Does Grip Strength, Performance, and Hand-Eye Coordination Affect Tennis Drive Skills?

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Abstract. Tennis research shows that stroke technique, which accounts for over 67% of attack success, is followed by serving and defending, which each account for 31% . It is imperative to synchronize the physical component components through training methods that are appropriate for the conditions of a particularly competitive event to smash the ball accurately on the side of the racket and hit the target with great precision. Recent studies suggest that cerebral intelligence and other components of kinesthetic awareness play a vital role in controlling muscular power and eye-hand synchronization for the development of tennis groundstroke techniques. The goal of this study was to determine how much the hand's functionality and hand-eye coordination contributed to court tennis drive stroke skills. The demographic and sample of this study consisted of 40 male students majoring in physical education, health, and leisure at the Faculty of Sports. Purposive sampling is employed in the selection process, and tests and measurements of grip performance using a hand grip dynamometer tool, hand-eye coordination using caste ball capture throwing, and stroke drive strength are utilized in forehand and backhand drive stroke tests (stroke accuracy) after the scoring of the fall of the ball hit is utilized in the data collection process. The data were also analyzed using double regression utilizing confession, a normality test using Kolmogorov-Smirnov, and descriptive analysis using descriptive frequency. All analyses were stopped at a significant level of 0.05 with the use of the SPSS program version 26.0.The research's conclusions are as follows: (1) grip strength performance contributed 0.681 (P-value 0.05) or 68.1% to the drive below; (2) force strength performance contributed 0.761 (P-value 0.05) or 76.1% to the drive stroke; and (3) grip strength performance and hand-eye coordination performance together contributed 0.848 (P-value 0.05) to the court tennis drive stroke skill. Additional study of his extensive physical attributes and technical elements will be needed to discover more about his contribution to tennis play, including gender traits.

Keywords: grip strength performance · hand-eye coordination · tennis drive

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1 Introduction

In sports, especially court tennis, every player wants to reach their full potential, but doing so requires careful planning and an integrated teaching strategy that is consistent and rigorous. An Indonesian who is whole, healthy physically and spiritually, and skilled to excel in sports to improve the dignity, dignity, and degree of the nation are among the goals of the nation that are being met by the expansion of the sports sector in that country.

Tennis is a racquet sport that is popular with players of all ages and genders [1]. Tennis requires a variety of physical component skills, including strength, speed, power, agility, and coordination [2]. Throughout the entire game, the physical element is utilized in swift, continuous, explosive gestures [3]. Tennis matches can be played solo or in pairs, and there is no set duration limit, therefore a four-hour match is feasible despite tennis having nearly equal match load, intensity, and length characteristics to other racquet sports [4]. Therefore, it is essential to maintain high standards of physical preparedness, technical proficiency, and psychological stability [5]. The ability to sustain physiological and psychological stress over prolonged competition has a substantial impact on tennis play during matches [6]. High technical aptitudes are next Jalali-Farahani then the capacity to exhibit sound physical condition [7], and finally high technical aptitudes [8].

Tennis stroke strategies can be divided into two groups: defensive stroke methods and aggressive stroke approaches [9]. Drive, lob, spin, and overhead/smash blows are regarded as offensive stroke techniques, while push, slice, and block strokes are considered defensive stroke methods [10, 11]. To excel in tennis, one needs to learn the four essential strokes of serve, forehand drive, backhand drive, and volley [12]. The serve, forehand drive, backhand drive, and volleyball are the four fundamental stroke techniques that must be mastered to compete well in tennis [13]. Three groups—groundstroke, volleyball, and overhead stroke—are used to classify the numerous stroke variations [14]. A groundstroke is a forehand or backhand stroke against a ball that has bounced off the ground. To execute this crucial ability, a player must swing a racket with regulated strength and high target precision on the side of the court [15]. A forehand is a stroke on a tennis ball made to the right of a player, whereas a backhand is a stroke made with a racket to the left of a player [16]. The backswing, the forward swing, and the follow-through are the three-stroke phases used to complete the forehand and backhand strokes in court tennis [17]. Studies show that to produce the right amount of racquet swing force for forehand and backhand groundstroke strokes as well as to strike the ball accurately, strong arm muscles and kinesthetic sense are necessary [18].

