

“COMPARATIVE EFFICACY OF PLYOMETRIC EXERCISES VERSUS CALISTHENICS ON AGILITY IN KARATE PLAYERS.”

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ABSTRACT

Background - Plyometric training (PT) involves dynamic and rapid muscle stretching (eccentric action) immediately followed by a muscle contraction (concentric action) of the same muscles and connective tissues. These high-intensity exercises combine strength and speed to enhance power. Calisthenics is a form of exercise involving various movements that primarily use body weight for resistance and require no equipment. It aims to improve neuromuscular function. **Procedure**- Ethical clearance was obtained from Institution Ethical Committee. Total 40 participants were included in this study according to the inclusive criteria; participants were allocated by randomization method into two groups. GROUP A included 20 participants (plyometric exercise) and GROUP B included 20 participants (Calisthenics exercise) for 3 days in a week for four weeks. **Outcome measures**- Agility T test, Illinois agility test. **Result**- Effect of GROUP A was assessed by using Paired t Test /Wilcoxon's Signed Rank Test. Effect of GROUP B was assessed by using Paired t Test / Wilcoxon's Signed Rank Test. Comparison Between both GROUP was done by using unpaired t Test / Mann-Whitney Test.

Results indicated improvement in both the groups with the Group A (plyometric exercises) showing significant improvement in agility than Group B (Calisthenics exercise) **Conclusion-** Both breathing exercises were effective in improving agility in karate players but Group A showed better results in enhancing agility due to excessive force production.

KEYWORD'S – Agility, Plyometrics, Calisthenics, Agility T-test, Illinois Agility test.

INTRODUCTION:

Martial arts are nothing but trained physiological movements of the human body for the intent of attack and defense. Te or Okinawa te, is an empty-handed combat technique that was first used by the Pechin class of Okinawa and is now known as Karate. Although, Karate is thought to be a Japanese art. It is frequently, but incorrectly, referred as a Samurai art. The introduction of Karate to Japan coincided with the term “Karate” gaining its current meaning as the name of a weaponless, empty-handed martial art. In the Funakoshi Gichin memorial’s lengthy inscription, there are two sayings ascribed to him “Karate is a martial art of a virtuous man” and “the Fist and Zen are one”. These sayings capture a crucial reality: the creators of karate wanted to develop much more than just a set of physical skills or a self-defense system. Additionally, and particularly, they viewed their art as a tool for self-improvement or self-perfection: when taught correctly, this discipline would help the practitioner develop into a morally upright, mature, socially responsible, and selfless person. ^[1] Karate is an unarmed martial art involving kicking, striking, and defensive blocking using arms and legs, emphasizing on maximum body power at the point and instant of impact. The striking surfaces used are the hands (knuckles and the outer edge), the ball of the foot, heel, forearm, knee and elbow. All the mentioned body parts are made tough by intensive training done against padded surfaces or wood. Other factors which are important are timing, tactics and spirit of the player. In sporting and training, blows and kicks are stopped short, preferably within an inch of contact. The matches last for about 3 minutes each. Contests of “kata” are also held, wherein a single competitor performs a series of predetermined movements stimulating defense and counterattack against several opponents. A panel of judges score the performance. Karate like any other martial art disciplines, stresses over the mental attitude, rituals of courtesy, costumes and a complex rating system (coded by color of the belt). ^[2]

The goals of karate which determine the performance of the player are endurance, flexibility, strength, agility, speed, distancing, co-ordination and reaction time. This can be imbibed through basic exercise and practice of chartered exercises including blocks, kicks, punches, formal exercise “kata”, prearranged exercise “ippon kumite” and free sparring “kumite”. ^[3]

Agility – Assessing motor skills is essential for tracking athletic performance and training. After undergoing modifications, the definition of agility has evolved to include “the ability to change speed and direction of movement rapidly and accurately,” typically in response to a highly specific stimulus.

