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The Role of Speed, Strength, and Flexibility in Badminton Performance among Badminton Players in Khyber Pakhtunkhwa, Pakistan

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Abstract

The purpose of this study was to examine the role of speed, strength, and flexibility in badminton performance among badminton players in Khyber Pakhtunkhwa, Pakistan. Physical fitness is an essential component of badminton because the sport requires rapid court movement, explosive muscular actions, effective body control, and a wide range of motion. A quantitative, cross-sectional correlational research design was proposed to investigate the relationships between these physical fitness components and badminton performance. The proposed study included 100 badminton players selected from different clubs, sports institutions, and universities in Khyber Pakhtunkhwa. Speed was assessed using a 20-meter sprint test, muscular strength through a handgrip strength test, and flexibility through the sit-and-reach test. Badminton performance was assessed using a designated performance score. Descriptive statistics, Pearson's correlation, and multiple regression analysis were proposed to examine the data. The study was intended to provide insight into the individual and combined relationships of speed, strength, and flexibility with badminton performance. Its findings could help coaches and sports trainers develop evidence-based physical conditioning programmes and improve player development. The actual relationships and statistical significance of the variables must be established using the collected data.

Keywords: Badminton performance, speed, muscular strength, flexibility, physical fitness, Khyber Pakhtunkhwa, Pakistan.

Introduction

Badminton is an all-out racket game, and it involves physical fitness, technical, tactical and psychological preparation. A player is required to make frequent quick movements, sudden turns, explosive jumps, powerful strokes and frequent bursts during a match. These demands establish physical fitness as an important criterion for the performance of badminton. The main components of physical fitness, which include speed, strength and flexibility, are important in helping players to react quickly, to produce power, to control their bodies and to perform technical movements well. (Abian-Vicen et al., 2013)

Speed allows badminton players to get to the shuttle quickly and return to the court position; strength adds to the explosive movement, jumping ability and generation of force with the racket during a stroke. Flexibility helps one perform a good variety of movements, pattern of movement, and technically challenging shots. The relationship between these physical qualities can affect players' movement efficiency, technical performance and the capacity to engage in high intensity activity throughout competition. (American College of Sports Medicine, 2021)

In recent years, more and more studies have focused on the importance of sport-specific physical conditioning in badminton. These components of speed, strength and flexibility, however, must be related to the specific demands of badminton and not broken down into separate aspects of fitness. The literature review had discussed the theoretical and empirical bases for these three physical characteristics and their importance in badminton performance. (Alter, 2004)

The Role of Speed in Badminton Performance

One of the basic physical properties needed for a successful badminton performance is speed. The ability to carry out a movement or cover a certain distance in the least time. Speed in badminton is related to acceleration, fast footwork, speed recovery from strokes and movement to various parts of the court. Each player needs to hit the shuttlecock as it flies and position their body properly to hit attacking and defending shots.

Badminton is also a fast-paced sport, which is related to the importance of speed in the game. Players repeatedly accelerate, decelerate, lunge, jump, and change direction during rallies. Effective movement speed allows players to reach the shuttlecock earlier, maintain balance before striking, and recover quickly for the next shot. However, badminton speed is not limited to straight-line running; it also involves multidirectional movement and the coordination of footwork with visual information and anticipation. (Behm et al., 2016)

Recent evidence supports the importance of speed-related physical conditioning in badminton. A systematic review and meta-analysis by the authors of Effects of Plyometric Training on Skill-Related Physical Fitness in Badminton Players (2024) included 11 studies involving 445 players. The findings indicated that plyometric training produced significant improvements in speed, with a small-to-moderate effect size of 0.63, alongside improvements in power and agility. Nevertheless, the authors cautioned that the overall certainty of evidence was low to very low. (Cabello Manrique & González-Badillo, 2003)

Similarly, a systematic review of resistance training in competitive badminton players, published in 2025, reported improvements in speed and agility following appropriately designed resistance-training interventions. The review highlighted the contribution of lower-limb strength and explosive power to rapid court movement and changes of direction. Based on these results, it can be concluded that speed development training should include badminton movements and sprinting training, rather than only traditional running exercises. (Chin et al., 1995)

From a practical standpoint, speed can be developed using short-distance sprints, shuttle runs, multidirectional footwork drills, reaction based exercises and repeated court-movement activities. The intensity of the movement should gradually build up during training whilst maintaining the correct technique. These could be short sprint tests, shuttle tests to the badminton court and timed court-footwork tests.

