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The Impact of Treadmill Retro Walking on Hamstring Flexibility and Speed in Distance Runners

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Abstract

Background: Distance runners frequently encounter constraints in terms of hamstring flexibility and running speed improvement. It is possible that existing training approaches may not sufficiently address these concerns. Analyzing the effect of retro-walking on a treadmill may provide valuable insights into an innovative strategy for enhancing hamstring flexibility and speed in distance runners. **Objective:** The study aims to investigate the effect of retro-walking on a treadmill on hamstring flexibility and speed in distance runners. **Methodology:** A total of 30 male distance runners were chosen for this quasi-experimental study. The hamstring flexibility and speed were evaluated by conducting a sit-and-reach test and a 35-meter sprint test before and after the intervention. The research intervention was administered 3 days a week over a duration of 12 weeks. The pre- and post-mean difference within the group was analyzed using a paired t-test. **Result:** The result showed that there was a significant improvement (mean±SD, $p<0.05$) in hamstring flexibility and speed within the group. **Conclusion:** In conclusion, incorporating retro walk into the training protocol may improve the hamstring flexibility and speed in distance runners.

Keywords

Distance runners, Hamstring flexibility, Retro walking.

Introduction

Endurance running describes the act of running continuously for a minimum distance of 1.9 miles. Physiologically, it is primarily aerobic and requires both mental and physical endurance. Endurance running is widely considered as one of the most popular sports globally, with individuals participating in it for recreational purposes physical well-being, and competitive purposes (Barros et al., 2017).

Over 68% of adults between the ages of 18 and 25 experience severe hamstring tightness, making it a common condition among college-bound adolescents. The desire for hamstring

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flexibility in running sports is primarily aimed at reducing muscle tears or strains and improving running efficiency, agility and speed. Hamstring flexibility is one of the primary judging criteria in speed and agility so success in these disciplines is very much dependant on knowing how to restore flexibility even following excessive muscle loading leading to tightness.

The hamstrings may be loaded under eccentric stretch where there is an increase in the concentric activity in the rectus femoris, which may be justified for the hamstrings' increased length (Lodge & Borkar, 2018). Hamstring activation during the sprints would be the highest since it involves rapid hip and knee joint movements that utilizes the hamstring to a large degree (van den Tillaar et al., 2017).

The benefits of backwards running include strengthening the quadriceps, calf, buttocks, and spine muscles. Walking backwards facilitates the use of the right brain hemisphere, the one responsible for intuition and musicality. Furthermore, running and backward motion enhance neural connections. Additionally, desired outcomes—weakness and firmer muscles—occur more quickly.

According to a study by the University of Oregon, individuals who engage in retro running are required to run at 80% of the speed in a forward run and it consists of one-tenth of the number of steps to get the same physiological impact.

Retro-running has been proven to strengthen overall performance, improve the proprioceptive function, balance, and the agonist/antagonist muscle ratio (Gurudut et al., 2019). While the quadriceps femoris muscle primarily contracts eccentrically when walking forward, it also contracts isometrically and concentrically when walking backward (Nardo et al., 2018). However, the use of both backward walking and backward running in the training of long-distance runners is encouraged to increase the activity of the knee extensors in these sports. Study shows that backward walking and/or backward running has the potential to improve the muscle imbalance between the knee flexors and extensors (Ansari et al., 2020). The main factors that determine the performance of middle and long-distance running are the level of speed-strength, speed, and speed endurance. Speed endurance is the foundation, speed is the core, and speed strength and strength endurance are guaranteed (Teng et al., 2023). However, no studies have been conducted to determine the effect of retro-walking on a treadmill for enhancing hamstring flexibility and speed among distance runners.

Methodology

Study Design and Participants:

This study is quasi-experimental; all participants were selected by purposive sampling. 30 collegiate level male distance runners between the ages of 18-21 years old, with positive sit and reach test scores (YMCA-below average level) were recruited in the study. Participants who had lower limb injury or surgery in the past 6 months, or any neurological and cardiopulmonary disorders which might affect the training were excluded from the study. The Institutional ethical committee approved the study before the commencement of the study. All the participants were explained the objective and risk involved in the study. After that the informed concerned was obtained. All the research information in this study will be kept confidential. The baseline data of Hamstring flexibility and Endurance of the athletes was collected in the 1st week and the end of the 12th week.

