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Effect of High Volume versus Low Volume Balance Training on Static and Dynamic Balance

Dr. Baljinder Singh Bal[1]

[1] Department of Physical Education (T), Guru Nanak Dev University, Amritsar, Punjab, India

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Abstract. The purpose of this study was to investigate the effect of high volume versus low volume balance training on static and dynamic balance. Forty adolescent girls (mean ± SD: age 15.52 ± 1.7 years, height 1.723± 0.00891 m, body mass 65.259 ± 0.465 kg), who participated in interschool volleyball competition and in the Catch Them Young (CTY) programme organised by Guru Nanak Dev University, Amritsar volunteered to participate. All participants were informed about the study aim and methodology as well as about the possibility of immediate acceptance at any time of the experimentation. Subjects agreed to the above conditions in writing. They were randomly assigned into two groups: A (Training Group) and B (Control Group), n=20 each. The subjects from training group were subjected to a 6-week high volume versus low volume balance training programme. This lasted 6-weeks and consisted of daily sessions, lasting 40 min each. The students completed the stork stand and wobble board tests to determine static balance on the leg respectively. The static and dynamic balance significantly improved in training group compared with the control one. The high volume versus low volume balance training programme may be recommended to improve static and dynamic balance and may contribute to enhance concentration based performance.

Keywords: Balance- Dynamic-Static-Training.

1. Introduction

Balance can be defined as the ability to maintain or make adjustments in order to keep the body's centre of gravity over the base of support [11,17]. This adjustment occur through movements of the ankles, knees, and hips and may be disturbed when the center of gravity and base of support is disrupted or when corrective movements are not executed in a smooth and coordinated fashion [4,5]. Balance and maintenance of postural control is a multisystem process requiring critical input from the vestibular, visual, and proprioceptive systems. Information regarding body position, gravity, musculoskeletal activity, tactile and visual feedback, and other input provides the nervous system with the information required to maintain balance during daily activities taking place in an ever-changing environment. The use of unstable platforms such as wobble boards, Swiss balls, and other equipment, which challenge balance, have been introduced as a part of rehabilitation and training programs. It has been shown that instability can contribute to less force production [1,2,13] and greater fatigue [9,14]. Studies have shown that implementing balance training resulted in improved strength and reduction in muscle imbalances [3,11].The maintenance of muscle activation levels concomitant with a decrease in force was due to the increased stabilizing responsibilities of the prime movers. Improvements in balance could decrease the proportion of prime mover muscles allocated to stabilization and allow them to contribute more to the propulsion of the body when jumping or running. Furthermore, an individual with an unstable base may not direct all their propulsive forces in the optimal direction. Based on this previous research, wobble board training and jump-landing training may be an important part of athletic training especially when considering activities that often lead to injuries (jump landings) and require strength and power. The performance of all activities of daily living requires good balance control while at rest or when moving from one position to another. Maintenance of balance requires the coordination of sensory, neural and musculoskeletal system. This promoted us to undertake this study with the aim to determine the effect of high volume versus low volume balance training on static and dynamic balance.

[1] Corresponding author. Tel.: +91-9876448434.
E-mail address: bal_baljindersingh@yahoo.co.in

2. Material and Methods

2.1. Subjects

Forty adolescent girls (mean ± SD: age 15.52 ± 1.7 years, height 1.723± 0.00891 m, body mass 65.259 ± 0.465 kg), who participated in interschool volleyball competition and in the Catch Them Young (CTY) programme organised by Guru Nanak Dev University, Amritsar volunteered to participate. All participants were informed about the study aim and methodology as well as about the possibility of immediate acceptance at any time of the experimentation. Subjects agreed to the above conditions in writing. They were randomly assigned into two groups: A (Training Group) and B (Control Group), n=20 each.

