by exercises? *Knee Surg Sports Traumatol Arthrosc*, 9,128–136.

Balter, S.G.T., Stokroos, R.J., Akkermans, E., Kingma, H. (2004). Babituation to galvanic vestibular stimulation for analysis of postural control abilities in gymnasts. *Neurosci Lett*, 366, (71-75).

Bernier, J.N., Perrin, D.H. (1998). Effect of Coordination Training on Proprioception of the Functionally Unstable Ankle. *J Orthop Sports Phys Ther,* 27(4), 264-75.

Bressel, E., Yonker, JC., Kras, J. (2007). Heath EM Comparison of Static and Dynamic Balance in Female Collegiate Soccer, Basketball, and Gymnastics Athletes. *J Athl Train*, 42(1), 42-6.

Cramer, J.T., Housh, T.J., Weir, J.P., Coburn, J.W. (2004). Acute effects of Static Stretching on Torque, Power, Electromyography and Mechanomyography During Eccentric Actions[Abstract]. *Medicine and Science in Sports and Exercise*, 36(5), 342.

Durmuş, A. (2014). Kadın Basketbolcularda Kangoo Jumps Ayakkabıları İle Antrenmanın Denge, Bacak Kuvveti Ve Şut Atışı Oranına Etkisi. Yüksek Lisans Tezi, Mersin Üniversitesi Eğitim Bilimleri Enstitüsü. Mersin.

Granacher, U., Lacroıx, A., Muehlbauer, T., Roettger, K., & Gollhofer, A. (2012). Effects of core instability strength training on trunk muscle strength, spinal mobility, dynamic balance and functional mobility in older adults. *Gerontology,* 59(2), 105-113.

Holm, I., Fosdahl, M.A., Friis, A., Risbrg, M.A., Myklebust, G., Steen, H. (2004). Effect of neuromuscular training on proprioseption balance, muscular strength, and lower function in female team handball players. *Clinical J of Sport Med,* 14(2), 88-94

Hrysomallıs, C. (2010). Balance Abılıty And Athletıc Performance. Instıtute of sport, exercıse and actıve lıvıng school of sport and exercıse scıence. Vıctorıa Unıversıty. Melbourne.Australıa

Irrgang, J.J., Neri, R. (2000). *The Rationale for Open and Closed Kinetic Chain Activities for Restoration of Proprioception and Neuromuscular Control Following Injury*. Ed: Lephart S.M., Fu F.H., Proprioception and Neuromuscular Control In Joint Stability. (pp.363-374). Human Kinetics.USA.

Jerosch, J., Prymka, M. (1996). Proprioception And Joint Stability. *Knee Surg, Sports Traumatol, Arthroscopy,* 4,171-179

Johnson, E.G., Larsen, A., Ozawa, H., Wılson, C.A., & Kennedy, K.L. (2007). The effects of Pilates-based exercise on dynamic balance in healthy adults. *Journal of bodywork and movement therapies,* 11(3), 238-242.

Military Pentathlon General Regulations.(MPGR) Part A. 2011 (11.05.2011). http: //www.militarypentathlon. org/ public/ milpent/ download/ PartA.pdf

Mononen, K., Konttinen, N., Viitasalo, J., Era, P. (2007) Relationships between postural balance, rifle stability and shooting accuracy among novice rifle shooters. *Scand J Med Sci Sports,* 17(2):180-5.

Murray, M.P., Seireg, A.A., Sepic, S.B. (1975). Normal postural stability and steadiness: quantitative assessment. *J Bone Joint Surg (Am)* ,57, 510-15.

Nelson, A.G., Guillory, I.K., Cornwell, A., Kokkonen, J. (2001). Inhibition of Maximal Voluntary Isokinetic Torque Production Following Stretching Is Velocity-specific. *The Journal of Strength and Conditioning Research,* 15(2), 241-246.

Perrin, P.P., Perrin, C.A., Courant, P. (1991). Posture İn Basketball Players. *Acta Otorhinolaryngol Belg,* 45, 341-347

Samson, K.M. (2005). The effects of a five-week core stabilization-training program on dynamic balance in tennis athletes. Master thesis, West Virginia Univ. Virginia

Tsang, W.W., Hui-Chan, C.W. (2005). Comparison of Muscle Torque, Balance and Confidence in Older Tai Chi and Healthy Adults. *American College of Sports Med*, 280-289.

Walker, C., Brouwer, B.J., Culham, E.G. (2000). Use Of Visual Feedback İn Retraining Balance Following Acute Stroke. *Phys Ther,* 80,886–895