Grip strength is one of the particular skills required for tennis striking [19]. Recent research indicates that the interplay of muscular contraction regions during the groundstroke method is primarily dominated by the upper arms, shoulders, trunk, limbs, and lower body muscles [20]. Hand-eye coordination is the capacity of an individual to adjust himself to carry out all physical processes with the synchronization of the body, particularly the eyes with the hands to conduct groundstrokes, backhands, and forehands [21]. The ability to recognize an opponent's movement of the ball, react by planning a series of reaction movements to hit the ball, and finally be able to execute movements

through precise coordination of strokes are all necessary for success in tennis, according to a related study. Tennis also requires good physical condition. To determine how arm strength and hand-eye coordination affect court tennis's direct stroke skills, the researcher conducted a scientific investigation.

2 Methods

This kind of study blends surveys research with quantitative research methods. The population and sample consisted of 40 students majoring in physical education, health, and recreation from the university's sports faculty. A test and evaluation of grip strength performance utilizing the grab test protocol as well as a ball capture throw test to gauge hand-eye coordination are all part of the data collection strategy. The fixtures employ chalk or tape as a limiter, and the targets are round with a 30 cm diameter. To acquire a predetermined score using the Hewitt test procedure with three strokes, the forehand and backhand drives are executed three times with 10 ball strokes per attempt into the selected target area.

The prerequisite test utilizes the Shapiro-Wilk method, and the data description using the Statistical Product and Service Solution (SPSS) for Windows program. This study used a correlational methodology to determine the impact of free variables and constrained factors. With a confidence interval of 95% and statistical significance set at p.05. The data is presented as an average value of standard deviation (SD), with a confidence interval of 95%.

3 Results

The information below displays the anthropometric, dietary, physiological, and psychological characteristics of respondents.

According to the study's findings, participants who reported being in good health and active had an average body mass index of 21.78 kg/m^2 and were enrolled in an elementary school with a grade point average of 1.32 and an average age of 18.25. Next, the average grip performance reached a value of 31.43 with an SD of 9.81, the average

Table 1. Age, BMI, grip strength performance, hand-eye coordination, and drive stroke characteristics

Variable	N	Mean	SD
Age (years)	40	18.25	1.32
BMI (kg/m2)	40	21.78	1.26
Grip strength performance	40	31.43	9.81
Hand-eye coordination	40	6.73	1.84
Backhand Drive	40	18.30	6.85
Forehand Drive	40	23.30	6.85

eye coordination reached a value of 6.73 with an SD of 1.84, and the average value was obtained for the backhand drive at 18.30 with an SD of 6.85 while the average value was obtained for the forehand drive at 18.30 with an SD of 6.85. A descriptive analysis of the expected variables is shown in Table 1. In this inquiry, preliminary computations were also carried out to determine whether the data were dispersed correctly. Following are the results of the Kolmogorov-Smirnov Z (KS-Z) test, which was used to establish normality for hypothesis testing with a significance threshold of 0.05 (Table 2).

The results of the normality test using the Kolmogorov-Smirnov Z (KS-Z) test indicated values of more than 0.05 ($p > 0.05$) for the forehand and backhand drive, grip strength performance, and normal distribution of hand-eye coordination. The samples and variables in this study are therefore referred to as normal-distributed populations.

Statistical Analysis

A paired sample T-test was employed to determine the difference in variable values in the group before and after modification as well as to evaluate the difference in values between the two study groups. The results are shown in the Table 3.

When compared to tennis groundstrokes utilized for the forehand and backhand, Table 3 shows remarkable results for grip strength performance and hand-eye coordination. Both the grip strength performance and the hand-eye coordination performance had significant values of 0.000, as can be seen. This conclusion was supported by the determinant values obtained from multiple regression analysis, which showed that grip

Table 2. Demonstrates hand-eye coordination, grip strength, backhand drive performance, and forehand data normalcy test results

Variable	N	Significance ($p > 0.05$)
Forehand Drive	40	0.014
Backhand Drive	40	0.000
Grip strength performance	40	0.012
Hand-eye coordination	40	0.012

