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Research article

Impact of strength and plyometric training on agility, anaerobic power and core strength in badminton players

Bodhisattva Dass[1], Khan Madiha[1], Rinkle Hotwani[1*], Sakshi P. Arora[2]

1. MGM School of Physiotherapy Aurangabad, a constituent unit of MGMIHS, Navi Mumbai, Maharashtra, India.
2. Ravi Nair Physiotherapy College, Datta Meghe Institute of Medical Sciences, Wardha, Maharashtra, India.

ABSTRACT

The study aimed to evaluate the effectiveness of strengthening and plyometric resistance training on anaerobic power and muscular strength in badminton players. The design used for the research is an experimental study with pre-test and pos-test measurement. The sample size used for the study was 40 both male and female with age ranging from 18 to 24 years and with the inclusion criteria of athletes who are under training for at least 1-2 years (.elite). Study procedure was started by measuring the agility of each badminton player by t-test, vertical jump and plank test before the strengthening and plyometric training. The subjects recruited for the study were equally distributed in two groups which included group A training group and group B control group. The mean and standard deviation bar graphs were used for the comparison. Comparison between the three outcomes measures done for the training group for the pre and post-test, concluding that there was a significant improvement in the values of the post intervention level.

Keywords: Strength, Plyometrics, Badminton Players, Agility, Anaerobic Power, Core

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Correspondence: Sakshi P. Arora* ✉ sakshi.arora@dmimsu.edu.in

Resident, Department of Community Health Physiotherapy, Ravi Nair Physiotherapy College, Datta Meghe Institute of Medical Sciences, Wardha, Maharashtra, India.

INTRODUCTION

Badminton is described as a multidirectional explosive sprint sport requiring players to demonstrate intense rhythmic movements. At high levels of play, the sport requires aerobic stamina, agility, strength, speed and precision [1]. The ability of body to change its position smoothly with coordination of movements following an integrated set of skilful mobility involving speed, endurance, coordination, reflexes, balance and stamina [2].

Many studies were done on plyometric training concluding that it increases explosiveness and power; mandatory in badminton players also [3]. The plyometric drills or stretch-strengthening training or stretch-shortening training, includes loading of muscle with a velocity high enough ranging from concentric to eccentric muscle movement, with reactions involving muscular reflexes and functional patterns [4]. When the muscle loads itself rapidly eccentrically, it brings in light the stretch phase of muscle wherein that concentrically brings the shortening phase [5]. There comes a point in between the contraction and stretching phase of muscle referred to as amortization phase [6].

Weight of the racquet plays a major role for any player basing upon any of the physiological changes concerned. The light weight racquets nowadays gives players an access to utilize short hitting action out of many strokes, allowing them to maintain an option of powerful hit or soft stroke according to the necessity [7].

Jumping is one of the other prime components in badminton, a complex multi-joint action demanding not only force production but also a high power output. It has been suggested that increase in power and efficiency due to plyometric may increase the agility training objective and hence plyometric activities have been used in sports as football, tennis, soccer or other sporting events to enhance their athletes agility [8].

By all of the things discussed up till now, it can be easily stated an efficient core is required to perform all these movements [9]. The strong core gives permission of maintaining the normal length tension association of acting antagonists and agonists leading to the maintenance of lumbo-pelvic- hip complex relationship [10].

The Plyometric drills involve the combination and effectiveness of elasticity of muscles and stretch reflex of neuromuscular unit. Furthermore, the stretch-shortening cycle is thought to stimulate the proprioceptors of muscles, tendons, ligaments and joints; increase the excitability of the neuromuscular training system [11].

The studies elaborating the effect of plyometric drills in association with power and strength of muscle is limited [12]. One of such study, concentrated on association of plyometric drills with muscle resistance, which may improve the dynamic muscular contractibility [13]. Also, very few but reliable results suggested that the plyometric drills may help to improve physical performance, and may reduce the prevalence of lower limb injury [6].

MATERIALS AND METHODS

The study proposal was registered in the research centre and ethical approval was obtained with registration number MGMEB/2020/112. It was an experimental with pre-test to post-test measurement. The sample size used for the study was 40 (male/female) Badminton players.

For 5 weeks duration. The technique used for sampling was consecutive consenting convenience sampling. The data was collected from Badminton Sports club of Aurangabad city. The inclusion criteria included age ranging from 18 to 24 years, both males and females, athletes who are under training from at least 1-2 years.(elite), candidates those who are willing to participate and sign the informed consent. The exclusion criteria included athletes with injuries, trauma, and pathology, any neurological or psychological complications and athlete with recent change in sports.

