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The Relationship Between Grip Strength, Agility, and Hand Eye Coordination Hand Eye Coordination on Groundstroke Ability Field Tennis Athletes

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ABSTRACT

Groundstrokes are an important technical skill in tennis that determine an athlete's performance, and their execution requires technical support and optimal physical condition. Three main physical components grip strength, agility, and hand-eye coordination contribute to the effectiveness of basic strokes. This study aims to determine (1) the relationship between grip strength and groundstroke ability in tennis players. (2) the relationship between agility and groundstroke ability in tennis players. (3) the relationship between hand-eye coordination and groundstroke ability in tennis players. (4) the relationship between grip strength, agility, and hand-eye coordination and groundstroke ability in tennis players. This correlational study involved 54 athletes aged 12 years or younger from the Selabora FIKK UNY Club and Kentoeng Tennis Academy, selected purposively. The instruments used included a hand grip dynamometer for strength, the Illinois Agility Test for agility, a tennis ball catch-throw test for hand-eye coordination, and the Hewitt Tennis Achievement for basic stroke skills. Data analysis was conducted using multiple regression. The results indicate a significant relationship between grip strength (r=0.303; contribution 5.32%), agility (r=-0.588; contribution 19.22%), and hand-eye coordination (r=0.818; contribution 51.56%) and groundstroke ability. Overall, the three factors contributed 76.10% (Fhitung=57.254It can be concluded that grip strength, agility, and hand-eye coordination significantly influence the groundstroke ability of tennis players.

Keywords: agility; grip strength; groundstroke ability; hand-eye coordination

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C) Analysis and interpretation of data;
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INTRODUCTION

Tennis is one of the most popular sports among the public and has experienced significant growth in recent years. The basic techniques of tennis include hitting the ball, groundstrokes, types of strokes, footwork, timing, forehand drive, backhand drive, forehand drive, and returning the ball (T. Nugroho, 2019). One of the basic techniques in tennis is the stroke technique, which consists of four types: service, forehand groundstroke, backhand groundstroke, and A player with good basic techniques will be able to play well.

Groundstroke shots are generally used more frequently in tennis matches than other shots, especially when attacking (Cantika Marrita et al., 2024). The forehand drive, as one of the basic stroke techniques, can be divided into three types related to spin or rotation: the forehand flat drive, the forehand topspin drive, and the forehand slice drive (Nurrochmah & Setiawan, 2021). The forehand drive at the intermediate and advanced levels is the primary target in a match. If the forehand drive is weak, the opponent will easily attack it and have the opportunity to score points in every attack (Maqbulatullah et al., 2022)

Tennis players need good physical condition to master the forehand groundstroke effectively. The physical condition of tennis players is based on the energy system used and the characteristics of tennis movements. In general, the physical components required for tennis players are endurance, strength, agility, speed, power, coordination, and flexibility (Hidayat & Jariono, 2021). This study specifically examines the physical components of grip strength, agility, and hand-eye coordination.

The first physical component is grip strength. Strength is one of the most important factors in performance and significantly determines an individual's physical condition (Fadli et al., 2025). Strength is the ability of a muscle or group of muscles to overcome resistance or load during an activity. When an athlete performs a forehand stroke, grip strength is essential to execute the stroke perfectly. Grip strength is the activity of a group of hand muscles to grasp or hold. The better an athlete's grip strength, the better their forehand stroke will be, which can affect where the ball lands in the target area (Kurdi & Qomarrullah, 2020)

The first physical component is agility. Tennis is a sport in which players must react continuously to any situation. For example, when chasing the ball, changing direction, reaching, intercepting, stopping, and starting (Meja & Visual, 2025). All of this must be combined with the maintenance of technique and physical agility throughout the match to achieve optimal results. Agility is the ability to change direction and body position quickly and accurately while moving, without losing balance or awareness of one's body position (Risca Septy Ayu & Sri Haryono, 2019). Good agility also benefits the ability to direct the return of the ball from the opponent in the desired direction when performing a groundstroke as an attack on the opponent's open area, making it difficult for the opponent to reach the ball.

In addition to having good grip strength and agility, success in executing groundstrokes also requires good coordination. (Halomoan et al., 2023) states that coordination is one of the physical condition components in tennis that cannot be overlooked. In this context, coordination refers to eye-hand coordination, which is the ability of the body to coordinate multiple movements into a single complex movement in tennis. Eye-hand coordination is the ability to combine vision and hand movements to direct something accurately toward a target (Suryati et al., 2020)

For example, in tennis, before the hitting motion, the eyes must focus on the target or object. Eye-hand coordination results in timing and accuracy. Timing focuses on the precision of timing, while accuracy focuses on the precision of the target. Through good timing, the contact between the hand and the object will align with the desired outcome, resulting in an effective movement. Accuracy determines whether the object hits the intended target (Putra et al., 2017). The higher a person's coordination level, the easier it is to learn new or complex techniques and tactics.

