Pertanika J. Soc. Sci. & Hum. 27 (S3): 183 - 192 (2019)

PERTANIKA JOURNALS

SOCIAL SCIENCES & HUMANITIES

Journal homepage: http://www.pertanika.upm.edu.my/

Effect of Six-week Plyometric and Resistance Band Training on Badminton Overhead Clear Stroke in 12 Years Old Players

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ABSTRACT

This study examined the effect of plyometric and resistance band training on overhead clear stroke of 12 years old badminton players via a 6-week intervention comprising plyometric and resistance band training sessions. The participants were ninety players (age, 12 years; height, 1.4-1.5m; body mass 30-40kg) comprised of 3 groups; plyometric training (n=30), resistance band training (n=30) and control group (n=30). The players completed the plyometric and resistance band training sessions. The badminton overhead clear stroke performance test (Onn, 1993) was conducted on 3 groups before and after the 6-weeks training. An ANCOVA was used to determine the changes between conditions and revealed the plyometric training significantly improved badminton overhead clear stroke ($p< 0.05$); pre: 5.20$\pm$0.49, post: 7.30$\pm$0.50 compared with resistance training ($p< 0.05$); pre: 5.21$\pm$0.31, post: 6.57$\pm$0.36 and control group ($p< 0.05$); pre: 5.22$\pm$0.29, post: 5.37$\pm$0.30. Although both experimental groups demonstrated a significant improvement as compared to the control group, the plyometric group showed a significant improvement as compared to the resistance group. Findings showed that 6 weeks of plyometric training was more effective compared with resistance band training in improving the performance of badminton overhead clear stroke.

Keywords: Badminton overhead clear stroke, plyometric, resistance training

INTRODUCTION

Badminton is a racket sport which needs power and agility in leaps, veers and quick arm movements. Most young players do not have enough ability to produce power, agility and quick arm movements. Badminton is a game played with rackets and shuttlecocks. One of the most important

ARTICLE INFO

Article history:
Received: 06 May 2019
Accepted: 31 October 2019
Published: 30 December 2019

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ISSN: 0128-7702
e-ISSN 2231-8534

strokes in badminton is the overhead stroke (Zhang et al., 2016). All the overhead forehand strokes movement have similarity except trajectory of the shuttlecock and strength while hitting the shuttlecock (Brahms, 2014). The overhead forehand stroke is played with full, throwing motion from the back half of the court. Forearm pronation important in forehand stroke. The forehand overhead stroke is probably the most powerful aspect of a player's game. You may use it as an offensive or defensive shot to move the opponent into back court and let the opponent to return a weak stroke (Zhang et al., 2016).

High and deep clear is usually use to gain time to return to the centre court position. It is often the recommended strategy especially in singles' play. While playing doubles', defensive clear is more recommended. The defensive clear is a high trajectory return similar to the lob in tennis. The tactical approach of the clear is to move the shuttle away from the opponent that would move him or her around the back court. By getting the shuttlecock behind the opponents or making them move more quickly than they would like, they will have less time to react and become more fatigued easily that forces weak returns. In addition, the clear can be defensive shot as it has a high and deep trajectory (Zhang et al., 2016).

Plyometric exercises which have to be perform explosively can be adapted more specific as well as mimic the throwing motion such as overhead clear stroke, overhead smash (badminton) and serve (tennis) in terms of movement similarity (Behringer et al., 2013). The utilisation of plyometric in training is found to gain an upper-edge in badminton-specific skills, patterns in movement such as jump, run and muscle-physiological changes which can improve the jump and speed performance (Joshi, 2012; Kansas, 2012). In addition, resistance band exercises have been utilised as a training method that can improve muscles strength and functional performance in sport specific skills (Treiber et al., 1998).