Procedure

The following study is based on plyometric resistance training in badminton player. The study was carried out in Aurangabad city. Place selected was Badminton court and Spots club of Aurangabad city. The sample population consisted of male and female badminton player's age group of 18 to 24 years. A convenient sample of 40 players was selected. Data collection sheet and concerned form was adapted for the study. Agility of each player was measured by T-test, vertical jump and plank test before the plyometric and resistance training. First of all clear explanation about the data and plyometric training was asked to the badminton players. Data collection sheet and concerned form was given to players who accepted to participate in the study. Participants were request to feel the data collection sheet. Data collection sheet were check for completeness.

RESULTS

Table 1. Demographic distribution

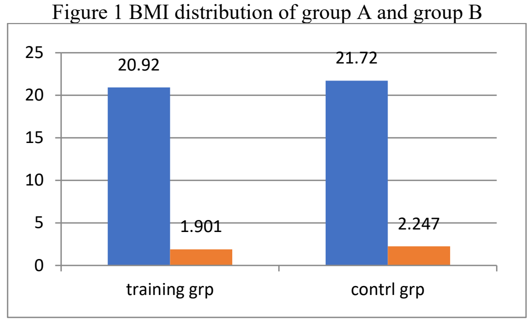
Group Name	Training Group	Control Group
Mean	21.35	21.1
Standard Deviation	1.954	1.832

The mean and standard deviation for the demographic detail is shown in the table above. The groups were consist of 20 subjects in each. The registered f and p value for age was 1.138 and 0.678 respectively. Between group analyses did not show any significant differences between the group in terms of age.

Table 2: BMI Distribution

Group Name	Training Group	Control Group
Mean	20.92	21.72
Standard Deviation	1.901	2.247

Figure 1 BMI distribution of group A and group B



The registered t and p value for age was 1.038 and 0.3121 respectively. Between group analyses did not show any significant differences between the groups in terms of BMI.

Table-3: Mean and Standard Deviation of vertical jump

Group Name	Training Group		Control Group	
	Vertical Jump			
	Starting Point1	Final Point1	Starting Point1	Final Point1
Mean	219.375	256.1	220.5	268.15
Standard Deviation	14.59	18.901	21.355	27.361
	Starting Point2	Final Point2	Starting Point2	Final Point2
Mean	219.375	263.32	220.5	269.3
Standard Deviation	14.597	17.87	21.355	27.94

For the control group, t value 2.467 was and P was 0.0233 (significant), for the training group, t value was 8.773 and P was 0.0001(significant)

Table 4: Mean and Standard Deviation of Plank test

Group Name	Training Group		Control Group	
	Plank			
	Pre	Post	Pre	Post
Mean	50	62.05	43.75	47.02
Standard Deviation	16.63	13.14	8.686	10.54

For the control group, t value was 3.139 and P was 0.0054 (significant) For the training group, t value was 8.052 and P was 0.0001(significant)

Figure 2 within group analysis was done using paired sample t-test.

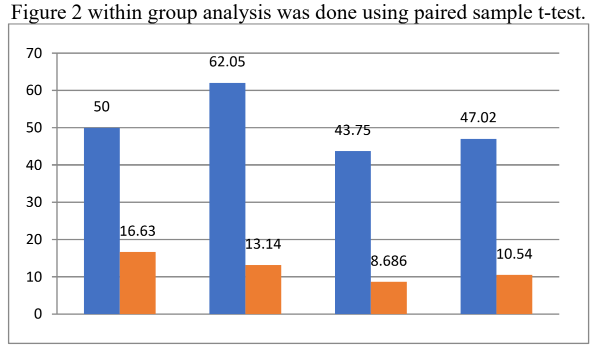


Table 5: Vertical jump measures for training group

group name	training group	
	vertical jump	
	starting point1	final point1
Mean	219.597	256.1
standard deviation	14.59	18.901
	starting point2	final point2
Mean	219.375	256.1
standard deviation	14.597	17.87

Table-6 Vertical jump measures for control group

group name	control group	
	vertical jump	
	starting point1	final point1
Mean	220.5	268.15
standard deviation	21.355	27.361
	starting point2	final point2
Mean	220.5	269.3
standard deviation	21.355	27.94

DISCUSSION

In this study, when comparison for three outcome measures was done for the training group between pre and post-test reading, there was significant improvement in the values for post intervention level. In vertical jump test, only the final point - pre and post treatment values were taken as starting point would differ according to the height of participants, starting point was taken just to know the baseline so no comparison was done. The p value for vertical jump test post reading value was found statistically significant (p value<0.0001).

