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# A study on prediction of playing ability in badminton from selected anthropometrical physical and physiological characteristics among inter collegiate players

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**Abstract**
Badminton being a highly explosive sport, involves a unique movement technique and strength over a relatively small court area. The purpose of the study was to develop prediction equation from the selected anthropometrical, physical and physiological characteristics among State level players. To achieve the purpose of the study, eighty four male Badminton players who have played at the state level were randomly selected as the subjects. The age of the selected subjects ranged from 19 to 23 years of age. The height, weight, arm length, leg length, forearm girth, wrist girth, calf girth and hand length were taken as the anthropometrical variables, agility, flexibility, leg explosive power, leg explosive strength and speed were selected as the physical variables and breath holding time, resting heart rate and peak expiratory flow rate were taken as the physiological variables. All the data was collected by using the standardised equipments and tests. The Pearson's Product Moment Coefficient of correlation was computed to determine the relationship between playing ability and selected criterion variables and respective linear predictive models (stepwise argument selection) was developed. From the analysis of data, it was concluded that agility, leg explosive power, leg explosive strength, height, leg length, arm length, wrist girth, breath holding time and weight becomes the common anthropometrical, physical and physiological characteristics to be required for the state level Badminton players.

**Keywords:** badminton, anthropometrical, physical and physiological

## Introduction
Among the indoor games, Badminton occupies a place of pride both as an individual as well as team sport in spite of frequent changes that have occurred in various aspects of competition pertained to the game including, fitness level, skills, strategies and tactics. Scientific pedagogies and innovative approach have made the game more performance oriented than ever before. Concerning Badminton athletes' physical characteristics, several factors contribute to the success in the sport, including technique and tactics, psychological preparation and game strategy (Chint *et al*., 1995) [3]. The identification of physical characteristics in a sport modality contributes to its success and enables to spot differences among athletes of different modalities, which is of great interest for both sport coaches and scientists. Faude, *et al*., (2007) [6] highlighted that it is a sport modality which requires both aerobic and anaerobic energy systems and such characteristic is directly related to both short and long rallies, as well as game duration. Badminton players must have great physical capacity, especially agility, an aerobic strength and explosive power. For improving the performance of Badminton players it is important to identify the specific traits and parameters, which contribute to the playing ability.

Sports performance is based in a complex and intricate diversity of variables, which include anthropometrical, physical (general and specific conditions), and physiological factors. Several studies have been conducted to find out the parameters required for Badminton skill performance. Badminton being a highly explosive sport, involves a unique movement technique and strength over a relatively small court area. The match is won normally by a perfect amalgam of physical condition, mental attitude, courage, intelligence and the player's technical skill and tactical efficiency. It calls for a co-ordinated functioning of the body and its reflexes. Studies have pointed out the importance of physical characteristics for different sports. Thus this study was undertaken to develop prediction equation from the anthropometrical, physical and physiological characteristics on performance among state level male Badminton players.

## Methods and Materials
Eighty four male Badminton players who have played at the state level in haryana were randomly selected as the subjects. The age of the selected subjects were ranged from 19 to 23 years of age. To achieve the purpose of the study, height, weight, arm length, leg length, forearm girth, wrist girth, calf girth and hand length were taken as the anthropometrical variables, agility, flexibility, leg explosive power, leg explosive strength and speed were selected as the physical variables and breath holding time, resting heart rate and peak expiratory flow rate were taken as the physiological variables. All the data were collected by using the standardised equipments and tests. The Pearson's Product Moment Coefficient of correlation was computed to determine the relationship between performance and selected criterion variables and respective linear predictive models (stepwise argument selection) was developed. The anthropometrical variables height was measured by stadio meter, for weight weighing scale was used, the anthropometric tape was used to measure the arm length, leg length, forearm girth, wrist girth,

calf girth and hand length. For agility we have organized semo-agility test, for flexibility modified sit and reach test was used, vertical jump was assessed as an leg explosive power, standing broad jump was assessed as an leg explosive power and the speed was measured by 50 m dash. The physiological variables breath holding time was measured in seconds, resting heart rate was calculated by number heart beat per minute during rest and peak expiratory flow rate was measured by using the peak flow meter. The playing ability of the subjects was assessed by three qualified coaches, which was taken as a performance factor. The guideline for assessment was provided by the investigators. Each coach will rate the playing ability of the selected subjects in 100 point scale for each player. The rating given on each player will be added and will be divided by 3 to make the individual score of the subjects. The Pearson's Product Moment Coefficient of correlation was computed to determine the relationship between playing ability and selected criterion variables of anthropometrical, physical and physiological characteristics among the state level Badminton players. All the anthropometrical, physical and physiological characteristics that statistically correlated with playing ability were used and from respective linear predictive models (stepwise argument selection) was developed. The level ofsignificance was set at $p > 0.05$ and the data were analyzed using statistical package SPSS.

