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RELATIONSHIP AMONG HEIGHT, EXPLOSIVE POWER AND SHOULDER STRENGTH ON SMASHING ACCURACY IN MALE BADMINTON PLAYERS

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Abstract:
Background: Badminton is one of the most popular racquet sports in the world. Into badminton, there are six basic strokes. Among these strokes, the most classical and powerful offending badminton technique used by the player to defeat the opponent is smashing. The Increase in height cans increments the number of positions in which an aggressive shot can be used. In badminton leg explosive power is a significant component and it results in the athlete being capable of moving instantly and constantly towards various directions of the shuttle and helping in lifting off the floor to play overhead strokes and Shoulder strength is a muscle's capacity to bury the resistant to execute a shoot. So higher the shoulder strength greater the velocity of smash, also the strength of the stroke could affect its path. The smashing is quite dependent on height, explosive power and shoulder strength. The relationship between these predictors and criterion variable are highly related and should be analyzed. **Objective:** Find out Relationship among Height, Explosive Power and Shoulder Strength on Smashing Accuracy in Male Badminton Players. **Methods:** This was a correlational study. Total 60 athletes were selected for the study. Three main predictor variables were measured – Height was measured by Stadiometer, Explosive power was measured by vertical jump and shoulder strength was measured by overhead medicine ball throw. Criterion variable – smashing accuracy, was measured by taking six consecutive smashes on a marked badminton court. **Result:** Analysis of the data showed that height was statistically significantly correlated with smashing accuracy at a significant level, but explosive power and shoulder strength not significantly correlated.($p < 0.05$) **Conclusion:** The findings of the study suggest that there exists a correlation between

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height and smashing accuracy in male Badminton players. Therefore, while selecting badminton players for the team during competitive events, Height would also be taken into consideration along with the sporting technique.

Keywords: smashing accuracy; explosive power; shoulder strength; vertical jump; overhead medicine ball throws

1. Introduction

Badminton is one of the most popular racquet sports of the world. It was discovered in China and currently has 200 million athletes worldwide. In Olympic, this game was included first time in the year of 1992 due to its gaining demands [1]. Badminton is guided by the uppermost regulatory body "Badminton World Federation" and in accordance to that badminton is an indoor game played on a rectangular court which is divided into two identical halves by a net[2]. Badminton is very famous and the second largest played sport after Cricket in India. In India, badminton is managed by the Badminton Association of India. Current successful Indian players are Saina Nehwal, Srikanth Kidambi, Parupalai Kashyap, P.V Sindhu and Jwala Gutta [3].

The game is played either by two players or four players and has three kinds of matches that are usually played as single, double and mix double with each player stand on the corresponding halves of the rectangular court with a net in the middle line [4]. Into badminton, there are six basic strokes. Among these strokes, the most classical and powerful offending badminton technique used by the player to defeat the opponent is smashing. Smash is defined as the most common killing shot. Of all the offending shots that are usually played in badminton, smash is played approximately 53.9%, therefore in badminton smash is decisive in the results. For a smash, the player hit the shuttle very hard and slam it downward as steep as possible, in order to ensure that it goes over the net. It helps the player to score the point because being hit so hard at such an angle it is very hard to defend [5].

Badminton may also be defined as a fast-speed racquet sport in which elite players are able to strike the shuttlecock with an exceptional speed and precision. The present-day Guinness World Record in shuttlecock velocity is 421 km/h [6]. Badminton players are able to speed up the racquet as well as shuttlecock to the observed velocity by the kinetics chain mechanism. The Kinetic chain mechanism is based on neuromuscular coordination (that is segments of a body move in a particular sequence) in a way to transfer energy from the ground to the legs, hip, lower back, upper back, arm, forearm, hand and lastly to racquet [5,7].