Similarly, when the comparison was done between post values of the training group versus control group for t-test (p value<0.0001) and for plank test (p value-<0.0001) whereas the inter group value i.e. pre and post readings for control group was not found significant (p value-0.3458). Paired and unpaired t-test was used to determine significant differences between pre-test and post-test periods within the groups and between the groups to analyse the data. Initially the mean value of plank test was 50 when the mean value of training group was calculated after training it increased till 62.05 which signifies that with plyometric training, anaerobic resistance training and plank training improves the core muscle strengthen simultaneously. The positive effects of plyometric drills of lower limb following a specific conditioning program is supported by many studies. There are such findings which supported the fact that the alteration in force, power, velocity, height and size result in improved performance [13]. Some of the reported findings suggested that plyometric training elicit the improvements in force production, power output, increase in vertical jump velocity, jump height and increase in muscle fibre size [14]. The study done by Fatouros et al [15] included that the intensity, selection of exercise and volume illustrates the progressive overload principle, varying from low intensity and simple exercises, reaching up to multi-joint, high intensity and complex techniques [16].

From the researchers conducted, it can be concluded that plyometric training has better beneficial effect on the agility and core strength and is more beneficial than other forms of training for badminton players [17]. One of the few studies suggested that plyometrics, either alone or in combination with other typical training modalities, elicits numerous positive changes in the neural and musculoskeletal systems, muscle function and the athletic performance of healthy individuals [18]. Plyometric training acts on agonist and antagonist muscles which enhance functional joint stability and reduces the risk of injury [19]. It is suggested that the frequency of plyometric training should not exceed 3 times per week and that if executed in back to back days, the same muscle groups not be stressed in succession [20].

Agility training significantly improves the spinal reflex time as well as cortical response time of the muscles being trained. In the previous study of plyometric training the authors speculated that improvements were an outcome of improved utilisation pattern of motor unit [21]. The responsiveness of an athlete is the result of neural adaptation occurring because of enhanced coordination between proprioception and CNS signals.

The present study demonstrated that there was no significant difference of age and gender on agility. Brown G.A.et al found that the blood lactate concentrations significantly increased above resting throughout plyometric training with no differences between sexes or sets [22].

Rahman Rahimi and Naser Behpur (2005) et al. conducted the study on comparing the effect three drills involving weight training, plyometric training and their association with anaerobic power, vertical jump and strength of muscle. The result included the different types of training methods enhanced significant improvements (p<0.05) in all the presented variables. But the training group combination were showing improved signs in the 50 yard dash, vertical jump performance and strength of leg evidently more as compared to remaining groups. This study provide support for the use of a combination of traditional weight training and plyometric training to improve the vertical jump ability, explosive performance in general and leg strength [23].

Jumping is one of the components, essential for badminton players to improve their game, mostly during smashing activities and placing as well. With the plyometric exercise, high-velocity resistance training is employed by a rapid, resisted, eccentric (lengthening) contraction during which the muscle elongates, immediately followed by a rapid reversal of movement with resisted concentric (shortening) contraction of the same muscle, that is essential in the badminton sport and which in turn helps to stimulate the proprioceptors to facilitate increased muscle recruitment in a minimal amount of time [24].

Tarik Ozmen (2017) et al. conducted the study for investigation of effectiveness of plyometric training on vertical jump and agility in adolescent badminton players. As per their study, it showed that a six week plyometric training improved agility and vertical jump in adolescent badminton players.

The high intensity movement leads to the explosive movement pattern called as agility. It depends on speed, strength of muscle, coordination and balance of muscle in dynamic pattern. Meylan & Malatesta explained the plyometric training in 3 phases due to which maximum power is generated and hence by this, the rapid change in direction and brake in the speed is taken into account or is achieved via the plyometric training [25]. The activated motor units determine the increased neural adaptation with the number of motor units activated, the neural adaptation will increase and the increased neural adaptation includes improved coordination at inter-muscular level affecting the agility. The core muscles act as a bridge between upper and lower limbs, and force is transferred from the core, often called the powerhouse, to the limbs.

CONCLUSION

Result of this study after analysis directs us towards the conclusion that, the plyometric training not only improves the agility or anaerobic power but also strengthen the core which is the power-generator of the body. Plyometrics basically focuses on the rapid transfer of energy hat is easily explained via the stretch-shortening cycle and this can be done through the muscle activation of the core musculature without whose support the rapid energy transfer is somewhat impossible. So, during the whole process of the plyometric training the core automatically gets involved and in turn improving the core strength.

Limitations

- The sample size was less.
- The study was conducted on a smaller scale and at a local level.
- Study duration was less.

Future scope

- The study can be done on a larger sample size and a larger scale.
- Balance training should be recommended in further study.
- 6 week of plyometric training having effect on agility.

Author's Contribution

All authors contributed equally to the manuscript.

Conflict of Interest

The authors declare no conflict of interest.

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Informed Consent

Written & Oral informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this manuscript.

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