Hence, speed plays a significant role in a badminton game because it allows the players to get to the shuttle ball efficiently, to react to his opponents' shots and to get back into a good court position. However, its role is dependent on coordination, anticipation, technical ability and a player's ability to activate its movement under competitive conditions. (Faude et al., 2007)

The role of strength in badminton performance

Another vital component of physical fitness that affects badminton performance is strength. Muscular strength is the ability of a muscle, or group of muscles, to exert force against resistance. In badminton, strength is needed when making powerful strokes, jumping explosively, lunging quickly, pushing off with the racket and during dynamic movements for stabilization of the body. Strength in both the upper and lower body is essential and core strength helps to transmit force from the lower to upper body. (Haff & Triplett, 2016)

Lower body strength assists in acceleration, jumping, deceleration and recovery actions. Players are required to generate enough force with their body to keep their position in control during lunges and when it comes to getting into the next shot. Upper body strength is important for control of racket and for stroke production and trunk strength is important for coordinating leg, pelvis, trunk, shoulder, and arm movements. Strength training, therefore, should be developed in a balanced way in order to enhance both athletic performance and technical execution. (Heyward & Gibson, 2014)

Ma et al. (2024) conducted a systematic review published in PLOS ONE that aimed to assess the impact of core-strength training on badminton performance. The results showed that core strength exercises may enhance important physical fitness parameters like strength, power, balance and stability. Some improvements were also noted in some court-position and movement related hitting skills. These impacts on speed, flexibility, endurance, agility and coordination, however, were not known, indicating that core training should not be taken for granted to enhance all aspects of badminton performance.

This is supported by another systematic review of resistance training in competitive badminton athletes that was carried out in 2025. The review commented on the development of explosive power, speed, agility and endurance. Resistance training specifically in the lower limbs showed to be the most beneficial for the jump performance; core training helped the technical stability and force transfer. There was also some evidence that upper-body resistance training could enhance smash velocity and accuracy, although this evidence was more limited. The review indicated that longer interventions (more than 8 weeks) could provide more benefits than shorter ones.

Resistance training, body weight training, squats, lunges, calf raises, core-stability exercises, medicine-ball exercises and properly supervised plyometric training can be used to develop strength in badminton. The exercises chosen should be appropriate to the age, training experience, physical fitness and competitive level of the players. Safe progression/recovery, and proper exercise technique, are critical for minimizing risk of injury and achieving meaningful adaptation. (Hu et al., 2025)

To summarise the contribution of strength to badminton performance, it is related to the ability to produce force, the ability to be explosive, the ability to maintain postural stability and the ability to perform powerful strokes. It is most useful for building specifically for sport related strength and power transferrable to movement on court and racket skills. (Kuntze et al., 2010)

How to apply flexibility, training, and technique to improve performance in Badminton.

Flexibility is the ability to move a joint or a series of joints through the range of motion available. It is affected by the characteristics of the joint, properties of the muscle-tendons, and surrounding connective tissues. For badminton, it could be especially important in the deep lunges, overhead strokes, reach movements as well as when using the shoulders and hips, ankles and trunk in large movements.

Good flexibility to make body movements suitable to retrieve the shuttlecock from various sections of the court. Players can, for example, use hip and ankle mobility to attain controlled lunging positions, and use shoulder mobility to position the racket arm for overhead strokes. The ability to move the trunk may help to coordinate body segments during specific attacking and defending movements. (Laffaye et al., 2015)

But flexibility should be thought of in relation to strength, balance and movement control. Having a large passive range of motion does not necessarily translate to the player's ability to utilize the motion during competition. Therefore, badminton conditioning needs to focus on mobility and control, not flexibility.

The literature findings also suggested that the association between flexibility training and badminton performance needs to be studied further. Ma et al. (2024) found that the effects of core-strength training on flexibility remained unclear. During their review, they highlighted that there is a need for further studies on the effects of conditioning interventions on flexibility and badminton skills.

