

EFFECTS OF SIX-WEEK TRAMPOLINE TRAINING ON DYNAMIC BALANCE PERFORMANCE

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The purpose of this study was to investigate the effects of trampoline training on dynamic balance performance in healthy, young males and females. Twenty-six participants were randomised into two groups: Trampoline Training (TT, $n = 13$) and Resistance Training (RT, $n = 13$). Participants underwent a six-week intervention programme two times per week, and performed either trampoline or classical resistance training. Dynamic balance performance was assessed before and after the intervention using the Y Balance Test™. Mixed model Analysis of Variance was applied to examine the effects of training and group. Results showed that across all participants, balance scores increased after training for both left and right legs ($p < 0.05$) but did not differ between the TT and RT groups. In conclusion, trampoline training is as effective as classical resistance training in improving dynamic balance performance in young, healthy individuals.

KEYWORDS: jumping, gymnastics, YBT, reach distance.

INTRODUCTION: Recently, trampoline parks have become increasingly popular as a recreational activity for children and adults. Given the attractive nature of trampolining in promoting fun and enjoyment, trampoline training has been used to successfully improve the functional outcomes of children assessed with developmental coordination disorder (Giagazoglou, Sidiropoulou, Mitsiou, Arabatzi, & Kellis, 2015). Modified trampoline training is also effective in improving balance ability in stroke patients (Hahn, Shin, & Lee, 2015) and the elderly (Aragao, Karamanidis, Vaz, & Arampatzis, 2011). Among healthy individuals, trampoline training has been shown to reduce body fat percentage and improve anaerobic fitness in high school students (Aalizadeh, Mohammadzadeh, Khazani, & Dadras, 2016).

It has been acknowledged that balance training via mini-trampoline can induce a strengthening effect on knee extensor and flexor muscles alongside improving static balance performance (Heitkamp, Horstmann, Mayer, Weller, & Dickhuth, 2001). This highlights the potential of using trampoline training as an alternative means to resistance training for maintaining fitness and good health. Considering the challenging nature of jumping on a trampoline, trampoline training can be expected to improve dynamic balance ability to a greater extent than classical resistance training using machines. In the literature, there was no information on the effects of trampoline training on dynamic balance.

The aim of this study was to investigate the effects of a 6-week trampoline training program on dynamic balance performance in healthy, young individuals. It was hypothesized that trampoline training would be more effective in improving dynamic balance performance when compared with classical resistance training.

METHODS: This study was approved by the Nanyang Technological University Institutional Review Board. Originally, 28 (14 males, 14 females) volunteers who provided written informed consent to participate in the study were randomized into two groups: Trampoline Training (TT) and Resistance Training (RT). Two female participants (one from each group) dropped out due to reasons unrelated to the study. The characteristics of the remaining 26 participants are compared in Table 1.

Table 1: Physical characteristics of 26 participants

Variables	Trampoline Training (TT) 7 males, 6 females	Resistance Training (RT) 7 males, 6 females	p-value*
Age [years]	24.1 (2.5)	23.0 (1.7)	.230
Height [cm]	164.7 (6.5)	167.3 (7.9)	.305
Body mass [kg]	59.7 (13.4)	62.0 (8.4)	.555

Note. *p-values determined from independent t-tests.

All participants underwent a six-week intervention programme, two times per week with at least 48 hours between sessions. Each session was supervised by trained personnel, lasting for about 30 min (10 min warm-up and 20 min training). The TT group training, conducted at a recreational trampoline park (AMPED Sports Pte, Ltd.), included basic trampoline movements with increasing degrees of difficulty from Session 1 to Session 12. Examples of trampoline movements were jogging on the spot, straight jumps, tuck jumps, straddle jumps, pike jumps, seat drops, and twists. The RT group performed classical strength training using machines targeting lower limb muscles (e.g. leg press, hip abduction, knee extension). Participants completed three sets of eight repetitions for each resistance exercise. To monitor the exercise intensity at moderate level, participants were asked to target an effort of 7 (in a scale of 0 to 10) using the OMNI Perceived Exertion Scale for resistance exercise (Morishita, Yamauchi, Fujisawa, & Domen, 2013). When the participant reported a 6 or below at the end of a set, the trainer would increase the load for the next set. Likewise, if the participant reported an 8 or above, the load would be reduced accordingly.

