"Correlation Of Hand Grip Strength And Shoulder Strength With Smashing Accuracy In Female Badminton Players"

Kanak Singh[1*] , Shivangi Pathania[2]

[1*]Student of Masters of Physiotherapy, Department of Physiotherapy, Chandigarh University, Mohali, Punjab, India
[2]Faculty of Physiotherapy (Assistant Professor), Department of Physiotherapy, Chandigarh University, Mohali, Punjab, India

***Corresponding Author:** Kanak Singh
*Student of Masters of Physiotherapy, Department of Physiotherapy, Chandigarh University, Mohali, Punjab, India

ABSTRACT:
Background: Badminton is a fast-paced activity and is regarded as the quickest of the racquet sports. Various components of fitness like speed, agility, flexibility, endurance, and power play an important role in an athlete's performance, moreover grip strength and shoulder strength are important components that are utilized for a better smash performance.
Aim: The main aim of the study was to observe the relationship between hand grip strength and shoulder strength on the accuracy of smash in collegiate female badminton players.
Materials and Methods: A observational study design was conducted on eight four female collegiate badminton players and were included according to inclusion criteria i.e., participants were female, aged 18-25 years, playing at least for 2 years. For hand grip strength hand held dynamometer were used. The players performed Medicine ball test to determine their shoulder strength. Players concurrently perform the smash stroke performance test for the smashing accuracy.
Results: To determine the correlation between the variables, we applied the Spearman's rank correlation coefficient. The result indicates the correlation value for hand grip strength and smashing accuracy is (r-value= -0.07) and correlation value for shoulder strength and smashing accuracy s (r-value= 0.32). This shows that there was a statistically significant (p-value <0.01).
Conclusion: The study concluded that there was weak positive significant correlation between shoulder strength with smashing accuracy and no significance between hand grip strength with smashing accuracy in female collegiate badminton players.

Keywords: Badminton, Collegiate players, Hand grip strength, Smashing accuracy, Shoulder strength.

INTRODUCTION:

Badminton is a racket sport that includes leaping, changing direction, quick arm movements, and a variety of body positions. It is intermittent individual sport, characterized by high-energy bursts alternating with brief intervals of low effort or relaxation.(Abián-Vicén et al., 2012) Aerobic stamina, agility, strength, speed, and accuracy are all required of players. It is also a technical sport that necessitates high motor coordination and the development of complex racquet motions.(Van Meche et al., 1992) It is a biomechanically demanding sport. The upper extremities, particularly the shoulder, is repeatedly stressed by the repetitive motion of overhead strokes and brief striking action. Their three-dimensional study of badminton strokes demonstrated the significance of radio-ulnar pronation, elbow extension, and wrist ulnar deviation while making forearm rotation-based badminton strokes.(Pardiwala et al., 2020)

Grip strength has been shown to improve sports performance when a sport object is held in the hand.(Koley et al., 2008) Hand grip strength is a physical characteristic that contributes to effectiveness and efficiency in daily job and sports activities.(Barut, 2008) Sports strength testing has traditionally been used to establish normative values for certain sport disciplines, to choose young players, to differentiate between different performance levels, or to measure the effects of physical activity in athletic training techniques. Hand grip strength testing is useful in a variety of scenarios. Many sports, such as cricket, badminton, volleyball, basketball, and tennis, place a high demand on your hands. All of these activities need strong grip strength, which is critical for avoiding injuries of any type.(Sharma Ex-Head, n.d.)

The shoulder complex is made up of several anatomical and one physiological joint.(Carmichael & Hart, 1985) The glenohumeral joint's biomechanics are determined by the interplay of static and dynamic-stabilizing components. When forces are applied via the glenohumeral joint, the static and dynamic stabilizers respond to provide stability at various points along the motion arc. Additionally extending the shoulder's range of motion, the scapulothoracic joint also adds to the stability of the joint.(Lugo et al., 2008) Technique and strategy are only two of the many elements that go into this sport's success. In order to compete well, badminton players require excellent physical aptitude, particularly agility, aerobic strength, and explosive force. Speed, agility, flexibility, shoulder strength, explosive strength, and muscular endurance all have a substantial impact on individual skill and are used to determine performance.(Phomsoupha & Laffaye, 2015)

In badminton there are so many net shots like smashed, clear, dropped, lobbed. There are two types of badminton strokes: forehand and backhand. There are also two types of smashes: forehand and backhand. IN general, "smash" refers to the forehand smash. The forehand smash is also thought to be crucial for scoring points since it has been noted that its shuttle velocity is quicker than that of the backhand smash. According to the study, badminton performance and shoulder strength are substantially associated. They demonstrated that efficient smashing requires shoulder strength because it enables the muscle to operate against opposition or overcome it. Measuring shoulder strength is crucial to assess the effectiveness of rehabilitation and training after a shoulder joint injury as well as during training to raise racket velocity. Additionally, the shoulder strength measuring technique must be accurate, uncomplicated, and pertinent to racket velocity.(Awatani et al., n.d.)