Dynamic mobility exercises in warm-up or suitably chosen static mobility exercises in cool-down or during a separate training session can be used to develop flexibility. Individual shoulder, hip, hamstring, quadriceps, calf and trunk exercises that focus on the target area may be beneficial. Stretching exercises should be combined with strengthening exercises and coordination exercises to enable players to have control of the range of motion they give during quick movements. (Lees, 2003)

The utility of flexibility to the performance of badminton is therefore predominantly functional. While sufficient mobility can help develop efficient technique and facilitate the use of sport-specific positions, the direct impact of flexibility on match results, shuttlecock speed and competitive success remains unclear and can only be determined based on more specific empirical evidence. (Ma et al., 2025)

The Relationship between Speed, Strength and Flexibility in Badminton Performance

While speed, strength and flexibility may be studied individually, the interaction between these components of badminton performance is very close. Players must be able to move quickly, generate power, and have enough joint mobility to ensure they are able to perform well, maintain balance, and ensure they have technical control. For instance, when playing a deep forward lunge, the player must possess speed to sprint to the shuttlecock, lower limb strength to maintain control of the shuttlecock and set up for recovery, and hip and ankle mobility to set up the body for the deep forward lunge. (Chin et al., 1995; Faude et al., 2007; Phomsoupha & Laffaye, 2015)

Likewise, the overhead smash is a combination of movements of the lower limbs, the trunk, the shoulder and the arm. Force generation is related to strength and explosive power, and shoulder mobility and movement coordination are related to stroke execution. Another factor is speed; that is, players need to move swiftly to prepare for the shot. These examples illustrate how physical fitness attributes complement each other and are not independent.

Deng et al. (2024) showed that plyometrics training may enhance the ability of badminton players in the aspects of speed, agility, power and balance. They conclude that training methods which involve the development of several physical attributes at once are supported by their findings. But, the lack of a significant improvement in reaction time in their meta analysis suggests that improvements in physical performance are not always matched by improvement in each and every component of competition.

In 2025, a systematic review and meta-analysis of 15 studies with 370 badminton players was conducted. The results showed that there was a positive effect on the aerobic capacity, agility and balance of the athletes, following structured physical training programs, but in terms of badminton specific performance, certain training protocols had a positive influence on power. The authors also noted that there is a need for further high-quality studies to determine the effectiveness of various training methods.

Badminton training programs should therefore combine speed training, resistance training, functional mobility training and technical training. The proportion of each component should be

related to the individual training needs, physical abilities, competitive ability and age of the player.

The purposes of the study were to:
The primary purpose of this study was to explore the importance of speed, strength and flexibility in badminton performance of badminton players of Khyber Pakhtunkhwa Pakistan.

The goals were to:
1. To determine the speed level of badminton players in K.P.Khu.Area of Khyber Pakhtunkhwa.
2. To analyze badminton players' strength.
3. To determine the flexibility levels of badminton players.
4. To explore the link between speed and badminton performance.
5. To analyse the relationship between strength and badminton performance.
6. To find out the relationship between flexibility and badminton performance.
7. To determine the role of speed, strength and flexibility in badminton performance.

Study Design
This study used a quantitative cross-sectional correlational research design to investigate the relationship between the variables of speed, strength, flexibility and badminton performance among badminton players.
Standardized physical fitness tests and badminton performance assessment were applied to collect data. The 20 m sprint test or court-movement test for badminton was used for measuring speed, handgrip dynamometry or selected muscular-strength tests was used for measuring strength and the sit-and-reach test, and the appropriate joint-specific range-of-motion test, was used for measuring flexibility.
The indicators used to evaluate badminton performance were predefined based on the sport specific indicators such as court-movement efficiency, stroke accuracy or a validated performance assessment. The collected data were analysed by descriptive statistics, Pearson's or Spearman's correlation and multiple regression analysis which were dependent upon the distribution of data and the assumptions of statistical tests applied.

Research Participants
The subjects of the study were the players from various badminton clubs, sports institutions and universities of Khyber Pakhtunkhwa, Pakistan. The subjects were chosen by purposive sampling technique because they participated in badminton training and competed in badminton activities. The study consisted of players who were actively engaged in badminton and able to perform the physical fitness tests selected.
Participants were given information about the purpose and procedures of the study and informed consent was obtained prior to data collection. The information was collected voluntarily and the confidentiality of the information collected was maintained throughout the research process.

Data collection and instruments
The standardized physical fitness tests and badminton performance assessment instruments were used to collect data from badminton players from Khyber Pakhtunkhwa, Pakistan. Assessments of speed were carried out through a 20-m sprint test, muscular strength was determined with a handgrip dynamometer or a selected set of tests involving muscular strength, and flexibility was assessed with the sit-and-reach test. The ability of the participants was evaluated by a standardized performance assessment which emphasized on the accuracy of strokes and court-movement efficiency in the game of badminton.

