

**EFFECT OF BALLISTIC SIX UPPER EXTREMITY PLYOMETRIC TRAINING FOR JUNIOR BADMINTON PLAYERS ON UPPER BODY POWER, STRENGTH AND ENDURANCE**Sivasankari A.<sup>1\*</sup> and Malarvizhi D.<sup>2</sup><sup>1\*</sup>Assistant Professor, School of Physiotherapy, VISTAS, Tamil Nadu, India.<sup>2</sup>Professor, SRM College of Physiotherapy, SRM Institute of Science and Technology, Kattankulathur, Tamil Nadu, India.

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**ABSTRACT**

**Background:** The sensible introduction of plyometric training in children appears to be a safe method of conditioning for children to enhance their performance in sports. There is only limited evidence regarding the effect of plyometric training on sports in children. **Methodology:** Quasi Experimental, Convenient Sampling, sample size was 20. Subjects were conveniently selected based on the inclusion and exclusion criteria and experimental group followed 12 weeks of ballistic six upper extremity plyometric training along with regular badminton training. **Conclusion:** The results of this study showed significant improvement on overhead medicine ball throw test with experimental post test mean value 474.6 and push up performance with experimental post test mean value of 12.8(p<0.05) This study concluded that, ballistic six upper extremity plyometric training showed statistically significant on Push up performance score test and clinically significant on Overhead medicine ball throw test among junior badminton players.

**KEYWORDS:** Plyometrics, Ballistic six exercise, Junior Badminton players.**INTRODUCTION**

An individual maintaining a lifestyle being successful in his sports performance without involving in any sports related injury is really a challenge for the player.<sup>[1]</sup> Plyometric are explosive type of exercises commonly used by players in all type of sports.<sup>[2]</sup> Performance based rehabilitation facilitate the development of power by using plyometric exercise. It is the role of the Physiotherapist who plays an active role in the sports based rehabilitation and programs ensure that the players must be well organised with improved strength and conditioning in order to prevent injuries during sports performance and to rehabilitate injuries within the time bound to get back the players into play.<sup>[3]</sup>

Plyometric training for players is one of the advanced methods of strength training which increases their power and improves sports performance.<sup>[4]</sup> Plyometric training produces stretch shortening cycle by utilizing an eccentric movement which is quickly followed by concentric movement.<sup>[5]</sup> Though plyometric training improves athletic sports performance, there might arise a question of which this plyometric training is inappropriate and heavy to practice on children. Despite that, plyometric training can be considered as a natural

movement patterns like jumping, skipping movements are typically seen among school aged children.<sup>[6]</sup>

Research and evidences shows that plyometric training can be incorporated among school aged children which do not produce any ill effects.<sup>[7]</sup> **Avery D Faigenbaum** stated that plyometric training will be a safe one and can be implied on children as a part of the conditioning program yet it should be initiated as simple low or moderate intensity training for the children who are ready for this level of training.<sup>[5]</sup>

Badminton, the most popular racquet sport encompasses intermittent rallies of high intensity performance.<sup>[2]</sup> The shoulder functional movements play an integral role in the badminton performance as the player should be present with good strength and functional range of motion of shoulder.<sup>[7]</sup> The physical exertions caused by repetitive and rotational movements during badminton sport play a major role in the increased force on upper and lower limb which may lead to various acute and chronic injuries. Especially, the recurring motion of overhead may produce shoulder and upper limb overuse injuries.<sup>[8]</sup>

A sport of Badminton, a commonly played sport all over the world involves more overhead movements of upper limb and it is important to maintain upper limb stability and function. A study by **Wong Zhen Feng, et al** suggested that, notwithstanding that in badminton sport, the probability of shoulder injuries can be reduced with a proper amount and duration of badminton training along with a strategy training to improve shoulder strength, this study also stated that regular strengthening exercises for a shoulder maintains a healthy shoulder and prevents injury.<sup>[7]</sup>

The ballistic six plyometric training includes a set of six plyometric exercises which is done ballistically with appropriate rest periods given in between and it is said that it stimulates the overhead activity.<sup>[9]</sup> In general upper extremity plyometric training includes both open kinematic and closed kinematic exercises like overhead medicine ball throw and push ups exercises respectively.<sup>[10]</sup> The ballistic six plyometric exercises activates the stretch shortening cycle and there are three phases as eccentric, amortization and concentric phase which are involved in it. In eccentric phase, there will be a rapid eccentric contraction that facilitates the stretch reflexes which results in more concentric type of contraction on the opposite direction. Followed by this, there will be an initiation of concentric force, and the time duration between the eccentric contraction and the concentric force is the Amortization phase. In the final phase of concentric contraction, there will be concentric contraction where the individual starts to initiate the second repetition.<sup>[9]</sup>

