

EFFECT OF PLYOMETRIC TRAINING VERSUS SWISS BALL TRAINING ON SPEED AND AGILITY IN KARATE PLAYERS - AN EXPERIMENTAL STUDY

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DOI: <https://doi.org/10.63299/ijopt.060456>

ABSTRACT

Background: Karate is an active activity that necessitates a combination of strength, power, flexibility, agility, and endurance for top performance. High-speed movements, particularly in executing kicks and punches, are greatly dependent on the strength and power of the lower limb muscles, especially those responsible for knee extension. Plyometrics are exercises that improve neuromuscular performance through natural sports movements like jumping, hopping, and skipping. Swiss ball training is done with an exercise ball or includes various exercises targeting different muscle groups in the body.

Objective: To determine the effect of plyometric training versus Swiss ball training on speed and agility in karate players.

Method: After considering the selection criteria and randomly dividing into two groups; 15 subjects in Group-A and 15 in group B. Group A received plyometric training and group B received Swiss ball training for 3 session/week for 3 weeks. Outcome measures were assessed with pre and post intervention with T- agility test & 50 Meter Dash test for speed & agility.

Results: The results of this study showed statistically significant improvement in T agility test & Dash test with both plyometric training & Swiss ball exercise. (P value<0.05).

Conclusion: Both groups showed statistically significant improvement of speed & agility in karate players with plyometric training & Swiss ball exercise. But all findings support the idea and concluded that plyometric training were found to be more prominent in improving speed & agility in karate players.

Keywords: T Agility test, 50 Meter Dash test, karate player, plyometric, Swiss ball.

INTRODUCTION

Karate requires strength, power, flexibility, agility, and endurance, with high-speed movements like kicks and punches relying heavily on the strength of lower limb muscles, especially those involved in knee extension. [1,2] Karate competition is typically defined as a high- intensity intermittent sport event,

in which most of the actions are performed explosively.[3]

Most karate injuries are caused by trauma, muscle contusions, and mild local injuries, while serious injuries like fractures, strains, and sprains are less common. Studies show that muscular injuries account for 65.4% of cases, head and face injuries

for 32.4%, with trauma (38.4%), contusion (15.1%), tension (7.5%), and strain being the most frequent. Facial trauma in sports has been linked to TMD, as sports activities produce stronger and more frequent forces, leading to six times more facial injuries than workplace accidents and three times more than violence or traffic accidents.[4]

Plyometric training can include e.g. stretch shortening cycles in an isokinetic dynamometer or plyometric jumps.[5] Plyometrics refers to exercises that are designed to enhance neuromuscular performance. For the lower body this involves application of jump, hopping and bounding training. Plyometric exercises constitute a natural part of most sports movements as they involve jumping, hopping, and skipping (i.e., such as high jumping, throwing, or kicking).[6]

The Swiss ball is used in musculoskeletal rehabilitation and physical conditioning programs. Muscle strengthening performed with the aid of this ball can improve joint and muscle stability, and proprioception. The use of Swiss ball training for core muscle development has been popular for several years. Swiss ball training uses an exercise ball to target different muscle groups, improving core stability, flexibility, balance, and overall strength. It should be performed under the guidance of a qualified fitness specialist to ensure proper and effective execution.[7]

T- Agility - The agility T-tests will be used to gauge agility. Agility, muscular strength, power, speed, flexibility, coordination, and balance are all necessary for a karate fight.[8]

The 50 Meter Dash is a short-distance sprinting test commonly used to measure an individual's speed, acceleration, and anaerobic power. It is widely utilized in schools, fitness assessments, and athletic training programs to evaluate how quickly a person can cover a relatively short distance.[9]

The need for studying the effect of plyometric training versus Swiss ball training on speed and agility in karate athletes stems from the increasing importance of enhancing performance in martial arts, particularly in disciplines like karate where speed, agility, and quick reflexes are essential. Karate requires explosive power, rapid changes in direction, and superior coordination, which are directly influenced by an athlete's agility and speed. Additionally, this study could contribute to the body

of research on sport-specific conditioning, offering karate practitioners evidence-based recommendations for the most effective training techniques to enhance their competitive edge.

OBJECTIVE OF THE STUDY: To determine the effect of plyometric training versus swiss ball training on speed and agility in karate players.

METHODOLOGY

- STUDY DESIGN: - An Experimental study
- STUDY POPULATION: Karate players
- AGE GROUP: - 15 to 19 year
- STUDY SETTING: karate classes of Vadodara
- STUDY DURATION: 6 Months
- STUDY PERIOD: 3 days/week for 3 week
- SAMPLING METHOD: Convenience sampling method
- SAMPLE SIZE: - 30 karate players (Group A = 15) (Group B = 15)

Inclusion Criteria:

- Age: karate players within a specific age range (e.g., 15-19 years).
- Karate experience: players with a minimum of 2-3 years of karate training and competition experience.
- Training frequency and volume: players training a minimum numbers of times per week (e.g., 3-4 times) and/or completing a minimum number of training sessions per month (e.g., 12-16 sessions).
- Availability for testing and data collection: players available for testing and data collection at specific times or locations.
- Health status: players with no severe injuries or medical condition that may impact their performance.

