

# Effectiveness of Aquatic Plyometric training versus Tabata training on improving endurance and strength in young adult swimmers-An experimental study.

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## ABSTRACT

**Background:** Swimming is one of the most popular Olympic sports. Competitive swimming has a long history and is currently one of the largest Olympic sports. Despite the game's world-wide popularity, recent data shows its lack of popularity in India. Competitive swimmers are suggested to have specific anthropometrical features compared with other athletes thus engage in large volumes of training in the pool and on dry land.

### Purpose of the study

The purpose of the study is to determine the effectiveness of aquatic plyometric versus tabata training on improving endurance and strength in young adult swimmers so that better and specific training guidelines can be formulated

### Methodology

Samples of n=30 swimmers between the ages of 18-25 years were included in the study. Subjects are divided into two groups by using chit method Group-A (APT) and Group B (TT). The study is carried out for the duration of 6 months the protocol for both the group is for 3 days per week for 5 weeks.

**Study design:** Experimental study

**Outcomes:** calculated at the start of the training and at the last day of training by using Cooper's run test and Vertical jump test.

## Results

The mean and average strength and endurance of group A before training is 49.54 & 43.98 and after training is 55.91 & 58.01. And in group B before training is 48.30 & 40.03 and after training is 53.18 & 45.92. This shows slight significant increase ( $p < 0.05$ ) in group A than group B.

## Conclusion

Therefore we concluded that aquatic plyometric training and tabata training both have improved performance but group A receiving aquatic plyometric training showed more powerful improvement in strength and endurance in swimmer.

**Key words:** Aquatic plyometric training, Tabata training, strength, Endurance.

## INTRODUCTION

The main focus of swimming in the first half of the nineteenth century was simply for enjoyment and pleasure, plus its endorsement by society as a wholesome rational recreation.<sup>1</sup> Swimming emerged as a competitive recreational activity in the 1830s in England. In India Swimming is done mainly as a recreational activity or just for fun but to adopt it as a sport is not very common yet.<sup>2, 3, 4</sup>

Aquatic-based plyometric training, while not a new concept, has become more popular within the last decade. Aquatic-based plyometric have the potential to decrease impact forces as compared with land-based plyometric training. Water is approximately 800 times denser than air and provides buoyancy and resistance to movement. Due to the principles of buoyancy, water acts as a counterforce to gravity, providing support for the athlete's body as it moves downward while resisting movement in the upward motion. Therefore, water buoyancy reduces forces on the musculoskeletal system during impact thereby decreasing the risk of injuries such as tendonitis, stress fractures and other overuse injuries.<sup>5, 6, 7</sup>

A combined intervention of strength and endurance training is common practice in elite swimming training, but the scientific evidence is scarce.<sup>8, 9</sup> Land-based resistance training and youth swimming performance studied by Marie Clare Grant et al. has concluded that two weekly sessions of maximal strength training is sufficient to improve maximal tethered swimming force in swimming.<sup>10</sup>

. However, of the three studies investigating the effects of dry-land strength training on swimming, only one found benefits between a combined strength, endurance and swim training group versus a swim-training only group, which was High Intensity Interval Training.<sup>8</sup>

One of the popular high intensity interval training is Tabata training. It is a subcategory of HIIT (High Intensity Interval Training). Izumi Tabata and colleagues have shown that HIIT improves the aerobic capacity at similar levels as the medium-intensity continuous training, and also improves anaerobic capacity.<sup>12</sup>

High interval and intensity training (HIIT) was introduced by Reindell and Roskamm in the 1950s. This type of training was designed to train at high running velocities, similar race pace. The results of the HIIT technique showed us that it can provide benefits not only in young swimmers' performance but in most of the studies that were carried out.<sup>13</sup>

## METHODOLOGY

This experimental study is to evaluate the effectiveness of aquatic plyometric versus tabata training on improving endurance and strength in young adult swimmers. This study was conducted in Parul University, Limda, Vadodara. The subject who met the inclusion criteria was included in the study. The 30 subjects were included and divided into two groups group A(n=15) and group B(n=15) by using chit method. An informed written consent was taken. The study was approved and conducted between 2018 and 2019 in accordance to the guidelines of the local ethics committee of the Parul Institute of Physiotherapy. The study is carried out for the duration of 6 months the protocol for both the group is for 5 weeks. Evaluation is taken before start of the training and at the end of the training with the use of COOPER'S RUN TEST and VERTICAL JUMP TEST

**Inclusion Criteria:** Both genders will be included in the study, Subject who is able to understand and follow simple verbal instruction, Age between 18-25 years with normal eye sight and ear function, and subjects who willingly participate or who signed inform consent. Subjects involved in swimming since 6 months

**Exclusion Criteria:** Mental retardation, other neurological and cardiovascular disorder subjects are excluded from the study, Aphasia, Presence of severe visual disability and visual field effects, any other psychological interventions, orthopaedic deformities, history of skin disease, , anaemia and any history of injury and illness.