Sports performance depends on the multiple variables. They are physical, physiological, psychological, social, biomechanical and general body characteristics. In order to enhance the player's performance most important thing is to establish the specific quality and parameters, which contributes to the playing ability [8,9]. In anthropometric characteristics, height is one of the fundamentally important for victorious performance in sports like volleyball and basketball [10,11]. The increase in height cans increments the number of positions in which an aggressive shot can be used and thus discriminate between the zone of expertise. According to the world ranking 2008 top 13 rankers, the male contestant is taller (+5cm) from their colleges [12]. The product of strength and speed is called explosive power; it is the capability of muscles to generate the greatest force in the least time. In badminton, leg explosive power is a significant component and it results in the athlete being capable of moving instantly and constantly towards various directions of the shuttle and helping in lifting off the floor to play overhead strokes [9]. According to Omosegaard et al 1996, an explosive athlete will generally capable of jumping high, switch directions speedily and usually appears too quick and versatile on a badminton court [13]. Shoulder strength is a muscle's capacity to bury the resistant to execute a shoot. So higher the shoulder strength greater the velocity of smash, also the strength of the stroke could affect its path. So the opportunity of obtaining points is more [12,14].

The smashing is quite dependent on height, explosive power and shoulder strength. The relationship between these predictors and criterion variable are highly related and should be analyzed, knowledge of the relationship among these variables can help to improve coaching and badminton skills. There exists a dearth in studies carried on the correlation between height, explosive power and shoulder strength on smashing accuracy in badminton player.

1.1 Objective

Find out Relationship among Height, Explosive Power and Shoulder Strength on Smashing Accuracy in Male Badminton Players. Previous discussion explains that the smashing is quite dependent on height, explosive power and shoulder strength. The relationship between these predictors and criterion variable are highly related and should be analyzed, knowledge of the relationship among these variables can help to improve coaching and badminton skills. There exists a dearth in studies carried on the correlation between height, explosive power and shoulder strength on smashing accuracy in badminton player.

2. Method

Our study was a correlational study. All players were recruited from different sports complexes. Players were selected for the study after screening on the basis of inclusion and exclusion criteria. The procedure, profit, and hazards of the study had been explained to the selected participants. The sample size prediction had done by the power analysis, we took more than the estimated value and also subject availability and the period of the study took into consideration when did prediction of sample size. As a whole 60 subjects were taken participation in the study. In our study, predictor variables were (1) height of the participants, (2) explosive power of lower limb and (3) shoulder strength and criterion variable was smashing accuracy.

Upon assessment the inclusion criteria were,(1) male, age group 18-25 years[15], (2) At least one year experience of playing at competitive level[16] and (3) BMI lies in normal range (18.5-24.9kg/m2): exclusion criteria[15] were,(1)history of any neurological impairment as describe by player which may affect the outcome of study, (2) any history of pathological status of bones or joints as describe by player which may affect the outcome of study and (3) any history of musculoskeletal or traumatic status as describe by the player which may affect the outcome of the study.

Research workshop was organised by the prime author, convenient sampling method was used to selecting the subjects and all measurements tests for predictor and criterion variables was performed by the players i.e. Stadiometer measurement, vertical jump test, overhead medicine ball throw test and six smashes had been performed on the marked badminton court respectively. Informed consent was taken from all the subjects before they participating in the study and all rights were protected of the participants. Institutional Review Board and Ethical committee had been approved the procedure of the study.

2.1 Court Marking [17]

A standardize badminton court as used to test the smashing accuracy of the players. Badminton court has two divisions of equal size, namely right court and left court both have equal measurements (length is 472 cm, width is 259 cm excluding short serve line and height of the net is 155 cm) for singles. One-half of the court was divided into five equal halves. Scoring was done according to the increased level of toughness where 1 was given at the easiest point and 5 as the toughest in order to get in the traditional smashing in badminton. For subsequent three cross smashes, the other half or second half of the court was used (refer to Figure 4).

