International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

*Original Research Article*

# Study of Back Strength and Its Correlations with Selected Anthropometric Variables and Performance Tests in District Level Badminton Players

**Sumit Bhandari[1], Shyamal Koley[2]**

[1]MYAS GNDU, Department of Sports Sciences and Medicine, Guru Nanak Dev University, Amritsar, 143 005, Punjab, India
[2]Department of physiotherapy, Guru Nanak Dev University, Amritsar, 143 005, Punjab, India

Corresponding Author: Shyamal Koley

## ABSTRACT

**Introduction:** Back plays a huge role in how entire body functions because it attaches to hips, abdomen, chest, shoulder and neck. Strengthening of back gives additional power in all sports by stabilizing the body to swing or throw harder. The purpose of the study was to evaluate the back strength and performance tests in district level badminton players and to search their correlations with selected anthropometric variables.
**Methodology:** A total of 102 district level badminton players (66 male and 36 female) aged 18-25 years were selected purposively from various badminton academies of Amritsar for the study. A total of nine anthropometric variables i.e. height, weight, BMI, biceps skinfold, triceps skinfold, subscapular skinfold, suprailiac skinfold, abdomen skinfold, calf skinfold, and back strength, and two performance tests such as, vertical jump test and standing broad jump test were measured on each subject.
**Results:** In results, one way ANOVA showed significant between-group differences ($p \leq 0.001$) in all the variables studied, among these four sets of population. In district level badminton players, back strength, vertical jump test and standing broad jump test had significant positive correlations ($p<0.001$) with weight, height, BMI, biceps skinfold and calf skinfold, and significant negative correlations (<0.001) with triceps, subscapular and suprailiac skinfold. However abdominal skinfold had significant positive correlations with back strength and standing broad jump, and significant negative correlation with vertical jump test.
**Conclusion:** From the findings of the present study, it might be concluded that back strength had strong association with all the anthropometric variables and performance tests studied. Also, vertical jump and standing broad jump had strong association with weight in district level badminton players. The data presented in the present study carry immense practical application and may be useful in future investigation on player selection, talent identification in badminton and training program development in the game.

***Keywords:*** Anthropometric variables. Back strength. Performance tests, District level badminton players.

## INTRODUCTION

Badminton is characterized by high-intensity, intermittent actions. [1] This sport comprises of short duration and high intensity demands coupled with short rest periods form the temporal structure of an individual game or match [2] which includes preparation for the stroke and to judge the shuttlecock's atypical and surprising flight trajectory and hit it, for which full length of the court is required to be covered with a considerable skill. [3] These factors have also influenced physiological demands. [4] Since the physical demands of badminton are high therefore, acute injuries to the limbs frequently occur [5] but, risk of overuse injuries of the back, shoulder, lower leg and knee is also present. [6,7]

Back strength is one of the important characteristics to keep the individuals at bay from back pain. Back plays a huge role in how entire body functions because it attaches to hips, abdominals, chest, shoulders and neck. Strengthening of back gives additional power in all sports by stabilizing the body to swing or throw harder. In fact, it is basic to performance in activities. Back strength is a major component of successful performance in almost every activity of daily living. It is vital to the maintenance of upright posture, ambulation, and the accomplishment of simple tasks such as eating and dressing, [8] also essential in various sports events. The position being able to stand up straight holding stomach in requires strong resilient muscles along spine and lower back. The decline strength in muscles of the lower back muscles may be related to problems such as disk herniation and chronic low back pain of soft tissue origin.

Anthropometry is the science that deals with measurements of size, weight and proportions of human body. It provides scientific methods and observations on the living humans. [9-12] Anthropometric techniques (such as, skinfold, % body fat, circumference and diameter measurements) are popular for predicting body composition because they are not much expensive, require little space and can be performed easily. [11,12]

Explosive strength can be defined as the product of speed and strength; it is the ability of a muscular unit or combination of muscular units to apply maximum force in minimum time. [13] Since, very less information is available in relevance to the explosiveness characteristics of players, therefore these characteristics are very less established. [14,15] This is surprising, given the ever increasing emphasis on power, speed and agility and the relative ease with which these factors can be assessed. Thus, in the present study, an attempt has been made to estimate the back strength of the district level badminton players and its correlations with selected anthropometric variables and performance tests.