## PROCEDURE

Subjects selected for the study were divided into two groups- group-A and group-B. Group-A for Aquatic Plyometric Training and group-B for Tabata Training.

### Group – A: Aquatic Plyometric (APT)

Aquatic Plyometric training was performed 3 days per week during the 5-week period. The training started with warm up for 10 minutes which includes walking, free style swimming and marching in pool and continued by aquatic plyometric training program such as ankle hops, countermovement jump, tuck jumps, single leg vertical jumps, drop jumps. At the beginning of the study, the exercise was conducted with 1 maximum repetition, 60% intensity while 1RM and 10% intensity were added each the 2 weeks.

### Group – B: Tabata Training (TT)

Before the Tabata training protocol, general warming was done to minimize the risk of disability. This warm up includes jumping, jogging and stretching. Participants were informed about the tests. The movement set on the 1st day of training was performed in 20 seconds and the selected motion was made in maximum repetition and active rest was given for 10 seconds. Thus, set 1 is completed. After 2 minutes of rest, the 2nd set was started. On the set 2, the same 8 movements were repeated. A total of 8 movements and 2 sets (4 + 4) 8-minute high intensity Tabata Training Program was applied for 5 weeks in total for 3 days a week. This training includes mountain climber, sit-ups, Jumping squat, biceps curls, Russian twists, push-ups, high knees, triceps dips. And then subjects perform jogging, stretching and jumping to cool down and recover for 10 minutes.

**TABLE 1: TABATA TRAINING PROGRAMME**

	WEEK 1 (one set)	Week 2 (two sets)	Week 3 (two sets)	Week 4 (two sets)	Week 5 (three sets)
1.	Mountain climbers	Mountain climbers	Mountain Climbers	Mountain climbers	Mountain climbers
2.	Sit ups	Sit ups	Sit ups	Sit ups	Sit ups
3.	Jumping squats	Jumping squats	Jumping squats	Jumping squats	Jumping squats
4.	Biceps curls	Biceps curls	Biceps curls	Biceps curls	Biceps curls
5.	Russian twists	Russian twists	Russian twists	Russian twists	Russian twists
6.	Push ups	Push ups	Push ups	Push ups	Push ups
7.	High knees	High knees	High knees	High knees	High knees
8.	High knees	High knees	High knees	High knees	High knees

**OUTCOME MEASURES:**

1) **VERTICAL JUMP TEST** The vertical jump test is a test of lower body power used for directly measuring the vertical jump height jumped. This test is simple and quick to perform. This method described above for measuring a person's vertical jump height is sometimes known as a Sargent Jump.

2) **COOPER'S RUN TEST:**

The Cooper 12 minute run is a popular maximal running test of aerobic fitness, in which participants try and cover as much distance as they can in 12 minutes. Calculate the estimated  $VO_{2max}$  by this formula- In kilometres:  $VO_{2max} = (22.351 \times \text{kilometers}) - 11.288$ .

**Statistical analysis****Statistical methods**

Descriptive statistical analysis was carried out in the present study. Outcome measurements were measured using Vertical jump test and Coopers run test presented as mean & SD. Significance was assessed at 5% level of significance  $p < 0.005$  ( 2-tailed hypothesis test considered)

Paired 't' test as a parametric had been used for analysis of Vertical jump test and Coopers run test within the Group A and Group B with calculation of percentage of change.

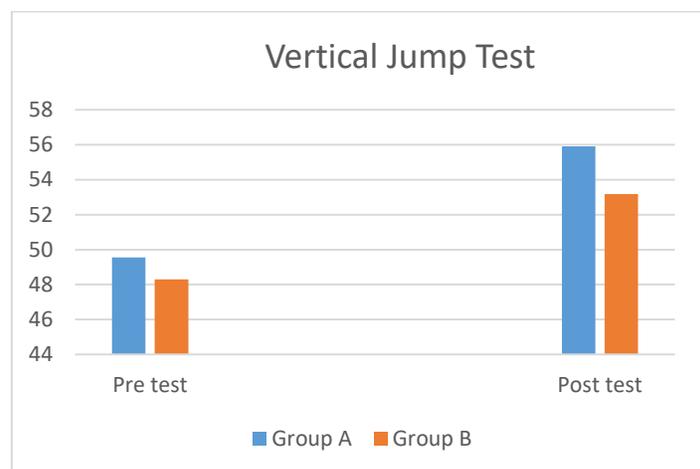
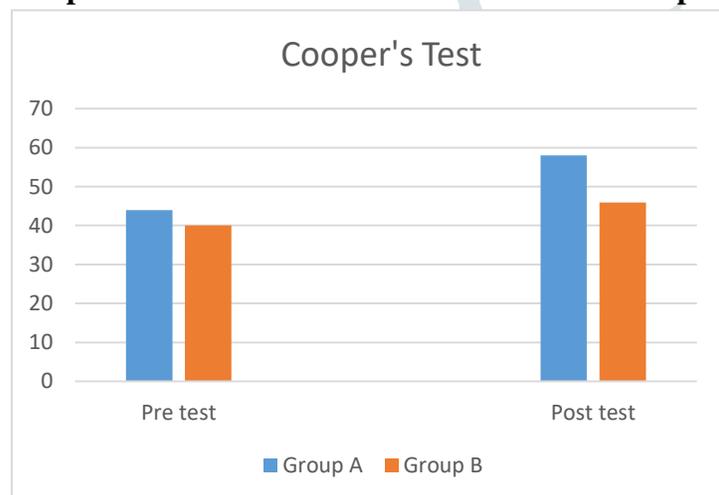
Independent 't' test as a parametric had been used to compare the means of Vertical jump test and Coopers run test between the groups with calculation of percentage of difference between the means.

