Jurnal Sains Sukan dan Pendidikan Jasmani Vol 14, Isu 1, 2025 (98-103)
ISSN: 2232-1918/ eISSN: 2600-9323
https://ejournal.upsi.edu.my/journal/JSSPJ

IS BALLISTIC STRETCHING EFFECTIVE IN IMPROVING FLEXIBILITY AND EXPLOSIVE POWER AMONG YOUNG ADULT RUNNERS?

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Received: 22 Januari 2024; **Revised**: 02 Mei 2025 **Accepted:** 10 Mei 2025; **Published:** 28 Jun 2025

To cite this article (APA): Yaakub, M. A., Bakar, N. A., Mohd Ramle, M. Y., Othman, N., Ahmad, M. F., & Amir, N. H. (2025). Is Ballistic Stretching Effective in Improving Flexibility and Explosive Power among Young Adult Runners?. *Jurnal Sains Sukan & Pendidikan Jasmani*, *14*(1), 98-103. https://doi.org/10.37134/jsspj.vol14.1.10.2025

To link to this article: https://doi.org/10.37134/jsspj.vol14.1.10.2025

Abstract

Although static and dynamic stretching are widely used to improve flexibility, recent studies suggest that ballistic stretching may be more effective for enhancing dynamic flexibility and neuromuscular coordination. However, its effects on runners remain underexplored. Therefore, this study examined the impact of a six-week ballistic stretching intervention on flexibility and explosive power in young adult runners in Penang. Twelve young adult runners (Mean age 21.8 ± 2.2 years) volunteered in this quasi-experimental study and underwent a 6-week ballistic stretching intervention. Flexibility and explosive power were measured using the V-Sit and Reach Test and the Standing Broad Jump Test, respectively, with results reported as mean ± standard deviation. A paired sample *t*-test revealed significant improvements in both flexibility (Pre vs post-intervention, 15.0 ± 4.7 vs 22.3 ± 4.6 cm, *P* = 0.001) and explosive power (pre- vs. post-intervention, 200.4 ± 17.5 vs 231.7 ± 17.2 cm, *P* = 0.001). These findings suggest that a six-week ballistic stretching intervention effectively enhances flexibility and explosive power performance in runners. However, proper execution is crucial to minimize injury risks. Future research should explore its long-term effects and applicability across different athletic populations.

Keywords: Ballistic Stretching, Explosive Power, Flexibility, Runners

INTRODUCTION

Flexibility is a critical component of running biomechanics, influencing stride length, joint range of motion, and overall athletic performance (Worrell et al., 1994). Greater flexibility has been associated with reduced injury risk and improved running economy. While static stretching is commonly used to improve flexibility, emerging evidence suggests that ballistic stretching, a vigorous form of dynamic stretching with rapid, bouncing movements, may be more effective in improving dynamic flexibility, neuromuscular coordination, and muscle activation when considered together (Matsuo et al., 2025; Sekir et al., 2010; Opplert & Babault, 2018).

Ballistic stretching has gained attention in athletic performance for its potential effects on flexibility and power. Recent meta-analyses have confirmed that dynamic and ballistic stretching induce modest but significant acute gains in range of motion across populations (Matsuo et al., 2025). Notably, ballistic stretching does not appear to impair—and may better preserve—vertical jump performance, unlike static stretching, which frequently reduces power outputs (Jaggers et al., 2008; Gessel et al., 2022). These effects are likely mediated by mechanisms such as neural facilitation, muscle spindle adaptation, and modulation of the stretch reflex, all integral to flexibility and explosive force production (Behm et al., 2016; Opplert & Babault, 2018).

Ballistic stretching has also been linked to improvements in explosive power, particularly in activities requiring sprinting, jumping, and rapid force production. In contrast to static stretching, which can decrease muscle-tendon unit stiffness and acute force production, ballistic stretching has been shown to avoid these negative effects (Gessel et al., 2022). Though some studies report improvements in motor unit pre-activation and jump performance following ballistic stretching (Woolstenhulme et al., 2004; Fletcher & Jones, 2004), overall findings remain somewhat inconsistent, and there are valid concerns regarding technique and safety.