Outcome measurement:

Sit and Reach test (SRT)

SRT assessment is used to measure the flexibility of the hamstrings and lower back. SRT has a moderate mean criterion-related validity for estimating hamstring extensibility. A yardstick is set on the ground, and the 15-inch mark is marked with tape laid across it at a right angle. The participants sit with their legs stretched at a right angle to the floor's taped line, holding the yardstick between them. The feet's heels should be spaced about 10 to 12 inches apart and should meet the taped line. With their arms extended, the participants should carefully reach forward and place one hand on top of the other, palm down. The patient should slowly reach forward with extended arms, placing one hand on top of the other facing palms down, as far as possible, holding this position for approximately 2 seconds. The score taken will be the most distant point (cm or in) reached with the fingertips. SRT has a moderate interclass correlation coefficient (r) of 0.57 and 0.74 among middle-aged older men and women, respectively. The best of three trials should be recorded (Lemmink et al., 2003).

35-meter sprints

Participants engage in a 10-minute warm-up session. The assistant marks a 35-meter linear segment using cones. The participant assumes a sprint-start position. The assistant issues the command "On Your Marks, Set, Go" and initiates the stopwatch. Next, the participants rapidly ran the distance of 35 meters. Upon the athlete's torso crossing the finishing line, the assistant promptly ends the stopwatch and documents the elapsed time. The test consists of three consecutive 35-meter sprints, with a 5-minute rest period between each sprint. The rating scale for 35m sprint test was <4.80- excellent, 4.80-5.09 - Good, 5.10-5.29 - Average, 5.30-5.60 - Fair, > 5.60 – Poor (Johnson, 2010).

Intervention Procedure

The intervention begins with 5-10 minutes cycling as a warm-up. After warm-up the participants stood on the treadmill facing away from the display panel, with the feet hip-width apart. Keep the posture upright, shoulders relaxed, and look straight ahead. Backward walking on treadmill with 5% inclination for initial 3 min. Increase the speed to accepted level and continue with the same speed at 5% inclination for 5 min. For the next 5 min, continue walking at the same speed, but add 10% inclination. For the last 2 min, decrease the inclination to 0% while gradually decreasing the speed till the treadmill stops. Overall sessions last for 25mins/day; 3days /week for 12 weeks.

Statistical Analysis

The statistical analysis of the data in this study was conducted using SPSS 26.0 software (IBM®, Armonk, NY, USA). Paired t-test was used to analyze the pre and post mean difference within the group.

Results

The participants (n=30) in the study were collegiate athletes (age 18.70±3.66, height, weight 55.67±11.70, BMI 22.93±4.57) with athletic experience of 2.58±1.38. The participants have an average of 2.67±0.90 training hours per week. The data is represented in Table 1.

Table 1. Demographic data of participants

Variables (n=30)	**Mean±SD**
Age	18.70±3.66
Height	150.80±29.15
Weight	55.67±11.70
BMI	22.93±4.57
Athlete Experience (years)	2.58±1.38
Frequency of Training(hours/week)	2.67±0.90

SD- Standard Deviation, BMI- Body Mass Index

Confidence interval was set at 95% and p value < 0.05 was considered significant. The results show that there is a statistically significant improvement in hamstring flexibility and sprint by retro walking in treadmill. After 12 weeks of treatment there was an improvement in the sit-and reach test the pretest mean ± SD is 8.1 ± 4.9 and the posttest mean ± SD is 11.57 ± 6.03. Meanwhile, for the 35m sprint test the pretest mean ± SD is 7.2 ± 4.2 and the posttest mean ± SD is 4.1 ± 2.96. There was a significant difference in the sit-and reach test and 35m sprint test after the intervention.

Table 2. Pre and post mean difference in Hamstring flexibility within the group after 12 weeks

TEST	MEAN	STANDARD DEVIATION	PAIRED "T" VALUE	P VALUE
Pre-test	8.1	4.9	9.04	P<0.05
Post-test	11.57	6.03	10.49	P<0.05

Significant at *P <0.05

Table 2 shows the pretest mean ± SD is 8.1 ± 4.9 and the posttest Mean ± SD is 11.57 ± 6.03 for hamstring flexibility. The calculated T value is 10.49 at <0.05 level of significance. The result indicates that there is a significant difference in hamstring flexibility followed by retro walking in treadmill.

Table 3. Pre and post mean difference in speed within the group after 12 weeks

TEST	MEAN	STANDARD DEVIATION	PAIRED "T" VALUE	P VALUE
Pre-test	7.2	4.2	9.37	P<0.05
Post-test	4.1	2.96	7.57	P<0.05

Significant at *P <0.05

Table 3 shows the pretest Mean ± SD is 7.2 ± 4.2 and the posttest Mean ± SD is 4.1 ± 2.96 for speed. This indicates that there is a significant difference in hamstring flexibility followed by retro walking in treadmill.