The study investigated the effectiveness of plyometric versus resistance band training on overhead clear stroke of 12 years old players. To date, there is no studies that examine the effect of plyometric training on puberty young children in sports-specific skills in badminton although numerous studies have examined physical components of different sports such as gymnastics (Bogdanis et al., 2019), soccer (Hammani et al., 2016), badminton (Irawan, 2017) and handball (Chelly et al., 2014). Therefore, the rationale of the study was to examine whether these two types of training methods would be able to improve the explosive movements of the young players in executing their badminton overhead clear stroke.

METHOD

Participants

A total of ninety players (36 males and 54 females) from a Chinese school located in Selangor, Malaysia participated in this study.

Permission was granted by their parents and the school's headmaster. In this study, the subjects involved were intact group of 12 years old students. Three classes of 12 years old students were involved in this study. All the first class of students were chosen for experimental group 1(plyometric training group), while as the second class of 12 years old students were chosen for experimental group 2 (resistance band training group) and the third class of 12 years old students were chosen for control group.

Experimental Design

The quasi-experimental design was used to compare the effectiveness of the plyometric training and elastic band training on badminton overhead clear stroke among year six students. The intact grouping method was selected due to quasi-experimental nature of the study design. According to Daniel (2011), an intact sampling method is a form of non-probability sampling method that yields result and can be generalized after making strong assumptions regarding sample. The chosen subjects were divided into three groups which are experimental group (plyometric training group and resistance band training group) and control group. The plyometric exercises were selected based on their similarity to badminton movement, level, volume and intensity of the players.

Training Intervention

The plyometric and resistance band exercises were adapted according to Brittenham (1992) guide lines based on the principles of progression, specificity and overload.

Plyometric training has been used to improve badminton overhead clear stroke. Sets of 3 with 20 repetition of shuttlecock throwing and 3 sets with 12 repetition of jumping lunges were conducted in the first week during plyometric training (Table 1). Starting from 2nd week until 4th week, participants would go through 2kg medicine ball shoulder throw (3 sets x 12 repetition)

Table 1
Plyometric training

Week	Training 1	Training 2
Week 1	Shuttlecock throwing (3 sets x 20)	*Jumpinglunge* (3 sets x 12)
Week 2	Dominant hand medicine ball shoulder throw (2kg) (3 sets x 12)	*Jumping lunge* (3 sets x 12)
Week 3	Dominant hand medicine ball shoulder throw (2kg) (3 sets x 12)	*Jumping lunge* (3 sets x 12)
Week 4	Dominant hand medicine ball shoulder throw (2kg) (3 sets x 12)	*Jumping lunge* (3 sets x 12)
Week 5	Dominant hand medicine ball shoulder throw (4kg) (3 sets x 12)	*Jumping lunge* (3 sets x 12)
Week 6	Dominant hand medicine ball shoulder throw (4kg) (3 sets x 12)	*Jumping lunge* (3 sets x 12)

Table 2
Resistance band training

Week	Training 1	Training 2
Week 1	3 sets x 12 of shoulder internal and external rotation exercises (6lbs of yellow resistance band)	3 sets x 12 squad (6 lbs resistance band)
Week 2	3 sets x 12 shoulder internal and external rotation exercises (6 lbs of yellow resistance band)	3 sets x 12 squad (6 lbs resistance band)
Week 3	3 sets x 12 shoulder internal and external rotation exercises (6 lbs of yellow resistance band)	3 sets x 12 squad (6 lbs resistance band)
Week 4	3 sets x 12 shoulder internal and external rotation exercises (9 lbs of green resistance band)	3 sets x 12 squad (9 lbs resistance band)
Week 5	3 sets x 12 shoulder internal and external rotation exercises (9 lbs of green resistance band)	3 sets x 12 squad (9 lbs resistance band)
Week 6	3 sets x 12 shoulder internal and external rotation exercises (9 lbs of green resistance band)	3 sets x 12 squad (9 lbs resistance band)

and jumping lunges (3 sets x 12 repetition) during plyometric training. From 5th week until 6th week, participants would go through 4kg medicine ball shoulder throw (3 sets x 12 repetition) and jumping lunges (3 sets x 12 repetition) during plyometric training.