Given the importance of flexibility in running mechanics and the role of explosive power in sprinting and acceleration, further investigation into long-term ballistic stretching protocols, especially in runners, is warranted. However, existing data are limited, with mixed findings and few longitudinal studies (Worrell et al., 1994; Koch et al., 2003). Therefore, the present study aims to evaluate the effectiveness of a six-week ballistic stretching intervention on flexibility and explosive power among young adult runners in Penang. It is hypothesised that the intervention will result in significant improvements in both flexibility and explosive power post-intervention.

MATERIALS AND METHOD

Participants

Twelve male young adult runners, aged 18-25, were recruited from a running club in Penang using convenience sampling. Eligible participants were those who ran at least 2–3 times per week and engaged in regular resistance training. Individuals with neurological disorders or those taking medications affecting muscle function were excluded. The sample size was calculated using PS: Power and Sample Size Program software with parameters set at 80% power and a 5% significance level to detect effects at an 80% difference. Considering a 20% dropout rate, 14 samples were calculated; however, only 12 participants completed the study. The study protocol was approved by the Branch Ethical Research Committee of Universiti Teknologi MARA Cawangan Perlis (Reference number: REC-ERC 265/2024).

Research Design

This study employed a quasi-experimental pre-test–post-test design to evaluate the effects of a six-week ballistic stretching intervention on flexibility and explosive power in young adult runners. This within-subject design was selected to minimize inter-individual variability and enable direct comparison of outcomes across two time points.

Procedures

Participants' anthropometric data, including height, weight, and body mass index (BMI), were recorded upon arrival to the nearest 0.1 cm and 0.1 kg, respectively. Flexibility was assessed using the V Sit and Reach Test, a modified version of the traditional Sit and Reach Test. Participants sat with legs extended and reached forward along a measuring line; the furthest distance reached was recorded in centimetres (cm). This test has demonstrated high test-retest reliability ($r = 0.85–0.99$) when standardised protocols—such as proper warm-ups and foot alignment—are followed (Ayala et al., 2012). Lower-body explosive power was measured using the Standing Broad Jump Test. Participants performed a maximal horizontal jump from a standing position, with the distance from the take-offline to the nearest heel upon landing recorded (Koch et al., 2003). This test has shown excellent reliability (r = 0.89–0.97) and strong correlations with laboratory-based measures of explosive strength, including vertical jumps and force plate assessments (Peyer et al., 2011). Both tests were performed three times at pre- and post-intervention, with the best trial used for analysis. Standardised instructions and procedures were applied throughout to ensure accuracy and consistency in measurement.

Ballistic stretching intervention

Ballistic stretching was incorporated into the participants' standard pre-running warm-up routine as a six-week intervention. This intervention, involving dynamic, repetitive bouncing movements, was designed to enhance neuromuscular coordination, muscle elasticity, power output, and flexibility. The protocol consisted of 2 minutes x 3 sets of five ballistic exercises—lunges, hamstring stretches, calf raises, leg swings, and side stretches— twice a week.

Statistical Analysis

All data were analysed using IBM SPSS Statistics (Version 29). The Shapiro-Wilk test was employed to assess data normality. Descriptive statistics were reported as mean and standard deviation (mean ± SD) or median (interquartile range) as appropriate. The differences between pre-test and post-test measurements were evaluated using a paired sample t-test. Effect sizes (Cohen's *d*) were calculated to observe the magnitude of the intervention and were classified as small (0.2), medium (0.5), or large (0.8) (Cohen, 1988), offering practical insight beyond statistical significance. This analytic approach ensures rigorous evaluation of the effects of ballistic stretching on flexibility and explosive power while adhering to established statistical standards.

RESULTS

Descriptive Statistic

The demographic characteristics of participants are presented in Table 1. The participants' mean age was 21.8 ± 2.2 years, with a mean BMI of 24.1 ± 3.0 kg/m², suggesting that, on average, participants were within the normal to slightly overweight range.