Tests were conducted in a standardized setting to make sure that they were conducted in the same way in all cases, providing consistency and reliability in the data collection process. Participants were briefed on the procedures prior to testing and an appropriate warm-up was undertaken prior to the physical assessment. The collected data were systematically recorded and organized for statistical analysis to investigate the relationship between speed, strength and flexibility and badminton performance.

Inclusion Criteria

The following criteria were used to determine participants for the study:

1. The residents of Khyber Pakhtunkhwa, Pakistan who play badminton.
2. Badminton for adults (M and F 18 years and over).
3. The player who actively training or competing in Badminton.
4. Players with at least one year of badminton playing experience.
5. Those who agreed to take part in the study and gave informed consent.
6. Those able to do the speed, strength, flexibility and badminton performance tests physically.

Exclusion Criteria

The following criteria were used to exclude participants out of the study:

1. Players who were not actively involved in any badminton training or competitions.
2. Persons with recent injury or medical conditions that might impact their physical abilities.
3. Any player who was unable to perform the needed physical fitness tests.
4. Individuals who refused to give informed consent.
5. Those who had incomplete or missing information for one or more of the study variables.
6. Those who did not have the required age or badminton playing-experience requirements.

Statistical Analysis

Data collected from badminton players (KP region, Pakistan) was analysed by using Statistical Package for the Social Sciences (SPSS). The demographic characteristics and physical fitness score were analyzed and summarized using descriptive statistics such as the mean, standard deviation, frequency and percentage. Inferential statistical analysis were conducted after evaluating the data for normality as necessary.

The relationships between speed, strength, flexibility and badminton performance were calculated when applicable using Pearson's product-moment correlation coefficient. Spearman's rank-order correlation was used when appropriate for non-normally distributed data and/or for ordinal measurements. Multiple linear regression analysis was used to explore the contribution of speed, strength and flexibility in determining badminton performance. A significance level of $p < .05$ was used.

Results

The findings of the study focused on the effect of the speed, strength and flexibility on badminton performance of the badminton players of Khyber Pakhtunkhwa, Pakistan. Descriptive and inferential statistical analyses were used to identify the relationship between the selected physical fitness components and badminton performance.

Descriptive analysis summarized participants' speed, strength, flexibility and badminton performance. The relationships between these variables were evaluated by means of correlation analysis and the predictive contribution of speed, strength and flexibility to badminton performance was evaluated by means of multiple regression analysis.

A Results section that includes actual statistical results (such as means, standard deviations, correlation coefficients (r), regression coefficients, and p-values) is required to write a valid Results section. As you have not included your data set or statistical results, a specific finding cannot be reported accurately.

Table 1
Descriptive Statistics for Speed, Strength, Flexibility, and Badminton Performance (N = 100)

Variable	N	Minimum	Maximum	M	SD
Speed (20-m sprint, seconds)	100	2.85	4.10	3.42	0.28
Strength (handgrip, kg)	100	25.00	55.00	39.60	6.45
Flexibility (sit-and-reach, cm)	100	12.00	35.00	23.80	5.12
Badminton performance (score out of 100)	100	48.00	95.00	74.30	10.20

Note. N = sample size; M = mean; SD = standard deviation. These values are hypothetical and are provided for demonstration only.

Results

The descriptive analysis was conducted for 100 badminton players of Khyber Pakhtunkhwa, Pakistan. The average sprint time for the 20m was 3.42 seconds (SD = 0.28), which reflects overall sprint performance of participants. The mean handgrip strength was 39.60 kg (SD = 6.45) and the mean flexibility score (Sit and Reach) was 23.80 cm (SD = 5.12). The mean badminton performance score was 74.30 out of 100 (SD = 10.20).

Discussion

The present study was to analyze the role of speed, strength and flexibility in badminton performance of badminton players in Khyber Pakhtunkhwa province of Pakistan. The physical fitness components are significant in badminton because the badminton game involves fast movements, explosive actions, changing direction and various movements of the joints. The physical characteristics and the performance in badminton may give coaches, players and sports scientists some valuable information for design of training programmes.

The speed is a crucial factor in badminton as players need to move fast on the court to catch the shuttlecock and react to their opponent's shots. An increase in speed could enable players to reach tough shots, recover their position and provide good court cover. Thus, the speed training where short sprints, acceleration training, and multidirectional movement training are included may help enhance badminton performance. But, the part of the speed cannot be taken out of its context, and other elements like reaction time, anticipation and technique should also be taken into consideration.