In resistance band training, starting from 1st week until 3rd week, participants would go through internal and external rotation exercises with 6lbs of yellow resistance band (3 sets x 12 repetition) and squat using 6lbs of yellow resistance band (3 sets x 12 repetition) (Table 2). From 4th week until 6th week, participants would go through internal and external rotation exercises with 9lbs of green resistance band (3 sets x 12 repetition) and squat using 9lbs of green resistance band (3 sets x 12 repetition).

Control Group Training

In control group training, all the12 years old players followed the normal physical education class. All players followed through physical education class for 6 weeks.

Badminton Overhead Clear Test

Standard badminton courts were used for test of overhead clear. During the pre-test and post-test, every player went through five times of attacking overhead clear test. Shuttlecock feeding started by the feeder from centre of opposite court to the participant. Every clear shot hit by the participant landed on the score area would be counted. There are three types of score which were 1, 2 and 3 based on areas that shuttlecock landed.

Statistical Analysis

The test for badminton overhead clear, Onn (1993) was used to evaluate the performance of overhead clear stroke among 90 participants during pre-test and post-test (Figure 1). All participants were required to go through this test during pre-test and post-test. Three attempts were given to every participant to hit the overhead clear. Each trial has three types of scores which are one, two and three. These

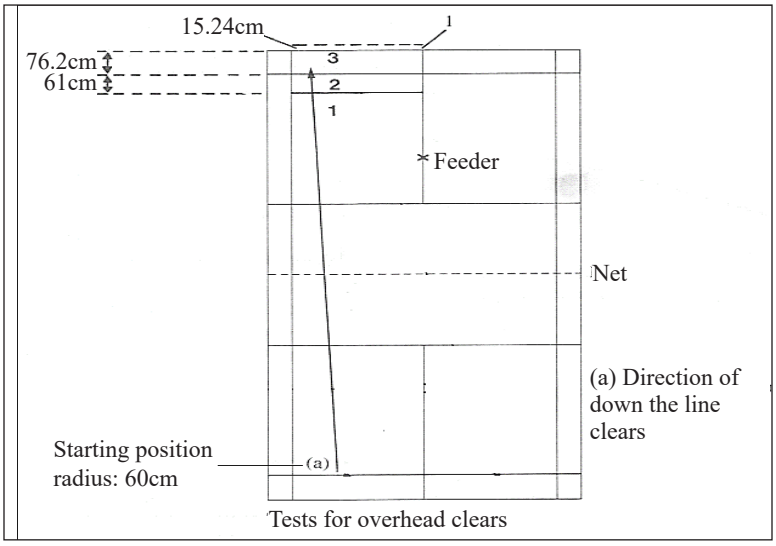

Figure 1. Test for overhead clear. Adapted from Onn (1993)

scores would be recorded after every clear stroke hit by the particular participant. Pre-test would be conducted in the first week followed by six weeks of plyometric training (experimental group 1), resistance band training (experimental group 2) and control group. Post-test has been conducted during the last week. After the post-test, the data has been collected.

RESULTS

The experimental group (plyometric training) showed significant improvement as compared to experimental groups (resistance band training) and the control group in the badminton overhead clear assessment.

Experimental 1 (Plyometric Training) vs Experimental 2 (Resistance Band Training)

Table 3 shows Levene's test of homogeneity of variance. Based on the table, the data from experimental group 1 and experimental group 2 were homogeneous (F=0.314, sig=0.578). According to Hair et al. (2010) if the significant is >0.05 the data is homogeneous.

Table 3
Levene's test of equality of error variances

F	df1	df2	Sig.
0.314	1	58	0.578

Table 4
Descriptive statistics

Group	N	Mean	Std. Deviation
Experiment 1	30	7.30	0.952
Experiment 2	30	6.57	1.104
Total	60	6.93	1.087

Table 4 shows the descriptive analyses on post-test for experimental group 1 and experimental group 2. Based on the table, the mean scores and standard deviation of post-test for experimental group 1 was 7.30 and 0.952 respectively. While the mean score and standard deviation of post-test for

experimental group 2 was 6.57 and 1.104 respectively. The results revealed the mean score of post-test for experimental group 1 was higher than mean score of post-test for experimental group 2 after treatment.