## MATERIALS AND METHODS

### Subjects

The present cross-sectional study was based on purposely selected 102 district level badminton players (66 male and 36 female) aged 18-25 years (mean age 22.20 ±2.68 years) collected from the various badminton academies in Amritsar, Punjab, India, during the months of September to December, 2018. An adequate number of controls (n = 104, 60 male and 44 female, mean age 21.68±2.05 years) were also taken from the same place for comparison. The age of the subjects were recorded from the date of birth registered in their respective institutes. The subjects were divided in such a way that age 18 refers to the individuals aged 17 years and 6 months through 18 years and 5 months and 29 days. A written consent was obtained from the subjects. The data were collected under natural environmental conditions in evening (between 4 PM. to 6 PM). The study was approved by the Institutional ethics committee.

### Anthropometric Measurements

Nine anthropometric variables, such as, height, weight, BMI, biceps skinfold, triceps skinfold, subscapular skinfold, suprailiac skinfold, abdomen skinfold and calf skinfold were taken on each subject using the techniques provided by Lohman et al. [16] and were measured in triplicate with the median value used as the criterion. The height was recorded during inspiration using a stadiometer (Holtain Ltd., Crymych, and

Dyfed, UK) to the nearest 0.1 cm. The subject was asked to stand erect on the stadiometer with bare foot. The horizontal bar of the stadiometer was placed on the vertex of the subject and the readings were recorded in centimetres. Weight was measured by digital standing scales (Model DS-410, Seiko, Tokyo, Japan) to the nearest 0.1 kg. The subject was asked to stand erect on the digital weighing machine with minimum cloths and bare foot. The readings were recorded from the scales of the digital weighing machine in kilograms. BMI was then calculated using the formula weight (kg)/height$^2$(m$^2$). For the measurement of biceps skinfold, triceps skinfold, subscapular skinfold, suprailiac skinfold, abdomen skinfold and calf skinfold the Harpenden skinfold calliper (British Indicators Ltd, St Albans, Herts) was used.

**Back Strength**

Back-leg-chest dynamometer was used to estimate the back strength of the subjects. The subject was positioned with body erect and knee bent so that grasped-hand rests at proper height. Then straightening the knees and lifting the chain of the dynamometer, pulling force was applied on the handle. The body was inclined forward at an angle of 60 degrees. The strength of the back muscles was recorded on the dial of the dynamometer as the best of three trials in kg. All subjects were tested after 3 minutes of independent warm-up. Thirty seconds time interval was maintained between each back strength testing.

**Performance Tests**

Two performance tests were considered for the present study, these were vertical jump test and standing broad jump test.

**Vertical Jump Test**

The subject was asked to stand side on to a wall and reach up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips was marked and recorded. This was called the standing reach height. The athlete was then asked to stand away from the wall, and leaped vertically as high as possible using both arms and legs to assist in projecting the body upwards. An attempt was made to touch the wall at the highest point of the jump. The difference in distance between the standing reach height and the jump height was the score for vertical jump test. The best of three attempts was recorded in cm.

**Standing Broad Jump Test**

The subject was asked to stand behind a line marked on the ground with feet slightly apart. A two foot take-off and landing was used, with swinging of the arms and bending of the knee to provide forward drive. The subject attempted to jump as far as possible, landing on both feet without falling backwards. Three attempts were allowed and the maximum value was recorded in cm.

**Statistical Analysis**

Data was analysed using SPSS (Statistical Package for Social Science) version 20.0. One way analysis of variance was tested for the comparisons of data among the district level badminton players and controls. Pearson's correlation coefficient test was done to observe the correlations of back strength and performance tests with selected anthropometric variables in badminton players. A 5% level of probability was used to indicate statistical significance.