Rapidity and agility are essential for performing sports movements efficiently and accurately in different situations. However, there is considerable uncertainty in the sports science field regarding a clear definition of agility. For optimal performance, agility depends on the smooth coordination between the nervous system and the musculoskeletal system, enabling fluid movement. In sports training, a comprehensive approach is more effective for studying agility since it examines movement as a whole rather than breaking it down into separate parts. Supporters of this viewpoint argue that various training factors influence each other, making it ineffective to study them in isolation, as done in reductionist approaches. Just like in biological processes, every component contributes to the overall development of the movement.

According to this perspective, core motor skills-including strength, coordination, speed, and agility- are closely connected and cannot be assessed independently. Since these elements continuously interact to create movement,

they should be examined as a single unit rather than distinct aspects. Therefore, when evaluating agility and speed, their combined role in overall movement must be taken into account. [4,5,6]

Plyometric exercises: Plyometric training (PT) involves dynamic and rapid muscle stretching (eccentric action) immediately followed by a muscle contraction (concentric action) of the same muscles and connective tissues. This method emphasizes transitioning from muscle extension to contraction in a fast, powerful manner, often seen in specialized jumping exercises. These high-intensity exercises combine strength and speed to enhance power. PT includes various hops and jumps that take advantage of the muscle's stretch-shortening cycle. The elastic energy stored within the muscles helps generate greater force than what can be achieved through concentric action alone. This process is marked by a quick deceleration of mass, immediately followed by a rapid acceleration in the opposite direction. [7]

Calisthenics: Calisthenics is a form of exercise involving various movements that primarily use body weight for resistance and require no equipment. It aims to improve neuromuscular function through activities such as swinging, twisting, jumping, and bending. There are multiple variations, including gymnastics-based exercises, push-ups, pull-ups, lunges, planks, and step-ups. According to Castron M., calisthenics is rhythmic, smooth, and adaptable to different fitness levels, making it suitable for both individuals and groups. This form of training enhances all aspects of physical fitness, contributing to strength, speed, and explosive power. [8]

These exercises primarily use body weight to build strength and flexibility. It is an aerobic and dynamic form of exercise suitable for all ages due to its low risk of injury. This workout is rhythmic, smooth, and enjoyable, making it easy to do alone or in groups. Calisthenics exercises are simple yet effective in enhancing body strength and flexibility while also improving endurance. Additionally, calisthenics fitness training helps develop muscular endurance, cardiovascular fitness, and psychomotor skills such as balance, agility, and coordination. It benefits both the muscles and overall physical performance. [8,9]

METHODOLOGY

Method of research: Comparative, study design: Interventional, type of sampling: Simple Random sampling, study setting: Karate schools, study duration: 1 year, target population: Practicing Karate players (10 to 25 years of age). Sample size: **Sample size calculation using G*Power software: Inclusion criteria:** All Genders, Age – 10 to 25 years, Karate players practicing for at least 1 year and 5 days a week. **Exclusion criteria:** Players having recent injuries, history of any respiratory or cardiovascular condition. **Materials:** Stopwatch, Cones, Measuring tape, Whistle, Boxes (16 inches), Medicine ball.

Procedure- The study protocol was presented for approval in front of institutional ethical committee and a protocol committee of D. Y. Patil Education Society Deemed to be university, Kolhapur. This experimental study was conducted from September 2024 to March 2025 on 40 Karate players. Samples were selected through simple random sampling method and were then assigned to a plyometric intervention group and calisthenics intervention group. All Karate players were between the age of 10-25 years, practicing from at least a year and 5 days a week. A thorough explanation of the research course was done to the participants followed by receiving their written informed consents. To assess the effect of plyometrics training versus calisthenics training, there are 40 participants divided in two groups with each group comprising of 20 individuals. Group A (plyometrics training) and Group B (Calisthenics training). Group A included plyometrics training (3 days/week for 4 weeks, 1 time a day, 15-20 min) at Chanakya Marshal Arts center 1 whereas Group B included calisthenics training (3days/week for 4 weeks, 1 time a day, 15-20 min) in karate players at Chanakya Marshal arts center 2. In Pre and post intervention Agility T test and Illinois Agility test were used for assessing agility. The inclusion criteria of the study were Karate players practicing for at least a year and minimum 5 days a week. The exclusion criteria were:

Participants with history of any cardiovascular or respiratory illness, any recent injuries within 1 year, participants who are newly joined (less than 1 year of joining)

RESULT

The Comparative efficacy of plyometric exercises versus calisthenics on agility in karate players revealed that Agility was improved more significantly in the Plyometric Group than the Calisthenics. There was reduction in time duration in both the outcome measures i.e. Agility T test and Illinois test. The gender distribution of the study participants is presented in Figure 1. The total sample size consists of 40 individuals, with 21 males (52.50%) and 19 females (47.50%). This distribution indicates a relatively balanced representation of both genders, with a slight predominance of male participants.

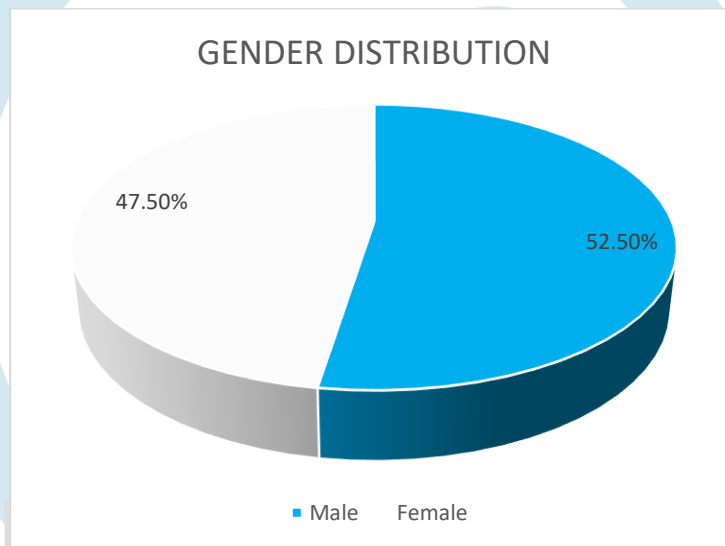


figure no. 1

PRE-& POST INTERPRETATION OF GROUP A

The paired t-test was used to analyze the pre- and post-test results for both the Agility T-test and the Illinois Agility Test in Group A. The findings are summarized and visualized in Figure 2.

Figure 2 illustrates the mean values of both tests before and after the intervention. The blue bars represent the pre-test results, while the red bars indicate the post-test scores. The significant reduction in time across both tests suggests that the training program or intervention had a positive effect on agility performance in Group A. These findings indicate that the applied training method effectively enhanced agility, as evidenced by the statistically significant improvements in Tests cores.