## Results

Since results of any endeavour plays an important role to interpret and explain the current trend of the concerned field. The results of the present investigation are presented in the preceding tables. The Table – 1 shows, mean and standard deviation values of State level Badminton players on selected anthropometrical, physical, physiological and playing ability.

**Table 1:** Descriptive Statistics of Selected Criterion Variables among State Level Badminton Players

| S. No. | Variables | N | Mean | SD (±) |
|---|---|---|---|---|
| | | 84 | 68.66 | 20.06 |
| 2 | Height | 84 | 175.03 | 5.74 |
| 3 | Arm Length | 84 | 77.87 | 3.87 |
| 4 | Leg Length | 84 | 94.15 | 4.26 |
| 5 | Forearm Girth | 84 | 25.35 | 3.62 |
| 6 | Wrist Girth | 84 | 15.93 | 1.09 |
| 7 | Calf Girth | 84 | 34.88 | 2.28 |
| 8 | Hand Length | 84 | 20.43 | 1.05 |
| 9 | Agility | 84 | 12.16 | 0.59 |
| 10 | Flexibility | 84 | 11.13 | 6.45 |
| 11 | Leg Explosive Power | 84 | 46.45 | 7.92 |
| 12 | Leg Explosive Strength | 84 | 214.36 | 13.97 |
| 13 | Speed | 84 | 7.25 | 0.53 |
| 14 | Breath Holding | 84 | 40.12 | 10.95 |
| 15 | Resting Pulse Rate | 84 | 74.00 | 6.80 |
| 16 | Peak Expiratory Flow Rate | 84 | 502.26 | 56.05 |
| 17 | Playing Ability | 84 | 53.38 | 14.47 |

The present study attempted to link the playing ability with the anthropometric, physical and physiological characteristics of state level men Badminton players, correlation analysis was made. Table – 2 displays a correlation matrix among each of the variables used in the study and shows the correlation coefficient associated with each other.

**Table 2:** Inter – Correlation Matrix of Selected Criterion Variables among State Level Badminton Players

| Variables | Weight | Height | Arm Length | Leg Length | Forearm Girth | Wrist Girth | Calf Girth | Hand Length | Agility | Flexibility | Leg Explosive Power | Leg Explosive Strength | Speed | Breath Holding Time | Resting Pulse Rate | Expiratory Peak RateFlow |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Playing ability | 0.07 | 0.13 | 0.08 | 0.12 | 0.15 | 0.01 | 0.03 | 0.10 | 0.74 | 0.27 | 0.57 | 0.35 | 0.55 | 0.15 | 0.09 | 0.04 |
| Weight | | 0.46 | 0.31 | 0.44 | 0.03 | 0.32 | 0.21 | 0.29 | 0.03 | 0.45 | 0.11 | 0.07 | 0.01 | 0.38 | 0.26 | 0.12 |
| Height | | | 0.84 | 0.89 | 0.29 | 0.48 | 0.07 | 0.56 | 0.02 | 0.16 | 0.04 | 0.18 | 0.07 | 0.15 | 0.30 | 0.19 |
| Arm Length | | | | 0.84 | 0.47 | 0.40 | 0.06 | 0.70 | 0.06 | 0.05 | 0.03 | 0.19 | 0.01 | 0.01 | 0.33 | 0.14 |
| Leg Length | | | | | 0.32 | 0.47 | 0.03 | 0.54 | 0.07 | 0.13 | 0.11 | 0.23 | 0.14 | 0.09 | 0.29 | 0.12 |
| Forearm Girth | | | | | | 0.17 | 0.36 | 0.22 | 0.19 | 0.14 | 0.02 | 0.23 | 0.08 | 0.06 | 0.09 | 0.01 |
| Wrist Girth | | | | | | | 0.47 | 0.46 | 0.09 | 0.19 | 0.03 | 0.18 | 0.10 | 0.04 | 0.23 | 0.14 |
| Calf Girth | | | | | | | | 0.18 | 0.12 | 0.15 | 0.00 | 0.22 | 0.08 | 0.05 | 0.10 | 0.01 |
| Hand Length | | | | | | | | | 0.03 | 0.09 | 0.04 | 0.19 | 0.07 | 0.02 | 0.01 | 0.34 |
| Agility | | | | | | | | | | 0.40 | 0.50 | 0.56 | 0.76 | 0.04 | 0.02 | 0.06 |
| Flexibility | | | | | | | | | | | 0.29 | 0.32 | 0.55 | 0.03 | 0.01 | 0.08 |
| Leg Explosive Power | | | | | | | | | | | | 0.70 | 0.64 | 0.17 | 0.19 | 0.02 |
| Leg Explosive Strength | | | | | | | | | | | | | 0.68 | 0.11 | 0.24 | 0.08 |
| Speed | | | | | | | | | | | | | | 0.23 | 0.05 | 0.29 |
| Breath Holding Time | | | | | | | | | | | | | | | 0.10 | 0.48 |
| Resting Pulse Rate | | | | | | | | | | | | | | | | 0.08 |

