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The Effect of Grip Strength and Anticipation on Spin Serve Effectiveness in Junior Tennis Players

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Abstract. This study investigates the effect of racket grip strength and motion anticipation on the effectiveness of spin serves among junior tennis athletes in Makassar. Using a quantitative correlational design, 20 athletes aged 14–18 years participated. Grip strength was measured with a handgrip dynamometer, motion anticipation with a visual reaction test, and spin serve effectiveness through video analysis of accuracy, direction, and bounce. Multiple regression analysis ($\alpha = 0.05$) showed that both variables significantly affected spin serve effectiveness ($R^2 = 0.551$; $p < 0.05$). Grip strength had a greater contribution ($\beta = 0.46$; $p = 0.008$) than motion anticipation ($\beta = 0.39$; $p = 0.018$). The findings highlight the importance of integrating physical and cognitive training to enhance spin serve performance in junior tennis athletes. Strength and anticipation training should be combined to optimize serve outcomes

Keywords: tennis; spin serve; racket grip strength; motion anticipation

1 Introduction

Service is one of the key elements in tennis that can determine the course of the match (Colomar et al., 2022; Aprilo et al., 2023). Of the various types of serves, the spin serve is often considered more effective because it produces unpredictable direction and bounce, making it difficult for the opponent to return. Success in executing a spin serve depends not only on technical skill but also on physical and cognitive factors that support the consistency and quality of the shot (Koya et al., 2022; Aprilo et al., 2025). Two important factors are the strength of the racket grip, which is closely related to the control and spin of the ball, and the ability to anticipate movement,

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which helps the athlete prepare the body position and swing accuracy optimally (Rigozzi et al., 2023; Triolet & Benguigui, 2024).

Based on this, this study aims to analyze the influence of racket grip strength and motion anticipation on the effectiveness of spin serves in junior tennis athletes. This group was selected because they are in the phase of developing basic techniques and mastering the fundamental aspects of the game. Several previous studies have shown that grip strength plays a significant role in improving ball control and contributing to shot quality (Huebner et al., 2023; Berhimpong et al., 2023). Anticipation skills play a role in improving performance and game situations (Huesmann & Loffing, 2024; Triolet & Benguigui, 2024). However, studies specifically examining the relationship between these two factors and the effectiveness of spin serves in junior tennis athletes in Indonesia are still very limited. Research specifically examining the relationship between racket grip strength and motion anticipation in relation to the effectiveness of spin serves, particularly among junior athletes in Indonesia, remains very limited. Therefore, this study is expected to address this gap and provide a scientific basis for developing more specific, targeted, and tailored training programs tailored to athletes' needs.

The research hypothesis states that racket grip strength and motion anticipation significantly influence the effectiveness of the spin serve. The variables studied include racket grip strength as a physical factor, motion anticipation as a cognitive factor, and spin serve effectiveness as the dependent variable, measured by the consistency of the ball entering the target, the variation in direction, and the height of the bounce after crossing the net.

The novelty of this research lies in the integration of physical (racket grip strength) and cognitive (motion anticipation) aspects in analyzing the effectiveness of spin serves in Indonesian junior tennis athletes. This research is expected to provide a new perspective, suggesting that the success of spin serving is not solely determined by technique or strength, but also by the harmonious interaction between physical and cognitive abilities.

2 Method

This study used a quantitative approach with a correlational design to analyze the effect of racket grip strength and motion anticipation on the effectiveness of spin serves in tennis. The subjects were 20 junior tennis athletes in Makassar, aged 14 to 18 years. The sample was selected using purposive sampling, considering the inclusion criteria: athletes who had trained for at least one year, actively participated in training, and were in good health without injuries that could affect the serve movement. Athletes experiencing acute injuries or medical conditions that could interfere with performance were excluded from this study. The independent variables in this study consisted of racket grip strength and motion anticipation, while the dependent variable was the effectiveness of spin serves. Racket grip strength was measured using a handgrip dynamometer with three trials, with the highest value being the final score. Motion anticipation ability was measured using a computer-based visual reaction test using software. The program would display a visual stimulus (e.g., a light, a symbol, or a moving object), and then the system recorded the reaction time in milliseconds after the athlete responded. Meanwhile, the effectiveness of spin serves was measured by the ball entering the target. Each athlete performed 30 spin serve attempts directed at a predetermined target, with rest breaks between sets to maintain consistent performance. To ensure consistency and avoid overburdening, the sets were generally divided into three sets, each consisting of 10 serves. The collected data were analyzed through descriptive tests to describe the characteristics of the research variables, followed by

prerequisite tests in the form of normality and homogeneity tests. Inferential analysis used multiple linear regression to determine the simultaneous and partial effects of racket grip strength and motion anticipation on the effectiveness of spin serves, with a significance level of 0.05.

