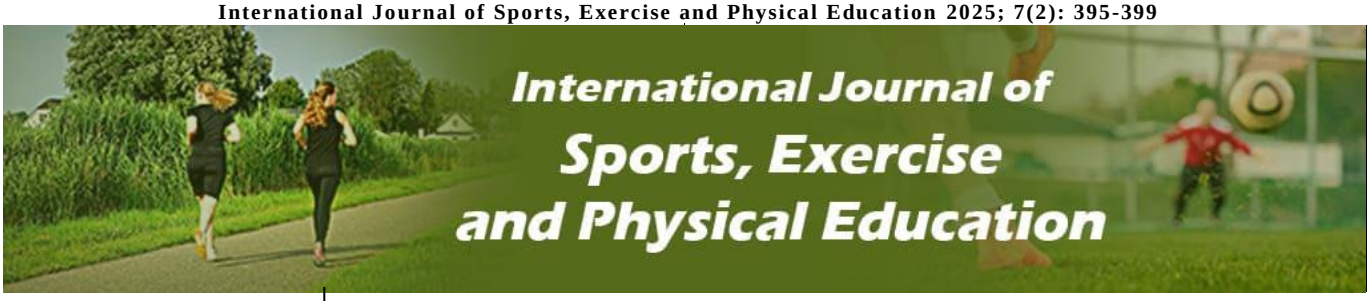

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Effectiveness of combined ATM Tabata interval training and line sprint training on speed and power among recreational sprinters - A pre and post experimental study

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Abstract
Objective: To evaluate the effectiveness of combined Aquatic Treadmill (ATM) Tabata Interval Training and Line Sprint Training (LST) on sprint speed and lower limb explosive power among recreational sprinters.
Background: Sprint performance relies heavily on acceleration, maximum velocity, and explosive power. While LST improves neuromuscular adaptations and sprint mechanics, ATM Tabata training offers resistance with reduced joint loading. The combination may enhance performance while reducing risk of overuse injuries.
Methods: Fifteen recreational sprinters (male and female, aged 18-22 years) participated in a 6-week intervention. Each session included LST followed by ATM Tabata Interval Training, three times per week. Outcomes were sprint speed (40 m Sprint Test) and lower limb explosive power (Vertical Jump Test, VJT). Paired t-tests were applied to pre-post differences ($p < 0.05$).
Results: Significant improvements were observed in sprint speed (pre-test mean 6.94 ± 0.37s vs post-test mean 6.19 ± 0.37s; t = 7.94, $p < 0.05$) and vertical jump height (pre-test mean 38.21 ± 2.45 cm vs post-test mean 44.77 ± 2.45 cm; t = 10.35, $p < 0.05$). Effect sizes were large (Cohen's d > 1.5).
Conclusion: Combined ATM Tabata Interval Training with LST significantly improves sprint performance and lower limb power among recreational sprinters. This hybrid approach offers a safe, effective training alternative to traditional land-based sprint conditioning.

Keywords: Recreational sprinters, Aquatic treadmill, Tabata training, Sprint speed, Explosive power

Introduction

Background

Sprint training is a high-intensity exercise that involves running short distances at high speed. It is an anaerobic exercise meaning the body uses glucose in muscles to produce energy instead of oxygen [1]. Sprint training is not just for track and field athletes, even tennis and basketball players still need to cover short distances at a higher speed [2]. Whether an athlete is a good sprinter or not often determines success or failure in their sport (owayo.com).

The term sprinting refers to the quick movement of the legs and arms in rapid succession while maintaining control [3]. Sprinting is a speed-oriented physical fitness event that combines strength and speed, involving four fundamental technical movements elicited at each phase of sprinting. Athletes must enhance the front swing hip amplitude during high-speed running while ensuring stability and coordination in their movements [4]. It stands out as one of the most visually impressive and competitive events in athletics and is among the sports that demand the highest levels of speed and strength in competition, characterized by rapid velocity, brief endurance, and necessitating athletes to possess significant muscle strength and endurance [5]. Line sprinting refers to running at maximum speed in a straight line. It involves repetitive full sprints over varying short distances (10m -100m) [6]. Studies have shown that this method of training could lead to improvements in muscle power capabilities and speed [7]. Underwater treadmill training is a method of gait training that uses the characteristics of water [15]. Water provides buoyancy, hydrostatic pressure, and viscosity, affecting the human body. Buoyancy makes the body float on the water.