The main objectives of this study were included as following;

1. To observe the correlation of hand grip strength on the accuracy of smash in collegiate female badminton players.
2. To observe the correlation of shoulder strength on the accuracy of smash in collegiate female badminton players.
3. To observe the relationship of hand grip strength and shoulder strength on the accuracy of smash in collegiate female badminton player.

METHODOLOGY

This observational study including a total of 84 female collegiate badminton players by purposive random sampling in Chandigarh University Sports Complex, Gharuan, Mohali (Punjab), from 2022-2023. Nature and objectives were explained to the participants. Informed consent was obtained from the players.

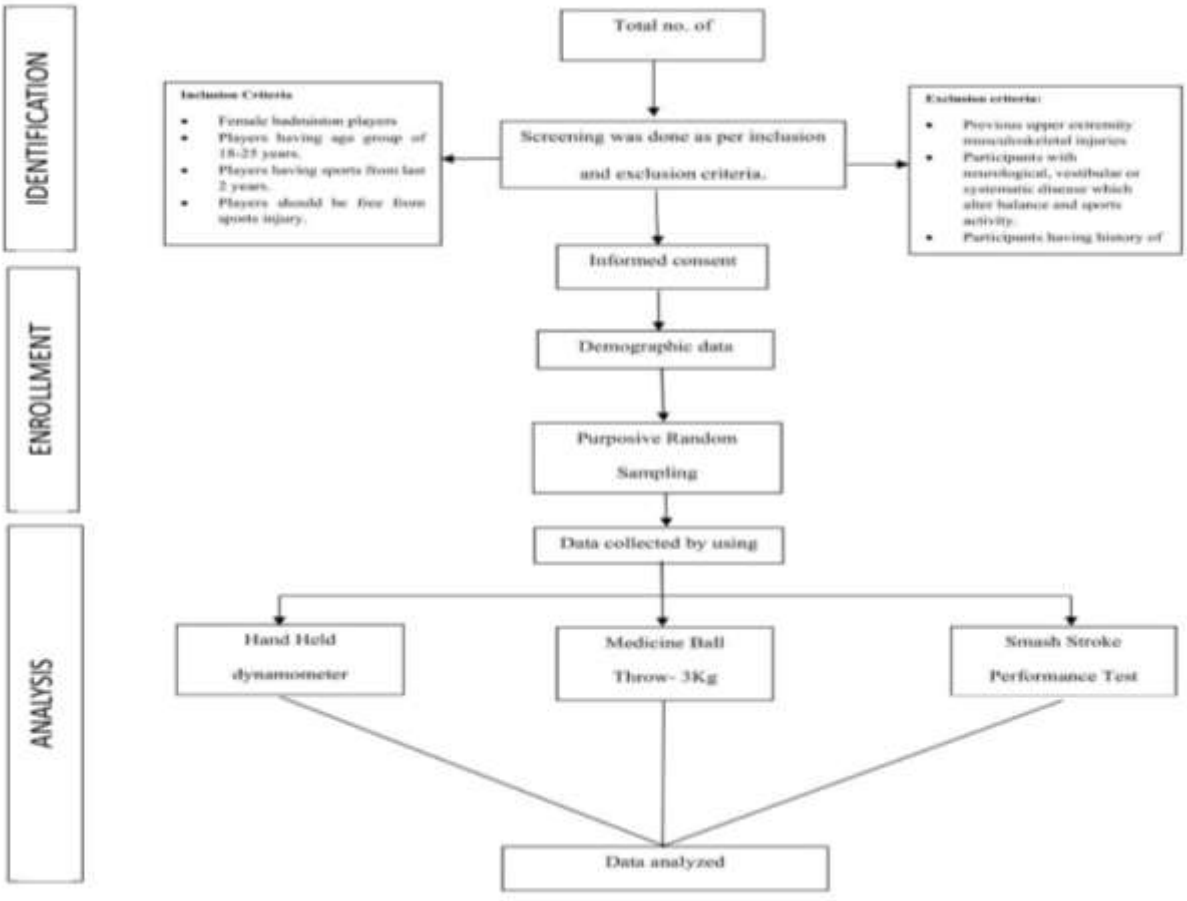
SELECTION CRITERIA:

This study included female badminton collegiate players, age group 18-25 years, who have been engaged in sports for at least 2 years. Participants who were free from injury. Participants who excluded did not have upper extremity musculoskeletal injuries, history of the upper extremity surgery, deformity, systemic disease and any neurological or vestibular problems.

STUDY PROCEDURE:

Purposive random sampling was done, the participants completed an informed consent form, and were recruited. Data concerning demographic data such as age, height and weight. Warm-up (jogging and stretching) followed by which they were assessed for hand grip strength, shoulder strength, and smash accuracy.

STUDY PROTOCOL



The STROBE flowchart illustrating the process of Identification, Enrollment and Analysis.

HAND GRIP STRENGTH:

Hand held dynamometer is a tool that measures hand grip strength. All subjects were assessing for their handgrip strength using a hand-held dynamometer. Three trails were given for each of the participants and an average score was recorded. The subject was made to sit on a chair with the elbow flexed at 90 degrees and the forearm in semi-pronation (neutral position) lying on an armrest (fig 1). There was a one-minute resting period was given in between each squeeze in order to overcome the fatigue. The mean value of three squeezes was recorded.(Awatani et al., n.d.; Ramajayam, 2018; Singh & Kumar, 2019)

SHOULDER STRENGTH:

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 they performed a medicine ball overhead forward throw to cover the greatest distance (fig 2). From all three trials, the average of the greatest two distances was noted in meters and 20sec. rest was given between each trial.(Asif et al., 2018; Indora et al., 2022)

SMASHING ACCURACY:

For the accuracy of the smash, Smash Stroke Performance Test was used. The (60×60) square target was set in the upper right corner of a single badminton court with a different colour. Each colour target size was 20 cm wide and 60 cm long, and marked with three different colours: Red-3 points, Blue-2 points and Yellow- 1 point. After a 10–15-minute warm-up, participants executed 10 maximal forehand smash strokes with a 5-10 second pause in between (fig 3). For deriving the accuracy rate, the sum total of score the player makes in trials was then divided by the maximum score a player can make and then multiplied by 100. For example- In 10 trails total sum score is 15, then the accuracy rate is the following, 15/30×100=50%. Hence, 50% is the accuracy rate of the player. (Indora et al., 2022)

Fig 1- Hand Grip Strength by Hand Dynamometer **Fig 2**- Medicine Ball Test(3KG) for Shoulder

Fig 3- Smash Stroke Performance test for Smash Accuracy

ETHICAL STATEMENT

Study was carried out as a part of research project and was approved by Project Evaluation Panel Department of Physiotherapy, UIAHS, Chandigarh University. The safety of the patient/participants was ensured by the primary researcher, and the study procedure was planned to eliminate the negative effects on patient's health. The study was done in accordance with the Helsinki declaration revised in 2013 and the National Ethical Guidelines for Biomedical Research involving human participants, 2017.

STATISTICAL ANALYSIS:

For the analysis, the primary researcher was in charge of gathering and entering the data in SPSS software version 29. The Kolmogorov-Smirnov test was used to check whether the data is normally distributed or not. The descriptive statistics expressed as a version of median (range) as data was not normally distributed. To determine the correlation between each variable, Spearman's rank correlation coefficient was used.

RESULT:

The Kolmogorov-Smirnov test was used to check whether the data is normally distributed. The descriptive statistic was expressed as a version of median and Interquartile range with minimum and maximum, because the data did not show the normal distribution. To determine the correlation between the variables, we applied the Spearman's rank correlation coefficient. Level of significance was fixed at 0.01.

Table 1 represents the demographic characteristics of the participants.

Variables	Median (Interquartile Range)
Age (Years)	21(18-25)
Height (Centimeter)	168.25(161.2-172.3)
Weight (Kilogram)	65(58-70)

In Demographic characteristics, variables taken to be in consideration is Age (in years) with median value 21.0, Interquartile range with minimum and maximum value of 18 and 25. Height (in centimeters) with median value 168.2, Interquartile range with minimum and maximum value of 161.2 and 172.3. And weight (in kg) with median value 65, Interquartile range with minimum and maximum value of 58 and 70.