The ANCOVA results in Table 5 showed a significant difference in the achievement on functions between the experiment 1 and experiment 2 groups, with the pre-test as the covariate (F(1,57)= 41.571, sig= 0.000, $p<0.05$). The participants in the experiment 1 group (mean=7.30) showed higher scores than experiment 2 group (mean= 6.57) (Table 4), which meant that the use of plyometric training had better effect on participants' achievement on badminton overhead clear than the resistance band training. The differential effect is small (partial eta square =0.001) (Cohen, 1988).

Table 5
Tests of between-subjects effects

Source	Type III Sum of Squares	DF	M^2	F	Sig.	η^2
Corrected Model	34.074a	2	17.037	27.232	0.000	0.489
Intercept	9.315	1	9.315	14.889	0.000	0.207
Pre-Score	26.007	1	26.007	41.571	0.000	0.422
Group	0.031	1	0.031	0.049	0.826	0.001
Error	35.660	57	0.626			
Total	2954.000	60				
Corrected Total	69.733	59				

Experimental 1 (Plyometric Training) vs Control Group

Table 6
Levene's test of equality of error variances

F	df1	df2	Sig.
0.495	1	58	0.484

Table 6 shows Levene's test of homogeneity of variance. The results showed that experimental 1 and control group were homogeneous (F=0.495, sig=0.484). According to Hair et al. (2010) if the significant is >0.05 the data is homogeneous.

Table 7 shows the descriptive analyses on post-test for experimental group 1 and control group. Based on the table, the mean scores and standard deviation of post-test for experimental group 1 was 7.30 and 0.952 respectively. The mean score and standard deviation of post-test for control group was 5.37 and 0.669 respectively. The results revealed the mean score of post-test for experimental group 1 was higher than mean score of post-test for control group after treatment.

Table 7
Descriptive statistics

Group	N	Mean	Std. Deviation
Experiment 1	30	7.30	0.952
Control	30	5.37	0.669
Total	60	6.35	1.260

The ANCOVA results in Table 8 showed a significant difference in the achievement on functions between the experiment 1 and control groups, with the pre-test as bi-covariate ($F(1,57)= 13.602$, sig= 0.001, $p<0.05$). The participants in the experiment 1 group (7.30 ± 0.952) showed higher achievement than control group (5.37 ± 0.669) (Table 7), which meant that the use of plyometric training had better effect on participants' badminton overhead clear than the training in-control group had. Such a differential effect is small (partial eta square =0.348) (Cohen, 1988).

Table 8
Tests of between-subjects effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	η^2
Corrected Model	64.882[a]	2	32.441	64.277	0.000	0.693
Intercept	12.297	1	12.297	24.365	0.000	0.299
Pre-Score	6.865	1	6.865	13.602	0.001	0.193
Group	15.339	1	15.339	30.392	0.000	0.348
Error	28.768	57	0.505			
Total	2513.000	60				
Corrected Total	93.650	59				

Experimental 2 (Resistance Band Training) vs Control Group

Table 9
Levene's test of equality of error variances

F	df1	df2	Sig.
0.973	1	58	0.328

Table 9 shows Levene's test of homogeneity of variance. The resulted showed that the experimental 2 group and control group are homogeneous ($F=0.973$, sig=0.328). According to Hair et al. (2010) if the significant is >0.05 the data is homogeneous.

Table 10
Descriptive statistics

Group	N	Mean	Std. Deviation
Experiment 2	30	6.57	1.104
Control	30	5.37	0.669
Total	60	5.50	0.813

Table 10 showed the descriptive analyses on post-test for experimental group 2 and control group. Based on the table, the mean scores and standard deviation of post-test for experimental group 2 was 6.57 and 1.104 respectively. While the mean score and standard deviation of post-test for control group was 5.37 and 0.669 respectively. The results showed that the mean score of post-test for experimental group 2 was higher than mean score of post-test for control group after treatment.

