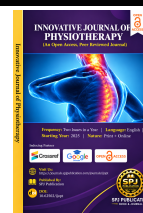




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Original Research

Effectiveness of Plyometric Training Versus Pilates Training on Explosive Muscle Strength and Running Performance in Recreational Marathon Runners

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ABSTRACT

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Background: Supplementary training may improve neuromuscular performance and running capacity in recreational marathon runners. Plyometric training emphasizes explosive force production, whereas Pilates focuses on core stability, postural control, and movement efficiency.

Objective: To compare the effectiveness of plyometric and Pilates training on explosive muscle strength and running performance in recreational marathon runners.

Methods: A comparative pre-test–post-test experimental study was conducted among 70 recreational marathon runners aged 18–45 years at the Department of Physiotherapy, Malla Reddy University, Hyderabad. Participants were allocated into two groups of 35 each. Group A underwent supervised plyometric training, while Group B received Pilates-based training for six weeks, in addition to their routine endurance training. Pre- and post-intervention performance was assessed using the 20-meter sprint test and 5-kilometer run test.

Results: Both groups demonstrated improvements in performance following the six-week intervention. In the plyometric group, 20-meter sprint time improved from 3.36 ± 0.12 to 3.07 ± 0.12 seconds, while 5-km run time improved from 24.98 ± 1.65 to 22.31 ± 1.28 minutes. In the Pilates group, sprint time improved from 3.35 ± 0.13 to 3.12 ± 0.13 seconds, and 5-km run time improved from 25.57 ± 0.70 to 23.49 ± 0.75 minutes. The plyometric group demonstrated greater numerical improvements in both outcomes.

Conclusion: Both plyometric and Pilates training may improve running performance in recreational marathon runners. However, plyometric training demonstrated comparatively greater improvements in sprint and 5-km running performance.

Keywords: Plyometric Training, Pilates, Marathon Runners, Explosive Muscle Strength, Running Performance, Sprint Performance

INTRODUCTION

Marathon running is a demanding endurance activity that requires sustained cardiovascular capacity, muscular endurance, neuromuscular coordination, biomechanical efficiency, and the ability to maintain an economical running pattern over prolonged periods. Although aerobic endurance is traditionally considered the primary determinant of marathon performance, supplementary strength and conditioning programs have increasingly been incorporated into endurance training to improve neuromuscular function, running economy, and performance while potentially reducing the risk of musculoskeletal injury. ^[1] In recreational marathon runners, who may have variable training backgrounds and limited access to structured strength programs, appropriate complementary training strategies may be particularly valuable. Plyometric training is a form of explosive exercise characterized by rapid eccentric loading followed immediately by concentric muscle action through the stretch-shortening cycle. This training method can enhance neuromuscular recruitment, rate of force development, lower-limb power, and reactive strength. ^[2] Improvements in these characteristics may positively influence running mechanics by increasing the ability of the lower extremities to generate and efficiently

transmit force during the stance and propulsion phases of running.^[3] Previous research has suggested that plyometric training can improve running economy and endurance performance, indicating that explosive-strength development may contribute to improved performance even in predominantly aerobic athletes.^[4] Pilates is a controlled exercise system emphasizing core stability, postural alignment, flexibility, breathing, body awareness, and coordinated activation of the deep trunk and pelvic musculature. Regular Pilates training may improve trunk control, muscular balance, flexibility, and neuromuscular coordination.^[5] Enhanced core stability can facilitate efficient force transfer between the lower and upper extremities and may help maintain appropriate running posture during prolonged exercise. These adaptations could be particularly relevant for marathon runners, as postural and biomechanical alterations associated with fatigue may negatively affect running efficiency and performance.^[6]

While both plyometric and Pilates training may provide beneficial physiological and neuromuscular adaptations, they target different components of physical performance. Plyometric training primarily emphasizes explosive force production and reactive neuromuscular function, whereas Pilates focuses more strongly on core stability, postural control, flexibility, and movement quality. Despite increasing use of both approaches among recreational runners, limited evidence directly compares their effects on explosive muscle strength and running performance in recreational marathon runners.^[7-9] Therefore, a comparative investigation of these two training strategies may help determine which approach provides greater benefits for recreational marathon runners. The present study was designed to compare the effectiveness of plyometric training and Pilates training on explosive muscle strength and running performance in recreational marathon runners.^[10-15]

Aim: To compare the effectiveness of plyometric training and Pilates training on explosive muscle strength and running performance in recreational marathon runners.

MATERIALS AND METHODS

Study Design and Setting: A comparative pre-test–post-test experimental study was conducted in the Department of Physiotherapy, Malla Reddy University, Hyderabad. The study evaluated and compared the effects of a six-week plyometric training program and a Pilates-based training program on

explosive muscle strength and running performance among recreational marathon runners.

Participants and Sample Size: A total of 70 recreational marathon runners were recruited for the study. Participants were selected based on predefined eligibility criteria and were subsequently allocated into two intervention groups, with 35 participants in each group. All participants were engaged in regular endurance training and had previous experience in marathon running.

