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Immediate Effects of Short- Versus Long-Duration Dynamic Stretching on Shot Put Performance: A Pilot Experimental Study Among Collegiate Athletes

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Abstract : Dynamic stretching is commonly incorporated into warm-up routines to enhance athletic performance; however, the optimal duration of dynamic stretching for shot put performance remains unclear. This pilot study aimed to compare how short-duration and long-duration dynamic stretching immediately affect shot put performance in collegiate athletes. Ten collegiate shot put athletes aged 18–25 years were allocated into two groups: short-duration dynamic stretching ($n = 5$) and long-duration dynamic stretching ($n = 5$). Shot put performance was measured immediately before and after the stretching intervention. Data were analyzed using descriptive statistics, The Shapiro-Wilk test, independent sample t-tests, paired sample t-tests, and descriptive statistics were used to examine the data. Both groups demonstrated significant improvements in shot put performance. The short-duration group showed a mean improvement of 0.84 m ($p < 0.001$), whereas the long-duration group improved by 0.46 m ($p = 0.006$). The groups showed a significant difference ($p = 0.006$), favouring the short-duration protocol. These findings suggest that dynamic stretching enhances immediate shot put performance, with shorter-duration protocols producing greater improvements than longer-duration protocols. To validate these results, more research with bigger sample numbers is advised.

Keywords: Dynamic stretching, Shot put, Warm-up, Athletic performance, Explosive power.

INTRODUCTION

Shot put is a power-based track and field event that requires rapid force production, explosive strength, and efficient neuromuscular coordination to achieve optimal throwing performance

[1]. Athletes must be able to produce large amounts of force quickly while retaining efficient movement mechanics along the kinetic chain in order to succeed at shot put [2].

Warm-up strategies are routinely performed before training and competition to improve physiological readiness and athletic performance. An effective warm-up increases muscle temperature, enhances nerve conduction velocity, improves metabolic activity, and prepares the neuromuscular system for high-intensity exercise [3]. Dynamic stretching has become an important component of modern warm-up routines because it combines active movement with flexibility enhancement while maintaining muscular activation [4].

Dynamic stretching can enhance muscle power, sprint performance, agility, and movement efficiency, according to earlier research [5]. Increased neuromuscular activation, improved stretch-shortening cycle efficiency, elevated muscle temperature, and improved motor unit recruitment are all responsible for these performance gains [6]. Consequently, dynamic stretching is widely recommended before activities requiring explosive movements.

The duration of dynamic stretching may influence subsequent athletic performance. Research suggests that different stretching durations produce varying effects on flexibility, neuromuscular readiness, and force production [7]. Short-duration dynamic stretching may provide adequate physiological activation without inducing fatigue, whereas prolonged stretching may alter musculotendinous stiffness and reduce the magnitude of performance enhancement [8].

Although dynamic stretching has been extensively investigated in sprinting, jumping, and agility performance, limited evidence exists regarding its influence on throwing events such as shot put. Furthermore, recent studies continue to explore the relationship between stretching duration and athletic performance [9,10]. Thus, the purpose of this pilot study was to assess how collegiate athletes' shot put performance was affected immediately by short-duration and long-duration dynamic stretching.

RESEARCH METHODOLOGY

The immediate effects of short-duration and long-duration dynamic stretching on collegiate athletes' shot put performance were compared in a pilot experimental study using a pre-test and post-test approach. After receiving ethical approval from the Institutional Ethics Committee of the A. J. Institute of Medical Sciences & Research Center (Reference No.

AJEC/REV/209/2025), the study was carried out among athletes recruited from several colleges and sports training facilities in Mangaluru, Karnataka, India.

Convenience sampling was used to choose ten collegiate shot put athletes who met the inclusion and exclusion criteria and were between the ages of 18 and 25. Before enrollment, written informed consent was obtained from each participant. Baseline demographic characteristics, including age, height, weight, training experience, and dominant hand, were recorded.

A standardized warm-up of five to ten minutes of light aerobic exercise, such as jogging or brisk walking, was completed by each participant. The best distance from three legitimate throwing attempts was then recorded in order to evaluate baseline shot put performance.

Participants were divided into two groups at random. Group A engaged in a brief dynamic stretching regimen consisting of less than 90 seconds of stretching per muscle group, with a total intervention duration of approximately 6–8 minutes. The protocol included anterior-posterior and medial-lateral leg swings, walking lunges with trunk rotation, arm circles, torso rotations, high knees, butt kicks, and dynamic overhead reaching exercises.

Group B performed a long-duration dynamic stretching protocol consisting of more than 90 seconds but less than 300 seconds of stretching per muscle group, with a total intervention duration of approximately 10–15 minutes. The same dynamic stretching exercises were performed with additional repetitions, sets, and shot put-specific dynamic drills to achieve the prescribed duration.