The ANCOVA results in Table 11 showed a significant difference in the achievement on functions between the experiment 2 and control groups, with the pre-test as the covariate ($F(1,57)= 8.122$, sig= 0.000, $p<0.05$). The participants in the experiment 2 group (6.57 ± 1.104) showed

Table 11
Tests of between-subjects effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	η^2
Corrected Model	9.188[a]	2	4.594	8.784	0.000	0.236
Intercept	9.542	1	9.542	18.245	0.000	0.242
Pre-Score	8.122	1	8.122	15.529	0.000	0.214
Group	0.894	1	0.894	1.710	0.196	0.029
Error	29.812	57	0.523			
Total	1854.000	60				
Corrected Total	39.000	59				

higher achievement than control group (5.37± 0.669) (Table 10), which meant that the use of resistance band training had better effect on participants' badminton overhead clear than the training in control group had. Such a differential effect is small (partial eta square =0.029) (Cohen, 1988).

DISCUSSION AND CONCLUSION

The results showed that plyometric training could help to enhance the performance of the badminton players in the overhead clear stroke. This implied that normal badminton training alone would not enable the players to have significant changes in their strokes performance. In addition, it can also improve the overhead smash stroke or tennis serve in tennis which has similar intermuscular coordination from the lower to the upper body and then to the shuttlecock or ball through a kinetic chain (Fernandez-Fernandez et al., 2016).

The results showed that experimental group 1 had a higher mean than experimental group 2 and followed by control group. The finding was consistent with previous study which found that plyometric training was one of the best methods to increase explosive power (Radcliffe & Farentinos, 2015). Plyometric training shows positive results to most sports such as football, karate, handball, badminton and tennis (Brito et al., 2012; Chelly et al., 2014; Fernandez-Fernandez et al., 2016; Middleton et al., 2016; Salonikidis & Zafeiridis, 2008). In addition, it can improve and influence the vertical power of the players on badminton techniques such as overhead clear stroke smashes (Fröhlich et al., 2014; Kannas et al., 2012). Players need the higher power of muscles in order to perform a good quality badminton overhead clear stroke. Power is just as dependent upon speed as it is force. It is synonymous with speed-strength or explosive strength. Therefore, strength plus speed equal to power. Plyometric training is a method which train both strength and speed to generate greater power in muscles. We can conclude that plyometric training is better method to improve badminton overhead clear strokes than elastic band training method.

In Ellenbecker and Roetert (2004) study, elastic band had been used to strengthen shoulder's muscles in tennis serves. Tennis serve and badminton overhead stroke have same motion as throwing action. The results showed that elastic band training also improved the badminton overhead clear stroke. However, plyometric training proved to be more effective in increasing strength in which badminton strokes require explosive power to produce powerful and effective strokes. Whereas, resistance band training has slightly lower mean score than plyometric training because the resistance band training focuses more on shoulder muscles. Resistance band also focuses on strength training compare to plyometric training which focuses on strength and speed.

According to Zhang et al. (2016), powerful throwing comes from all body segments that produce maximal absolute velocity to your dominant hand and transfer the energy into your racket in one smooth movement. In plyometric training, a complete movement of throwing action apply during training session. This training would produce a powerful throwing movement that comes from all body segments that produce maximal absolute velocity to your dominant hand and transfer the energy into your racket in one smooth movement. Elastic band training focuses on strengthening shoulder muscles but other part of the body movements have been restricted. The results proved that plyometric training have positive effects on their jump heights, reach, racquet-head speed and stability of the players in executing their strokes. This implied that plyometric movements that mimic the badminton overhead clear stroke would improve the performance of the young badminton players.

The implementation of plyometric training that mimic sport-specific skills and progressively in the normal training programs is important as it can lead to specific athletics quality enhancements in terms of explosive actions in badminton. The study was limited to young adolescent players, and future studies should look into the combination of both plyometric training and elastic band training to other ethnicities, age groups and competitive levels of the athletes.