Discussion

This quasi-experimental study aims to investigate the effect of retro walking on a treadmill in improving the speed and hamstring flexibility of distance runners. The outcome tool was a sit-and-reach test and 35-meter sprint test to measure hamstring tightness and speed. The total treatment duration is 12 weeks. After the end of 12 weeks, post-test values are measured using a sit-and-reach test and 35-meter sprint test. The result of the present study for retro walking is supported by research conducted by (Lodge & Borkar, 2018), which observed the effect of retro walking on hamstring flexibility in normal healthy individuals. The study indicates that retro walking in young adults with below-average hamstring tightness who underwent backwards walking training protocol, showed significant improvement in hamstring flexibility. Another study reported that retro-walking and suboccipital muscle inhibition techniques in hamstring muscle flexibility in collegiate students. The study showed that both techniques improved hamstring muscle flexibility, however, suboccipital muscle inhibition technique is more effective compared to the retro walking technique (Desai et al., 2019).

Furthermore, the mechanism of the muscle control for backward and forward walking is different. Forward walking, in contrast to backward walking, starts with the heel hitting the ground and ends with the toe leaving the ground. This is different from backward walking, where the heel is lifted off the ground early on and supported by the simultaneous contraction of various muscles in the limbs, such as the flexors and extensors in the hip, knee, and ankle joints. During forward walking, the knee extensors and ankle plantar flexors are both active (Zych et al., 2021).

During backward walking, the rectus femoris will be replaced by the propulsive concentric contraction instead of eccentric contractions, as it starts with toes on the ground and heel raise during the stance phase. The action started at 0 degrees of inclination, and the knee was flexed by about 31 degrees during initial contact. By mid-stance, the knee joint will be in extended position of approximately 14 degrees of knee flexion. Concurrently, the rectus femoris contracts, most likely concentrically to stabilize in knee extension during backward walking, at the ankle, backward walking will increase the range of motion of dorsiflexion range (ElGendy et al., 2022).

According to the study by Hao & Chen (2017), they stated that the rectus femoris muscle would be more active during backward walking, as a concentric contraction took the place of the muscle's typical eccentric contraction. The increase of concentric activity in the rectus femoris will increase the eccentric stretch of the hamstrings which may lead to an increase in the hamstring length. In terms of research purposes, the treadmill is a common device to conduct an experiment because treadmill can be placed in a fixed place, provides a standardized and reliable performance task, and most importantly, is for data collection where the researcher doesn't require to follow the participants to run while recording the movement (Driller et al., 2017).

Earlier literature (Girard et al., 2011) stated that the physically driven speed and agility in both physical and perceptual-cognitive aspects of speed are the main examples of sprinting in a straight line and direction changes. A previous study (Rumpf et al., 2016), reported that the speed tests fall into several categories, including linear sprinting, change-of-direction sprinting, repeated sprinting, agility, and combinations of all types of sprinting. In this study, linear sprinting relates to straight-line sprinting over various distances, including acceleration and maximum speed. In the analysis and interpretation of the sit-and-reach test for hamstring flexibility in distance runners: There was a significant improvement showing the pretest mean ± SD is 6.5 ± 20.55 and the posttest mean ± SD is 8.1 ± 25.61 of hamstring flexibility. In the analysis and interpretation of the 35-meter sprint test for speed in distance runners**:** There was a significant improvement showing the pre-test mean ± SD is 24.5 ± 77.15 and the post-test mean ± SD is 20.5 ± 64.82 in speed. Based on the findings as stated above, there is significant improvement in hamstring flexibility and speed using retro walking on a treadmill as an intervention. Future research should compare the effects of treadmill retro walking with other training modalities, such as dynamic stretching or plyometric exercises, to determine the most effective approach for enhancing hamstring flexibility and speed.

Conclusion

To summarize, retro walking on a treadmill shows potential as an effective technique for improving hamstring flexibility and speed in long-distance runners. This exercise specifically focuses on the muscles in the posterior chain, which helps to achieve balanced muscle development and decreases the likelihood of being injured. Our research indicates that using retro walking in regular training routines can result in substantial enhancements in hamstring flexibility. Future investigations should examine the enduring consequences and the most effective training procedures to optimize the advantages for athletes at different proficiency levels.

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