Water depth supports body weight: water as high as symphysis pubis relieves the weight by 40%, as high as the navel relieves by 50%, and as high as the xiphoid process relieves more than 60% of the weight [10]. The water pressure rises as immersion depth increases, and the increase in water pressure induces movement of bodily fluids. Due to the viscosity of water, friction occurs against the skin, and fluid resistance of the water enables it to be used in resistance training [3].

Materials and Methodology

Study Design
Pre and post experimental study design.

Study Duration
The duration of the study was 6 months.

Study Setting
The study was conducted at Sri Ramakrishna Hospital, Coimbatore-641 044.

Sampling Method
Purposive sampling method has been used.

Sampling Size
A total of 15 recreational sprinters were selected and pre-test evaluation has been done. Then trained over a period of 6 weeks and post-test evaluation has been done for the outcomes such as speed and lower limb explosive power. Hence all the subjects were provided the same set of training to evaluate the progress.

Criteria for Sampling
Inclusion Criteria
- Both male and female subjects were included.
- Age group between 18 to 22 years.
- Recreational sprinters who are motivated to improve their performance.
- Willingness to participate in the study.
- Subjects who have not participated in similar studies in the past 6 months.
- No previous history of cardiac or respiratory issues that limits exertion.

Exclusion Criteria
- History of injury in the last 6 months.
- Chronic illness or disorders that might affect high intensity training.
- Currently on medication which affects performance or recovery.
- Psychological factors such as stress or depression.
- Previous history of any surgery that limits sprint training.
- Previous participation in similar studies with last 1 year.
- Subjects with the use of alcohol or illegal drugs or smoking.
- Unreliable or uncooperative subjects.

Variables
Dependent variables
- Speed
- Lower limb explosive power

Independent variables
- Line sprint training
- ATM Tabata Interval Training

Assessment Tools
- 40m Sprint Test
- Vertical Jump Test

Procedure
Fifteen subjects were randomly selected based on the inclusion and
exclusion criteria. Participants volunteered to participate in the study. All of them were recreational sprinters and were motivated to improve their performance. All participants were provided with an informed written consent before the procedure. All the participants were able to complete the training within the allotted time period.

Pre-test and post test data collection 40 meter sprint test
It is also known as 40m yard dash, a test for acceleration and speed. The subject is asked to sprint with maximum speed from the marked start to the finish line and time taken is measured using a stopwatch. Test is performed thrice and the mean is recorded.

Vertical Jump Test
It is used to measure lower limb explosive power. The subject stands on the side of wall with the finger tips pointed with arm raised above the head and the height is marked. The subject attempts to touch the wall at the highest point of the jump. The difference in distance between the standing reach height and the jump height is measured. Test is performed thrice-mean is recorded.

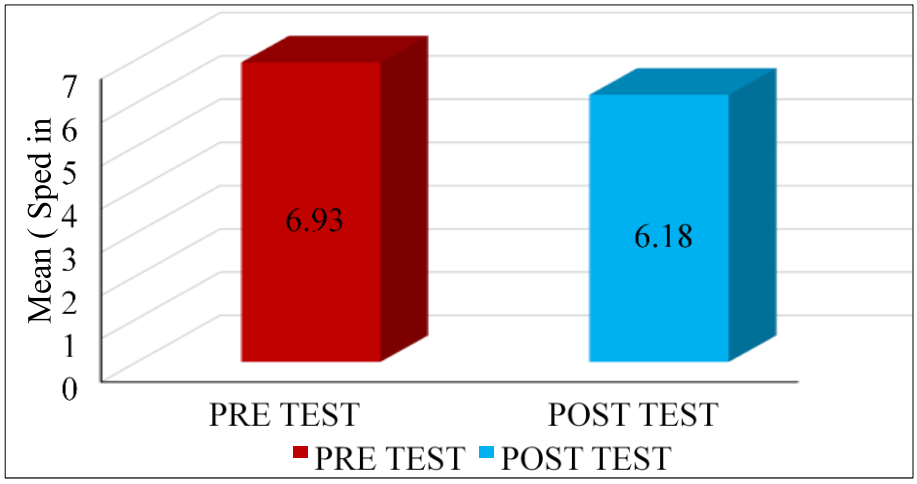
Combined training protocol Line sprint training
Line sprint training involves repetitive full sprints over varying short distances (10m to 40m).