Within five minutes of completing the assigned stretching protocol, participants performed three additional valid shot put throws, and the longest throwing distance was recorded as the post-intervention score. Shot put performance was measured in metres from the inside edge of the toe board to the first point of ground contact of the shot, in accordance with World Athletics competition rules, using a standardized measuring tape. The best distance achieved from three attempts during both the pre-intervention and post-intervention assessments was considered for statistical analysis.

Calculations were made for descriptive statistics, such as mean, standard deviation, median, minimum, maximum, skewness, and kurtosis. The Shapiro-Wilk test was used to evaluate the data's normality. Pre-intervention and post-intervention scores within each group were compared using paired sample t-tests, while improvement scores between the two groups were compared using independent sample t-tests. Levene's test was used to assess the homogeneity of variance. All statistical analyses were carried out using Jamovi software (Version 2.4), and the threshold for statistical significance was set at $p < 0.05$.

RESULTS AND DISCUSSION

Descriptive Statistics

Table 1: Descriptive Statistics of Pre-Test and Post-Test Shot Put Performance Following Short- and Long-Duration Dynamic Stretching

Test	Group	Mean	Median	SD	Min	Max	Skewness	Kurtosis
Pre-Test	Long-Duration Dynamic Stretching	8.44	8.5	0.422	7.8	8.9	-0.831	0.581
Pre-Test	Short-Duration Dynamic Stretching	8.8	9.0	0.339	8.3	9.1	-0.962	-0.873
Post-Test	Long-Duration Dynamic Stretching	8.9	8.9	0.453	8.4	9.4	0.000	-2.759
Post-Test	Short-Duration Dynamic Stretching	9.64	9.8	0.329	9.2	10	-0.518	-1.687

The descriptive statistics indicated improvements in shot put performance following both stretching interventions. The short-duration dynamic stretching group demonstrated greater improvement in post-test performance compared to the long-duration group. The standard deviation values indicated relatively consistent performance among participants.

Normality Test

Table 2: Test of Normality Using Shapiro–Wilk Test

Test	Group	W	p
Pre-test	Long-Duration Dynamic Stretching	0.962	0.822
Pre-test	Short-Duration Dynamic Stretching	0.858	0.221

Post-test	Long-Duration Dynamic Stretching	0.897	0.395
Pre-test	Short-Duration Dynamic Stretching	0.914	0.490

The distribution of the collected data was examined using the Shapiro–Wilk test. Since all variables demonstrated p-values greater than 0.05, the assumption of normality was satisfied, indicating that parametric statistical methods were appropriate for subsequent analyses.

Paired Sample t-Test – Short Duration Group

Table 3: Paired sample *t*-test for the short-duration dynamic stretching group.

Variables	T	df	p-value	Mean Difference	95% CI Lower	95% CI Upper	Effect Size (Cohen's d)
Pre-Test vs Post-Test	-16.5	4	< 0.001	-0.84	-0.982	-0.698	7.37

The paired sample t-test revealed a statistically significant improvement in shot put performance following short-duration dynamic stretching, $t(4) = -16.5$, $p < 0.001$. The findings demonstrated a substantial practical effect with a very large effect size.

Paired Sample t-Test – Long Duration Group

Table 4: Paired Sample t-Test for Long-Duration Dynamic Stretching

Variables	T	Df	p-value	Mean Difference	95% CI Lower	95% CI Upper	Effect Size (Cohen's d)
Pre-Test vs Post-Test	-5.28	4	0.006	-0.46	-0.702	-0.218	2.36

The paired sample t-test demonstrated a statistically significant improvement in shot put performance following long-duration dynamic stretching, $t(4) = -5.28$, $p = 0.006$. Although performance improved significantly, the magnitude of improvement was lower than that observed in the short-duration group.

Independent Sample t-Test

Table 5: Homogeneity of Variance Test

Variable	F	df1	df2	p-value
Improvement Score	1.65	1	8	0.235

Levene's test confirmed that the assumption of homogeneity of variance was satisfied.

Table 6: Independent Sample t-Test Comparing Improvement Scores

Variable	T	df	p-value	Mean Difference	SE Difference	Effect Size (Cohen's d)
Improvement Score	-3.76	8	0.006	-0.38	0.101	2.38

Table 7: Group Descriptive Statistics

Group	N	Mean	Median	SD	SE
Long-Duration Dynamic Stretching	5	0.46	0.40	0.195	0.0872
Short-Duration Dynamic Stretching	5	0.84	0.80	0.114	0.051

The independent sample t-test demonstrated a statistically significant difference between the two groups, indicating that short-duration dynamic stretching resulted in greater improvement in shot put performance compared to long-duration dynamic stretching.