figure no. 2 PRE-& POST INTERPRETATION OF GROUP B

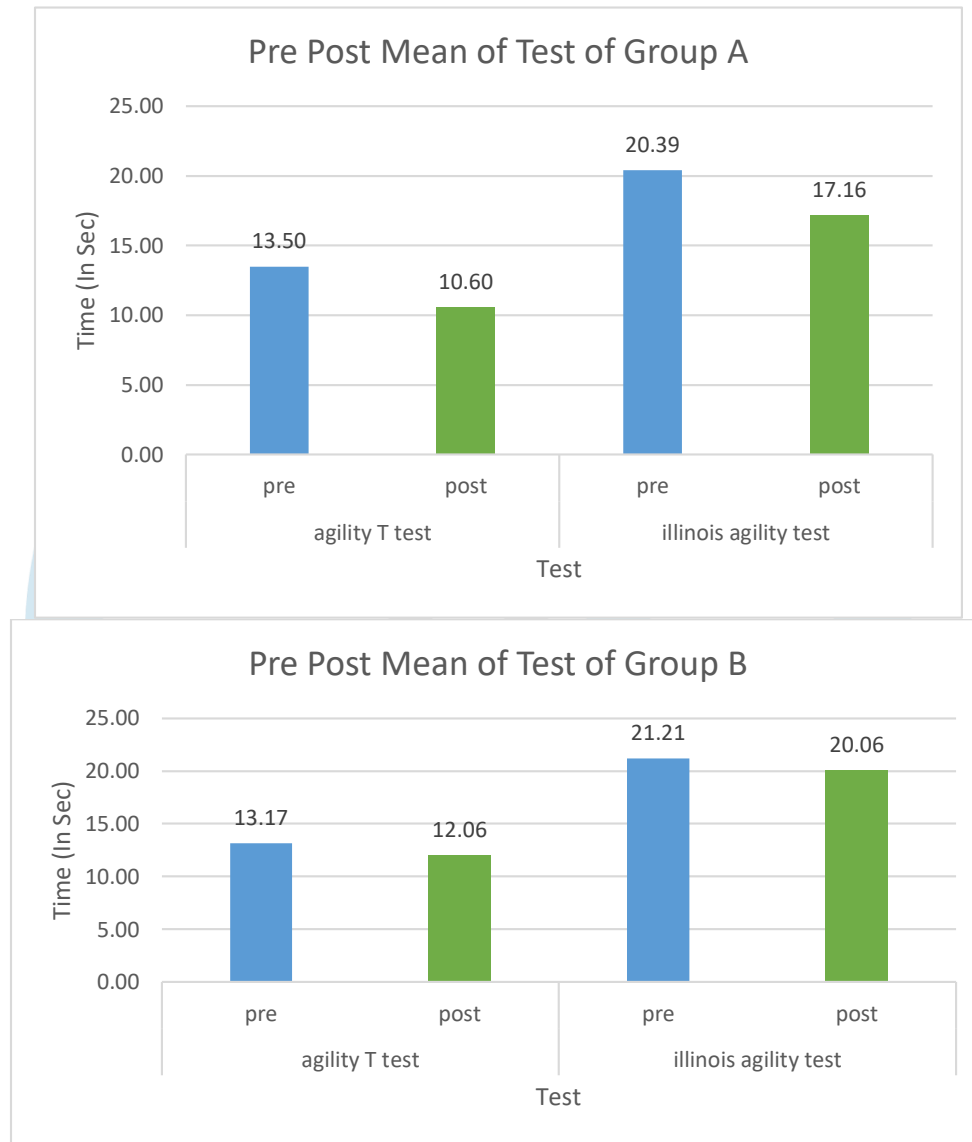


Figure 3

The paired t-test was conducted to assess the pre- and post-test results for both the Agility T-test and the Illinois Agility Test in Group B. The results are presented in Table 3 and visualized in Figure 3. Figure 3 presents a bar chart comparing the mean pre-test and post-test results. The blue bars represent the pre-test values, while the red bars indicate post-test values. Both tests show a reduction in time, demonstrating that the intervention led to improvements in agility.

