TACSM Abstract

Analyzing Performance of Skilled and Unskilled Jump Ropers During a Two-footed Jumping Task

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ABSTRACT

The purpose of this study was to determine if reduced tibial acceleration characterized skilled rope-skipping performance for a two-footed jumping task and to examine if the style of rope used had an effect on performance. Following a 3-minute treadmill warm-up, fifteen volunteers from Southwestern University (8 women and 7 men; 20.6 ± 0.91 years; 168.5 ± 8.9 cm, 68.3 ± 9.9 kg) completed three one-minute trials of two-footed jump roping. Each trial was performed with one of three different jump ropes of varying material and mass (0.10 kg plastic rope, 0.14 kg cable rope, 0.17kg beaded rope). The ropes selected are the three most commonly used in competitive jump rope competitions across the United States. Participants were instructed to perform as many jumps as possible within the time frame while minimizing mistakes. Based on jump frequency, the top third of participants were classified as the high skill group while the bottom third of participants were classified as the low skill group. Three-minute resting intervals were required between trials, including after the initial warm-up. A wireless triaxial accelerometer was attached to the antero-medial aspect of the tibia. Long-axis tibial acceleration was recorded at 1000 Hz for 20 s. Peak long-axis tibial accelerations were averaged across 20 consecutive jumping cycles. A 3x2 (jump rope x skill level) mixed-model ANOVA was use to analyze differences in peak tibial acceleration. Mean peak tibial acceleration across all ropes for the novice group (8.73 g) was nearly double that of the experienced group(4.52 g) ($F_{(2,8)} = 6.284$, $p < 0.05$, $\eta^2 = 0.440$). However, the style of rope had no effect on peak tibial acceleration within subjects ($F_{(1,8)} = 0.074$), ($p > 0.05$). Furthermore, the standard deviation of the peak tibial accelerations across 20 consecutive jumps was much larger for novice jumpers (3.61 g) than experienced jumpers (0.73 g). These data suggest that the acquisition of a simple two-footed rope-jumping task was characterized by the ability to generate consistent and reduced tibial accelerations upon landing. Excessive tibial accelerations have been linked to higher levels of muscle activation due to muscle stiffness resulting in a reduced ability to dissipate the shock of landing impact that leads to injury. During competition rope skipping competitors have performed as many as 1,000 consecutive jumps in 3 minutes. Therefore, in addition to improving performance, modifying loading mechanics to generate reduced tibial accelerations to an optimal level may prevent overuse injuries and stress factors during training. Furthermore, higher levels of bone mineral density have been correlated to both lower tibial accelerations and greater skill-level during a jumping task. Although reduced tibial accelerations seem to be unfavorable for the promotion of bone growth in young children, according to Neil et al. (2002), landing forces as low as 4.0 g are sufficient to bring about desired increases in bone mineral content for children under the age of 18 years. So, the impacts sustained by participants who were more experienced in the two-footed jumping task (mean value of 4.54 g) may be beneficial for physical development in young children in addition to the improved performance of novice jumpers.