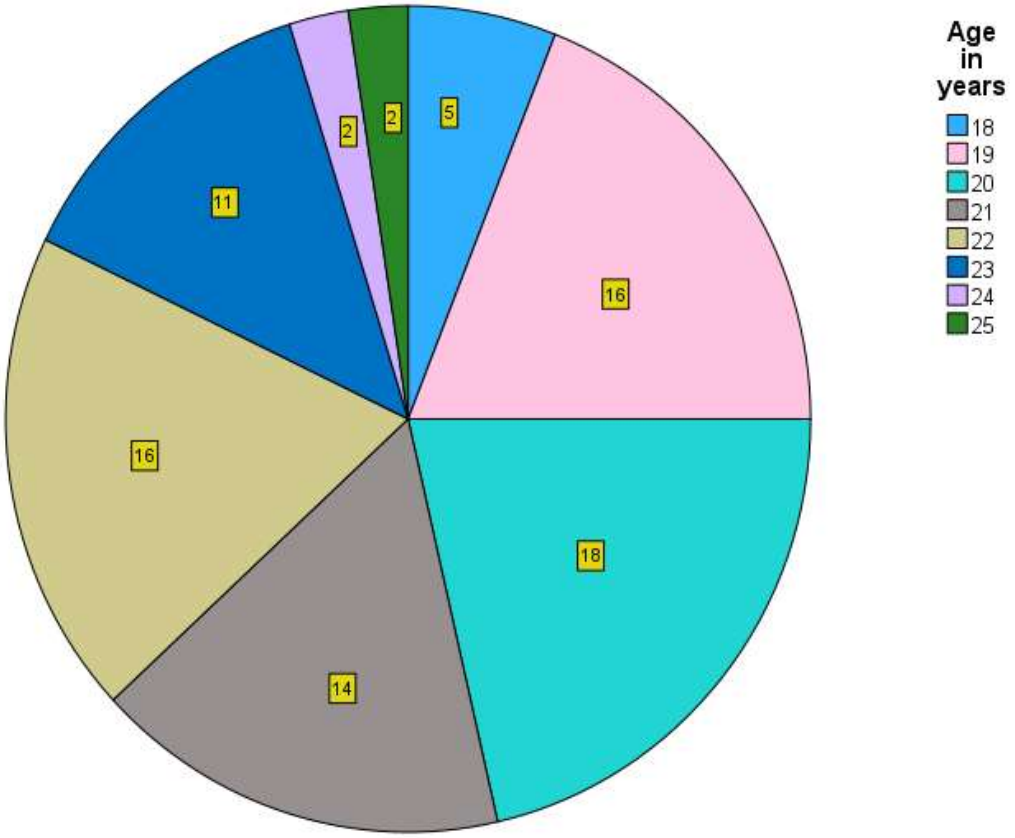


Figure 4- Represent the distribution of age in the study.

This pie-chart is representing the age distribution of participants (total 84). The majority of the participants in this research (a total of 18) were in the age of 20 years. Second majority of the participants in this research (total of 16) were in the age of 19 and 22 years. There was a total of 14 participants in the age of 21 years. Total 5 participants were in the age of 18 years and the least participants in this research, total 2 was in the age of 24 and 25 years.

Table 2: Representing Median and Interquartile ranges of variablesVariables	**Median (Interquartile Range)**
HGS (in lbs.)	55 (35-67.5)
Shoulder Strength (in meter)	5.6 (5.0-7.0)
Smashing Accuracy Rate (in percentage)	44.99 (30.00-56.66)

The following table representing the median and interquartile ranges with minimum and maximum of variables. In variable HGS, median value is 55.0 and Interquartile range is with minimum value is 35 and maximum value is 67.5. In variable shoulder strength, median value is 5.6 and Interquartile range is with minimum value is 5.0, maximum value is 7.0. In variable smashing accuracy, median value is 44.99 and Interquartile range is with minimum value is 30.00, maximum value is 56.66.

Table 3: Correlation of handgrip strength with shoulder strength and smash accuracy rate

Variables		Shoulder Strength	Smash Accuracy Rate
Hand Grip Strength	r	-0.14	-0.07
	p	0.89	0.49
*r = correlation coefficient			*p = level of significance

The table 3 represent the correlation of HGS with and shoulder strength and smash accuracy rate. The table showed weak negative correlation of hand grip strength with shoulder strength and smashing accuracy rate, where r is correlation coefficient and p is level of significant.