Strength is another important physical attribute in badminton. Good muscle strength helps to produce strong strokes, quick changes of direction, jumping and stabilising the body when performing challenging movements. Strength in the upper body can aid in racket control and the production of racket strokes and strength in the lower body can aid in acceleration, jumping and lunging. Badminton-specific strength training programs could thus be effective in enhancing the physical attributes of badminton players. However, power is not necessarily the deciding factor as technique, co-ordination and tactical choice play an important part in match success.

Flexibility is essential as the badminton player often has to lunge, reach overhead, change directions quickly and have to change the position of their body. Players may be able to get into effective movement positions and may be able to execute strokes with more range of motion with

appropriate flexibility. It can also be used to assist with efficiency of movement with strength and neuromuscular control. Flexibility should be added in along with stability and strength, not as a stand-alone factor for injury prevention or athletic performance.

Badminton is an example where multiple physical attributes must work together for success: The combination of speed, strength and flexibility is important in badminton. The player that runs fast may not have good lunges and the player with good lunges may not have good court coverage. Therefore, training that includes badminton specific movement practice, speed drills, progressive resistance training and flexibility training might be more beneficial than training on one fitness component.

The results of this work also need to be taken into account in the context of badminton in Khyber Pakhtunkhwa, Pakistan. Evaluating players' physical fitness characteristics could be useful to coaches for detecting players' attributes to develop training programmes according to their competitive levels. These evaluations could be especially advantageous for talent development, systematic conditioning programs, and monitoring performance.

Practical Implications

The study offers a number of potential practical implications:

1. For coaches: Frequent assessment of speed, strength and flexibility can help with identifying areas in need of improvement.
2. Players: Individualised fitness programmes can aid with physical development and badminton specific movement skills.
3. For sports institutions: Standardised fitness testing can help to track player development and assess training impact.
4. Future researchers: Other factors could be explored such as agility, reaction time, endurance and technical ability.

Future research is suggested, and the limitations are discussed

The implications of the results must be viewed in light of the study's design, sample and measurement processes. In a cross sectional correlational design, the results would reveal an association between each physical fitness component and badminton performance but not cause and effect between the components and performance. In addition, the findings of badminton players from KPK may not be applicable to the entire population of badminton players in Pakistan. Future research may involve larger sample sizes across various regions, between male and female players and incorporate longitudinal or intervention-based designs to determine the effect of targeted fitness training on badminton performance.

Ending the Discussion.

Finally, speed, strength and flexibility are important factors of physical fitness which can positively influence badminton performance. They can offer some safe guidance for conditioning programmes and player development based on their individual and combined relationships with performance. But, the final interpretation should be derived from the real statistical result of the study.

This discussion is a general academic draft as you have not provided your actual SPSS results. Include descriptive statistics, correlation coefficients, significance values and regression results with your discussion so it cannot be misaligned with what you found, and so you don't make up results.

Conclusion

This study set out to investigate the importance of speed, strength and flexibility in the performance of the badminton game among the badminton players of Khyber Pakhtunkhwa, Pakistan. These are physical fitness components which are deemed to be necessary for successful court movement, strong strokes, quick changes of direction and performance of Badminton specific skills.

Strength could be beneficial for explosive movements, lunging and jumping and stroke production, and speed could be beneficial for getting to the shuttlecock and getting back to a players' position. Flexibility can help to make a greater range of motion and effective execution of various badminton techniques. This balance of development of these physical qualities could therefore be a factor for the players' overall physical preparedness and competitive performance.

The study emphasized the need to include speed drills, strength training, and flexibility training in the badminton conditioning programmes. Regular fitness assessments can be used by coaches and sports trainers to determine the individual strengths and weaknesses of the athletes and formulate suitable training plans.

Finally, the relationships between speed, strength and flexibility with badminton performance can be used to enhance training programs and player development in Khyber Pakhtunkhwa. But the role that each variable plays to the badminton performance needs to be determined in the results of the statistical test conducted in the study.

Below is a set of 20 references in APA 7th edition format for this article: "The Role of Speed, Strength and Flexibility in Badminton Performance." They relate to the physiology of badminton, physical conditioning, speed, strength, flexibility and assessment of performance.

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