* *Significance ($p > 0.05$)*

Table 3. Multiple Regression Test

Variable	Group	N	R_Square	Significance ($p > 0.05$)
Drive Stroke (Y)	Grip strength performance (X_1)	40	0.681	0.000
	hand-eye coordination (X_2)	40	0.761	0.000
	Grip strength performance (X_1)* hand-eye coordination (X_2)	40	0.848	0.000

Significance ($p < 0.05$)

strength (X1) performed 0.681 times better than drive stroke skills, hand-eye coordination (X2) performed 0.761 times better than drive stroke skills, and grip strength (X1) and hand-eye coordination (X2) performed 0.848 times better than drive stroke skills individually. According to the statistical analyses discussed above, grip strength and eye-hand synchronization have an impact on forehand and backhand groundstroke skills. The research's conclusions may be generalized or applied to further sample groups representing different demographics.

4 Discussion

The results of the study supported other studies that showed how crucial grasp strength and hand-eye coordination are for being able to drive with a groundstroke in tennis. The results of descriptive and inferential analyses conducted at the Sebelas Maret University sports faculty further confirmed these conclusions. Grip power and hand-eye coordination are known to be essential elements for generating the best possible velocity when hitting a tennis court drive.

It is well-recognized that grip force performance is a crucial element in obtaining the best propulsion while striking the tennis court [11]. High arm muscle strength results in a more secure grip on the racket, better control of the racket when receiving the ball, a stronger swing force on the racket when striking the ball, and an increase in ball speed, all of which make it more difficult for the opponent to return the ball, according to studies on strength and conditioning [13], Additionally, biomechanical research on the impact of hand strength on tennis ball accuracy indicated that high arm strength on the racket offered more solid control over the racket while hitting the ball [22].

However, scientific research is required to address the power of the grip and eye-hand coordination required to withstand tennis shots. Based on the findings of the research described [23] it can be said that grip strength significantly increased service accuracy by 23.5%, eye-hand coordination significantly increased service accuracy by 25.3%, and grip strength and hand-eye coordination together significantly increased service accuracy by 33.1%. This is supported by a recent study [23] which found a substantial correlation between the hand's grabbing power and eye coordination and the forehand's capacity to drive groundstrokes. Technically speaking, research on physical fitness demonstrated a substantial difference between athletes who employed the position of the legs of close horses and those who used wide horses, with the former having higher accuracy and stability when completing groundstroke forehand drive strokes [23]. By including additional physical component components, this may be used as a reference to master fundamental stroke methods.

Similar research demonstrates that direct groundstroke workouts involve alternately contracting arm muscles in the forehand and backhand directions over time and can considerably increase arm muscular strength [24]. A human motion study, which claims that backhand motions including posterior extension movements and abduction and forehand drive movements in court tennis are physically impacted by opposing muscles, supports this belief [25]. Since grip strength and hand-eye coordination are regarded as two of the scientific advancements that may be applied in practice to develop tennis abilities effectively and efficiently, additional research into groundstroke skills in tennis is required [26].

Tennis drills should be supported by the required factors, such as the type of workout technique employed and the player's range of motion, without ignoring other supporting factors [27]. As a result, it is inappropriate to distinguish the exercise technique and a series of learning processes or between the exercise technique and a set of mandatory goals [28]. Aspects that influence the success of motion learning in groundstroke skills include comprehension of what is learned, opportunities for a response, feedback, and reinforcement. To play tennis at the level indicated above, one must have a basic awareness of how certain talents can be developed or mastered, as well as what conditions favor skill development. Fundamentally, mastering groundstroke methods necessitates that they are learned or trained following a set of standards, such as practicing them consistently for enough time. Because of this, developing tennis techniques takes a lot of practice, which must be done consistently and carefully. One of this study's novelties and distinguishing characteristics is the lack of a correlation between intelligence quotient and groundstroke forehand and backhand abilities, although numerous studies have demonstrated that intelligence quotient is one of the factors influencing success in groundstroke abilities. To ascertain the relationship between those traits and the student's capacity to groundstroke in tennis, further research involving larger samples and additional variables is necessary.

5 Conclusions

The results of the study show that grip strength and hand-eye coordination are both necessary for performing tennis driving skills. However, it is crucial to further evaluate the standard of physical conditions and student psychology to determine the court tennis performance according to gender characteristics.

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