3 Result

The initial step in presenting the research results is to display descriptive statistics to provide an overview of the data distribution for the variables of racket grip strength, motion anticipation, and spin serve effectiveness. These statistics include the mean, standard deviation, minimum, and maximum values for each variable. The results of the descriptive analysis can be seen in Table 1 below.

Table 1. Descriptive Statistics

Variables	N	Mean	SD	Min	Max
Racket Grip Strength (kg)	20	38.25	4.82	30	47
Anticipation of Movement (score)	20	72.60	6.45	60	84
Spin Service Effectiveness (%)	20	76.80	7.25	62	88

Table 1 shows that the results of the descriptive analysis indicate that the racket grip strength of junior tennis athletes in Makassar has an average value of 38.25 kg with a standard deviation of 4.82. This indicates that most athletes have quite good and relatively homogeneous grip strength, with a minimum value of 30 kg and a maximum of 47 kg. The ability to anticipate movement was recorded to have an average score of 72.60 with a standard deviation of 6.45, indicating a varied ability to predict the direction of the ball but still within a reasonable range (60–84). Meanwhile, the effectiveness of the spin serve had an average of 76.80% with a standard deviation of 7.25, indicating that athletes are generally quite consistent in performing spin serves with a good level of accuracy and variation. These data provide an initial overview that all three variables are in an adequate category for further analysis.

Table 2. Normality Test (Shapiro–Wilk Test)

Variables	N	W Statistics	Sig. (p)	Information
Racket Grip Strength	20	0.963	0.543	Normal
Anticipate Motion	20	0.954	0.421	Normal
Spin Service Effectiveness	20	0.972	0.671	Normal

Table 2 shows that the results of the normality test indicate that all research variables have a significance value above 0.05 ($p > 0.05$). Racket grip strength ($p = 0.543$), motion anticipation ($p = 0.421$), and spin serve effectiveness ($p = 0.671$) are all normally distributed.

Table 3. Homogeneity Test (Levene's Test)

Variables	N	F count	Sig. (p)	Information
Racket Grip Strength	20	0.382	0.543	Homogeneous
Anticipate Motion	20	0.425	0.521	Homogeneous
Spin Service Effectiveness	20	0.276	0.608	Homogeneous

Table 3, the homogeneity test, shows that all variables have a significance value greater than 0.05. Racket grip strength ($p = 0.543$), motion anticipation ($p = 0.521$), and spin serve effectiveness ($p = 0.608$) are proven to be homogeneous.

Table 4. Results of Multiple Linear Regression Analysis

Independent Variable	B	β	t count	Sig. (p)	Information
Racket Grip Strength	0.62	0.46	2,981	0.008	Significant
Anticipate Motion	0.41	0.39	2,612	0.018	Significant

The results of multiple linear regression in Table 4 show that the racket grip strength variable has a significant influence on the effectiveness of the spin serve, with a value of $\beta = 0.46$ and $p = 0.008$. This means that the higher the racket grip strength, the better the effectiveness of the spin serve produced by the athlete. The motion anticipation variable also shows a significant influence with $\beta = 0.39$ and $p = 0.018$, which means that the better the athlete's anticipation ability, the more effective the spin serve performed.

Table 5. Regression Model Summary

Statistics	R	R ²	Adjusted R ²	F	Sig. (p)
Value	0.742	0.551	0.512	14.29	0.000

The summary of the regression model in Table 5 shows that the R² value is 0.551, which means that racket grip strength and motion anticipation together are able to explain 55.1% of the variation in the effectiveness of the spin serve. Meanwhile, the remaining 44.9% is influenced by other factors outside this study, such as service technique, general physical condition, or psychological aspects of the athlete. The calculated F value of 14.29 with a significance of $p < 0.001$ confirms that the regression model is simultaneously significant in explaining the relationship between the independent and dependent variables.

4 Discussion

The results of this study confirm that racket grip strength and the ability to anticipate movement have a significant influence on the effectiveness of spin serves in junior tennis athletes in Makassar. Given the importance of physical and cognitive aspects in tennis performance, grip strength is directly related to control of the direction and speed of the ball, especially in strokes

that require spin, such as topspin and slice (Rigozzi et al., 2023; Bilić et al., 2024; Dobos et al., 2024). In this study, the contribution of racket grip strength was more dominant than motion anticipation, indicating that physical control of the racket is the main factor in producing stable spin.