ACKNOWLEDGMENT

The authors acknowledge the school headmaster and participants.

REFERENCES

Behringer, M., Neuerburg, S., Matthews, M., & Mester, J. (2013). Effects of two different resistance-training programs on mean tennis-serve velocity in adolescents. *Pediatric Exercise Science, 25*(3), 370-84.

Brito, J., Krustrup, P., & Rebelo, A. (2012). The influence of the playing surface on the exercise intensity of small-sided recreational soccer games. *Human Movement Science, 31(*4), 946-956.

Bogdanis, G. C., Donti, O., Papia, A., Donti, A., Apostolidis, N., & Sands, W. A. (2019). Effect of plyometric training on jumping, sprinting

and change of direction speed in child female athletes. *Sports, 7*(5), 1-10.

Brittenham, G. (1992). Plyometric exercise: A word of caution. *Journal of Physical Education, Recreation and Dance*, *63*(1), 20-24.

Chelly, M. S., Hermassi, S., Aouadi, R., & Shephard, R. J. (2014). Effects of 8-week in-season plyometric training on upper and lower limb performance of elite adolescent handball players. *The Journal of Strength & Conditioning Research, 28*(5), 1401-1410.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd Ed.). Hillsdale, Michigan: Lawrence Erlbaum.

Ellenbecker, T. S., & Roetert, E. P. (2004). An isokinetic profile of trunk rotation strength in elite tennis players. *Medicine and Science in Sports and Exercise. 36*(11), 1959-1963.

Fernandez-Fernandez, J., Villarreal, E. S., Sanz-Rivas, D., & Moya, M. (2016). The effects of 8-week plyometric training on physical performance in young tennis players. *Pediatric Exercise Science*, *28*(1), 77-86.

Fröhlich, M., Felder, H. & Reuter, M. (2014). Training effects of plyometric training on jump parameters in D/DC-squad badminton players. *Journal of Sports Research, 1*(2), 22-33.

Hair, J. F., Black, W. C., & Babin, B. J. (2010). *Multivariate data analysis: A Global perspective* (Global Ed.). Pearson Education.

Irawan, D. S. (2017). Six weeks progressive plyometrics training on Badminton player's agility. *Advances in Health Sciences Research, 2*, 18-21.

Joshi, I. (2012). *Comparative analysis of 4 weeks agility training program and plyometric training on agility in Badminton players – A randomized clinical trial*. (Unpublish Doctoral Thesis) KLE University, India.

Kannas, T. M., Kellis, E., & Amiridis, I. G. (2012). Incline plyometrics-induced improvement of jumping performance. *European Journal of Applied Physiology, 112*(6), 2353-2361.

Middleton, G., Bishop, D. C., Smith, C., & Gee, T. I. (2016). Effectiveness of a low-frequency sports-specific resistance and plyometric training programme: The case of an elite junior badminton player. *International Journal of Coaching Science, 10*(2), 24-33.

Onn, P. Y. (1993). *Coaching and playing badminton the right way*. Selangor, Malaysia: Delta Publishing Sdn Bhd.

Salonikidis, K., & Zafeiridis, A. (2008). The effects of plyometric, tennis drills, and combined training on reaction, lateral and linear speed, power, and strength in novice tennis players. *Journal of Strength Conditioning Research, 22*(1), 182-191.

Treiber, F. A., Lott, J., Duncan, J., Slavens, G., & Davis, H. (1998). Effects of Theraband and lightweight dumbbell training on shoulder rotation torque and serve performance in college tennis players. *The American Journal of Sports Medicine, 26*(4), 510-515.

Zhang, Z., Li, S, Wan, B., Visentin, P., Jiang, Q., Dyck, M., Li, H. & Shan, G. (2016). The influence of x-factor (trunk rotation) and experience on the quality of the badminton forehand smash. *Journal of Human Kinetics, 53*(1), 9-22.