Eligibility Criteria: Inclusion criteria:

1. Participants aged 18–45 years.
2. Recreational marathon runners who regularly participated in endurance training.
3. Participants who had completed at least one marathon within the preceding 12 months.
4. Participants willing to participate in the six-week intervention program.

Exclusion criteria:

1. Participants with current musculoskeletal or neurological conditions that could affect running performance or exercise participation.
2. Participants currently involved in a structured strength or resistance-training program.
3. Participants unable to complete the prescribed training sessions or outcome assessments.
4. Participants demonstrating inadequate compliance with the intervention protocol.

Intervention Procedure: Following baseline assessment, participants were divided into two groups. Group A (Plyometric Training Group) received a supervised plyometric training program designed to improve lower-limb explosive strength, reactive ability, and neuromuscular performance. Group B (Pilates Training Group) participated in a supervised Pilates-based exercise program emphasizing core stability, postural control, flexibility, muscular control, and coordinated movement. Both intervention programs were conducted over a period of six weeks in addition to the participants' routine endurance-training activities. Training sessions were performed under supervision to ensure appropriate exercise technique and adherence to the prescribed protocols. Participants were instructed to maintain their usual endurance-training routine throughout the intervention and to avoid initiating any additional structured strength-training program.

Outcome Measures: The primary outcomes were assessed before and after the six-week intervention using standardized testing procedures:

- **20-Meter Sprint Test:** Used to assess short-distance running speed and explosive lower-limb performance. The fastest recorded time was used for analysis.

- 5-Kilometer Run Test: Used to assess running performance and endurance capacity. Participants completed a 5-km run under standardized conditions, and completion time was recorded.

Assessment Procedure: Baseline (pre-test) measurements were obtained before commencement of the intervention. Following completion of the six-week training program, the same outcome measures were reassessed (post-test) using identical testing procedures and conditions wherever feasible. The pre- and post-intervention values were subsequently compared within and between the two groups to determine the relative effectiveness of plyometric and Pilates training on explosive muscle strength and running performance.

RESULT

A total of 70 recreational marathon runners were included in the analysis, with 35 participants allocated to the plyometric training group and 35 to the Pilates training group. Following the six-week intervention, both groups demonstrated improvement in sprint performance and 5-km running performance compared with baseline values. However, the magnitude of improvement was greater in the plyometric training group.

In the plyometric training group, the mean 20-meter sprint time decreased from 3.36 ± 0.12 seconds at baseline to 3.07 ± 0.12 seconds following the intervention, indicating improved sprint performance. Similarly, the mean 5-km run time decreased from 24.98 ± 1.65 minutes to 22.31 ± 1.28 minutes, demonstrating an improvement in running performance.

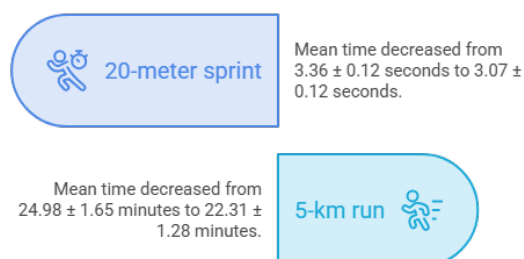


Figure 1. Plyometric training performance metrics

In the Pilates training group, the mean 20-meter sprint time decreased from 3.35 ± 0.13 seconds at baseline to 3.12 ± 0.13 seconds after six weeks. The mean 5-km run time also decreased from 25.57 ± 0.70 minutes to 23.49 ± 0.75 minutes following the intervention. Overall, both training interventions were associated with improved performance from pre-test to post-test.



Figure 2. Pilates Training Improvements

The plyometric training group demonstrated a greater numerical reduction in both 20-meter sprint time and 5-km run time compared with the Pilates training group, suggesting a comparatively greater effect of plyometric training on explosive running performance and endurance-related running outcomes.

Limitation: The study was limited by its short six-week intervention, single-center design, and relatively small sample size. Larger multicenter studies with longer follow-up are recommended to confirm these findings.

CONCLUSION

Both plyometric and Pilates training demonstrated beneficial effects on explosive muscle strength and running performance among recreational marathon runners following the six-week intervention. However, plyometric training produced comparatively greater improvements in 20-meter sprint performance and 5-km running performance, suggesting a potentially greater effect on explosive neuromuscular performance and running efficiency. Pilates training also contributed positively to overall physical performance, particularly through improvements in core stability, postural control, and movement coordination. Incorporating structured supplementary training alongside routine endurance training may therefore be beneficial for recreational marathon runners seeking to optimize running performance.

DECLARATIONS

Ethical Approval: The study was reviewed and approved by the Institutional Ethics Committee prior to commencement.

Source of Funding: No external funding was received for this study.

Conflict of Interest: The authors declare that there is no conflict of interest.

Author Contribution: All authors contributed to the

conceptualization, methodology, investigation, data curation, formal analysis, and interpretation of the study.

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