Various researches have been done on which the set of six exercises done ballistically involving upper limb plyometric training improves the upper limb strength when performed as strength and conditioning program. A research by **Ryan Pretz** concluded his study that the ballistic six interval training program on baseball pitchers resulted in improved shoulder performance and which in turn prevented injuries.<sup>[9]</sup> **Carter et al** used a ballistic six exercises involving upper extremity plyometric training with a baseball team and concluded the improvements in isokinetic power of shoulder.<sup>[11]</sup> **Gelen et al** demonstrated that high volume plyometric training for upper limb benefit the service speed of elite junior tennis players.<sup>[12]</sup>

Participation of children in any kind of physical activity or sports has so many benefits like obesity prevention. These will make the children to be physically and mentally fit and healthy. The physiological aspects associated with the regular physical activity involve the reduced risk of diseases and improved quality of life with more physiological and psychological benefits.<sup>[13]</sup>

By considering the health benefits of children involved with sports participation, it is the role of the Physiotherapist to ensure the development of health in children. More than this, the important role is to prevent

the injuries in the sports participation. As badminton is one of the most popular overhead sports which involve rapid fast repetitive movements of upper extremity, there should be a more concern on the injury prevention especially among children and young athletes.

Research and evidences have concentrated more on plyometric training for lower extremities when compared with upper extremity. Though the plyometric exercise training for upper extremity must be followed with certain guidelines and should be performed more carefully on children, this plyometric exercise training for upper extremity shows a good result as that with lower extremity.<sup>[3]</sup> It is known that the upper limb strength, power and endurance make up a role in the sports performance and injury prevention. Also, there are only fewer evidences on ballistic six plyometric training for Children and young athletes and to our knowledge there is no evidence based on ballistic six training for badminton players of this age group. Therefore, this study is focused to find out the effects of ballistic six upper extremity plyometric training for junior badminton players on upper body, strength, power and endurance.

## MATERIALS AND METHODS

This study was conducted in order to explore the effects of ballistic six upper extremity plyometric training for junior badminton players on upper body power, strength and endurance. The Participants for the study were selected based on the inclusion and exclusion criteria. The inclusion criteria includes Junior badminton male players of Age 10 – 14 years with at least 2 years background of badminton experience and training and who were able to perform at least five hand push-ups.

All Children and their parents were explained about the procedure of the study and the parental/guardian informed consent was obtained before the start of the study. Participants were divided into experimental group (Group A) with 10 participants and control group (Group B) with 10 participants. All the participants were taken pre test scores on Overhead medicine ball throw test and push up performance score test. Participants in the experimental group followed a set of six exercises in upper extremity plyometrics along with their regular badminton training program for a period of 12 weeks, whereas the participants in the control group were trained only the regular badminton training. The regular training includes a badminton specific skill and strategy training.

The six exercises followed by experimental group includes,

- (a) Wall push ups
- (b) Two hand chest pass (with 2kg medicine ball)
- (c) Two hand overhead throw (with 2kg medicine ball)
- (d) Two hand rotations from side (with 2kg medicine ball)
- (e) Wrist flexor flips (with 2kg medicine ball)
- (f) Wrist extensor flips (with 2kg medicine ball)

A 15-minute warm-up session which includes the push-ups (1–2 sets of 6–10 repetitions) and free throws of the medicine ball (2–3 sets of 8–10 repetitions) were performed so as to prepare the participants for the medicine ball exercises (twice per week for 12 weeks) as per the protocol. All the participants performed 15 minutes of cool down session which includes the supervised stretching program for upper limb. Two 15 second stretches performed just “before the point of discomfort” with approximately 10 second between repetitions at the end of exercise training.

After the collection of the outcome scores of Overhead medicine ball throw test and push up performance test, the scores was analysed to find the effectiveness of 12-weeks ballistic six upper extremity plyometric training for all of the participants.

## RESULT

The result of this study proved that the experimental group which received plyometrics including ballistic six

exercises for upper limb for duration of 12 weeks showed an improvement in strength, endurance and power of upper body. The statistical analysis showed the significant improvement in the push up performance test and not in overhead medicine ball throw test but the mean value of the experimental group showed an improvement in the outcome. The post test values of Overhead medicine ball throw test values in interventional group is 474.6 and control group is 438.1 mean respectively and standard deviation of experimental group is 66.94 and control group is 53.50. Statistically it does not show significant as the p value was not less than 0.05. The Push up performance post test values of interventional group and control group were 12.8 and 8.9 mean and the standard deviations of experimental group is 4.04 and control group is 1.19 and it is significant as the p value is less than 0.05. However, in both the outcomes, the experimental group showed improvement clinically in the power, strength and endurance of upper body after training.

