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The Effect of Racket String Tension at 28 lbs and 24 lbs on Smash Speed of Badminton Athletes

Rayhan Achdhika[1]✉, Komarudin[2], Angga M Syahid[3]

University of Education Indonesia. Dr. Setiabudi Street no. 229, Bandung City. 40154, Indonesia[123]

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Abstract

Badminton is a racket sport that emphasizes movement technique training such as jumping, turning, fast arm movements and requires the right racket strings. One of the factors to get the speed of a badminton athlete's smash is one of them using the tightness of a 28 LBS and 24 LBS racket string. Therefore, this study aims to examine the effect of the tightness of the 28 LBS and 24 LBS racket strings on the speed of a badminton athlete's smash. The method used by the researcher is an experimental method with an Ex-Post Facto research design. The sample involved in this study consisted of 10 badminton athletes selected according to the criteria desired by the researcher. The instrument used uses kinovea software. The analysis of this data was taken by the researcher using the SPSS version 23 application. The data obtained by the researcher was in the form of an average value of 1.50, with a standard deviation of 0.513. The results of the homogeneity test showed that the significance value of 0.663> 0.05, so it can be concluded that the data variance is homogeneous. Along with the t-test results show that the significance value (2-tailed) is 0.000 <0.05, which means that there is a significant difference in average speed between the tightness of the 28 LBS and 24 LBS racket strings. The results of this study indicate that there is a significant effect of the tightness of the 28 LBS and 24 LBS racket strings on the speed of badminton athletes smash.

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✉ Correspondence address :
E-mail: achdhikasrayhan@gmail.com

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INTRODUCTION

Badminton is a sport that requires jumping, lunging, and quick movement when hitting the ball (Tober et al., 2021). Badminton has several categories: singles, doubles, and mixed doubles. Badminton is a very popular sport in various countries, including Indonesia. According to (Alsaudi, 2020), badminton is a favorite elective course for prospective students, and badminton movements are a fundamental step in every badminton training process. Badminton is an exciting racket sport that requires jumping, turning, and quick arm movements (Hong et al., 2014).

According to (Gou, 2021), basic techniques are the main thing that every player must master and understand in playing badminton. The basic techniques in badminton that must be mastered include: serve, lob, dropshot, smash, jump smash, netting, and drive. According to (Syayyif et al., 2022) "The way players grip the racket can be divided into four different ways, namely (1) the western grip (American grip), (2) the continental grip (backhand grip), and (3) the handshake grip or pistol grip (shakehand grip or often called the forehand grip), and (4) a combination of these three grips.In badminton, mastered skills or techniques are needed to gain points from the opponent.

A smash is a shot that is executed hard and sharp, functioning as a way to kill the opponent and gain points from them (Li et al., 2017). Smash is an overhead shot that is aimed at the opponent's area with the shuttlecock diving and is done with full power (Junanda et al., 2016). In addition to the smash, there is also a smash with a jump, or what is commonly called a jump smash. The advantages of a jump smash are first, the hit is faster and stronger, second, the hit is more accurate, and finally the hit is more difficult to predict. Badminton athletes are required to have great power to gain points from opponents through the smash technique thrown at their opponents.

However, there are several external factors that can affect the results of a badminton athlete's smash speed. One of them is the tightness of the string tension on the racket used, which can be one of the influences on the smash results. The tightness of the racket string also greatly affects the performance or results of a badminton athlete's stroke, for example, when performing a smash movement technique where in addition to requiring hand strength to get a strong and fast smash result, it also requires good string quality and in accordance with the standards of badminton athletes in general.

According to (Mohandhas et al., 2016), regarding the effect of string tension on shuttlecock speed. By using variations of string tension of 22 lbs, 24 lbs, 26 lbs, 28 lbs, 30 lbs, it was shown that the higher the string tension, the lower the shuttlecock speed. This is also supported by those who state that the effect of high string tension will result in a lower bounce speed than low string tension (Bower & Cross, 2005). Strings with a low tension of 24 lbs or even less are more elastic, providing a larger sweet spot. Experimental study with automatic rackets: strings with lower tension (22>24>26>28>30lbs) produced higher shuttle speeds (Arianto et al., 2017) The sweet spot on these rackets is usually smaller and located at the top of the racket, making them suitable for generating significant power, especially on smashes and attack shots.

