

The Effectiveness Of Sport Specific Trampoline Training On Dynamic Balance Among Amateur Wushu Athletes

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Abstract: Balance ability is responsible for the complex sport movements, as well as for injuries prevention. Balance training is used prophylactically to reduce the risk of lower extremity injuries in athletes allowing for successful athletic participation. The purpose of this study is to identify the effectiveness of sport specific trampoline training in improving dynamic balance among amateur Wushuathletes in Sultan Idris Education University, Malaysia. The study design used was purposive sampling. There were 12 amateur Wushu athletes age ranging from 20 to 25 years old who fulfilled the inclusion criteria were randomly assigned equally into Experimental Group (EG) or Control Group (CG). The EG was undergone 12 sessions sport specific trampoline training intervention in four weeks while the CG did not receive any intervention but remained normal training. The Y-Balance Test was used to measure the dynamic balance before and after the intervention for both groups. Data was analysed using independent sample t-test and the significance level was predetermined at $p < 0.05$ prior to study. The study finding indicated that the EG showed significant improvement on dynamic balance ($p = 0.016$) after completing the intervention. The researcher is suggesting the Wushu coaches and athletes to incorporate this intervention as one of their training regime in order to improve dynamic balance, hence, it may reduce the risk of sustaining lower extremities injuries.

Keywords: Sport Specific Trampoline Training, Dynamic Balance, Wushu

1. INTRODUCTION

Balance has an important role protecting the body composition that is necessary for successful performance. Balance is a term that commonly used by health professionals and associated with terms such as equilibrium and stability. It is known that all sports required a certain level of stability [1]. Balance is defined as a state of bodily equilibrium or the ability to maintain the center of body mass over the base of support without falling [2]. Balance can be defined into three ways: the ability to maintain a position, the reaction to the external disturbance, and postural adjustment to voluntary movements [3]. The ability to maintain

balance is essential to nearly all daily life activities. However, this ability is influenced by a complexity of factors, which are sensory information (from somatosensory, visual and vestibular systems), range of motion (R.O.M), and strength [4]. Balance ability is responsible

for the complex sport movements, as well as for injuries prevention. Balance is categorised into static balance and dynamic balance. Static balance require the athlete's feet remain in the fix position with little or no movement in the centre of gravity while dynamic balance require the athlete to maintain the postural stability when the body parts are in the motion. Dynamic balance training is used to improve balance for those athletes who perform activities such as jumping and landing, cutting and pivoting, and running. This is due to the above mentioned activities required the athlete to repetitively lose and regained balance to perform sport without falling or sustaining injury [5].

Nowadays, Wushu ranks as one of the biggest sports and is featured in the SEA Games and Asian Games. Wushu is one of the most popular traditional martial arts that originated from China and it is dependent on multiple components of training and development of strength, power, endurance, flexibility, proprioception and balance. Wushu is a sport where static balance and dynamic balance are the limiting factors of performance. Wushu consists of performing a routine of martial arts movements as well as acrobatic jumps and frequently lead to injury that are probably the result of impaired stability and balance. Balance is a key component in both the maintenance of functional activities and high performance of physical activity. Its impairment not only affect the outcome, but may also increase the risk of injuries. Postural stability may be impaired by intensive bouncing exercises due to the high vertical forces during jumping. Non-contact mechanisms, such as landing from a jump, frequently lead to joint or ligament injuries that are probably the result of strength deficits or impaired stability and balance [6]. The lower extremities were the most commonly injured body parts of both males and female, the prevalence was 102.94/1,000 AE and 282.61/1,000 AE, respectively [7]. This is supported by Lee, et al. (2018) revealed that most common injury location among Perak, Malaysia athletes in contact-sports was lower extremities (66.5%). Study finding revealed less ideal body composition such as postural stability causing the athletes incompetence in high performance sports. Athletes who are lack of postural stability indicated higher postural sway, hence, it may be a causal factor for lower extremities injury [8]. This is in agreement with the studies conducted by Lee et al. (2017) and Lee et al. (2018) stated that lower extremities (51.1%) seems to be the most common injury location. Any weight bearing sports that required the athletes to run, turn, change of direction and jump will often lead to lower extremities injury especially knee and ankle region [9, 10].