Table 1: Participants' demographic characteristics

Variable (N = 12)	**Mean ± SD**
Age, years	21.8 ± 2.2
Height, cm	173 ± 5.6
Body Mass, kg	71.9 ± 8.5
Body Mass Index, kg/m²	24.1 ± 3.0

Flexibility And Explosive Power Performance

Following the six-week ballistic stretching intervention, significant improvements were observed in both flexibility and explosive power. Flexibility, assessed using the V Sit and Reach Test, increased from 15.0 ± 4.7 cm at pre-test to 22.3 ± 4.6 cm at post-test (P = 0.001, ES = 1.6). Explosive power, measured by the Standing Broad Jump Test, improved from 200.4 ± 17.5 cm to 231.7 ± 17.2 cm (P = 0.001, ES = 1.8). Both outcomes demonstrated large effect sizes, indicating a substantial impact of the intervention. These findings support the hypothesis that ballistic stretching enhances both performance measures.

Table 2: Flexibility and explosive power at pre- and post-ballistic stretching intervention

	Pre-test (n = 12)	Post-test (n = 12)	*P*-value	Effect size (ES)
Flexibility				
● V Sit and Reach Test, cm	15.0 ± 4.7	22.3 ± 4.6	0.001*	1.6
Explosive power				
● Standing Broad Jump Test, cm	200.4 ± 17.5	231.7 ± 17.2	0.001*	1.8

**** Significant value p < 0.05***

DISCUSSION

This study demonstrates that a six-week ballistic stretching intervention significantly improved flexibility and explosive power in young adult runners. These improvements are likely attributed to the repetitive bouncing movements characteristic of ballistic stretching, which may have increased stretch tolerance over time, leading to greater muscle lengthening and elasticity. These findings align with previous research highlighting the benefits of ballistic stretching in enhancing flexibility (Behm et al., 2016; Matsuo et al., 2019). Improvements in explosive power may be explained by greater activation of fast-twitch muscle fibres and increased efficiency of the stretch-shortening cycle—both essential for forceful, high-velocity movements (Koch et al., 2003). Similar effects have been reported by Woolstenhulme et al. (2004) and Sekir et al. (2010), who noted that ballistic stretching enhances neuromuscular coordination and power output. These results support the inclusion of ballistic stretching in warm-up routines, particularly for athletes engaged in power-based activities.

While the study demonstrated clear benefits, individual responses to ballistic stretching may vary based on factors such as body composition, limb length, and age. Higher body fat can reduce flexibility due to increased soft tissue resistance and joint compression and may impair explosive power by lowering the power-to-weight ratio essential for movements like jumping and sprinting (Chen et al., 2020). Conversely, individuals with lower BMI and greater lean muscle mass often exhibit better neuromuscular coordination and greater responsiveness to stretching interventions (Folland & Williams, 2007). Taller individuals may require modified protocols, as longer limbs alter joint mechanics and leverage during dynamic movements (Manna et al., 2016). Additionally, age-related declines in collagen elasticity and increased muscle stiffness can further limit flexibility (Pavan et al., 2020).

Despite its benefits, ballistic stretching must be executed with proper control, as excessive or improper application may increase the risk of muscle strain (Bradley et al., 2007). Compared to static stretching—which may decrease muscle stiffness and impair power output—ballistic stretching appears to preserve better or enhance neuromuscular activation, making it more suitable for pre-performance routines. In summary, these findings support the inclusion of ballistic stretching in warm-up routines to enhance flexibility and explosive power, particularly in athletes engaged in high-intensity, power-based activities such as running.

CONCLUSION

This study found that a six-week ballistic stretching intervention significantly improved flexibility and explosive power in young adult runners. These results support its inclusion in warm-up routines for sports requiring explosive movements. Proper technique and progression are essential to ensure safety and effectiveness. Future research should examine its long-term effects, application across diverse populations, and potential role in injury prevention and recovery.

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