Table 4: Correlation of shoulder strength with hand grip strength and smashing accuracy rate

Variables		Hand Grip Strength	Smash Accuracy Rate
Shoulder Strength	r	-0.14	0.32
	p	0.89	0.00
*r = correlation coefficient			*p = level of significance

Table 4 represent the correlation of shoulder strength with hand grip strength and smashing accuracy rate. The table showed weak negative correlation between shoulder strength and hand grip strength and weak positive correlation between the shoulder strength and smashing accuracy, where r is correlation coefficient and p is level of significant.

Variables		Hand Grip Strength	Shoulder Strength
Smash Accuracy Rate	r	-0.07	0.32
	p	0.49	0.00
*r = correlation coefficient			*p = level of significance

Table 5: Correlation of smashing accuracy rate with hand grip strength and shoulder strength

Table 5 represent the correlation of smash accuracy rate with hand grip strength and shoulder strength. The table showed weak negative correlation between smash accuracy rate and hand grip strength and weak positive correlation between smash accuracy rate and shoulder strength, where r is correlation coefficient and p is level of significant.

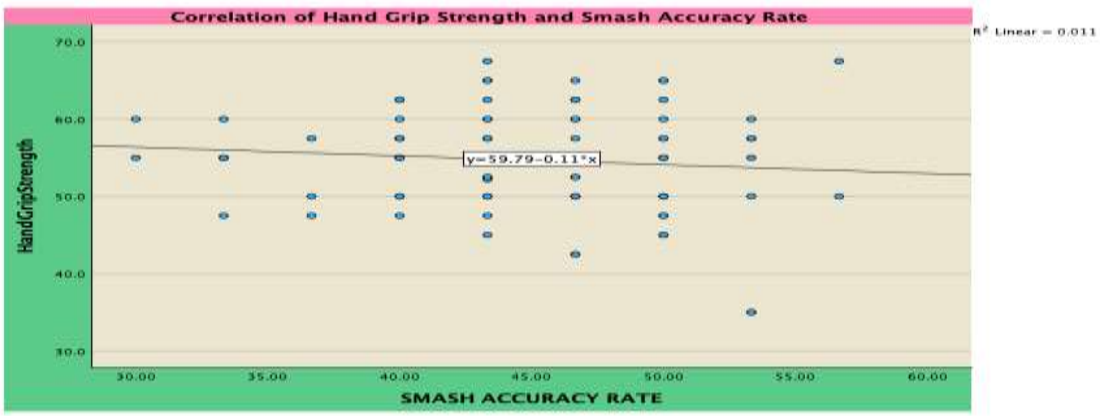


Figure 5: Representation of correlation between hand grip strength and smash accuracy

Above scatter plot graph is representing the correlation between HGS and smash accuracy rate. Reference line is showing the poor negative correlation between the variables, hand grip strength and smash accuracy rate with the value of R2 = 0.011