2.2 Smashing Accuracy [18]

Smashing Accuracy was measured by taking six consecutive strokes on the marked court, the six consecutive strokes were taken 3 diagonally and 3 straight. The score was given on the basis of the smashing strokes that were taken to the marked court, Higher the score getting from smashes higher will be the smashing accuracy

2.3 Outcome Measure

A. Stadiometer (Height) [18]

The subject was standing erect at the base with head in FrontoHorizontal (F-H) plane. The head bar was pulled down to touch the head, reading on the scale recorded to the nearest cm (refer to Figure 1).

B. Vertical jump test (Explosive Power) [15,18]

For assessing the explosive power of the lower limb athlete coloured the tip of his middle finger, Then athlete was stand at side of the wall and tries to maximum stretch his arm to reach up maximally with the hand closest to the wall, keeping both feet on the ground and then from point of fingertip a marked put on the wall. This was the standing reach point (M1). Then the athlete jumps as high as possible from its static position and marks the wall with the chalk on his middle fingers (M2), distant between M1 and M2 was noted in cm, the athlete had repeated the test 3 times with the 20 sec. rest between each trial and the average of the noted distances was used to evaluate the athlete's explosive power (refer to Figure 3).

C. Shoulder Strength Test (Overhead forward medicine ball throw) [18]

For assessing the explosive strength of the shoulder, 3kg Medicine ball and measuring tape was used. The athlete stands before the beginning point (a Parallel stance with feet appropriately apart) holding a 3kg medicine ball with both hands and then he performed a medicine ball overhead forward throw to cover the greatest distance. From all three trials, the average of the greatest two distances was noted in meters and 20sec. rest was given between each trial (refer to Figure 2).

3. Procedure [18]

Several athletes were assessed on the basis of the inclusion and exclusion criteria of the research. Based on the assessment, the selected athletes were incorporated in the study and a detailed explanation of the procedure, profit and hazards of the study was given to them. They were given a specific time to report.

The data collection started with a ten minute warm up consisting of low intensity exercises [19,20]such as calf stretch, toe touch, reach ups, jogging shoulder circling following which all the athletes were given the appropriate number of trials of medicine ball throw in order to familiarize them with the test and most importantly do decrease the chances of error. Three trials of medicine ball overhead forward throw test with a rest of twenty seconds in between were performed by the athletes and an average of greater two distances was noted. After that, appropriate number of trials for vertical jump followed by the vertical jump test was performed thrice with a rest of twenty seconds in between. An average of the distance recorded was used to evaluate the explosive power of the athlete.

Next, the athletes were given appropriate friendly trials of both straight and cross court smashes. Following the trials, three attacks of straight and cross court attack were performed. The athletes were asked to smash the shuttle cock cross during the first three trials and smash straight during the next three trials. The points were recorded on the basis of in which zone the base of the shuttlecock hits first, also on the specific court and if it grounded, out of the court margin or on the net zero points were given. Scoring was done as the sum of the scores obtained from the target values of the six trials. Finally, the data was analyzed.

3.1 Analysis

Data had been analyzed by using SPSS 21.0, IBM software. Pearson's Coefficient of Correlation formula was applied to find correlation among the variables. Demographic data, descriptive statics were obtained using Student's t-test. All Predictor variables were compared with the application of Pearson Correlation. The formula was applied at 95 % Confidence Interval and significant p values set at 0.05. The results were taken to be significant at $p \leq 0.05$.

4. Results

60 Male Badminton players (Mean age and BMI are 19.32 + 1.6 years old and 20.94 + 1.50 kg/m2 respectively) completed the procedure and were taken up for statistical analysis of their results (Table 1).

4.1 Height and Smashing Accuracy

The Results show that the Correlation of Height with Smashing Accuracy has a statistically significant positive correlation with an r value of 0.27 and a p-value of 0.04 (Mean 172.45, + Std. Deviation 5.82). The results also showed that Smashing accuracy was not very highly correlated when the values of the Height of the samples as the r value was found to be less than 0.5 (Table 2 & Table 3).