Based on the researcher's observations at the Selabora Tennis Club of the Faculty of Sports Science and Health (FIKK) at Yogyakarta State University (UNY) and the Kentoeng Tennis Academy Club in July 2024, several issues were identified, including that the groundstroke shots of athletes at the Selabora FIKK UNY Tennis Club and the Kentoeng Tennis Academy Club were still low. This is because both clubs have athletes who are not focused on achieving high performance. The researcher also observed during matches and training sessions, showing that athletes often hit the ball out of bounds, fail to reach the target, or get the ball stuck in the net. Additionally, the groundstrokes are not well-directed and lack power, making it easier for opponents to receive the ball. The researcher identified

the errors as being caused by insufficient grip strength and the athletes' lack of agility in executing groundstrokes and chasing the ball.

Based on interviews with coaches at the Selabora FIKK UNY Tennis Club, it was stated that the elements and factors supporting groundstroke ability are not given sufficient attention. The coach at the Kentoeng Tennis Academy stated something similar, that factors influencing groundstroke ability, such as grip strength, agility, and eye-hand coordination, are rarely trained. Coaches train groundstroke technique using drill methods. Such conditions make it difficult to achieve optimal success in developing groundstroke ability.

The research by (Agusrianto & Rantesigi, 2020) proves that there is a significant relationship between grip strength and forehand and backhand groundstrokes, with tcount = 3.23 > ttabel 1.73. The results of Marrita et al.'s (2024) study demonstrate a significant correlation between hand-eye coordination and forehand and backhand groundstrokes, with tcount = 2.83 > ttabel 1.73. The results of (Prabowo et al., 2021) study show that the analysis yielded a correlation coefficient between agility and consistency in forehand groundstrokes and backhand groundstrokes in tennis, with a calculated r value of -0.461 and an r value of 0.329 at the 0.05 significance level with 35 degrees of freedom. Different results were shown in Nugroho's (2019) study, which found no effect of agility on the results of forehand tennis strokes among students at the Faculty of Education, IKIP PGRI East Kalimantan (p=161). Based on the presentation of these observational results, this study aims to further investigate the "Relationship Between Grip Strength, Agility, and Hand-Eye Coordination on the Groundstroke Ability of Tennis Players."

METHOD

This section includes details about the type of research, time and location, objectives or targets, research subjects, procedures, instruments, data collection techniques, and data analysis techniques. All of these elements provide a comprehensive overview of the research methods used. Authors should clearly explain how each aspect was designed and implemented to ensure the validity and reliability of the research.

This type of research is correlational research. Correlational research is research conducted to determine whether there is a relationship between two or more variables (Arikunto 2019, p. 247). The method used in this research is the survey method. The research was conducted at the Selabora Club of the Faculty of Sports Science, Yogyakarta State University, and the Kentoeng Tennis Academy Club. The research was conducted in January-February 2025.

The population in this study consisted of 62 tennis players from the Selabora FIKK UNY Club and the Kentoeng Tennis Academy Club. Purposive sampling was used. The criteria for determining the sample included: 1) still actively participating in training; 2) aged ≤ 12 years; 3) willing to complete the tests provided; 4) not currently ill. Based on these criteria, the sample size for this study was 54 athletes. Arikunto (2019, p. 192) states that "Data collection instruments are tools selected and used by researchers in their activities to collect data so that these activities become systematic and easier." The research instruments are as follows; 1) Grip strength is measured using a handgrip dynamometer. This test has a validity of 0.82 and a reliability of 0.87 (Purwitasari et al., 2020) ; 2) Agility is measured using the Illinois Run Test. This test has a validity of 0.99 and a reliability of 0.89 (Ertanto et al., 2021); 3) Eye-hand coordination is measured using the method of throwing and catching a tennis ball against a target wall. This test has a validity level of 0.78 and a reliability

level of 0.81 (Herlambang et al., 2022); 4) The instrument for measuring groundstroke ability uses the Hewitt Tennis Achievement test with a validity coefficient of 0.67 and a reliability coefficient of 0.75.

Data collection techniques should include how the data were obtained, for example, through surveys, in-depth interviews, or experiments. The author needs to explain the data collection method in detail to show the procedures' appropriateness. Multiple linear regression analysis is an analysis to determine the effect of more than one independent variable on one dependent variable. The multiple linear regression analysis model is used to explain the relationship and the extent of the effect of independent variables on the dependent variable (Jansen et al., 2021). To test the influence of several independent variables on the dependent variable, the following mathematical model can be used (Sugiyono, 2019, p. 303)

RESULTS AND DISCUSSION

Preliminary Test Results

Normality Test

The Kolmogorov-Smirnov method was used to test the normality of the data in this study. The summary is presented in table 1 as follows:

Table 1. Normality Test Results

Variable	p-value
Grip strength (X1)	0,183
Agility (X2)	0,103
Hand-eye coordination (X3)	0,110
Groundstroke ability (Y)	0,113

Based on the analysis using the Shapiro-Wilk test in Table 1, the data on grip strength (sig. 0.183 > 0.05), agility (sig. 0.103 > 0.05), hand-eye coordination (sig. 0.110 > 0.05), and groundstroke ability (sig. 0.113 > 0.05), which means the data is normally distributed.