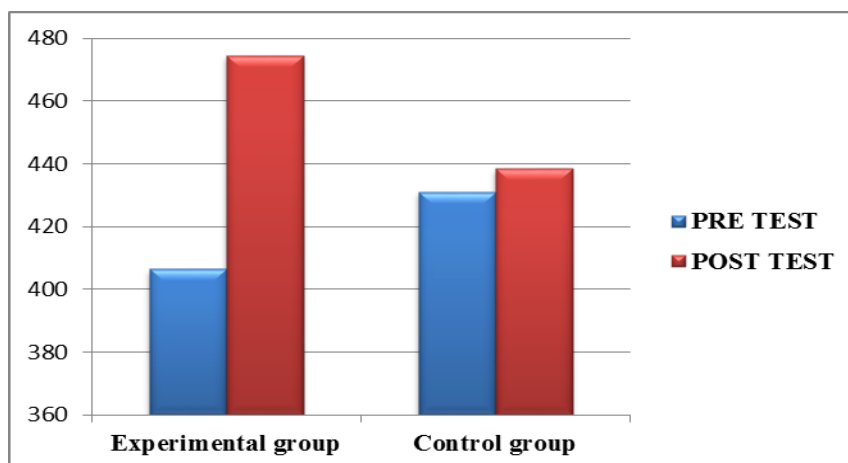


Figure 1: Overhead medicine ball throw test values.

It shows that the experimental group showed an increased value in the post test of overhead medicine ball throw test after training with the ballistic six upper

extremity plyometric training exercises. On average pre test value for overhead medicine ball throw test is 406.5 whereas the post test value is 474.6.

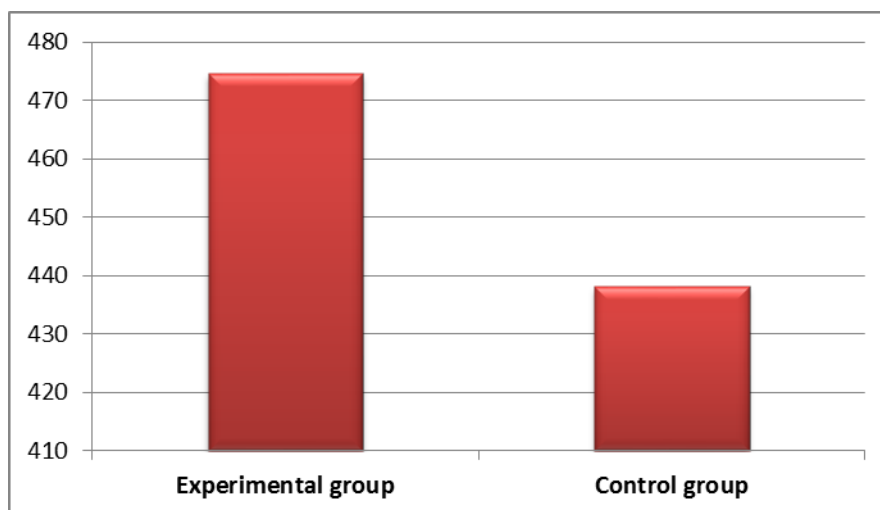
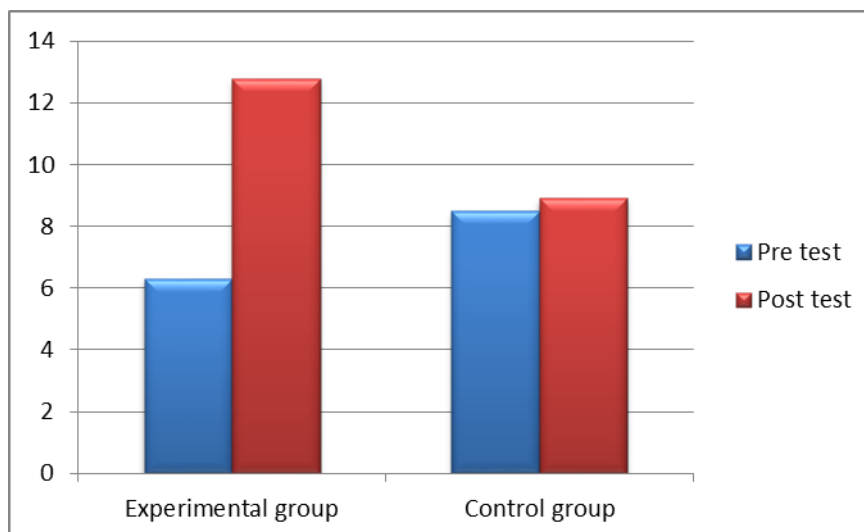


Figure 2: Comparison of Overhead medicine ball throw test values with experimental and control group.