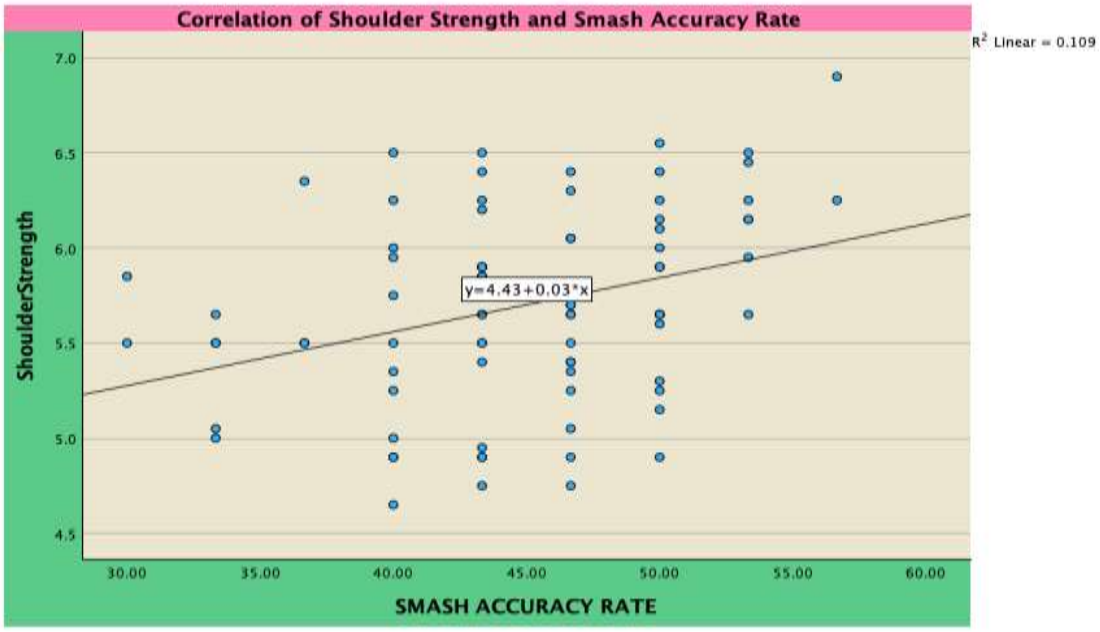


Figure 6: Representation of correlation between shoulder strength and smash accuracy

Above scatter plot graph is representing the correlation between shoulder strength and smash accuracy rate. Reference line is showing the fair positive correlation between the variables, shoulder strength and smash accuracy rate with the value of R2 = 0.109

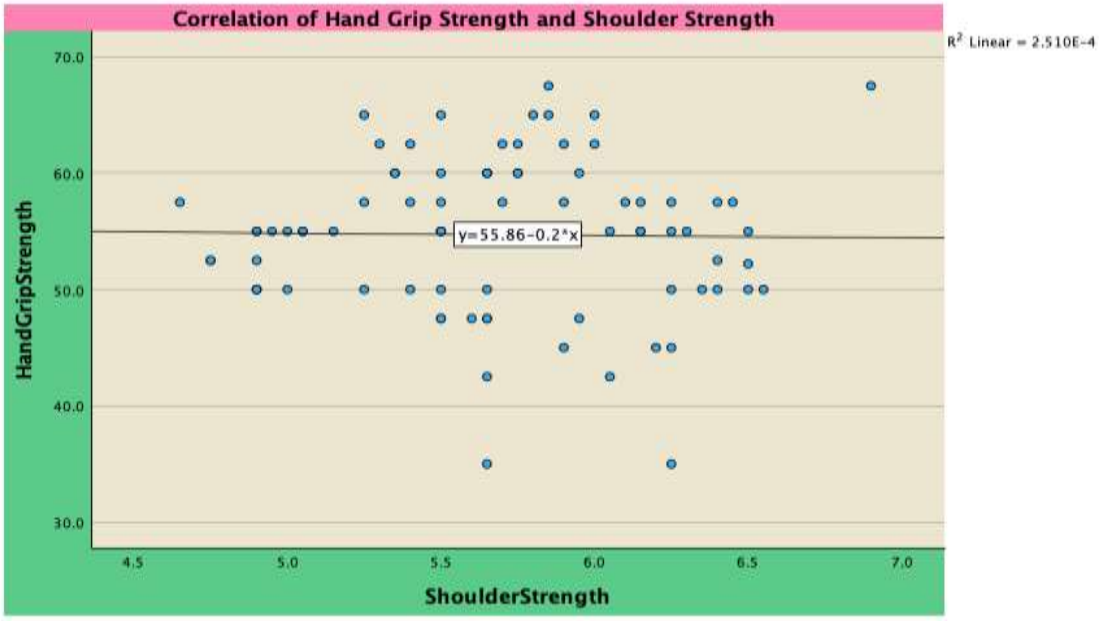


Figure 7: Representation of correlation between hand grip strength and shoulder strength

Above scatter plot graph is representing the correlation between hand grip strength and shoulder strength. Reference line is showing the no correlation between the variables, hand grip strength and shoulder strength with the value of R2 = 2.51