Dynamic balance performance was assessed before and after the six-week intervention using the Y Balance Test™ (FunctionalMovement.com, Danville, VA, Figure 1). For each leg, the reach distance was measured in three directions: anterior, posteromedial, and posterolateral. All distances were normalized to the limb length (anterior superior iliac spine to medial malleolus) of the tested leg. A composite score was calculated as the average of the three reach distances in different directions, and used as an overall indication of dynamic balance performance (Hudson, Garrison, & Pollard, 2016). A two-way mixed model Analysis of Variance was used to compare the balance scores before and after training (within-subject factor: time, between-subject factor: group). Statistical significance was set as $p < .05$. Data are expressed in mean (standard deviation). Mean differences between TT and RT groups and 95% confidence intervals (CI) are also presented.

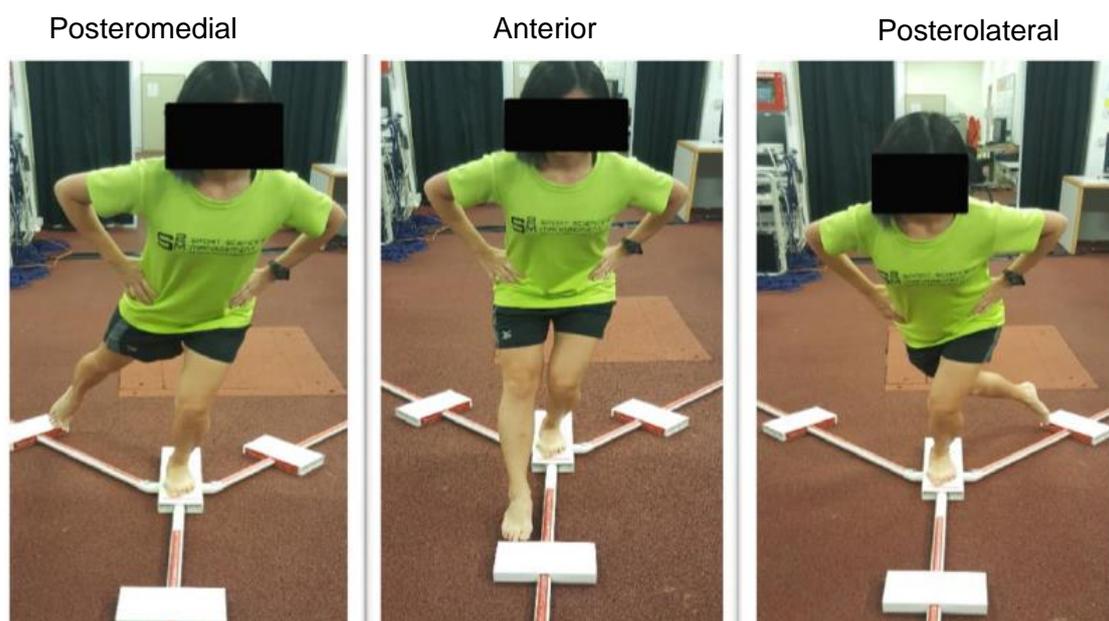


Figure 1: Dynamic balance performance was assessed using the Y Balance Test™.

RESULTS: Across both TT and RT groups, the composite scores increased after six weeks of training for both left and right legs but no significant main effect of group or group by time interaction was noted (Table 2).

Table 2: Dynamic balance performance before and after 6 weeks of training

Composite score (%)		Pre-test	Post-test	p-value*		
				Time	Group	Interaction
Left	TT	92.6 (9.1)	96.4 (6.4)	0.005	0.271	0.677
	RT	89.1 (8.2)	94.0 (5.5)			
	Diff [95% CI]	3.4 [-3.5, 10.5]	2.3 [-2.5, 7.1]			
Right	TT	89.9 (10.4)	96.0 (8.3)	0.001	0.668	0.853
	RT	89.0 (6.3)	94.6 (5.3)			
	Diff [95% CI]	0.9 [-6.1, 7.8]	1.4 [-4.2, 7.1]			

Note. *p-values determined from mixed model Analysis of Variance. TT = trampoline training; RT = resistance training; Diff = Mean difference (TT – RT); CI = confidence intervals.