Exclusion Criteria:

- Beginners: players with less than 2-3 years of karate training and competition.
- Injured players: players with severe injuries (e.g., fractures, ligament sprains) that may impact their performance.

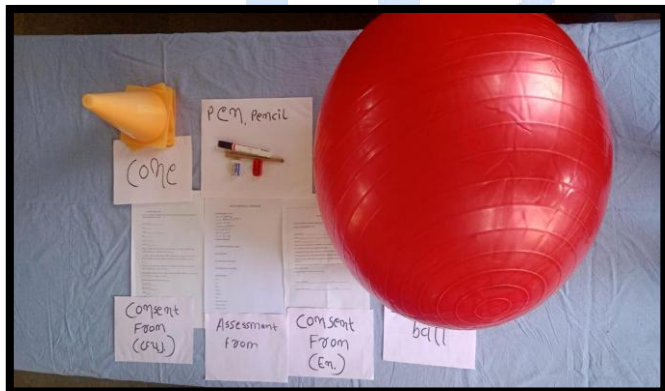
•Players with chronic medical condition: players with conditions (e.g., diabetes, hypertension) that may impact their performance or require special considerations.

•Inability to provide informed consent: players unable to provide informed consent due to cognitive or linguistic limitations.

•Cardiovascular conditions: players with cardiovascular condition (e.g., heart failure, arrhythmias) that may impact their physical performance.

Materials:

- Met
- Cone
- Pen \ pencil
- Swiss ball
- Assessment form
- Stop watch
- Consent form (Gujrati & English)



Group A = Plyometric Training:

1. Side to side Ankle Hops(15 Sets, 2 Reps)
 2. Lateral cone Hops single leg(7 Sets, 2 Reps)
 3. Double leg Hops (6 Sets, 2 Reps)
 4. Front cone Hops(10 Sets, 2 Reps)
- The training was done using the plastic cone.
 - Familiarization session was administered the protocol.



Fig: 2 Side to Side Ankle Hops

PROCEDURE:

- Permission and approval to carry out the research work was obtained from the head of the institutional ethical committee.
- Participants were selected on the basis of convenience sampling method and were divided into
- two Group; Group A and Group B.
- Group A = Plyometric Training for 3 weeks [3 sessions per week]
- Group B= Swiss ball training for 3 weeks [3 sessions per week]



Fig: 3 Lateral Cone Hop Single Leg



Fig: 4 Double Leg



Fig:6 Wall squats



Fig:5 Front cone Hops



Fig:7 Plank

Group B = Swiss Ball Training

1. Wall squats 10 Reps
2. Plank 10 Reps
3. Stability ball crunch 10 Reps

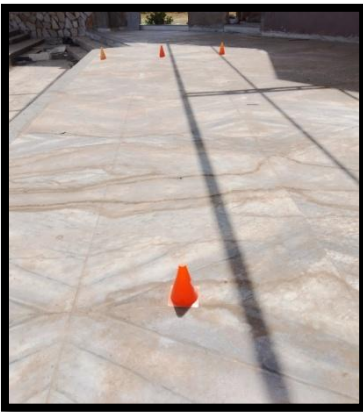
- The training was done using the Swiss ball.



Fig:8 Stability ball crunch

OUTCOME MEASURES:**Agility t- test**

The T-Test assesses agility in athletes through forward, lateral, and backward running, where after health screening, consent, and warm-up, participants start at cone A and complete a specific running and shuffling pattern to cones B, C, D, and back, with time recorded to the nearest 0.1 second. Three successful trials are conducted, with the best time recorded, provided participants follow the rules such as not crossing feet while shuffling and maintaining forward facing throughout.[8]

**50 Meter Dash Test**

The 50-meter sprint test assesses acceleration and speed, where participants, after health screening, consent, and warm-up, start from a stationary position and sprint 50 meters on command with time recorded to the nearest two decimal places. Two trials are allowed, with the fastest time recorded, starting from the first movement and ending when the chest crosses the finish line. [9]

RESULTS:

Data was normally distributed therefore an unpaired parametric t – test was applied.

BETWEEN GROUP ANALYSIS:

Comparison between effect of plyometric training versus Swiss ball training

BASELINE DATA:

In this study, total 30 karate players were recruited, 15 in each group.

Group A was treated with plyometric training.

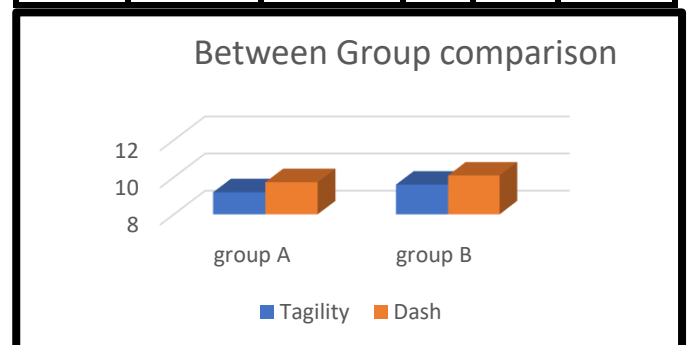
Group B was treated with Swiss ball training.