Table 1: Subjects' Demographics

Variable	Group	
	Training Group (N=20)	Control group (N=20)
	Mean ± SD	Mean ± SD
Age (years)	15.52 ± 1.71	15.52 ± 1.9
Body mass (kg)	65.258 ± 0.452	65.275 ± 0.494
Body height (m)	1.723 ± 0.00933	1.723 ± 0.00826

N; sample size, SD; standard deviation, m; meters, kg; kilograms

2.2. Methodology

Table 2: Differences in training load between LVT and HVT

Week 1 & 2	Exercise	Sets	Reps/ Duration	Sets	Reps/ Duration
	Single leg stance	2	18 s	3	18 s
	Controlled inversion/eversion	2	11	2	14
	Controlled plantar flexion/dorsiflexion	2	10	2	14
Week 3 & 4	Exercise	Sets	Reps/ Duration	Sets	Reps/ Duration
	Single leg stance	2	28 s	3	28 s
	Single leg squat	2	13	4	8
	4- point star	2	13	4	8
Week 5 & 6	Exercise	Sets	Reps/ Duration	Sets	Reps/ Duration
	Single leg stance	3	30 s	3	35 s
	¼ squat to raise	4	9	3	15
	Single leg hip hike	4	9	3	15

LVT; Low volume training, HVT; High volume training, Reps; repetitions, s; seconds

The study was approved by the Ethics Committee of Directorate of Sport in Guru Nanak Dev University, Amritsar, India. The training program consisted of nine exercises that were to be completed over a 6 week training period. This training duration was chosen as it was in accordance with other training studies that have used a similar training period of between 4 and 10 weeks [7,10,14,15,16]. A progressive overload approach was taken with the degree of proprioceptive demand gradually increasing over the 6 weeks. The exercises chosen were all closed-chain in nature and were specific to training the musculature of the hip, talocrural and subtalar joints (as these are both affected during LAS). To increase the proprioceptive demand of these exercises they were all completed on a Dura Disc (Guru Nanak Dev University, Amritsar) throughout the entire 6 week intervention. Previous research [19] has quantified training volume only by training time (minutes per day), whereas our study aims were to use an excise prescription model to determine and quantify training volume through "sets and repetitions". Both training groups completed the same closed chain exercises 3 times per week for 6 weeks; however, they were performed at different volumes, as the aim was to investigate whether a HVT or LVT program would cause a greater change in static and dynamic balance. With both groups completing the same closed chain exercises, the adaptations that occurred during the 6 week period can be attributed to the volume of training (i.e. sets and repetitions) completed and not the difference in exercises, as different exercises generally require different neural strategies therefore producing different training responses.

2.3. Measurement of Static Balance

The stork stand was used to measure balance. For the stork stand, the subjects completed the test on the dominant and non-dominant foot. The subjects kept their hands on their hips with the uninvolved foot against the medial side of the knee of the stance leg. Each subject maintained this position while standing on the ball of the foot for the maximum possible time. The trial ended when the heel of the involved leg touched the floor, the hands came off of the hips, or the opposite foot was removed from the stance leg. The best of three trials was recorded for analysis.

2.4. Measurement of Dynamic Balance

The subjects also performed the wobble board test in a unilateral stance on their dominant and non dominant foot. With the shoes off, the subjects stood on the center of the wobble board and the uninvolved foot free to move in space. During a 15 second period, each subject attempted to maintain balance without allowing the board to touch the contact plate that was positioned on the floor 2 inches under the wobble board. The subjects were instructed to regain their balance as quickly as possible when the wobble board touched the contact plate. Within the 15 second period, the duration the wobble board touched the contact plate (time off balance) was recorded for analysis. The least duration of time off balance during the 15 second period after 3 trials was analysed.

Figure 1: Static balance

Figure 2: Dynamic Balance

3. Data Analysis

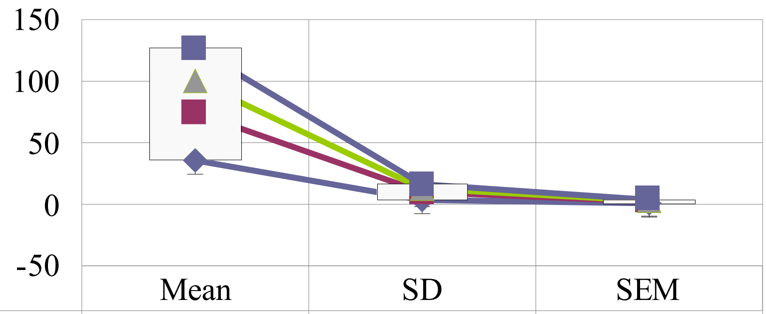
Statistical ® 7.0 software was used in data analysis. Student's t-test for independent data was used to assess the between-group differences and for dependent data to assess the Post-Pre differences. The level of $p \leq 0.05$ was considered significant.