4.2 Explosive Power and Smashing Accuracy

The Results show that the Correlation of Explosive Power with Smashing Accuracy was not statistically significantly correlated with r value 0.22 and p-value 0.09 (Mean 42.75, + Std. Deviation 6.88) was found when the values of Explosive Power of the samples were compared with smashing accuracy. But if we check the significance at p-value 0.1 then explosive power was found statistically significantly correlated with smashing accuracy, r value 0.22 (Table 2 & Table 3)

4.3 Shoulder Strength and Smashing Accuracy

The Results show that the Correlation of Shoulder strength with Smashing Accuracy was not statistically significantly correlated with r value 0.12 and p-value 0.36 (Mean 6.2, + Std. Deviation 0.85) was found when the values of Shoulder Strength of the samples were compared with smashing accuracy. And if we check the significance at p-value 0.1 then also be shoulder strength was not found statistically significantly correlated with smashing accuracy, r value 0.12 (Table 2 & Table 3)

5. Discussion

The aim of our study was to find out the relationship among Height, Explosive Power and Shoulder Strength on Smashing Accuracy in Male Badminton Players

5.1 Height & Smashing Accuracy

The Results showed that the Correlation of Height with Smashing Accuracy had a statistically significant positive correlation with an r value of 0.27 and a p-value of 0.04 (Mean 172.45, + Std. Deviation 5.821). The results also showed that Smashing accuracy was not very highly correlated when the values of the Height of the samples as the r value was found to be less than 0.5.

The primary finding was that height had a statistically significant positive correlation with smashing accuracy, although height was not very highly correlated with smashing accuracy, the values still evidently showed a tendency of low correlation (r-0.27: p-0.04). In the actual sports world as we experienced that the degree of that much relation can also be put the impact on winning the medals. Therefore, a low correlation of height with smashing accuracy would be very significant for a player, especially in racquet sports to enhance the possibility of the number of situations in which an aggressive shot should be used most importantly smash and thus discriminate between zones of expertise. The Correlation between height and smashing accuracy in our study was identical to some other studies, such findings mimic with our findings these researches are Poliszczuk T. et al. 2010 [21] conducted a study and he had recognized that badminton players were taller and slimmer than the persons who were not engaged in sports. Michael et al. 2014 [12] he founded that in the world ranking 2008 the first 13 rankers athletes were higher (+5cm) from their colleges. This may be due to the fact that increase in height can increment the number of positions in which an aggressive shot can be used and thus discriminate between zone of expertise and also in tennis the height of both male and female athletes is a very significant factor which affects the serve velocity, probably the taller athletes had significant biomechanical leverage (Vaverka F. et al. 2013) [22]. S. Veeramani et al. 2015 [18] found that height and spiking accuracy in volleyball were statistically positively correlated and in our study, we found that height was statically correlated with smashing accuracy, but not highly correlated, this difference in the findings of the study might be due to the fact that they had taken only 15 subjects in their study and we took 60 subjects. So the number of participants more the chances of reducing errors in the measurements and probability of more accurate results in the study, as we had found.

5.2 Explosive Power and Smashing Accuracy

The Results show that the Correlation of Explosive Power with Smashing Accuracy was not statistically significantly correlated with r value 0.22 and p-value 0.09 (Mean 42.75, + Std. Deviation 6.88) was found when the values of Explosive Power of the samples were compared with smashing accuracy.

The main finding was that explosive power did not have statistically significantly correlated with smashing accuracy, but some similar researchers found that explosive power had a statistically significant correlation with playing capability and spiking accuracy. R. Jeyaraman et al. 2012 [9] concluded that agility, leg explosive power, speed and leg explosive strength where the huge positive correlation with playing capability. This variability in the finding may be attributed to their selection of subjects, which was from different colleges in Coimbatore. They did not put the criteria of level of selecting subjects might be the National level players were taken part in the study so the level of performance and expertise definitely higher, another reason that subjects might also play another game like tennis in which the circumference of lower limb muscles is more and ultimately producing more power than badminton players who had less lower limb circumference. So the higher circumference of calf muscles would produce more power and more power leads to jump higher and ultimately it affected the smashing accuracy as we had discussed about the advantages of higher height. Another reason may be due to the fact that they had taken 84 subjects and we took only 60 subjects, so as we already discuss the number of subjects can influence the findings of the study. S. Veeramani et al. 2015 [18] found that explosive power and spiking accuracy in volleyball was statistically positively correlated. This variation in the finding may be because of a number of participants who had taken part in the study. They had taken only 15 subjects and we took 60 subjects so the probability of getting the most accurate result in increasing the number of the participant that ultimately reduces the chances of errors.