Table:1 Baseline data

CATEGORY	MEAN ± SD
No. of Participants	30
Age(years)	16.9 ± 1.30
Weight(kg)	50.9 ± 5.90
Height(cm)	157 ± 5.15
BMI (kg/m ²)	20.8 ± 2.07

Table:2 Between Group Analysis (Group A & Group B)

Out come Measure s	Group - A (Mean +SD)	Group - B (Mean + SD)	D F	P - Value	Remarks
T-AGILITY TEST	(9.19+1.052)	(9.60+0.934)	230	0.277	Significant
50-DASH TEST	(9.73+0.864)	(10.09+0.859)	280	0.266	Significant



Graph: 1 Mean difference between Group A & Group B

DISCUSSION:

Competitive karate performance is depending on both, technical aspects, and strength and power abilities (Loturco, Artioli, Kobal, Gil, and Franchini, 2014). According to the rules imposed by the World Karate Federation, athlete's main goal is to score by touching the opponent; hence highintensity actions in punching and kicking techniques are required prior to a response from the opponent (Mori, Ohtani, and Imanaka, 2002). Agility, muscular strength, power, speed, flexibility, coordination, and balance are all necessary for a karate fight. [10]

The aim of the study was to determine the effect of plyometric training and swiss ball exercise on agility & speed in karate players.

This study was conducted in 30 karate players with age group 15-19 years and divided into Group A & Group B. Baseline measurement of T agility test & Dash test were taken on Day 1.

Players of Group A were treated with Plyometric training & Group B with swiss ball exercise and post data was collected after 3 weeks. The results that were obtained showed marked improvement in T agility test & Dash test in both groups.

Sajjan Pal, Joginder Yadav, Bijender Sindhu, Sheetal Kalra (2020) "Effect of Plyometric and Pilates Training on Physical Fitness Skill of Male Karate Athletes" this study total sample are 120, Players are divided into 3 group, each group sample size 40. Group A (plyometric group), Group B (Pilates group), Group C (control group). The age group between 18 to 24 years, study conducted three days per week for 8 weeks. outcome measures were taken according to t- test for agility, Sargent jump test for power and 40m sprint test for speed. The results of study are both the training method have showed improvement in the physical fitness skills. the finding of the study revealed that plyometric and Pilates both improve physical fitness skills of karate player, but plyometric training method had more positive and better effect on agility, power, and speed on karate athletes than Pilates Training. [11]

Bhem et al., showed that exercises performed on unstable (Swiss ball) surface stressed the musculature and activated the proprioception activity and gain the stability. A study by Cosiolima et al., showed the effects of physio ball and conventional floor exercises on early phase

adaptation in back and abdominals core stability and balance in women for 5 weeks and the physio ball group was found to give significantly greater mean change in EMG flexion and extension activity and greater balance score. Drake et al., in a study on 8 subjects came with a result that the use of an exercise ball will always create a greater challenge for the musculoskeletal system which does not support the present study. In young, healthy population, there does not appear to be any training advantages to perform exercises on a ball versus mat. However, in a rehabilitation scenario, these exercises performed on a ball could reduce low back pain loading and hence reduced the potential for injury.[12]

Unilateral plyometric training significantly improved change-of-direction speed and jump performance, directly benefiting karate athletes in executing rapid, explosive movements during sparring and kata, as supported by [Souissi et al., 2024]. While Swiss ball exercises had a lesser impact on agility, they contributed to core strength and balance, helping maintain control and posture during dynamic movements, similar to findings in sports like hockey. Combining both methods offers a well-rounded conditioning approach, with plyometrics enhancing speed and agility, and Swiss ball exercises supporting stabilization and injury prevention, though plyometric training should be prioritized for improving karate-specific performance.[13]

The results of this study showed statistically significant improvement in T agility test & Dash test with both plyometric training & swiss ball exercise.

CONCLUSION:

The result of this study supported the alternative hypothesis and both groups showed statistically significant improvement of speed & agility in karate players with plyometric training & Swiss ball exercise. But all findings support the idea and concluded that plyometric training were found to be more prominent in improving speed & agility in karate players.

LIMITATIONS:

- Training duration of 3day/week for 3-week period may not be sufficient capture long term adaptation may be.

- No Long-Term Follow-Up: The study did not assess whether the gains in speed and agility were maintained after the intervention ended.

FURTHER RECOMMENDATIONS:

- Additional studies could compare the effects of plyometric and Swiss ball training with other training methods such as resistance training, core stability programs, or functional training.
- Future research should explore the effects of these training methods on other key aspects of karate performance such as balance, power, endurance, coordination, and reaction time.

ETHICAL CLEARANCE: Yes, by institutional ethical committee from Neotech institute of physiotherapy

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