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Comparative Acute Effects of Static and Dynamic Stretching on Jumping Performance in Sprinter Athletes

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I. INTRODUCTION

Stretching is a fundamental element of warm-up protocols in athletic training, used to optimise muscle readiness, improve joint mobility, and minimise injury risk. Two widely practised modalities are static stretching (SS), where a muscle is held in a lengthened position, and dynamic stretching (DS), involving active, movement-based exercises through the full range of motion [1]. Sprinting demands explosive lower-limb power and neuromuscular coordination. Vertical jump height is a well-established indicator of lower-body explosive power and correlates strongly with sprint acceleration [2]. Despite extensive research, limited evidence compares the acute effects of SS and DS among adolescent sprinter athletes aged 14–17 years, who may respond differently because of their developing neuromuscular systems. This study investigated and compared the acute effects of both protocols on vertical jump performance in this under-represented population.

II. METHODS

A within-subject crossover experimental design was employed. Twenty-one male sprinter athletes aged 14–17 years (mean age = 15.6 ± 1.12 years; height = 164.4 ± 6.47 cm; body weight = 53.7 ± 6.40 kg) were recruited via purposive sampling. Sample size was determined using G*Power 3.1.9.7 (paired-samples t-test; $d_z = 0.65$; $\alpha = 0.05$; power = 0.80; $n = 21$).

Two testing sessions were conducted with a minimum 48-hour rest between sessions. Each session began with a 5-minute standardised general warm-up before the assigned stretching protocol. The SS protocol required 20-second holds for quadriceps, hamstrings, calves, and glutes (twice per side). The DS protocol consisted of two sets of high knees, butt kicks, walking lunges, and leg swings over a 10-metre distance. Immediately after stretching, participants performed three maximal countermovement vertical jumps using the Vertec system, and the best of three trials (cm) was recorded. Data were analysed using Jamovi 2.6.26. Descriptive statistics, Shapiro–Wilk normality tests, paired-

samples t-tests within each condition, and an independent-samples t-test between conditions were performed. Statistical significance was set at $p < .05$.

III. RESULTS AND DISCUSSION

Normality testing confirmed all data were normally distributed ($p > .05$), justifying parametric analysis. Results are summarised in Table I.

TABLE I
VERTICAL JUMP PERFORMANCE RESULTS (CM)

Condition	Pre M (SD)	Post M (SD)	<i>t</i> (df)	<i>p</i>
Dynamic	38.9 (3.40)	46.1 (3.51)	-51.9 (20)	<.001
Static	38.9 (3.40)	41.2 (3.39)	-16.3 (20)	<.001
DS vs SS	—	Δ -4.90 cm	-4.61 (40)	<.001

Note. M = Mean; SD = Standard Deviation. Cohen's $d = -1.42$ for between-group

Dynamic stretching produced a significantly greater improvement in vertical jump height (pre: 38.9 cm $\rightarrow$ post: 46.1 cm; $\Delta = +7.2$ cm) compared to static stretching (pre: 38.9 cm $\rightarrow$ post: 41.2 cm; $\Delta = +2.3$ cm). Both improvements were statistically significant ($p < .001$). The independent-samples t-test confirmed post-test DS performance was significantly higher than SS, $t(40) = -4.61$, $p < .001$, with a large effect size (Cohen's $d = -1.42$). These findings are consistent with literature showing that DS enhances explosive power by increasing muscle temperature, neural drive, and neuromuscular activation, thereby optimising stretch-shortening cycle efficiency [3][4]. The significant improvement following SS, contrary to findings suggesting performance impairment, may reflect the short hold duration (20 s), which evidence suggests does not hinder power output when performed within a complete warm-up [3]. The superiority of DS also supports comparative studies in sport-specific populations [5].

IV. CONCLUSIONS

Both stretching protocols produced significant acute improvements in vertical jump performance among male adolescent sprinter athletes. Dynamic stretching was significantly more effective (+7.2 cm vs. +2.3 cm). Dynamic stretching should therefore be prioritised in pre-activity warm-up routines for youth sprinters to optimise explosive lower-body performance, while static stretching remains suitable for flexibility maintenance or cool-down. These findings provide age-specific, evidence-based guidance for coaches and sports practitioners in youth track and field settings.

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