5.3 Shoulder Strength & Smashing Accuracy

The Results show that the Correlation of Shoulder strength with Smashing Accuracy was not statistically significantly correlated with r value 0.12 and p-value 0.36 (Mean 6.2, + Std. Deviation 0.85) was found when the values of shoulder strength of the samples were compared with smashing accuracy.

The main finding was that shoulder strength did not have statistically significant correlations with smashing accuracy, but some similar researchers found that shoulder strength had a statistical correlation with smashing accuracy. Sakurai and Ohtsuki, 2000 [23] found that smacking accuracy was higher and also determine more consistent temporal control of the upper limb muscles in skilled athlete and non-skilled individual. For great smashing performance, muscle's good temporal control was an important quality. This variability in the finding may be due to the fact that they had done this study in a controlled environment .i.e., in the lab not on the badminton court with a fix distance of the target, the constant projectile of shuttle and fix smashing position of subjects, but we had done this study in the badminton court, position of smashing was not fixed and no constant projectile shuttle for the smashing. So all these conditions and situations of research were different, that's why the findings were different. Another reason for the difference in finding because their study was a pre and post-experimental design and our study was one time correlations. They had produced the effect of learning and ours was a one-time study, so no learning could be possible. S. Veeramani et al. 2015 [18] found that Shoulder strength was statistically highly correlated with Spiking Accuracy in volleyball players. This variation in the finding may be because of a number of participants who had taken part in the study. They had taken only 15 subjects and we took 60 subjects so the probability of getting the most accurate result with increasing the number of the participant that ultimately reduces the chances of errors. Another reason may be due to the fact that they had taken the 2kg medicine ball to measure shoulder strength and we took 3kg medicine ball for measuring the shoulder strength, so the athlete throws farther the lighter weight medicine ball rather than the heavier weight medicine ball, So the readings would be different and ultimately it affected the results.

5.4 Limitation

The findings of our study can't be generalized because Only male players were included in the study, Small sample size, Age group above 25 years were not included in the study, Players with higher experiences were not included, The data for smashing accuracy was not taken during a competitive event, Videography was not carried out and The racquet used during the study was equipment used by basic and intermediate level players and not elite class players.

5.5 Future Research

Both sexes, male and female will be included in future researches, Large sample size will be taken, Age group above 25 years should be included in the study, Players of higher competitive level should be included, The data for smashing accuracy will be taken during competitive events, Videography will be carried out, The racquet uses during the study will be advanced level racquet.

6. Conclusion

The findings of the study suggest that there exists a correlation between height and smashing accuracy in male Badminton players. Therefore, while selecting badminton players for the team during competitive events, Height would also be taken into consideration along with the sporting technique.

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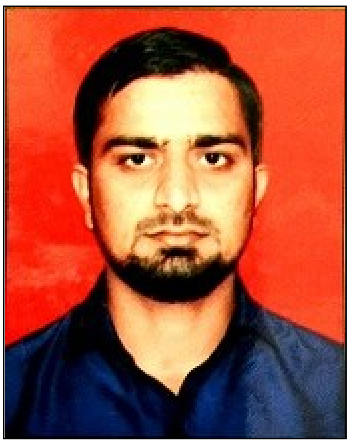
About the Author



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Appendix

Table 1: Descriptive statistics of participants (Demographic data)

	N	Age	BMI
Mean ± SD	60	19.32±1.6	20.94±1.5

N = number of participants; BMI = body mass index; SD = standard deviation.