Change in normalised reach distances in the anterior, posteromedial, and posterolateral directions are compared in Figure 2. Similar to the composite scores, only significant main effect of time was found for the reach distances in all directions ($p < 0.05$).

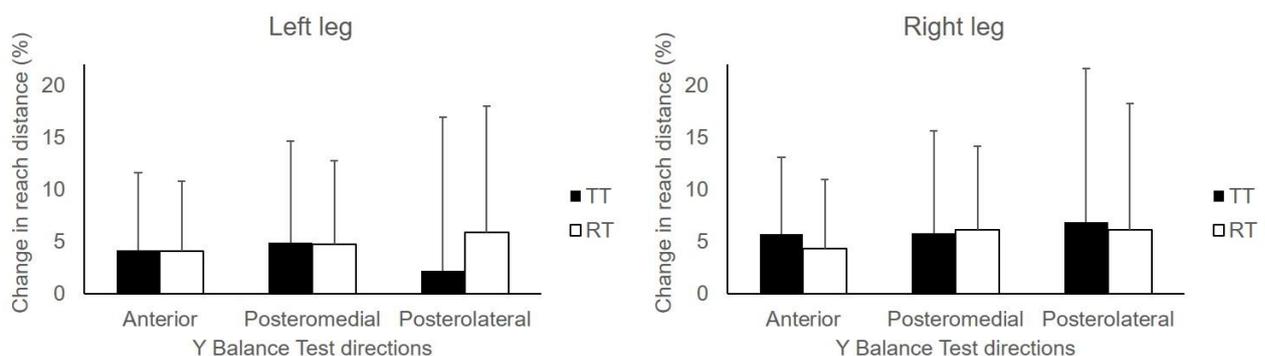


Figure 2: Change in normalised reach distances (post-test minus pre-test) in anterior, posteromedial, and posterolateral directions. Significant main effect of time ($p < .05$) was found for all variables, with no difference between trampoline (TT) and resistance (RT) training.

DISCUSSION: This study investigated the effects of trampoline training on dynamic balance performance. After six weeks of training, participants in both TT and RT groups showed similar improvements in Y Balance Test™ scores for both left and right legs, and in all directions. This suggests that trampoline training is as effective as classical resistance training in improving dynamic balance ability.

It was originally hypothesized that trampoline training would be superior to resistance training using machines in improving balance performance due to the challenge in controlling the centre of mass position in relation to the base of support on the trampoline. Through adapting to the unstable trampoline surface to maintain balance, alternations in the complex sensory motor stimulation can be expected and hence lead to enhancing balance performance (Hahn et al., 2015). The results, however, did not fully support this hypothesis as dynamic balance in both TT and RT groups improved in a similar manner. A previous study showed that six weeks of mini-trampoline training improved static balance performance during a one-leg balance, which was measured on a stabilometer (Heitkamp et al., 2001). While no data on dynamic balance were available for direct comparison, the study by Heitkamp et al. (2001) also showed that knee extensor and flexor strength increased after the mini-trampoline training. It is probable that improvement in muscular strength have

contributed to enhancing balance performance. This may also explain why the RT group in the present study showed substantial improvement in dynamic balance performance although the training exercises on machines did not impose specific demand in maintaining balance. Nevertheless, it is a promising finding to show that trampoline training is as effective as classical resistance training in improving dynamic balance. Bearing in mind that jumping on the trampoline can be fun and enjoyable for many, trampoline training can potentially be an alternative means to resistance training in maintaining general fitness and good health. It is acknowledged that this study only adopted the Y Balance Test™ to assess dynamic balance since the test procedures were simple to administer and that comparative data are readily available across a variety of sports and athletes (Hudson et al., 2016). This simple test does not provide information on the mechanism or strategies on how balance is controlled. In addition, interpretation of the balance test scores concerning sports performance or risk of injuries should be cautioned as there are limited evidence on trampoline-related activities.

CONCLUSION: Six weeks of trampoline training was as effective as classical resistance training using machines in improving dynamic balance performance in young, healthy males and females.

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