Strings with a high tension of 28 lbs or more provide greater control and precision but require more skill and strength to generate power (Sakurai & Ohtsuki, 2000). According to (Zhu, 2013), it was revealed that the average maximum speed varies with string tension, but in different ways for different skill levels. The speed decreases for beginners, increases for recreational players, but remains stable for expert players. Previous research (McErlain-Naylor et al., 2020) entitled "Effect of Racket-Shuttlecock Impact Location on Shot Outcome For Badminton Smashes by Elite Players" has explained that the location of the smash impact on the racket and shuttlecock can also affect the speed and location that the athlete wants to aim at when the athlete makes a smash movement.

The purpose of this study was to determine which racket string tension (24 lbs and 28 lbs) would maximize a badminton athlete's smash speed. The novelty of this study proves that, in addition to shuttlecock placement affecting smash speed, racket string tension can also influence the smash speed of a badminton athlete.

METHODS

This study employed an experimental method with an ex-post facto research design. Ex-post facto research is research in which the independent variables have already occurred when the researcher begins observing the dependent variable in a study (S. Permadi et al., 2020). The ex-post facto method is a method used in research that examines causal relationships that are not manipulated by the researcher. The existence of a causal relationship is based on theoretical studies, that a certain variable causes a certain variable

(Syahrizal & Jailani, 2023).

This research was conducted at the Kayp1 Champion Academy badminton club, which has adequate facilities for training and testing smash technique skills. The population in this study used 30 athletes from the Kayp1 Champion Academy badminton club, with a sample of 10 athletes who met certain criteria that the researcher had determined. For the treatment carried out by the author, namely by carrying out drill smash on the sample 10 times at each string tension of 24 lbs and 28 lbs. The sample must also direct the smash to the point that has been directed by the author, to make it easier to calculate the speed of the smash in the Kinovea application.

The sampling technique used in this study was purposive sampling, with the following criteria: 1) Have trained in badminton for at least 5 years, 2) Be male, 3) Have won a national-level competition, and 4) Have good smash techniques. The test instrument in this study used the Kinovea software application. This Kinovea software application can be a solution for teachers or coaches to be able to know and analyze every movement or technique performed by runners to be used as a reference for making improvements and increasing performance (Tamim et al., 2024). Once the data has been obtained, the next step is to analyze the data.

The data obtained by the researcher will be analyzed and processed using the Kinovea software application. The recorded video is then connected to a laptop containing the Kinovea software application for analysis. According to (Jariono et al., 2020), kinovea software is a training video analysis tool in one of the sports by slowing down a movement for analysis and recording. The advantage of this Kinovea software is that it makes it easier to analyze movements through exercise videos by slowing down the movements to be documented and used as evaluation material.

RESULTS AND DISCUSSION

This section presents the research findings based on the collected and analyzed data. The results are presented systematically to answer the research questions and test the proposed hypotheses. The data are organized in tables and graphs, which are then explained descriptively to provide a clear picture of the influence of the independent variables on the dependent variable. The results of the descriptive statistical data analysis of the 24 lbs and 28 lbs string tensions on smash speed obtained by the researcher are shown in **Table 1.**

Table 1. Descriptive Statistics

Subject	N	Min	Max	Mean	Std. Deviation
24 lbs	10	18,24	19,18	18,78	0,314
28 lbs	10	15,76	16,46	16,03	0,228

Based on **Table 1**, it shows that the data obtained in the string tension of 24 lbs racket with a sample of 10 athletes with a minimum value of 18.24 and a maximum value of 19.18 in addition there is an average of 18.78 and a standard deviation of 0.314. Then in the string tension there is a minimum value of 15.76 and a maximum value of 19.78, in addition there is an average of 18.78 and a standard deviation of 0.228..

Based on the normality test, the sig. (0.362 and 0.548) values were obtained > 0.05. Therefore, it can be concluded that all data are normally distributed. Homogeneity test was conducted to ensure that both racket string tension data were the same. The test was conducted using Levene's Test. Data calculate the sig. (0.531 and 0.532) > 0.05 were obtained.

Therefore, it can be concluded that all data in the two groups meet the homogeneity assumption. After conducting the homogeneity test and having found that the data used were homogeneous, the author continued with the next test, namely the Independent t-test to determine whether there was a difference in average speed between the 24 lbs and 28 lbs racket string tensions. The test results are shown in.