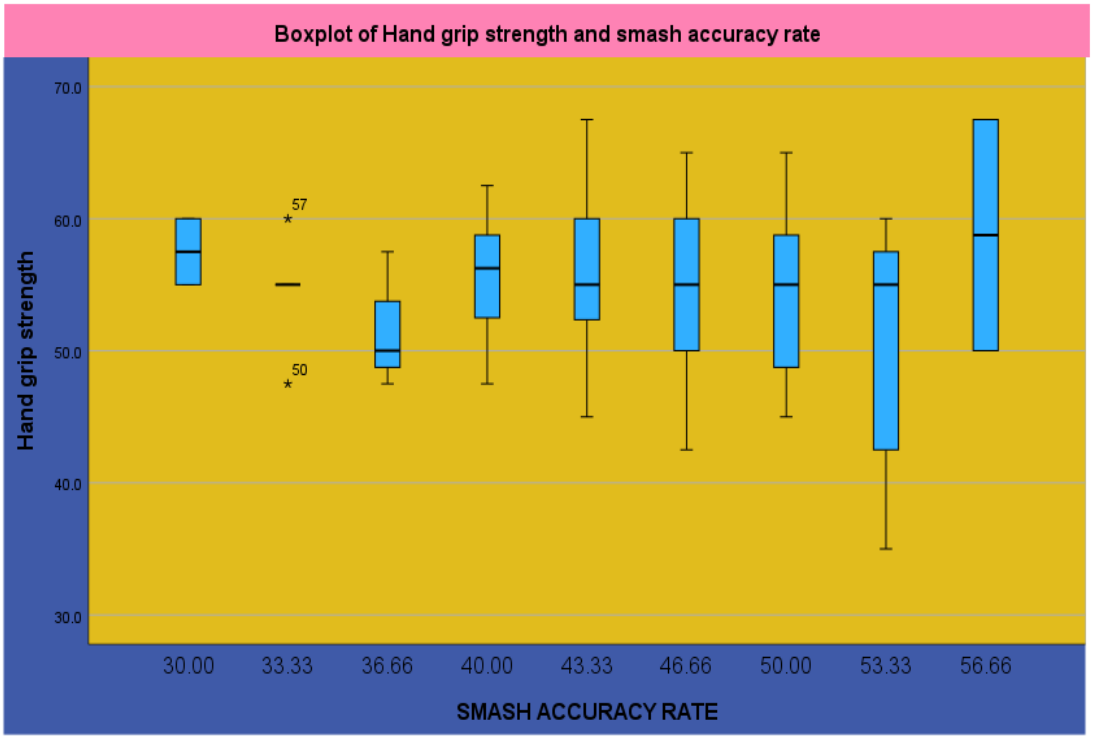


Figure 8: Box & Whisker plot represent the correlation between hand grip strength and smash accuracy rate

The box's range, which corresponds to the IQR, is from Q1 (the first quartile) to Q3 (the third quartile) of the distribution, HGS (Q1: 50 and Q3: 60) with smash accurate rate (Q1: 5.4 and Q3: 6.1). The median is indicated by a line across the box.

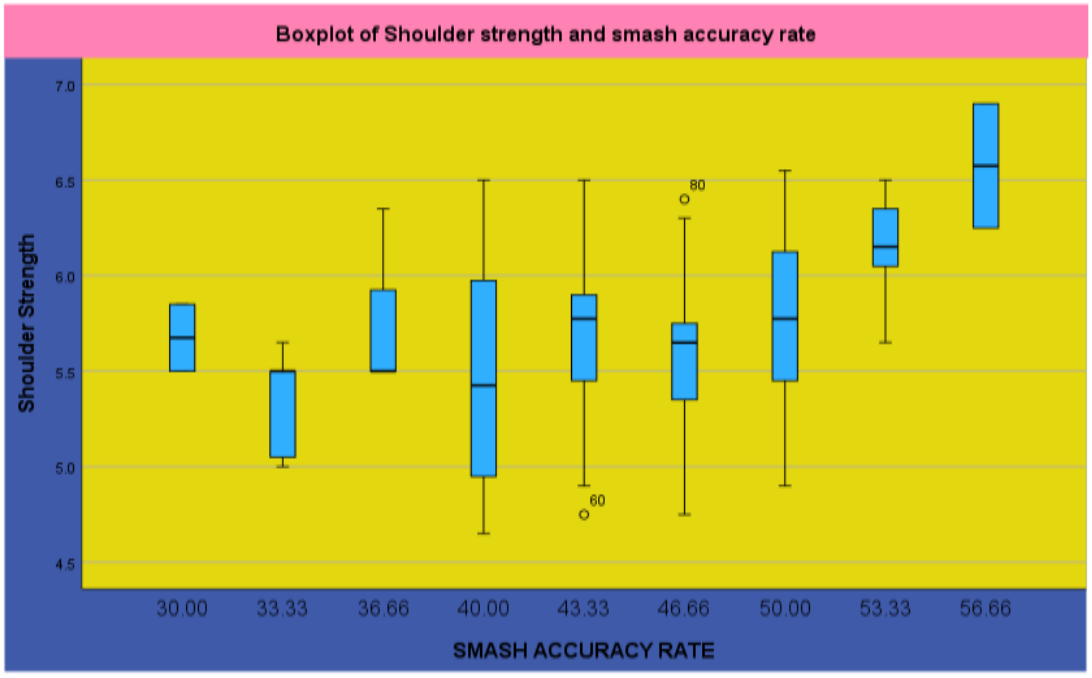


Figure 9: Box & Whisker plot represent the correlation between shoulder strength and smash accuracy rate