Exercise / Reps / Sets
- 1st week- 10m sprint / 5 / 3
- 2nd week- 10m sprint / 5 / 3
- 3rd week- 20m sprint / 5 / 3
- 4th week- 20m sprint / 5 / 3
- 5th week- 40m sprint / 4 / 3
- 6th week- 40m sprint / 4 / 3

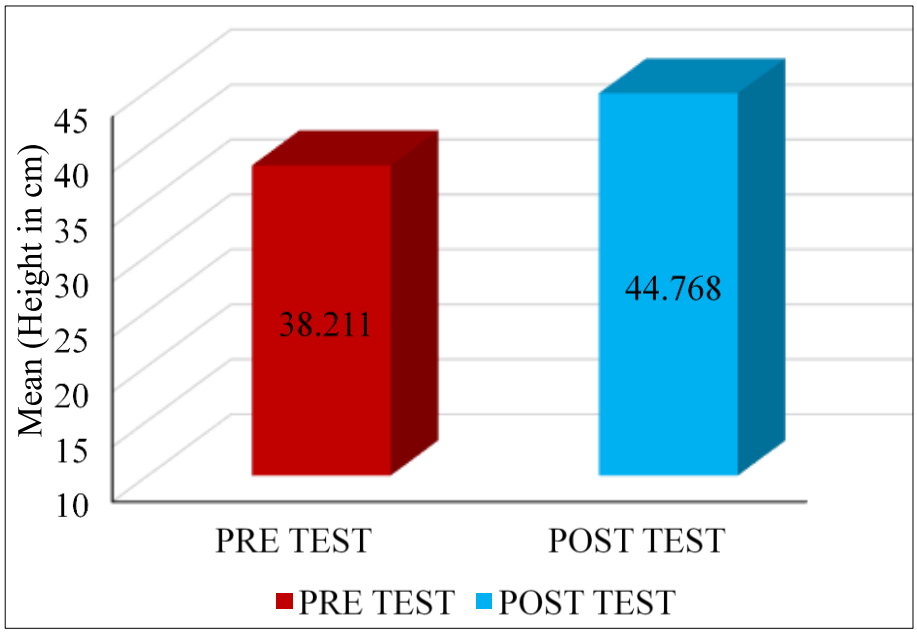
The training was performed for 3 days per week for 6 weeks.

Atm Tabata Interval Training
Tabata training involves an intense exercise for 20sec followed by 10sec of rest for
a total of 8 rounds which will last up to 4mins. The participants first completed a 5mins warm up in which speed progressively increased from 4 to 6 miles/ hour with front jets followed by a 2 mins rest period. After which the Tabata Interval Training was initiated at a speed of 8.5 miles/hour with front jets. Then the participants perform the 5mins cool down with front jets in which speed progressively reduced. The training was performed 3 times a week for 6 weeks.

Data analysis and interpretation
Dependent 't' test (paired)



Graph 1: 40 M Sprint Pre and Post Mean Value



Graph 2: Vertical Jump Test Pre and Post Mean Value

Results
The study evaluated the effectiveness of an ATM Tabata Interval Training with LST program on 40m sprint performance and vertical jump height in 15 collegiate recreational athletes. The results, analysed using SPSS software, revealed significant improvements in both variables:

40m Sprint Test
- **Pre-Test Mean:** 6.94 seconds
- **Post-Test Mean:** 6.19 seconds
- **Mean Difference:** 0.75 seconds
- **Standard Deviation:** 0.37
- **t-Value:** 7.94
- **table t value:** 1.761
- **p-Value:** < 0.05

Vertical Jump Test
- **Pre-Test Mean:** 38.21 cm
- **Post-Test Mean:** 44.77 cm
- **Mean Difference:** 6.56 cm
- **Standard Deviation:** 2.45
- **t-Value:** 10.35
- **table t value:** 1.761
- **p-Value:** < 0.05

Both tests showed statistically and practically significant improvements, confirming the effectiveness of the training program.