From the above cited table – 2, it's seemed that there was a correlation exists between playing ability versus agility (0.74), leg explosive power (0.57), speed (0.55) and leg explosive strength (0.35) respectively. Rest of the other variables was showed low correlation with the playing ability.

From the table – 3, it was noted that R and $R^2$ were calculated for each variable. Anthropometrical, Physical and physiological variables that statistically correlated with playing ability were used to form respective linear predictive models (step-wise argument selection) was developed.

**Table 3:** Regression Models for Selected Criterion Variables among State Level Badminton Players

| Steps | Variables | R | $R^2$ | Unstandardized Coefficients | | Standardized Coefficients |
|---|---|---|---|---|---|---|
| | | | | B | Std. Error | Beta |
| 1 | (Constant) | 0.740 | 0.547 | 275.140 | 22.316 | |
| | Agility | | | -18.230 | 1.832 | -.740 |
| 2 | (Constant) | 0.776 | 0.602 | 211.779 | 28.245 | |
| | Agility | | | -14.913 | 1.989 | -.605 |
| | Leg Explosive power | | | .495 | .147 | .271 |
| 3 | (Constant) | 0.807 | 0.651 | 288.614 | 35.110 | |
| | Agility | | | -16.671 | 1.946 | -.676 |
| | Leg Explosive power | | | .845 | .174 | .463 |
| | Leg Explosive Strength | | | -.334 | .100 | -.323 |
| 4 | (Constant) | 0.839 | 0.703 | 207.218 | 39.265 | |
| | Agility | | | -17.229 | 1.813 | -.699 |
| | Leg Explosive power | | | .982 | .165 | .538 |
| | Leg Explosive Strength | | | -.447 | .097 | -.431 |
| | Height | | | .605 | .163 | .240 |
| 5 | (Constant) | 0.874 | 0.764 | 168.619 | 36.250 | |
| | Agility | | | -17.836 | 1.632 | -.724 |
| | Leg Explosive power | | | 1.185 | .155 | .649 |
| | Leg Explosive Strength | | | -.504 | .088 | -.487 |
| | Height | | | 1.939 | .331 | .769 |
| | Leg Length | | | -1.961 | .436 | -.577 |
| 6 | (Constant) | 0.884 | 0.781 | 188.687 | 36.082 | |
| | Agility | | | -18.486 | 1.604 | -.750 |
| | Leg Explosive power | | | 1.236 | .152 | .677 |
| | Leg Explosive Strength | | | -.537 | .087 | -.518 |
| | Height | | | 1.712 | .334 | .679 |
| | Leg Length | | | -2.447 | .467 | -.721 |
| | Arm Length | | | 1.001 | .408 | .268 |
| 7 | (Constant) | 0.893 | 0.797 | 197.696 | 35.237 | |
| | Agility | | | -18.568 | 1.557 | -.753 |
| | Leg Explosive power | | | 1.343 | .154 | .735 |
| | Leg Explosive Strength | | | -.630 | .093 | -.609 |
| | Height | | | 1.909 | .334 | .757 |
| | Leg Length | | | -2.388 | .454 | -.703 |
| | Arm Length | | | 1.005 | .397 | .269 |
| | Wrist Girth | | | -2.095 | .879 | -.157 |
| 8 | (Constant) | 0.899 | 0.808 | 198.099 | 34.470 | |
| | Agility | | | -18.683 | 1.525 | -.758 |
| | Leg Explosive power | | | 1.312 | .151 | .719 |
| | Leg Explosive Strength | | | -.639 | .091 | -.617 |
| | Height | | | 2.026 | .332 | .804 |
| | Leg Length | | | -2.331 | .445 | -.686 |
| | Arm Length | | | .827 | .397 | .221 |
| | Wrist Girth | | | -2.202 | .861 | -.165 |
| | Breath Holding Time | | | -.148 | .070 | -.112 |
| 9 | (Constant) | 0.905 | 0.818 | 213.978 | 34.595 | |
| | Agility | | | -18.604 | 1.493 | -.755 |
| | Leg Explosive power | | | 1.317 | .148 | .721 |
| | Leg Explosive Strength | | | -.624 | .089 | -.602 |
| | Height | | | 1.918 | .329 | .761 |
| | Leg Length | | | -2.463 | .440 | -.725 |
| | Arm Length | | | .943 | .393 | .252 |
| | Wrist Girth | | | -2.350 | .846 | -.177 |
| | Breath Holding Time | | | -.197 | .073 | -.149 |
| | Weight | | | .093 | .045 | .128 |