An independent sample t-test was conducted to determine whether there was a significant difference without conducting a pretest and posttest. Therefore, the analysis continued with the t-test results showing a significance value (2-tailed) of 0.000 (<0.05), so it can be concluded that there was a significant difference between the two groups in smash speed. The results of the image of the percentage increase in each group are presented in **Figure 1.**

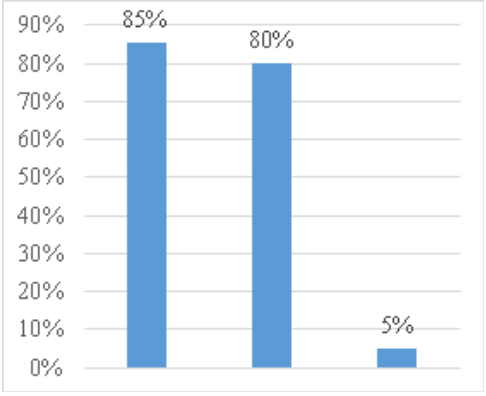

Figure 1. Percentage of Smash Speed

Based on the results of **Figure 1**, the results of the average difference in smash speed increase in the 24 LBS group had a percentage of 85%, while in the 28 LBS group it had a percentage of 80%, the difference in increase between the groups was 5%. The results of the percentage of the 24 LBS group had a percentage that had a greater influence on increasing the smash speed of badminton athletes.

The findings demonstrate that the 24 LBS group achieved significantly higher learning outcomes compared to the 28 LBS group. This result suggests that the instructional approach or learning strategy applied in the 24 LBS group was more effective in enhancing athletes' performance. Since the data were normally distributed and homogeneous, the validity of the statistical conclusions is supported by meeting the basic assumptions of parametric analysis.

The significant difference between the two groups may be attributed to the characteristics of the 24 LBS approach, which likely promotes better engagement, comprehension, or retention of learning material. This finding aligns with previous studies suggesting that more interactive and structured learning methods can improve student outcomes. This finding is in line with the biomechanical theory of badminton strokes proposed by (King et al., 2020) which states that higher string tension results in a more accurate stroke direction and maximum energy transfer when hit with the right technique. It is also consistent with the theoretical perspective that student-centered learning environments enhance intrinsic motivation and academic achievement.

Overall, the results provide empirical evidence that the 24 LBS method is more effective in improving learning outcomes than the 28 LBS approach. The results of this study align with those presented by (McErlain-Naylor et al., 2020), who found that lower string tension increases the repulsion power of the racket. More elastic strings create a trampoline effect, allowing the shuttlecock to travel at higher speeds despite the player's relatively constant energy input. In addition, research (Rusdiana et al., 2020) supports this by revealing that tighter strings with a tension above 26 lbs can increase the results of shuttlecock speed by 5-10% compared to looser racket strings, but if used by players at intermediate level and above.

Future research may explore the specific components of the 24 LBS framework that contribute most strongly to learning gains and test its applicability in different educational contexts. The author's suggestion for badminton coaches and athletes is to pay more attention to the needs of badminton athletes, especially regarding smash speed.

This basic technique is one way for badminton athletes to generate or gain points from their opponents. By selecting an effective string tension, such as 28 lbs, coaches can also apply it to their athletes, especially for match needs. This study also proves that the effect of a higher racket tension can produce maximum smash speed, when compared to a lower racket string tension.

In addition, training factors from proper smash training can also affect the results of the athlete's smash speed. And no less importantly, training activities should include psychological approaches such as building self-confidence, managing pressure during matches, and developing a positive competitive mentality, because mental aspects also contribute to an athlete's smash speed performance.

CONCLUSION

The results of the independent t-test analysis were obtained for the groups using racket strings with a tension of 24 LBS and 28 LBS. The value of 0.000 <0.05 indicates that there is a difference between the smash speed in the group with string tension of 24 LBS and 28 LBS. This happens because the string with a tension of 24 lbs has more elastic properties, so that when the shuttlecock is hit, the string provides a greater bounce effect or trampoline effect.

Conversely, at a string tension of 28 lbs, the string surface becomes stiffer, reducing the string's elasticity. This results in a shorter dwell time between the shuttlecock and the string, resulting in less energy being transferred to the shuttlecock. It can be concluded that the tightness of the 28 LBS racket strings has a significant influence on increasing the smash speed of badminton athletes.

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