Acute Effects of Plyometric Exercise on Lower Limbs Explosion in Cheerleading Athlete

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Summary

The purpose of this study was to investigate the acute effects of post-activation performance enhancement (PAPE) induced by plyometric exercises on the explosive power of cheerleading athletes, with consideration of competition-specific demands. A total of 21 amateur cheerleaders were randomly assigned to either a plyometric exercise group (PLY) or a control group (CON). Countermovement jump (CMJ) performance was measured using a force plate before and after the intervention. The primary findings revealed that a 4-minute rest interval following plyometric exercise intervention significantly enhances jump performance.

Introduction

PAPE has emerged in recent years as a prominent topic in sports training. It refers to the temporary improvement in athletic performance following a conditioning activity (CA) and a brief recovery period [1,2]. However, no empirical research has yet demonstrated whether PAPE can achieve similar outcomes in the context of cheerleaders. Typically, after completing warm-ups and proceeding to the check-in area, teams must wait approximately 30 minutes before competing. During this waiting period, athletes often feel their bodies cooling down, diminishing the benefits of the warm-up. Plyometric exercises, often used to induce PAPE, involve high-speed, unloaded jumping movements that include a stretch-shortening cycle (SSC). The SSC refers to the rapid elongation of the muscle-tendon complex during the eccentric phase, followed immediately by its shortening in the concentric phase [3]. Therefore, this study aims to investigate the acute effects of lower-limb plyometric exercises on explosive power in cheerleading athletes.

Methods

The PLY group (N = 10) engaged in a plyometric regimen that included 40-times jump. In contrast, the CON group (N = 11) rested, defined as sitting on a chair or performing minimal physical activity. Data collection was conducted utilizing a force plate to assess CMJ performance. All participants completed a standardized warm-up, followed by a 10-minute rest period prior to the pretest. To simulate the conditions of a competition day, a 30-minute rest period was implemented before the intervention. Then, both groups rested for 4 minutes before proceeding to the posttest. Statistical analyses were conducted using a mixed design 2 × 2 two-way ANOVA. Effect sizes (ES) were calculated using Cohen's d, with thresholds defined as ES ≥ 0.2 for small effects, ES ≥ 0.5 for medium effects, and ES ≥ 0.8 for large effects.

Results and Discussion

During the posttest, the PLY group maintained their performance in JH and PRPP, while the CON group exhibited a significant decline (JH: $p = .002$, ES = 0.28; PRPP: $p < .0001$, ES = 0.34). For ARBP, the CON group maintained their performance at the posttest, whereas the PLY group showed a significant improvement ($p = .031$, ES = 0.38) (Table 1). The lack of improvement in JH observed in the PLY group could be attributed to the high intensity of the intervention or insufficient rest, leading to fatigue accumulation [4]. Previous studies have reported a strong correlation between improvements in maximum and average propulsive power and changes in maximum and average braking power following exercise interventions [5]. Given the essence of cheerleading, athletes are required to execute rapid squats followed by immediate vertical jumps. Jump height and lower-limb explosive power are highly correlated, and superior lower-limb explosive power is essential for athletes to perform routines flawlessly [6].

Conclusions

Plyometric exercises involving repetitive jumping movements can help cheerleading athletes maintain or even enhance their performance after waiting periods (exceeding 30 minutes).

References

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Table 1: CMJ variable scoring

CMJ Variable (Unit)	CON		PLY	
	Pre	Post	Pre	Post
Jump Height, JH (cm)	31.5 ± 7.7	29.4 ± 7.3**	30.8 ± 6.7	30.8 ± 6.3
Average Relative Braking Power, ARBP (W/kg)	-13.3 ± 2.4	-13.2 ± 2.7	-12.5 ± 2.9	-13.5 ± 2.4*
Peak Relative Propulsive Power, PRPP (W/kg)	49.8 ± 8.0	47.1 ± 8.0***	52.1 ± 9.1	52.1 ± 8.5

Data are presented as mean ± SD. * $p \leq .05$; ** $p \leq .01$; *** $p \leq .0001$, compared to the pretest. Negative sign indicates a downward direction.