The table – 3 the shows that out of 9 step models, the final model has the $R^2$ change up to 0.271, reported that 81% of model has accuracy enough for predicted the playing ability. In first model, agility scores accounted for 55% of the playing ability. The leg explosive power, leg explosive strength, height, leg length, arm length, wrist girth, breath holding time

and weight were subsequently added significantly (0.01 and 0.05 levels of confidence) to predict the playing ability of State level men Badminton player. For the final model, the agility, leg explosive power, leg explosive strength, height, leg length, arm length, wrist girth, breath holding time and weight were identified as the predictor variables for playing ability of state level Badminton players. From this the following regression equation was derived to predict the playing ability of Sate level men Badminton players.

Playing Ability = 275.14 – 18.604 (Agility) + 1.317(Leg Explosive Power) – 0.624 (Leg Explosive Strength) + 1.918 (Height) – 2.463(Leg Length) + 0.943 (Arm Length) – 2.35 (Wrist Girth) – 0.197 (Breath Holding Time) + 0.093 (Weight)

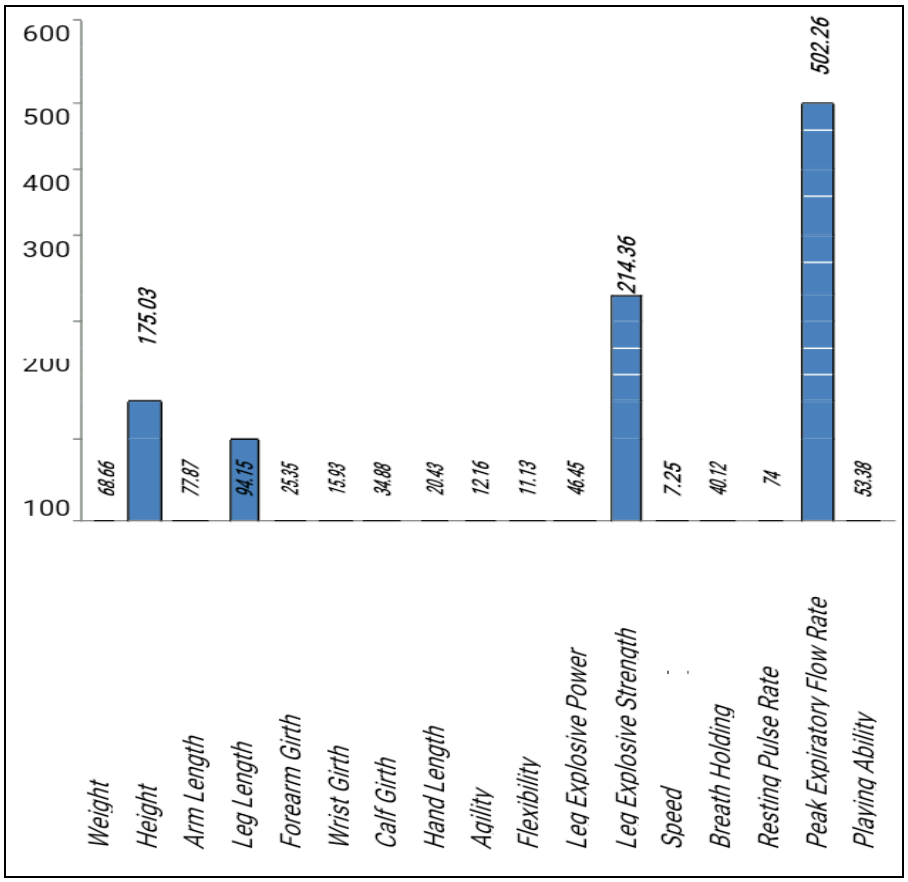


**Fig 1:** Mean Values of Selected Dependant and Independent Variables of Inter-Collegiate men Badminton Players

**Discussions**

Badminton is an intermittent sports activity characterized by long bouts of high intensity exercise combined with rest periods. Badminton players are required to have a good stroke production and physical fitness, as well as physiological characteristics that will enable successful performance. The present study was stated that there was a correlation existed between the playing ability versus agility, Leg explosive Power, speed and leg explosive strength respectively. Joseph Singh et.al (2011) [7] findings are supported the present study. Their results of this study indicated that there is a significant relationship between agility and wrist flexibility a variable of physical characteristics and level of performance where as an in significant relationship were observed between arm length, leg length and spine flexibility the variables of physical characteristics and level of performance at 0.05 level of confidence. The finding indicates that agility and flexibility of wrist of the subjects were important variables for better performance in Badminton. The agility and shoulder – wrist flexibility of the Badminton players were important for better performance in Badminton (Sohil Raza (2008) [12] from the analysis of data, agility accounted for 55% of the playing ability in the 1step model (Table – 3). Agility and Running speed are very important to the Badminton player due to the need for speed variation, height and angle of approach to the shuttle. The ability to cover short distances quickly will also be of great advantage to the Badminton player (Todd and Mahoney, 1995). Due to the nature of the game and the size of the court, it is important for the Badminton player to reach his/her maximum speed as fast as possible. Agility is crucial to good court movement and proper positioning on the Badminton court, and requires a combination of strength, speed and correct footwork technique. Correct positioning on the court is essential in order to strike the shuttle effectively, and requires the use of the legs and feet.

Leg explosive power and leg explosive strength is an important component in Badminton in that it results in the player being able to move quickly and consistently to the shuttle in various directions and to jump high to play overhead strokes. Greater leg explosive power results in a greater acceleration and faster speed when lifting off the floor when moving or jumping to the shuttle. According to Omosegaard