Sprain and strain were the second most identified injuries for amateur Wushuathletes. Zetaruk et al. (2005) conducted a study to compare the incidence of injuries for five different martial arts consist of shotokan karate, aikido, tai chi, Wushu and taekwondo. They found that Wushu athlete sustained higher frequency of injury to the lower limbs (35.9%) compared to other anatomical regions [11]. Poor dynamic balance when performing acrobatic movement in Wushu or known as nandu routines is the potential determinants of injury to the lower limbs joint in amateur Wushu athlete [11]. Meaning to say, the ability of athlete to maintain balance is inversely proportional to the risk of injuries. The greater the balance abilities, the lower the risk of sustaining injuries.

Traditionally, balance training has been used for injury rehabilitation. However, balance training is now being used prophylactically to reduce the risk of lower extremity injuries in athletes allowing for successful athletic participation. Strengthening exercises and proprioception exercises have both been shown to be effective for improving postural stability. There were also several studies that have evaluated the effects of balance training on static balance and dynamic balance abilities. Specific balance training improves balance performance of individuals, while these balance exercises reduce the risk of injuries of

athletes. In previous studies, there were research stated that trampoline training can improve dynamic balance for special population such as stroke and intellectual disability people. A significant amount of research has examined the effectiveness of balance training on trampoline, demonstrating improved balance [16, 17, 18, 19]. However, there is no study conducted to identify the effectiveness of sport specific trampoline training using trampoline on healthy amateur Wushu athletes.

Therefore, the purpose of this study is to identify the effectiveness of sports specific trampoline training on dynamic balance among amateur Wushu athletes. The researcher is hoping that if the sports specific trampoline training on dynamic balance is effective in improving dynamic balance abilities, it could be suggested as one of the training regime to be included in Wushu training program so to reduce the risk of sustained lower extremities injury.

2. RESEARCH METHODS

The study design used purposive sampling where the entire amateur Wushu team (total 32 athletes) in Sultan Idris Education University, Malaysia, age ranging from 20 to 25 years old were identified as the subjects. However, only 15 amateur Wushu athletes volunteered in this study. They were screened using a self-report questionnaire and 12 amateur Wushu athletes who fulfilled the inclusion criteria were recruited in this study. All the qualified subjects were randomly assigned into either Experimental Group (EG) or Control Group (CG) to eliminate any possible biases that may arise in the experiment.

The selected subjects were asked to complete a questionnaire regarding demographic data, previous injury, and sports history. Written informed consent was distributed to all the subjects in order to make sure they understood the procedure of research. Before starting the sports specific trampoline training program (pre-intervention) and after completed the training program (post intervention), all the subjects were required to undergo a dynamic balance assessment. The instrument used to assess the dynamic balance was Y-Balance Test (YBT). The test-retest Intraclass Correlation Coefficients (ICCs) for Y-Balance Test were 0.98, 0.98, and 0.99 on anterior, posteromedial, and posterolateral directions respectively, indicating excellent test-retest reliability for all three directions in Y-Balance Test [12].

The Experimental Group is entitled to undergo 12 sessions of sport specific trampoline training, whereas, the Control Group did not follow any intervention but remained normal training. The sports specific trampoline training intervention were designed to challenge each of the balance components consist of base of support, visual, vestibular and proprioception. The training variations such as stance, visual, jumping height and equipment were changed gradually (see Table 1). The intensity of training for the first week was low, moderate for the second week and high intensity for the third and fourth week. The intervention required subjects to perform vertical jump with bare hand on the first week and progress to perform Wushu jumping movement with weapon on the last week. Besides that, the jumping height was increasing from 3 cm to 5 cm every week. All subjects were required to do warming up and cooling down exercises as well as stretching before every training session to prevent injury. All exercise variations that prescribed in this sport specific balance training were performed only on trampoline. Estimated training duration for each session was within 30 minutes to 45 minutes. There were two minutes rest between each set and each exercise variation.