Table 2: Correlations among Height, Explosive Power and Shoulder Strength with Smashing Accuracy

		Height	Explosive power	Shoulder strength	Smashing accuracy
Height	r - value	1	0.17	0.05	0.27*
	P - value		0.19	0.7	0.04
	N	60	60	60	60
Explosive power	r - value	0.17	1	0.26*	0.22
	P - value	0.19		0.04	0.09
	N	60	60	60	60
Shoulder strength	r - value	0.05	0.26*	1	0.12
	P - value	0.7	0.04		0.36
	N	60	60	60	60
Smashing accuracy	r - value	0.27*	0.22	0.12	1
	P - value	0.04	0.09	0.36	
	N	60	60	60	60

*. Correlation is significant at the 0.05 level (2-tailed). r = Pearson Correlation; p = Sig. (2-tailed)

Table 3: Descriptive Statistics of Variables

	Height	Explosive power	Shoulder Strength	Smashing Accuracy
Mean ± SD	172.45 ± 5.82	42.75 ± 6.88	6.2 ± 0.85	19.73 ± 3.20

SD = standard deviation.

Figure 1: Height Measurement by Stadiometer

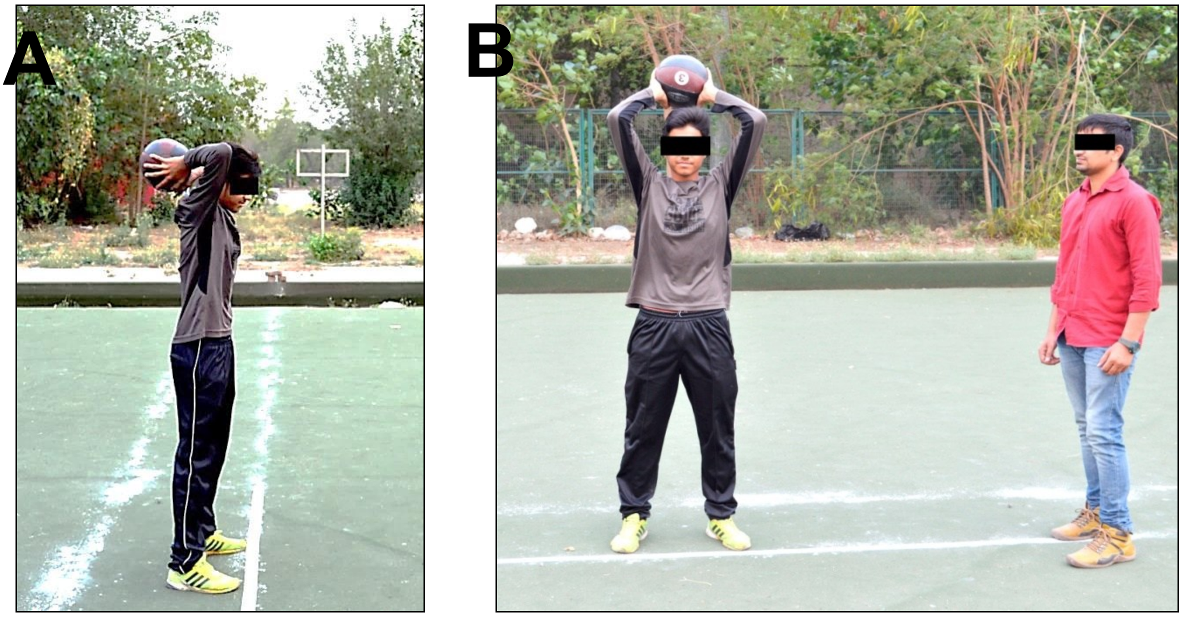

Figure 2: Over Head Medicine Ball Throw Test (A) lateral view: (B) Anterior view

Figure 3: Vertical Jump test. (A) Starting position. (B) Mid Position. (C) End position