(1996) [9], an explosive player will typically be able to jump high, change direction quickly and will generally appear to be swift and mobile on the Badminton court. Leg explosive power is therefore a combination of co-ordination and muscular properties.

The male subjects in this study had a mean height of 175.03 ± 5.74cm (n=84) (Table 1). This value is closer to that of national class Badminton, and top club level tennis players and national elite Swedish tennis players who have recorded mean heights of 181.0 ± 5.7cm, 175.4 ± 5.4cm, 181.0 ± 0.02cm, 182 ± 7cm and 184 ± 6cm respectively Andersson *et al.*, 1988 [1]; Christmass *et al.*, 1995 [4]; Reilly and Palmer, 1995 [11]; Faccini and Dal Monte, 1996 [5] and Majumdar *et al*., 1997 [8]. Height values from studies performed by Rannou *et al*. (2001) [10] on national and international handball players show mean height values of 177.0 ± 1.4cm and 190.0 ± 1.2cm respectively. However, the height, arm length and leg length are very useful for ability to cover the court easily and also reach the shuttle with minimum effort than the short Badminton player.

The regression equation shows that the wrist girth was one of the predictor variables. The wrist plays a crucial role in Badminton performance. While go for net kill, there is a risk of you hitting the net, once you make contact with the shuttle, let your racket rebound back to ensure no follow through. Here, wrist action is useful for play a net kill, no racket arm movement. The deception is one of the major tactical skills in Badminton. In any case, try to reach the shuttle as early as possible so that you can have various shot options. Here the wrist plays a key part in creating deception. An important thing to note here is that whether you are playing a Badminton clear, drop shot or smash your wrist plays a vital role in creating deception.

The modern Badminton becomes more aerobic than anaerobic in nature. The study pointed out that the breath holding Time is also essential to play Badminton at optimal level of inter-collegiate competitions.

The presents study was showed the mean value of the weight is 68.66 ± 20.06 kg (n=84) (Table 1). This value were relatively corresponds with values obtained from elite Danish Badminton players and handball players whose values range from 73.3kg to 76.9kg (Omosegaard, 1996) [9], and from 74 ± 2kg to 79.4 ± 0.8kg (Rannou *et al.*, 2001) [10] respectively. It is however, similar values obtained from studies on national male Badminton players, leading junior tennis players, top squash, and professional soccer players who have recored values of 69.8 ± 4.8kg and 64.8 ± 6.9kg (Faccini and DalMonte,1996 and Majumdar *et al.*, 1997) [5, 8].

## Conclusions

The results obtained in the present study illustrated the formation of predictive equation models in male Badminton players with reference to anthropometrical, physical and physiological characteristics. From the analysis of data,

1. The results revealed that there was a strong correlation existed between playing ability versus agility, leg explosive power, speed and leg explosive strength. Rest of the other variables was showed low correlation with the playing ability.
2. The results also revealed that agility, leg explosive power, leg explosive strength, height, leg length, arm length, wrist girth, breath holding time and weight were the common predictor variables for predicting the playing ability ofsate level Badminton players.

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