Discussion
The study was aimed to check the effectiveness of combined ATM Tabata Interval Training with Line Sprint training on speed and lower limb explosive power among recreational sprinters. The combination of line sprint training with ATM Tabata Interval Training offers a unique and effective approach to enhancing athletic performance while minimizing joint stress and in the prevention of injury. While traditional resisted sprint methods, such as sled

training, focus on building explosive power and acceleration, underwater resistance sprinting provides additional benefits by leveraging water's buoyancy and viscosity. This reduces joint load and minimizes the risk of overuse injuries, making it particularly advantageous for athletes recovering from injuries or seeking low-impact alternatives. The resistance provided by water allows for the activation of multiple muscle groups, improving strength, endurance, and sprint mechanics in a controlled environment.

Furthermore, water's hydrostatic pressure aids in recovery by promoting circulation and reducing inflammation. By integrating these two training methods, sprinters can achieve optimal performance improvements while addressing the challenges of joint stress and fatigue, offering a balanced and innovative approach to sprint conditioning.

In this study, the findings highlight the substantial impact of ATM Tabata Interval training on athletic performance, in addition to Line sprint training, particularly in sprint speed and lower limb explosive power. These improvements can be attributed to several physiological and biomechanical factors:

Resistance and Buoyancy Effects:

- The underwater treadmill provides a unique resistance environment, enhancing muscular endurance and strength.
- Participants experienced a significant reduction in DOMS due to the effect of underwater training.
- The buoyancy of water reduces joint load and minimizes injury risk, allowing athletes to train with greater intensity and frequency [24].

Neuroplastic Adaptations:

- The aquatic environment promotes proprioceptive feedback, aiding in improved neuromuscular coordination.
- Repetitive underwater motions likely contributed to enhanced motor unit recruitment, reflected in faster sprint times and higher jumps [25].

Muscle Power Development

The significant increase in vertical jump height indicates improved explosive power in the lower limbs. This could result from the combined effects of resistance training and enhanced muscular recovery facilitated by hydrostatic pressure [26].

Practical Implications

The sprint test results demonstrate improved anaerobic capacity and stride efficiency, key factors in athletic performance. A mean reduction of 0.75 seconds over 40 meters is particularly notable in recreational athletes, where small improvements translate to competitive advantages.

Cohen's d Effect Size

For the 40m sprint test, Cohen's d was calculated as 1.57, indicating a very large effect size. This highlights not only statistical significance but also the practical importance of the training program.

In this study, when comparing the pre and post test results of 40m sprint and vertical jump there is significant improvement.

1. 40m sprint Test - Pre and post test mean - 6.94 seconds and 6.19 seconds 2. Vertical Jump Test - Pre and post test mean - 38.21 cm and 44.77 cm respectively.

Conclusion

The study concludes that there is a marked improvement in sprint speed and lower limb explosive power in the post test evaluation on speed and lower limb explosive power.

So the null hypothesis is rejected and alternate hypothesis is accepted which states "There is significant difference between the pre and post mean values". The study suggested that combining ATM Tabata Interval Training with Line Sprint Training is effective than isolated Line Sprint Training.

Limitations

- Small sample size was studied.
- The study was limited within the age group of 18-23 years.
- The study was conducted only in a short duration.
- Only Line sprint training has been involved.
- The selection criteria involved only recreational sprinters.

Suggestions

- The study can be extended to a larger population.
- The study can be done for longer duration.
- The effectiveness could be studied with professional or elite sprinters.
- Various other parameters of sprinting could be assessed.
- Future studies could examine the long-term effects of underwater treadmill training or compare its efficacy with other traditional land-based training methods.

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