A. GROUP WISE COMPARISON

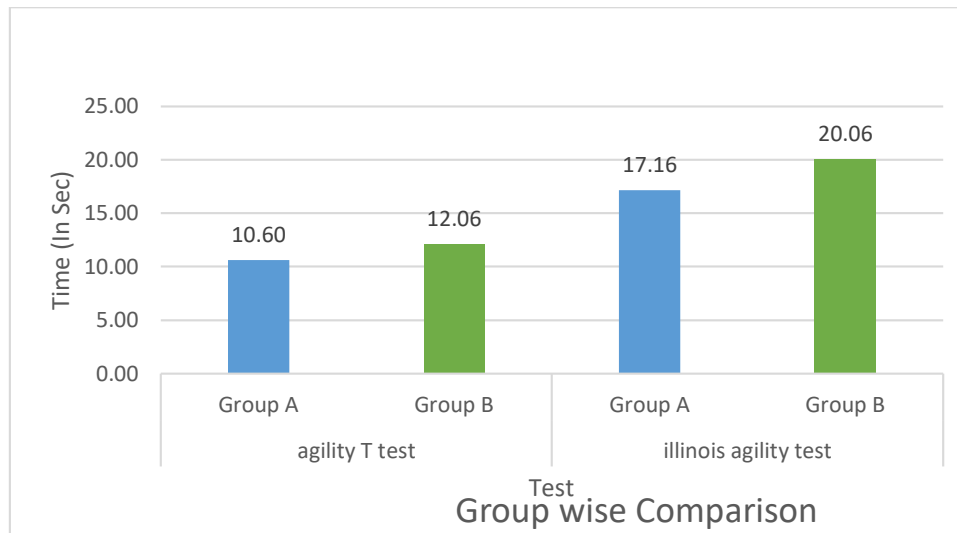


Figure no. 4

This section presents a comparative analysis of Group A and Group B for both the Agility T-test and Illinois Agility Test, highlighting differences in post-test performance.

The significant p-values confirm that Group A demonstrated better agility improvement than Group B in both tests. The graphical representation Figure 4 further supports this, as Group A consistently recorded lower times than Group B, indicating a more effective training intervention.

DISCUSSION

This study aims to compare the efficacy of Plyometric exercises versus Calisthenics on agility in karate players.

A total of 40 subjects were recruited in the study age group of 10 – 25 yrs, divided into two groups with 20 in each group.

Group A will receive Plyometric exercise for 10-15 min/days 3 times/week for four weeks and Group B will receive Calisthenics exercise for 10-15 min/days 3 times/week for four weeks. The primary objective of this study was to compare the effectiveness of plyometric exercises and calisthenics in improving agility among karate players. Agility was assessed through the Agility T-test and Illinois T-test, two well-established tools for evaluating athletic agility. After a 4-week intervention period, both the plyometric and calisthenic groups showed significant improvements in agility, with reduced mean values in both tests. These findings suggest that both training modalities can positively impact agility in karate players. However, a comparative analysis revealed that plyometric exercises were more effective than calisthenics in enhancing agility.

The results of this study align with previous research indicating that plyometric exercises, which involve explosive, high-intensity movements, can lead to significant improvements in agility and overall athletic performance. Plyometrics target muscle strength, power, and neuromuscular coordination, which are critical components for improving quick, reactive movements in sports like karate. The reduction in Agility T-test and Illinois T-test times for the plyometric group suggests that this type of training is especially effective at enhancing

the fast-twitch muscle fibers and improving the athletes' ability to change direction and accelerate, both of which are essential for success in karate.

In contrast, while calisthenics also resulted in improvements in agility, the gains were not as substantial as those observed in the plyometric group. Calisthenics, which primarily focuses on bodyweight exercises and muscular endurance, provides a foundation of strength and conditioning, but it may not adequately stimulate the same level of explosive power and speed necessary for optimizing agility. These findings support the idea that while calisthenics is beneficial for building overall fitness, plyometric training may have a more direct impact on agility, particularly in sports that require rapid changes in movement patterns, such as karate.

It is important to note that both interventions were effective in improving agility, which highlights the potential value of incorporating both training modalities into an athlete's training regimen. Plyometrics can be used to focus on agility and explosive movements, while calisthenics can complement this with muscular endurance and functional strength. A combined training approach may offer the best results for enhancing overall athletic performance in karate players.

Moreover, the observed improvements in agility may have broader implications for other sports that require similar quick, reactive movements. While this study focused specifically on karate players, future research could explore the effects of plyometric and calisthenic exercises on agility in athletes from other sports, such as football, basketball, or tennis, to determine if similar patterns emerge across different athletic populations.

One limitation of this study was the relatively short intervention period of just 4 weeks. While both groups showed significant improvements in agility, the long-term effects of these training interventions remain unclear. Future studies could examine the lasting impact of plyometric and calisthenic training on agility over a longer duration or with follow-up assessments to determine whether the improvements are sustained over time. Additionally, the study did not control for other variables, such as diet, rest, or training experience, which could have influenced the results. Further research should consider these factors to provide a more comprehensive understanding of the relationship between exercise and agility.