## RESULTS

Table 1 showed the one way ANOVA of back strength, selected anthropometric variables and performance tests in badminton players and controls. The results showed significant between-group differences ($p \leq 0.05$-0.001) in all the variables studied among these four sets of population.

The correlation coefficients of back strength and performance tests with selected anthropometric variables in badminton players were given in table 2. Back strength showed significant positive correlations ($p<0.001$) with weight, height, BMI, biceps skinfold, abdominal skinfold, vertical jump test and standing broad jump test, whereas, significant negative correlations (p<0.001) were found with triceps skinfold, subscapular skinfold and suprailiac skinfold, Vertical jump test showed significant positive correlations (p<0.025-0.001) with weight, height, BMI, biceps skinfold, abdominal skinfold, and standing broad jump test, whereas, significant negative correlations (p<0.001) were found with triceps skinfold, subscapular skinfold and suprailiac skinfold, Standing broad jump test showed significant positive correlations (p<0.005-0.001) with weight, height, BMI, biceps skinfold and abdominal skinfold, whereas, significant negative correlations (p<0.001) with triceps skinfold subscapular skinfold and suprailiac skinfold.

**Table 1: One way ANOVA of back strength, selected anthropometric variables and performance tests in badminton players and controls**

| Variables | MBP (n=66) | | FBP (n=36) | | CM (n=60) | | CF (n=44) | | F- value | P- value |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD | | |
| WT kg) | 64.86 | 5.83 | 54.6 | 4.88 | 64.86 | 4.79 | 55.53 | 4.78 | 107.954 | <0.001 |
| HT (cm) | 171.10 | 5.04 | 161.92 | 3.98 | 171.17 | 5.70 | 159.4 | 4.62 | 75.396 | <0.001 |
| BMI (kg/m$^{2}$) | 22.15 | 1.68 | 20.8 | 2.18 | 24.00 | 2.30 | 22.88 | 2.29 | 19.819 | <0.001 |
| BSF (mm) | 5.61 | 2.60 | 3.40 | 0.80 | 6.82 | 1.39 | 5.44 | 0.99 | 29.080 | <0.001 |
| TSF (mm) | 10.58 | 1.23 | 16.06 | 1.57 | 13.39 | 2.32 | 18.33 | 1.86 | 173.334 | <0.001 |
| SSSF (mm) | 8.42 | 1.45 | 16.87 | 1.54 | 13.15 | 2.66 | 19.48 | 1.87 | 289.241 | <0.001 |
| SISF (mm) | 18.81 | 4.12 | 28.99 | 2.22 | 19.66 | 1.30 | 29.21 | 2.66 | 188.901 | <0.001 |
| ABSF (mm) | 28.27 | 4.12 | 27.38 | 2.92 | 31.60 | 2.97 | 28.23 | 2.80 | 17.104 | <0.001 |
| CSF (mm) | 12.45 | 1.40 | 10.24 | 1.43 | 11.10 | 1.82 | 12.26 | 2.20 | 16.573 | <0.001 |
| BS (kg) | 78.21 | 11.59 | 24.4 | 8.34 | 75.78 | 14.04 | 21.79 | 5.26 | 382.091 | <0.001 |
| VJT (cm) | 41.77 | 3.11 | 35.08 | 4.12 | 29.95 | 2.11 | 31.981 | 3.21 | 175.697 | <0.001 |
| SBJT (cm) | 197.64 | 9.15 | 128.39 | 8.99 | 186.23 | 6.47 | 121.06 | 3.04 | 1330.996 | <0.001 |

MBP = male badminton players, FBP = female badminton players, CM = control males, CF = control females, WT = weight, HT = height, BMI = body mass index, BSF = biceps skinfold, TSF = triceps skinfold, SSSF = subscapular skinfold, SISF = suprailiac skinfold, ABSF = abdominal skinfold, CSF = calf skinfold, BS = back strength, VJT = vertical jump test, and SBJT = standing broad jump test.

