

Effectiveness of speed endurance vs plyometric training on speed, power and high-intensity running ability in elite Canadian youth female soccer players.

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Introduction and Purpose

Speed endurance training and plyometric training are two commonly used methods of developing fitness in soccer, and both have been shown to elicit improvements in multiple areas of fitness in soccer players. Female soccer players, in particular, may experience further benefits from speed endurance and plyometric training because of the relationship between this type of training and prevention of injuries to joints that are more prominent in female soccer players, such as the anterior cruciate ligament (ACL). The use of a high speed / high incline running treadmill may be advantageous versus over-ground running, due to the fact that certain variables, including running speed and percent incline, can be more closely controlled with incline treadmill running. To date, there has been little research comparing the effectiveness of speed endurance training, using incline treadmill running, with plyometric training on markers of physical fitness in soccer players. The aim of this study was to measure improvements in speed, power, and high intensity running ability by comparing speed endurance (SET) training done using an incline treadmill training protocol, versus plyometric training (PT).

Methods

Female soccer players (N=21), recruited from a local youth soccer club, first completed a fitness assessment with a series of tests, which were as follows:

Counter Movement Jump (CMJ) – The Opto Jump timing system featuring 2 bars with an infra-red timer run along the floor was used to assess jump height. Athletes began by standing in between the 2 bars, with hands on hips and feet shoulder-width apart. Two repetition of maximal jumps with the hands held on the hips, were performed, with the highest jump recorded.

10, 20, and 35 Metre Linear Sprint (10SPRINT, 20SPRINT, 35SPRINT) – Infrared timing gates were set at the start and finish lines, as well as at the 10- and 20-metre marks. Athletes began from a stationary position with one foot on the start line and sprinted maximally through the finishing gates. Two trials were performed with the fastest time recorded.

Yo-Yo Intermittent Recovery Test-Level 1 (YO-YO) – The 20 metre course and 5 metre recovery zone were marked with cones. Athletes traveled out and back on the course keeping pace with audible beeps from the Yo-Yo CD and had 10 seconds recovery between each shuttle (40 metres). A warning was given after the first unsuccessful shuttle and the test was terminated after the second. The final stage completed was recorded.

Following testing, players were randomly assigned to either SET, PT, or control (CT) groups, using a simple computer-generated randomization. 7 players participated in each of the SET, PT and CT groups. Each training protocol comprised 6 weeks of training, with 2 training sessions completed each week. A standardized 15-minute warm-up protocol was performed pre-training with both training groups. Training was conducted as follows:

Speed Endurance Training (SET): This training was performed on the Woodway Pro-Elite high speed running treadmill at the Soccer Fitness Training Centre. All players performed 9 repetitions of 20-second sprints, with 90 seconds of recovery, and the treadmill set at a 25% grade. Running speeds were individualized for each participant at 60% of maximal running speed, as determined from the time taken to complete the “split” between the individuals’ 20 and 35 metre sprint test.

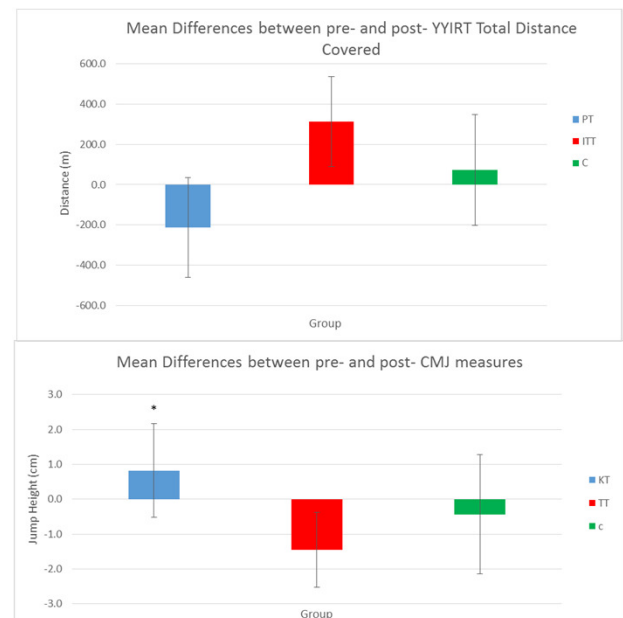
Plyometric Training (PT): This training was performed on a plyometric platform at the Soccer Fitness Training Centre. The PT protocol included 12x10-second plyometric exercise with 20-seconds of recovery, performed on a plyometric platform, as well as strength training exercises performed for 3 sets of 10 repetitions.

Results

At baseline, there was no difference in CMJ, 10m, 20m and 35m sprint times between the SET, PT and CT groups. Improvement in jump, sprint, and Yo-Yo Test performance was assessed following 6 weeks of training by comparing the difference in scores pre- and post- training. Following 6 weeks of training, girls randomly assigned to PT had significant improvements in CMJ, whereas girls randomly assigned to SET had significant improvements in Yo-Yo test performance. When evaluating program effectiveness, PT was shown to improve leg power, and SET was shown to improve high intensity running ability.

Results

Figure 1. Difference in Yo-Yo Intermittent Recovery Test (YYIRT) and Counter Movement Jump (CMJ) scores between SET and PT groups.



Discussion and Conclusions

Results of the study indicate that Speed Endurance Training produced a significant increase in high intensity running ability (via improvement in the Yo-Yo Intermittent Recovery Test), whereas Plyometric Training produced a significant increase in leg power (via improvement in the Counter Movement Jump). The exact mechanisms responsible for the improvements in performance as a result of speed endurance and plyometric training are not clear. High intensity running ability and performance in the Yo-Yo tests is a complex physical ability that requires both a strong neuromuscular/anaerobic component (including speed, and agility to change directions during the shuttle run) as well as a strong metabolic component (oxidative capacity, creatine phosphate replenishment, H⁺ buffering). Because the speed endurance training was carried out on a high incline running treadmill, it may be possible that improvements in high intensity running ability occurred through adaptations at both the neuromuscular and metabolic levels.

The Plyometric Training group performed plyometric exercises which are aimed at improving neuromuscular efficiency, as well as strength training exercises aimed at improving strength and maximal force production. Improvements in leg power seen in the Plyometric Training group could have resulted from increased neuromuscular efficiency, and/or from improved muscular strength and maximal force production.

Since both high intensity running ability and leg power are critical components of performance in soccer, the results of this study warrant further research into using high speed / high incline treadmills, and plyometric exercises as a means of improving these physical abilities in soccer players. Perhaps, more research examining the mechanisms of improvement (for example, the changes in running economy and/or running mechanics following Speed Endurance Training done on a high speed / high incline treadmill, or the changes seen at the physiological and neuromuscular levels to key soccer-specific muscles such as hip and knee extensors following Plyometric Training), would be useful.

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