In conclusion, the results of this study suggest that both plyometric exercises and calisthenics can improve agility in karate players, with plyometrics proving to be more effective. These findings emphasize the importance of incorporating plyometric exercises into training programs for athletes looking to enhance their agility and overall performance in sports like karate. Future research with larger sample sizes, longer intervention periods, and consideration of other variables would be valuable in further confirming these results and understanding the broader applicability of these training methods across various athletic disciplines.

Ioannides et al. (2020) [3] investigated the effects of a six-week plyometric training program on power, muscle strength, and rate of force development (RFD) in young competitive karate athletes. The study found that the plyometric training significantly improved all three performance measures, highlighting the benefits of this training modality for enhancing explosive strength and rapid force production. These improvements are particularly relevant to karate, where power and speed are critical for performance. The findings suggest that incorporating plyometric exercises into training can be a valuable strategy for boosting physical performance in combat sports.

Wang and Zhang (2016) [7] examined the effects of plyometric training on soccer players, focusing on key performance factors such as strength, speed, and agility. The study found that plyometric training led to significant improvements in these areas, which are critical for soccer performance. Specifically, the athletes showed enhanced explosive strength, faster sprinting times, and better agility, all of which are essential for success in

soccer. The results suggest that incorporating plyometric exercises into training programs can be an effective way to boost performance in soccer players, particularly in terms of their ability to execute quick, powerful movements on the field.

Castron (2016) ^[8] explored the role of calisthenics in improving physical fitness, highlighting its benefits in strength, endurance, flexibility, and overall health. The study emphasized how calisthenic exercises, which rely on bodyweight movements, can effectively enhance muscular strength, cardiovascular fitness, and mobility. The findings suggest that regular calisthenic training offers a practical, accessible, and efficient way to improve physical fitness without the need for specialized equipment. The article supports the idea that incorporating calisthenics into training routines can lead to significant fitness gains, making it an ideal method for both beginners and experienced athletes.

Panihar and Rani (2022) ^[9] conducted a randomized controlled trial to examine the effect of calisthenics training on physical fitness parameters and sport-specific skills in soccer players. The study found that calisthenics training significantly improved key fitness components, including strength, flexibility, and endurance, while also enhancing soccer-specific skills such as agility, coordination, and speed. These results suggest that incorporating bodyweight exercises into soccer training can effectively boost both general physical fitness and sport-specific performance, highlighting the value of calisthenics in optimizing athletic development in soccer players.

Ghorbani, Yaali, and Sadeghi (2025) ^[10] investigated the impact of calisthenics training on muscular endurance, balance, and agility in young females, comparing those with and without flexible flatfeet. The study found that calisthenics significantly improved muscular endurance, balance, and agility in both groups, with additional benefits observed in participants without flatfeet. The results suggest that calisthenic exercises can be an effective training method to enhance key physical attributes in young females, though the presence of flexible flatfeet may influence the extent of improvement in certain areas. This study emphasizes the versatility of calisthenics in addressing various fitness components across different populations.

CONCLUSION

In conclusion, the study highlights that both plyometric exercise and calisthenics significantly improve agility in karate players, as assessed through the Agility T-test and Illinois T-test. After a 4-week treatment period, both groups showed a reduction in the mean values of agility scores, indicating an improvement in agility within each group. However, when comparing the two methods, plyometric exercise demonstrated a more substantial effect on agility enhancement. The plyometric group showed greater reductions in agility test times, particularly in both the Agility T-test and Illinois T-test, compared to the calisthenics group. This suggests that plyometric exercises, which focus on explosive strength and dynamic movement, are more effective in enhancing agility in karate players than calisthenics, which primarily targets muscular endurance and bodyweight movements. Therefore, incorporating plyometric exercises into training regimens may be more beneficial for athletes looking to improve their agility and performance in karate.

CONFLICT OF INTEREST

The authors declare no potential conflicts of interest with respect to research, authorship and / or publication of this article.

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