**Table 2: The correlation coefficients of back strength and performance tests with selected anthropometric variables in badminton players**

| Variables | BS | | VJT | | SBJT | |
|---|---|---|---|---|---|---|
| | r-value | p-value | r-value | p-value | r-value | p-value |
| WT (kg) | 0.651 | <0.001 | 0.446 | <0.001 | 0.638 | <0.001 |
| HT (cm) | 0.655 | <0.001 | 0.447 | <0.001 | 0.683 | <0.001 |
| BMI (kg/m$^{2}$) | 0.311 | <0.001 | 0.222 | <0.025 | 0.274 | <0.005 |
| BSF (mm) | 0.440 | <0.001 | 0.455 | <0.001 | 0.428 | <0.001 |
| TSF (mm) | -0.830 | <0.001 | -0.612 | <0.001 | -0.869 | <0.001 |
| SSSF (mm) | -0.875 | <0.001 | -0.643 | <0.001 | -0.906 | <0.001 |
| SISF (mm) | -0.758 | <0.001 | -0.758 | <0.001 | -0.773 | <0.001 |
| ABSF (mm) | 0.549 | <0.001 | 0.464 | <0.001 | 0.606 | <0.001 |
| CSF (mm) | 0.158 | 0.112 | -0.035 | 0.729 | 0.100 | 0.316 |
| VJT (cm) | 0.639 | <0.001 | 1.00 | - | 0.652 | <0.001 |
| SBJT (cm) | 0.903 | <0.001 | 0.652 | <0.001 | 1.00 | - |

## DISCUSSION

Back strength is a major component of successful performance in almost every activity of daily living. It is vital to the maintenance of upright posture, ambulation, and the accomplishment of simple tasks such as eating and dressing, it is also essential in various sports events. [8] In the present study, male badminton players had significantly greater back strength then their female counterparts and also from their control counterparts. Hormonal factors play a key role in the body composition differences between males and females. Following puberty males secrete more testosterone while females secrete more oestrogen. The testosterone increases bone formation which leads to larger bones and increased synthesis of protein, ultimately increasing muscle mass and muscle strength. [17] The present study also supported the same findings. Regular physical exercise and training in badminton players also made the differences in back strength.

Gender-related differences in bone width are more apparent after puberty. For example, periosteal growth, which enlarges bone diameter, accelerates at puberty in males. Thus, gender differences in skeletal size and BMD persisted at most skeletal sites even after matching for body size. To support this, the results of this study showed significantly greater differences in male badminton players than their female counterparts for anthropometric measures such as height, weight and BMI.

In combined male and female badminton players, back strength showed significant positive correlations with weight, height, BMI, vertical jump test and standing broad jump test. As athletes become heavier, they do not become inherently stronger per kilogram of body mass. But various neural, morphological or maturation adaptations must explain this association between strength and body weight or BMI. [18] Another study reported that increased strength and power, facilitated increased leg drive and showed association with explosive leg strength, and sprint momentum seemed to be of crucial importance to athletes. [19]

Many researchers have studied various performance parameters in badminton players but very limited research has been done to find the sex differences in performance parameters of badminton players and their correlations with various body measurements. Thus, more research is required in this field especially in the Indian subcontinent.

## CONCLUSION

Back strength and explosive power had significant positive correlations with height, weight, BMI and biceps skinfold, whereas significant negative correlations were found with triceps skinfold, suprascapular skinfold and sub scapular skinfold. Back strength also showed strong positive correlation with explosive power as checked by vertical jump test and standing broad jump test. The data presented in the present study carries immense practical applications such as player selection and talent identification in badminton also for strength and power training programming.