The intensity and volume of sports specific trampoline training in this study was progressively increased to prevent plateau occur which is the body had been adapt to the

stress given such as the rebound force. Intensity of exercise was increased by changing difficulty of exercise from bilateral to unilateral to challenge proprioception input, eyes open and eyes closed to challenge visual input, from bare handed to weapon equipped. The volume of exercise was increased every session (see Table 1). This is due to different configurations of training volume and intensity result in different forms of physiological stress, which in turn induce different neural and muscular adaptation [13].

Table 1: The variations of 12 sessions Sport Specific Trampoline Training

Sessions	Variable				Intensity
	Stance	Visual	Vestibular	Weapon	
1	Bilateral	Eyes Open	15 cm height (jumping vertical)	Bare hand	Low
2	Bilateral	Eyes Closed	10 cm height (jumping vertical)	Bare hand	Low
3	Unilateral	Eyes Open	15 cm height (jumping vertical)	Bare hand	Low
4	Bilateral	Eyes Open	20 cm height (turning jump 180 degree)	Bare hand	Moderate
5	Unilateral	Eyes Open	15 cm height (turning jump 180 degree)	Bare hand	Moderate
6	Unilateral	Eyes Closed	10 cm height (turning jump 180 degree)	Bare hand	Moderate
7	Bilateral	Eyes Open	20 cm height (jumping kick)	Bare hand	High
8	Unilateral	Eyes Open	15 cm height (jump turning kick 180 degree)	Bare hand	High
9	Bilateral	Eyes Open	15 cm height (turning jump 360 degree)	Short Weapon	High
10	Unilateral	Eyes Open	15 cm height (turning jump 360 degree)	Short Weapon	High
11	Bilateral	Eyes Open	20 cm height (turning jump 360 degree)	Long Weapon	High
12	Bilateral	Eyes Open	20 cm height (turning jump 360 degree)	Weapon	High

The researcher monitored and make sure that all the exercise variations were being performed correctly and safety during the four weeks intervention period. After completed the four weeks intervention, the outcome measures i.e. dynamic balance using Y-Balance Test were recorded and analysed using independent sample t-test and paired sample t-test in Statistical Package for Social Science (SPSS) version 22. Independent sample t-test was used to compare the difference in dependent variable between Experimental Group and Control Group. The paired sample t-test was used to compare the difference on dynamic balance before and after intervention in Experimental Group to determine the effectiveness of sport specific trampoline training intervention. The level of significance was predetermined at $p < 0.05$.

3. RESULTS AND DISCUSSION

The comparison of pre-test for dynamic balance on absolute reach between Experimental Group and Control Group, revealed there was no significant difference for pre-test of dynamic balance, indicating that both Experimental Group and Control Group were recruited from homogeneous group ($t=-1.512$, $p=0.162$) before sports specific trampoline training intervention (see Table 2). The comparison between pre-test and post-test of Control Group, indicated that there was no significant difference in absolute reach (67.85 cm to 69.71 cm) for dynamic balance ($t=-1.411$, $p=0.217$) (see Figure 1 & Table 3). The Control Group did not improve in dynamic balance because they did not undergo this intervention but remained their normal training. Under the researcher's observation during these amateur Wushu athletes routine training, their training regime did not emphasize in improving dynamic balance, instead their coaches focus more on skill training.

The comparison before and after 12 sessions of sports specific trampoline training intervention, the mean of absolute reach for dynamic balance of Experimental Group had increased for 15.64 cm i.e. from 63.18 cm to 78.82 cm (see Figure 1). The study finding revealed there was significant improvement in dynamic balance on absolute reach ($t=-7.309$, $p=0.001^*$) (see Table 3). When compared post-test scores between Experimental Group and Control Group, the result showed that there was a significant difference for dynamic balance ($t=2.992$, $p=0.016^*$), indicating that the intervention is effective in improving dynamic balance of amateur Wushu athletes who undergone the 12 sessions of sports specific trampoline training intervention (see Table 2).