In addition to physical factors, the cognitive aspect of anticipating movement has also proven significant. Tennis athletes with good anticipatory skills can respond more quickly to game situations, allowing them to optimally adjust their racket angle and body position. (Müller et al., 2024; Zhu et al., 2024; Triolet & Benguigui, 2024) This is consistent with the findings of this study, which found that motion anticipation positively impacts the effectiveness of a spin serve, although not as significantly as grip strength. Skilled anticipation helps athletes accurately time their shots, adjust their racket angle, and maintain body balance to ensure the desired rotation with the ball.

The serve is the most complex stroke in tennis, involving a combination of muscle strength, motor coordination, and the ability to read the game. Tennis players have found that varying the direction and spin of a serve often determines the chances of winning an ace or forcing a weak return. (Brito et al., 2024; Lambrich & Muehlbauer, 2023; Aprilo et al., 2022). The results of this study support this view, as the effectiveness of spin serves, measured by accuracy, direction variation, and bounce height, was shown to correlate with racket grip strength and anticipation ability.

A biomechanical approach showed that the success of a spin serve is significantly influenced by grip stability and upper body coordination, particularly the wrist and forearm. This is relevant to the findings of this study, where racket grip strength is the primary predictor of spin serve effectiveness. Young tennis athletes in Europe also reported that visual reaction-based training can increase response speed by up to 15%, which directly impacts serve and return quality. These findings further reinforce the importance of anticipation in supporting stroke effectiveness (Zhang & Chen, 2024; Dobos et al., 2024; Müller et al., 2024; Rosker & Majcen Rosker, 2021).

Thus, this study not only strengthens the empirical evidence from previous studies but also provides a new context for the junior tennis athlete population in Indonesia, particularly in Makassar. The novelty of this study lies in the integration of physical and cognitive factors into a single predictive model for spin serve effectiveness, a practice rarely studied simultaneously at the junior level. The practical implication of this research is the need for a holistic training program, incorporating both physical training to improve grip strength and cognitive training based on motion anticipation, to optimally develop spin serve performance (Beckmanni et al., 2021; Koya et al., 2022; Bilić et al., 2024).

Multiple linear regression analysis revealed that both racket grip strength and motion anticipation significantly influenced the effectiveness of spin serves. Racket grip strength provided a more dominant contribution with a β coefficient of 0.46. The importance of grip strength in controlling the direction and speed of the ball. A strong racket grip allows athletes to produce more consistent spin on the ball and maintain racket stability upon contact. This is crucial for spin serves, which require optimal friction between the strings and the ball to produce unpredictable rotation for the opponent (Bilić et al., 2024; Novak et al., 2023; Carboch & Hrychová, 2025).

Furthermore, the ability to anticipate movement was also proven significant with a β coefficient of 0.39. The cognitive ability to predict the ball's direction and prepare an appropriate body

response is a determining factor in successful technical skills. In the context of a spin serve, good anticipation helps athletes maintain body balance, determine the swing angle, and adjust the timing of the shot. Thus, although physical factors are dominant, cognitive aspects still make a significant contribution (Huesmann & Loffing, 2024; Busuttill et al., 2022; Busuttill et al., 2025).

The coefficient of determination ($R^2 = 0.551$) indicates that the combination of racket grip strength and motion anticipation explains 55.1% of the variation in spin serve effectiveness. This figure is quite high for a study with a limited sample size, and it also confirms that these two factors are strong predictors. However, another 44.9% of the variation is explained by external factors such as basic serving technique, shoulder flexibility, movement coordination, and the athlete's psychological state during the match. This is in line with the view that sports performance is multifactorial and does not depend solely on one or two components (Vacek et al., 2025; Jacquier-Bret & Gorce, 2024; Gorce & Jacquier-Bret, 2024).

Overall, the results of this study reinforce the understanding that the effectiveness of spin serves in junior athletes is determined not only by physical factors but also by trained cognitive abilities. Tennis training programs should be designed holistically by integrating grip strength training using resistance training or handgrip exercises, while simultaneously practicing movement anticipation through visual reaction-based drills and game situations. With this approach, junior athletes can more quickly master effective spin serves and be highly competitive in matches.

3 5 Conclusion

Based on the research results, it can be concluded that racket grip strength and motion anticipation skills significantly influence the effectiveness of spin serves in junior tennis athletes in Makassar. Racket grip strength proved to be the dominant factor in producing consistent spin quality, while motion anticipation also supports body readiness, shot timing, and ball direction variations. The combination of these two factors was able to explain 55.1% of the variation in spin serve effectiveness, while the remainder was influenced by other factors such as basic technique, flexibility, and the athlete's psychological condition. Therefore, a tennis training program should be designed comprehensively, including grip strength training and situation-based anticipation training, so that the effectiveness of spin serves can be optimally improved.

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