It shows that post test values of experimental group showed increased value than a control group in overhead medicine ball throw test. The post experimental group

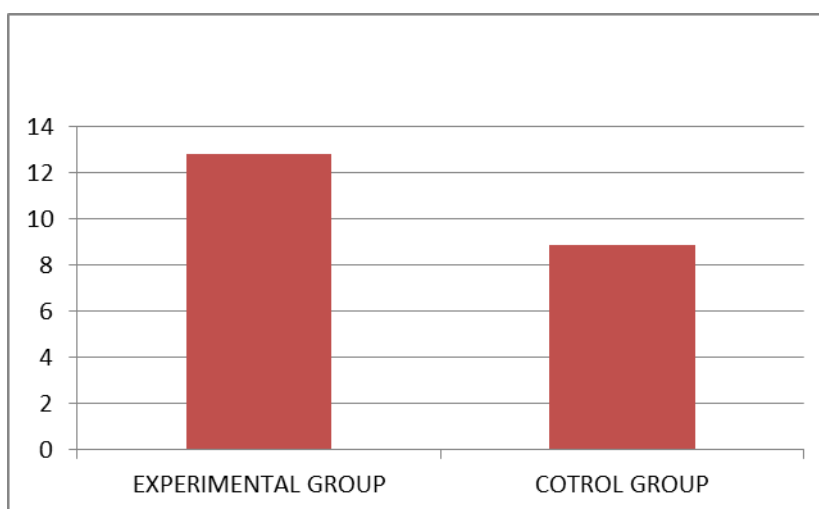
and control group values were 474.6 and 438.1 mean respectively.



**Figure 3: Push up performance score values.**

It shows that experimental group showed an increased value in the post test of Push up performance after training with the ballistic six upper extremity plyometric

training exercises. On average pre test value for push up performance test is 6.3 whereas the post test value is 12.8.



**Figure 4: Comparison of Push up performance score values with experimental and control group.**

It shows that post test value of experimental group showed a marked increase than a control group in push up performance. The post experimental group and control group values were 12.8 and 8.9 mean respectively.

## DISCUSSION

There is a growing level of evidences nowadays regarding the children being trained with weights, strength and conditioning program and power development program like Plyometric which shows the beneficiary effects in their sports performance activities and their general health.<sup>[1,3]</sup> Studies say that the children trained with appropriate well designed strength training

programs under proper supervision will have safe and successful outcomes. **Avery D. Faigenbaum** says that Children can safely perform plyometric exercises as a part of a conditioning program, provided age specific guidelines are followed.<sup>[3]</sup>

Plyometric exercise training is one of the best interventions which improve the neuromuscular ability to enhance power and endurance. In sports like Badminton, the important aspects of performance based rehabilitation for the improvement of power is essential and which can easily be attained by means of plyometric training.<sup>[4]</sup> The main role of Physiotherapy in the field of sports is to prevent injuries and to rehabilitate the injuries in a timely

manner so that the athlete will return to their sport. There are evidences on effect of upper and lower limb plyometric training for adults but there are only limited evidences showing the effectiveness of plyometric on children.

The sensible and reasonable introduction of plyometric training in children appears to be a safe method of conditioning for children to enhance their performance in sports. There is a need to determine the benefits of plyometric training in children. Therefore this study was focused to rule out the effects of ballistic six exercises of upper extremity plyometric training in junior badminton players on their power, strength and endurance of upper body.

**Ryan Pretz** in his study recommended the implementation of sports specific upper extremity plyometric training for overhead throwing athletes. Since badminton can be considered as the overhead sport, the implementation of ballistic six exercises of upper extremity plyometric training was used as an intervention in this study to know its effectiveness.<sup>[5]</sup>

Study by **Deepika Singla, et al** in her study of systematic review, recommended the need of future studies on finding the effectiveness of upper body plyometric training for a clear and strong conclusion of upper body plyometric training.<sup>[12]</sup>

The Study mainly focused on the effects of upper limb plyometric exercise in children. Since there are only limited amount of studies showed the effects on plyometric on Children, this study was done with the plyometric exercise which was properly designed with the exercise principle to minimize the adverse effects. Throughout the study, there were no adverse effects found in executing the plyometric exercise protocol framed for Children. The one limitation of the study is the limited sample size due to Covid pandemic due to which the badminton clubs were closed and was difficult to perform study with larger sample group.

This study concluded that there was an improvement in the strength, power and endurance of upper body after 12 weeks of ballistic six exercise training with upper extremity plyometric exercises on junior badminton players which can improve their sports performance and helps in injury prevention.

## CONCLUSION

This study concluded that, ballistic six upper extremity plyometric training showed statistically significant effect on Push up performance score test and clinically significant effect on Overhead medicine ball throw test among junior badminton players.

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**ETHICAL CLEARANCE:** Departmental ethical committee clearance was obtained before conducting the study.

**CONFLICT OF INTEREST:** Nil.

**SOURCE OF FUNDING:** Self.

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