DISCUSSION

The current pilot study examined how collegiate athletes' shot-put performance was affected immediately by short-duration and long-duration dynamic stretching. The findings demonstrated that both stretching protocols significantly improved throwing performance. However, athletes who performed short-duration dynamic stretching showed significantly greater improvement than those who completed the long-duration protocol.

The observed improvements following dynamic stretching are consistent with previous investigations reporting enhanced explosive performance after dynamic warm-up activities. Yamaguchi and Ishii [5] demonstrated that dynamic stretching improves muscular power and force production compared with static-stretching. Similarly, McMillian et al. [6] reported improvements in power output and agility following dynamic stretching, supporting its effectiveness as a pre-performance warm-up strategy. These findings are consistent with the present study, where both intervention groups demonstrated significant improvements in shot put performance.

The superior performance observed in the short-duration dynamic stretching group may be explained by several physiological mechanisms. Dynamic stretching increases muscle temperature, enhances nerve conduction velocity, improves motor unit recruitment, and facilitates neuromuscular activation, thereby preparing the muscles for explosive movements [3,9]. Short-duration stretching may provide sufficient physiological stimulation while preserving musculotendinous stiffness required for maximal force production during the throwing action.

In contrast, prolonged dynamic stretching may increase metabolic demand and reduce musculotendinous stiffness, potentially decreasing the efficiency of force transmission during explosive movements. Although long-duration stretching significantly improved performance, the magnitude of improvement was lower than that observed following short-duration stretching. These findings suggest that extending the duration of dynamic stretching does not necessarily produce additional performance benefits in explosive athletic activities.

The significance of stretching length in maximizing athletic performance is also supported by recent research. Matsuo et al. [10] and Tanaka et al. [11] reported that stretching volume influences flexibility, muscle function, and subsequent athletic performance. The findings of the present pilot study further support these observations by demonstrating that shorter-duration dynamic stretching may be more effective for enhancing immediate shot put performance.

From a clinical and practical perspective, the findings of this study are relevant for sports physiotherapists, strength and conditioning coaches, and athletics coaches. Pre-competition warm-up exercises that include short-duration dynamic stretching may enhance explosive throwing performance while reducing tiredness. Such evidence-based warm-up strategies may contribute to enhanced athletic performance during both training and competition.

The present study has significant limitations. Because this was intended to be a pilot study, the sample size was rather limited, which could limit how far the results can be applied. Furthermore, only the immediate effects of dynamic stretching were investigated, and physiological variables such as muscle activation, muscle temperature, or biomechanical parameters were not measured. It is suggested that future research should involve bigger groups, various types of athletes, and biomechanical studies to verify these results and better explain the reasons behind the noted enhancements in performance.

CONCLUSION

This pilot study compared the immediate effects of short-duration and long-duration dynamic stretching on shot put performance among collegiate athletes. Both stretching protocols significantly improved shot put performance, indicating that dynamic stretching is an effective warm-up strategy for explosive throwing events. However, the short-duration dynamic stretching protocol resulted in significantly greater improvement than the long-duration protocol, suggesting that shorter durations may be more effective in enhancing immediate athletic performance.

The greater improvement observed following short-duration dynamic stretching may be attributed to enhanced neuromuscular activation, increased muscle temperature, and improved movement readiness without inducing excessive fatigue. In contrast, although long-duration dynamic stretching also improved performance, the magnitude of improvement was comparatively lower. These findings indicate that stretching duration is an important factor when designing warm-up programmes for athletes participating in explosive power events such as shot put.

From a practical perspective, coaches, sports physiotherapists, and strength and conditioning professionals may consider incorporating short-duration dynamic stretching into pre-training and pre-competition warm-up routines to optimise throwing performance. As this was a pilot study involving a small sample, further research with larger participant groups and different athletic populations is recommended to confirm these findings and establish evidence-based recommendations regarding the optimal duration of dynamic stretching.

DECLARATIONS

Study Limitations

The current research included a small group of participants, which might limit how broadly the results can be applied. Only the immediate effects of the interventions were examined, and the lasting impact of dynamic stretching on athletic performance was not analyzed. Furthermore, factors like biomechanical variables, electromyographic activity, muscle temperature, and force development rate were not measured. Future research should consider these aspects and involve more participants to enhance the support for the findings.

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Competing Interests

The researchers state that there are no conflicts of interest associated with this research.

Ethical Approval

Ethical approval was obtained from the Institutional Ethics Committee, A. J. Institute of Medical Sciences & Research Centre, Mangaluru, Karnataka, India, under Reference Number AJEC/REV/209/2025, dated 27 June 2025. The research was carried out in accordance with the ethical principles outlined in the Declaration of Helsinki.

Informed Consent

Informed consent in writing was secured from every participant before they joined the study. Participants were made aware of the study's goals and the evaluation process.

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