**Statistical software**

The Statistical software namely SPSS 17.0 was used for the analysis of the data and Microsoft word and Excel had been used to generate graphs, tables etc.

**Results**

The mean and average strength of group A before training is 49.547 and after training is 55.913. Pre- test SD for strength is 2.8638 and post- test SD is 3.7428. The mean and average strength of group B before training is 48.3000 and after training is 53.1800. Pre- test SD for strength is 2.58816 and post- test SD is 2.45130. The mean and average endurance of group A before training is 43.987 and after training 58.010. Pre- test SD for endurance 6.9259 and post- test SD 3.2945. The mean and average endurance of group B before training is 40.0380 and after training 45.9240. Pre- test SD for endurance 6.84347 and post- test SD 7.19695. Thus the above result shows that there is significant improvement in tabata training but there is more significant improvement in aquatic plyometric training. Thus the above result shows that both the outcome measures endurance and strength of Group A and Group B show improvement.

**Graph-1: Mean difference in Strength in Group A and Group B****Graph-2: Mean difference in Endurance in Group A and Group B**

## Discussion

Our findings suggest that aquatic plyometric training showed more powerful improvement in strength and endurance after 5 weeks training duration. This study was performed to determine whether there are any significant differences in strength in vertical jump height and endurance in cooper's test as a result of participating in Tabata training program and an aquatic Plyometric training program.

Swimming requires both muscular strength and endurance. While endurance is the ability of the muscles to perform repeated submaximal contractions over time, strength is the amount of force that your muscles are able to produce. In swimming, muscular strength dictates how much force your muscles are able to apply to the water, which in turn propels your body forward.

We took subjects of n=30 swimmers between the ages of 18-25 years were included in the study. Subjects are divided into two groups by using chit method Group-A (APT) and Group B (TT). The study is carried out for the duration of 6 months the protocol for both the group is for 3 days per week for 5 weeks. The mean and average strength and endurance

of group A before training is 49.54 & 43.98 and after training is 55.91 & 58.01. And in group B before training is 48.30 & 40.03 and after training is 53.18 & 45.92. This shows slight significant increase ( $p < 0.05$ ) in group A than group B.

B Orna A. Donoghue et al., compared the aquatic plyometric and land plyometric and reported that aquatic plyometric makes it more difficult to maintain stability in upright position, decreasing the stretch shortening cycle reaction time and increasing drag due to arm swing through the water and thus improve strength more than with plyometric training performed on land. Our finding is similar to this study.<sup>16</sup>

HIIT is a training method for both male and female athletes, and can be used with excellent results in physiological parameters including maximal oxygen uptake, running economy, heart rate and perceived exertion.<sup>11</sup> Tabata training is a subcategory of HIIT (High Intensity Interval Training). Izumi Tabata and colleagues have shown that HIIT improves the aerobic capacity at similar levels as the medium-intensity continuous training, and also improves anaerobic capacity.<sup>12</sup>

Training in young swimmers at the age of 18-25 is often limited by time factors, such as leisure time activities and college commitments. Therefore they can't focus on their swimming performance. From this perspective, it seems logical that time-saving strategies for enhancing performance- limiting factors, such as efficient propulsion, endurance and strength performance are desirable. In the tabata training, the training duration is less and the exercise Intensity is more. Therefore, this training is more convenient.<sup>18</sup>

The benefits of aquatic exercise originate from the supportive nature of the water environment, muscular strengthening, and toning of muscles which result from the resistive properties of water as a dense liquid. Aquatic exercises can increase the strength, speed, endurance, explosive power and aerobic capacity, according to research.<sup>22,23</sup>

## Conclusion

During the course of this study, it has been concluded that – aquatic plyometric training and tabata training both have improved strength and endurance in young adult swimmers. There is significant increase in both aquatic plyometric training and tabata training after 5 week training duration in both groups. But group A receiving aquatic plyometric training showed more powerful improvement in strength and endurance.

**Ethical clearance:** Taken from Ethical Parul institute of physiotherapy committee.

**Conflict of Interest:** Nil

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