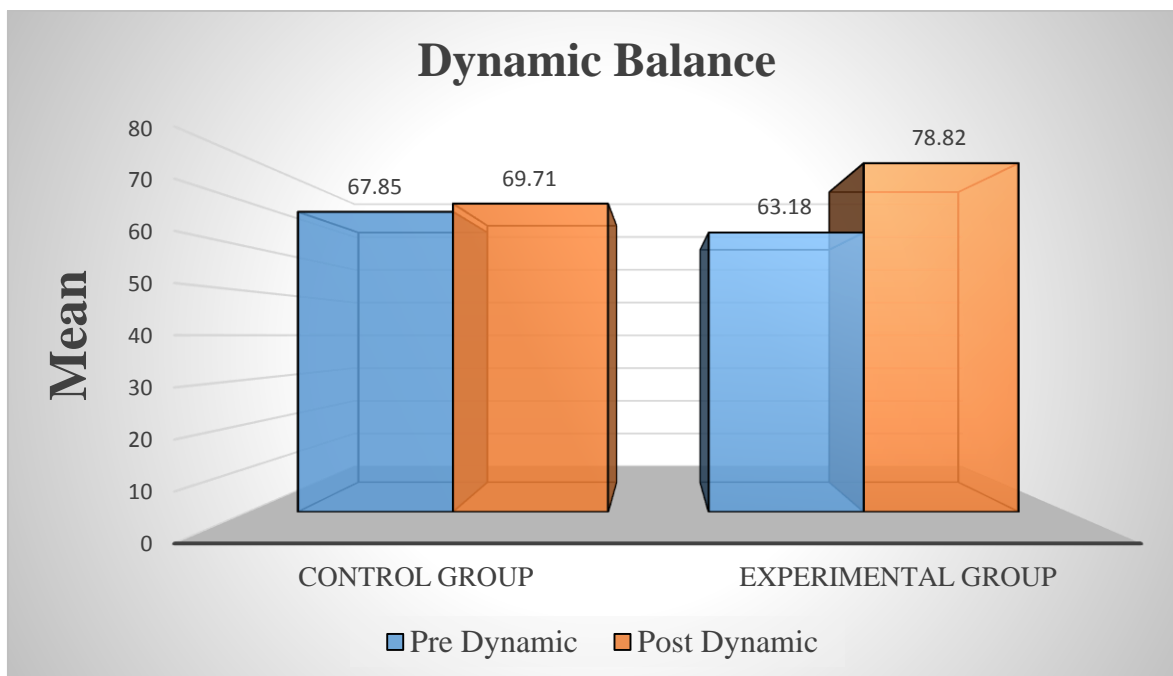


Figure 1: The Mean of Experimental Group and Control group for Dynamic Balance on Absolute Reach in Centimetres using Y-Balance Test Before and After Intervention.

Table 2: The Comparison of Pre-Test and Post-Test Between Experimental Group and Control Group for Dynamic Balance on Absolute Reach using Y-Balance Test Before and After Intervention.

	Control Group (CG)	Experimental Group (EG)	t	p
Pre test	(μ +SD) 67.85 ± 6.14	(μ +SD) 63.18 ± 4.40	-1.512	0.162
Post test	69.71 ± 6.30	78.82 ± 3.98	2.992	0.016*

* Level of Significance $p < 0.05$

This study finding is in agreement with study conducted by Lee, A.C. and Kuang, P.F. (2016), indicated that sport specific balance training program could improve balance ability in male basketball players, thus may reducing the risk of lower extremity injuries. This is due to the ability of neuromuscular control was improved through balance exercise and also improve motor sensory perception of the basketball players [14]. Lee, A. C. & Magee, D. J. (2017) suggesting that a multisensory training program designed to specifically improve sensory function was effective in the improvement of postural sway control and balance control [15].