4. Results

The results of high volume versus low volume balance training on static and dynamic balance of the training and control groups are presented in the following tables.

Table 3: Mean, Standard Deviation (SD), Standard Error of Mean (SEM) of Static Balance of Training and Control Group Paired Samples t-Test

	Training Group	
	Pre-Test	**Post-Test**
Sample size	20	20
Arithmetic mean	35.64	38.90
95% CI for the mean	34.00to 37.29	35.93 to 41.86
Variance	12.35	40.07
Standard deviation	3.53	6.32
Standard error of the mean	0.76	1.42
Mean difference	3.24	
Standard deviation	7.92	
95% CI	0.45 to 6.95	
Test statistic t	1.82*	
Degrees of Freedom (DF)	19	
Two-tailed probability	P = 0.0819	
	Control Group	
	Pre-Test	**Post-Test**
Sample size	20	20
Arithmetic mean	25.63	26.53
95% CI for the mean	24.31 to 26.98	24.87 to 28.22
Variance	8.13	12.78
Standard deviation	2.84	3.56
Standard error of the mean	0.62	0.77
Mean difference	0.90	
Standard deviation	3.52	
95% CI	0.75 to 2.55	
Test statistic t	1.14	
Degrees of Freedom (DF)	19	
Two-tailed probability	P = 0.2694	



	Mean	SD	SEM
Training (Pre-test)	35.64	3.53	0.76
Traningt (Post-test)	38.9	6.32	1.42
Control (Pre-test)	25.63	2.84	0.62
Control (Post-test)	26.53	3.56	0.77

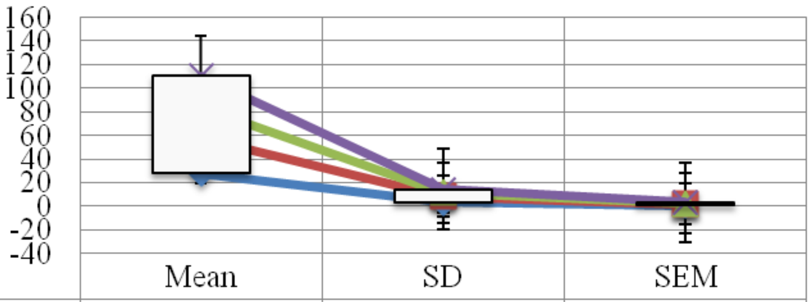
Figure 3: Mean, Standard Deviation (SD), Standard Error of Mean (SEM) of Static Balance of Training and Control Group Paired Samples t-Test

Table-3 shows that the mean of static balance of pre-test of training group and post-test of training group was 35.64 and 38.90 respectively, whereas the mean of static balance of pre test of control group and post test of control group was 25.63 and 26.53. The t value in case of experimental group was 1.83 and for control group it was 1.13. The critical value of t at 95% probability level in training group is much lower (1.72) than the observed value of t (1.82). The data does suggest that the differences between pre-test and post test of static balance in training group are significant. The graphical representation of responses has been exhibited in figure-3.

Table 4: Mean, Standard Deviation (SD), Standard Error of Mean (SEM) of Dynamic Balance of Training and Control Group Paired Samples t-Test

	Training Group	
	Pre-Test	**Post-Test**
Sample size	20	20
Arithmetic mean	27.64	30.41
95% CI for the mean	26.01 to 29.28	28.04 to 32.75
Variance	12.23	25.30
Standard deviation	3.47	5.03
Standard error of the mean	0.76	1.12
Mean difference		2.75
Standard deviation		6.50
95% CI		0.29 to 5.79
Test statistic t		1.88*
Degrees of Freedom (DF)		19
Two-tailed probability		P = 0.0740
	Control Group	
	Pre-Test	**Post-Test**
Sample size	20	20
Arithmetic mean	25.64	26.68
95% CI for the mean	24.31 to 26.98	25.34 to 28.05
Variance	8.13	8.43
Standard deviation	2.85	2.90
Standard error of the mean	0.6377	0.64
Mean difference		1.05
Standard deviation		3.36
95% CI		0.52 to 2.62
Test statistic t		1.37
Degrees of Freedom (DF)		19
Two-tailed probability		P = 0.1788