## REFERENCES

1. Phomsoupha M, Laffaye G. The science of badminton: game characteristics, anthropometry, physiology, visual fitness and biomechanics. Sports Medicine 2015; 45(4): 473-495.
2. Manrique DC, Gonzalez-Badillo JJ. Analysis of the characteristics of competitive badminton. British Journal of Sports Medicine 2003; 37(1): 62-66.
3. Alam F, Chowdhury H, Theppadungporn C, Subic A, Khan MMK. Aerodynamic properties of badminton shuttlecock. International Journal of Mechanical and Materials Engineering 2009; 4(3): 266-272.
4. Laffaye G, Phomsoupha M, Dor F. Changes in the game characteristics of a badminton match: a longitudinal study through the olympic game finals analysis in men’s singles. Journal of Sports Science & Medicine 2013; 14(3): 584-590.
5. Yung PSH, Chan RHK, Wong FCY, Cheuk PWL, Fong DTP. Epidemiology of injuries in Hong Kong elite badminton athletes. Research in Sports Medicine 2007; 15(2): 133-146.
6. Fahlström M, Lorentzon R, Alfredson H. Painful conditions in the Achilles tendon region in elite badminton players. The American Journal of Sports Medicine, 2002; 30(1): 51-54.
7. Fahlström M, Söderman K. Decreased shoulder function and pain common in recreational badminton players. Scandinavian Journal of Medicine & Science in Sports, 2007; 17(3): 246-251.
8. Berne RM, Levy MN. Physiology, The CV Mosby Company, St. Louis, Toronto.1983.
9. Claessens AL, Lefevre J, Beunen G, Malina RM. The contribution of anthropometric characteristics to performance scores in elite female gymnasts. Journal of Sports Medicine and Physical Fitness 1999; 39: 355-360.
10. Bourgois J, Albrecht L, Claessens JV, Renaat P, Renterghem BV, Thomis M, Janssens M, Loos R, Lefevre J. Anthropometric characteristics of elite male junior rowers. British Journal of Sports Medicine, 2000; 34: 213- 216.

11. Reilly T, Bangsbo J, Franks A. Anthropometric and physiological predispositions for elite soccers. Journal of Sports Sciences 2000; 18: 669-683.
12. Slater GJ, Rice AJ, Mujika I, Hahn AG, Sharp K, Jenkins DG. Physique traits of lightweight rowers and their relationship to competitive success. British Journal of Sports Medicine 2005; 39: 736-741.
13. Tiwari LM, Rai V, Srinet S. Relationship of selected motor fitness components with the performance of badminton player. Asian J Phys Educ Comput Sci Sports 2011; 5(1): 88-91.
14. Ooi CH, Tan A, Ahmad A, Kweong KW, Sompong R, Ghazali KAM, Liew SL, Chai WJ, Thompson MW. Physiological characteristics of elite and sub-elite Badminton players. Journal of Sports Sciences 2009; 27: 1591-1599.
15. Hughes MG, Bopf G. Relationships between performance in jump tests and speed tests in elite badminton players. Journal of Sports Sciences 2008; 23(2): 194-195.
16. Lohman TG, Roche AF, Martorell R. Anthropometric Standardization Reference Manual. Champaign, IL: Human Kinetics Books.1998.
17. Boutet S, Lomb L, Williams GJ, Barends TR, Aquila A, Doak RB, Messerschmidt M. High-resolution protein structure determination by serial femtosecond crystallography. Science 2012; 337: 362-364.
18. Häkkinen K, Keskinen KL. Muscle cross-sectional area and voluntary force production characteristics in elite strength- and endurance-trained athletes and sprinters. European Journal of Applied Physiology and Occupational Physiology 1989; 59(3): 215-220.
19. Barker M, Wyatt TJ, Johnson RL, Stone MH, O'bryant HS, Poe C, Kent M. Performance factors, psychological assessment, physical characteristics, and football playing ability. The Journal of Strength & Conditioning Research 1993; 7(4): 224-233.

How to cite this article: Bhandari S, Koley S. Study of back strength and its correlations with selected anthropometric variables and performance tests in district level badminton players. Int J Health Sci Res. 2019; 9(3):71-76.

******