Table 3: The Comparison of Pre-Test and Post-Test within Experimental Group and Control Group for Dynamic Balance on Absolute Reach using Y-Balance Test Before and After Intervention.

	Pre test (μ +SD)	Post test (μ +SD)	t	p
Control Group	67.85 ± 6.14	69.71 ± 6.30	-1.411	0.217
Experimental Group	63.18 ± 4.40	78.82 ± 3.98	-7.309	0.001*

*Level of Significance $p < 0.05$

This study finding also supported by Aragao and Hahn [16, 17], reporting an improved balance ability of elderly subjects after undergone mini trampoline training intervention. They reported that trampoline training could improve dynamic balance for special population such as stroke patients. The result comparing mean values of stability before and after the intervention, the experimented group showed an improvement of about 35% while the control group did not show statistical differences. Moreover, the between group statistics values showed an improvement in dynamic stability and 10% muscle strength of the calf muscles in the experimented group [16]. Initially, the training was focus on absorbing forces when landing on the trampoline. It has been suggested that mini-trampoline exercises consist of a multi component approach which are likely to affect many physical factors such as strength, body stability, muscle coordinative responses, joint movement amplitudes and spatial integration [16]. Trampoline is characterized by dynamic movement pattern. Trampoline exercises are focusing at lower extremities and require particularly kinaesthetic, visual, vestibular perception, balance and movement control. During trampoline training, subjects

are “forced” to continuously respond to the change of posture and centre of gravity trajectory by high speed jump which provide deep proprioception as well as other sensory inputs such as tactile, visual and vestibular. Atilgan(2013) also stated that it is important to control the body position in the air at the time of jumps, and to use proper balance landing and jumping techniques [18].

In addition, performance improvements in dynamic balance may be due to alterations in the complex sensory motor stimulation of participants’ efforts to adapt to the trampoline unstable surface and maintain balance [19]. Rebounding on a trampoline requires the body to be repetitively in motion, subject eyes must continually adjust to the different fields of vision. The intervention group who received sport specific trampoline training showed a significant improvement may due to their training on the trampoline bare footed. Perrin et al. (2002) expressed in their studies that bare foot trainings caused improvement on orthostatic balance control with the reason of foot position [20]. During the intervention, the subjects had to maintain their balance while performing various movements or tasks on the unstable surface bare footed. These task likely contributed to improve the subjects’ balance ability due to the repeated sensory feedback and the continuous experience to postural sway. Moreover, performing sports specific movement for Wushu such as jumping front kick, turning kick and turning jump with weapon on a trampoline gave subjects more challenge to improve their orientation in space and balance ability during training or competition on a stable surface. This was also supported by Hahn et al. (2015) mentioned that performing operations such as hopping or jumping on a trampoline should give patients more experience to help them avoid falls during activities on a solid surface [17].

In conclusion, the study findings revealed that the 12 sessions of Sports Specific Trampoline Training Intervention is effective in improving dynamic balance significantly for amateur Wushu athletes. The nature of Wushu require athlete to jump and land firmly with weapon during performing, forcing them to repetitively lose and regained balance without falling. If Wushu athletes have poor dynamic balance when performing acrobatic movement, it is the potential determinants of injury to the lower extremities [11]. Therefore, drills to improve jumping and landing should be incorporated into Wushu training program to prevent inefficient balance that will lead to injuries and poor performance. The ability of athlete to maintain dynamic balance is inversely proportional to the risk of injuries. The greater the balance ability, the lower the risk of sustaining injuries. Since the 12 sessions Sports Specific Trampoline Training Intervention is effective in improving dynamic balance significantly, the researcher is suggesting to the Wushu coaches and athletes to incorporate this intervention as one of their training regime in order to improve dynamic balance, hence, it may reduce the risk of sustaining lower extremities injuries.

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