The box's range, which corresponds to the IQR, is from Q1 (the first quartile) to Q3 (the third quartile) of the distribution, Shoulder strength (Q1: 5.4 and Q3: 6.1) with smash accurate rate (Q1: 5.4 and Q3: 6.1). The median is indicated by a line across the box.

DISSCUSSION:

The important contribution of this study illustrates the correlation of HGS and shoulder strength on the smashing accuracy in collegiate female badminton players, who have playing badminton from at least last 2 years. This study was done with the age group 18-25 years, descriptive statistics were used to find out the median and interquartile range with minimum and maximum ranges from demographic data and variables. The interpretation that HGS and shoulder strength of the collegiate female player was associated with the smashing accuracy was partially supported.

In this study, there was poor negative correlation between the hand grip strength and smashing accuracy with the r-value = -0.7. And there was poor positive correlation between shoulder strength and smashing accuracy with the r- value = 0.32.(level of significance, p-value <0.01)

A study reported by Ramajayam done to find out the comparison of dominant hand grip strength among intercollegiate men ball badminton players. It shows there was significant difference among inter collegiate men ball badminton players of dominant hand grip strength. In another study done by Singh K, Kumar N, the study's findings show a strong relationship between forehand smash speed and handgrip strength among badminton players. Compared to right-handed badminton players, the left-handed player's forehand smash speed is faster. A significant correlation between forehand smash speed and handgrip strength has been discovered. This idea may be applied to increase the performance of badminton players' forehand smashes through sport-specific training.(Ramajayam, 2018; Singh & Kumar, 2019)

In a study done by Joseph E to find out the evaluation of maximal isometric hand grip strength in different sports. The findings of the present study showed that the maximum grip strength measured in both hands is higher in Cricket players than in Hockey, Tennis and Badminton players. The data suggest that the lack of differences between players may be related to anatomical and physiological differences, as well as differences in training programs. DefneOcal Kaplan investigated a study with the aimed to evaluate the relation between dominant and non-dominant hand perimeters and handgrip strength of basketball, volleyball, badminton and handball athletes on total 101 active athletes and results of the analysis showed that dominant and non-dominant handgrips of athletes in all disciplines and gender are significantly different and hand and finger perimeters developing different depending on the way they use the ball or racket grip.(Defne Öcal Kaplan, 2016; Sharma Ex-Head, n.d.)

Moreover, some study by Asif et al has given a study for relationship among height, explosive power and shoulder strength on smashing accuracy in make badminton players. The primary intent of the study was to gain an insight into check the correlation of height and upper arm strength with smashing accuracy among 60 badminton players. The result of this study indicates that there exists a correlation between height and smashing accuracy in male Badminton players. Indora et al in a cross-sectional study investigated the correlation of upper limb explosive power with smash velocity and performance in badminton players with the help of medicine ball test, smash stroke performance test and smash velocity test and revealed that the smash velocity of the badminton player was related to the explosive power of the upper limb. So, to improve the smash performance of the athlete, the upper limb should be trained properly to gain strength and improve its explosive power.(Asif et al., 2018; Indora et al., 2022)

As further research needs to work over the current limitations of the study as, sample size of the study was less, the population of this research was done only on female athletes, the participants in the study were collegiate players. Majorly, Measurement, type, and texture of racket and footwear were not considered in this study.

Future Scope

- To include both genders.
- Sample size can be more.
- Study can be conducted on elite athletes.
- future researchers should consider other tests to isolate core muscles.
- The samples were limited to an age group between 18-25 years. It can be generalized to other age group

CONCLUSION:

The study concluded that there was weak positive significant correlation between shoulder strength with smashing accuracy and no significance between hand grip strength with smashing accuracy in female collegiate badminton players. So, to improve the smash performance of the athlete, the shoulder strength should be trained properly.

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