Table-4 shows that the mean of dynamic balance of pre-test of experimental group and post-test of experimental group was 27.64 and 30.41 respectively, whereas the mean of static balance of pre test of control and post test of control group was 25.64 and 26.68. The critical value of t at 95% probability level in training group is much lower (1.72) than the observed value of t (1.88). The data does suggest that the differences between pre-test and post test of dynamic balance in training group are significant. The graphical representation of responses has been exhibited in figure-4.



	Mean	SD	SEM
Control (Post-test)	26.68	2.9	0.77
Control (Pre-test)	25.64	2.85	0.63
Traningt (Post-test)	30.41	5.03	1.12
Training (Pre-test)	27.64	3.47	0.76

Figure 4: Mean, Standard Deviation (SD), Standard Error of Mean (SEM) of Dynamic Balance of Training and Control Group Paired Samples t-Test

5. Discussion

Athletes and coaches are in continuous search of newer and better techniques to enhance Performance. This paper examined the effects of 6 weeks of high volume versus low volume balance training on static and dynamic balance. Our training program consisted of nine exercises that were to be completed over a 6 week training period. Balance and maintenance of postural control is a multisystem process requiring critical input from the vestibular, visual, and proprioceptive systems. Information regarding body position, gravity, musculoskeletal activity, tactile and visual feedback, and other input provides the nervous system with the information required to maintain balance during daily activities taking place in an ever-changing environment. The use of unstable platforms such as wobble boards, Swiss balls, and other equipment, which challenge balance, have been introduced as a part of rehabilitation and training programs. In this study, the 6 weeks of high volume versus low volume balance training programme showed significant improvement in static and dynamic balance in training group and insignificant improvement in control group. These findings are supported by other reports by [12] indicate that not only is the mini-trampoline an effective tool for improving balance after LAS, but it is equally as effective as the dura disc. Similar to the findings of a number of wobble board [6] and sensor motor [8] training studies there were improvements in static balance following fixed foot balance training. Following the concept of training specificity [18], there were no crossover effects of functionally directed balance training on static balance measures. As such a specific balance training program targeted to a particular sport can be productive for the performance of an athlete.

6. Conclusion

Some of the findings in the present study illustrated the training specificity of balance training. The results from our study are very encouraging and demonstrate the benefits of 6 weeks of high volume versus low volume balance training on static and dynamic balance. It is concluded that the high volume versus low volume balance training programme may be recommended to improve static and dynamic balance and may contribute to enhance concentration based performance.

7. Acknowledgement

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8. Practical Applications

(a) The findings of the study will help to understand the benefits of 6 weeks of high volume versus low volume balance training on static and dynamic balance.

(b) The findings of the present study will help the coaches and physical education teachers for identification of talent and development of the balance ability in young volleyball players.

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CORRESPONDING AUTHOR

Baljinder Singh Bal, Ph.D.

Assistant Professor

Guru Nanak Dev University, Amritsar-143002 (Punjab), INDIA

Tel. No.: +91-9876134130

E-mail: bal_baljindersingh@yahoo.co.in

Dr. Baljinder Singh Bal was born on 25.11.1975. He is working as Assistant Professor in the Department of Physical Education (T) at Guru Nanak Dev University Amritsar, Punjab, India. He received the B.P.E., M.P.E. and M.Phil degree in Physical Education from Lakshmibai National Institute of Physical Education (Deemed University) Gwalior (M.P.) India. He obtained his Ph.D. from Panjab University, Chandigarh under the esteemed supervision of Late. Prof. (Dr.) Ajmer Singh, (Olympian) Arjuna Awardee. Dr. Baljinder Singh Bal is the recipient of 1^{st} JSHR Research Award 2009 (Martos) Spain. His areas of interest include Biomechanics and Motor Control of Human Movements, Science of Sports Training and Hatha Yoga Pradipika.