Hypothesis Test Results

Partial correlation tests were performed using product moment correlation analysis/partial t-tests. Correlation tests were performed to determine the relationship between each independent variable, namely grip strength, agility, and hand-eye coordination, and the groundstroke ability of tennis players. The results of the r test analysis are presented in the table below.

Table 2. Correlation Test Analysis Results

Variable	r_{count}	*p-value*
Grip strength (X1)	0,303	0.183
Agility (X2)	-0,588	0.103
Hand-eye coordination (X3)	0.818	0.110

Based on the results of the analysis in Table 3 above, the following can be explained: 1) The variable of grip strength on groundstroke ability obtained a rcount value of 0.303 > rtabel 0.266, sig. 0.030 < 0.05, so H0 is rejected, meaning the hypothesis stating "There is a significant relationship between grip strength and groundstroke ability in tennis players" is accepted. The correlation coefficient is positive, meaning that as grip strength improves, groundstroke ability in tennis players also improves; 2) The agility variable in relation to

groundstroke ability yielded a calculated value of -0.588 > table value of 0.266, sig. 0.000 < 0.05, so H0 is rejected, meaning that the hypothesis stating "There is a significant relationship between agility and groundstroke ability in tennis players" is accepted. The correlation coefficient is negative, meaning that as agility decreases, groundstroke ability in tennis players improves; 3) The eye-hand coordination variable in relation to groundstroke ability yielded a calculated value of 0.818 > table value 0.266, sig. 0.000 < 0.05, so H0 is rejected, meaning the hypothesis stating "There is a significant relationship between eye-hand coordination and groundstroke ability in tennis players" is accepted. The correlation coefficient is positive, meaning that as eye-hand coordination improves, groundstroke ability in tennis players also improves.

Based on the analysis results, the calculated F value was 57.254 > the table F value of 2.79, and the significance level was 0.000 < 0.05. Thus, the hypothesis stating that "There is a significant relationship between grip strength, agility, and eye-hand coordination on the groundstroke ability of tennis players" is accepted. It can be concluded that the selected regression model is suitable for testing the data, and the regression model can be used to predict that grip strength, agility, and eye-hand coordination are collectively related to the groundstroke ability of tennis players.

Based on the Coefficient of Determination (R^2), the adjusted R-square coefficient value obtained is 0.761. This means that the contribution of grip strength, agility, and eye-hand coordination variables to the groundstroke ability of tennis players is 76.10%, while the remaining 23.90% is influenced by factors outside this study.

Based on the effective contribution (SE) and relative contribution (SR), it shows that the hand-eye coordination variable (X3) contributes the most to the groundstroke ability of tennis players at 51.56%, while the grip strength variable (X1) contributes the least to the groundstroke ability of tennis players at 5.32%.

Discussion

The Relationship Between Grip Strength and Groundstroke Ability

Based on the research results, there is a significant relationship between grip strength and groundstroke ability, with a contribution of 5.32%. This means that the better the grip strength, the better the groundstroke ability. The research results are supported by (N. A. Nugroho et al., 2020) research, which shows that grip strength determines the groundstroke ability of tennis forehand. (Naibaho et al., 2023) research proves that there is a significant correlation between grip strength and forehand and backhand groundstrokes, with t-value = 3.23 > ttable 1.73.

(Lukito et al., 2024) demonstrated that there is a relationship between grip strength and the results of six slice serves in tennis among fifth-semester students at the Faculty of Physical Education and Sports Science, IKIP Mataram, in the 2016/2017 academic year. (Indik Syahrabanu, 2023) research found that grip strength contributes 45.8% to the accuracy of flat serves among tennis athletes at PTL UNP. Thus, the strength of grip strength can determine groundstroke ability in tennis. Hand grip strength is related to the ability to perform strokes in several sports, such as table tennis and badminton. Strong hand grip strength can help maintain the racket or bat and control the racket or bat to perform strokes.

As shown in the research by (Wulan Krisna Dewi et al., 2021), grip strength contributes to forehand strokes in table tennis by 79%. The hand functions to hold the racket or bat, which serves as an extension of the athlete's arm connected by the grip. The racket

can function effectively if the hand possesses good physical ability. Therefore, the grip strength of each athlete will significantly aid in executing forehand strokes in table tennis.

Strength is a crucial component of overall physical condition, as it serves as the driving force behind every physical activity. Strength is the ability of muscles to contract or pull (Jatra et al., 2020). Physiologically (physiology), strength is the ability of muscles to overcome resistance or exercise, while physically (physics), strength is the product of mass multiplied by acceleration (Amni et al., 2019). Grip strength is the ability of the hand to clench or grasp an object. Therefore, grip strength in this study refers to the ability of a group of muscles in the hand to grasp or hold a racket when performing a groundstroke in tennis (Setyawan & Irwansyah, 2019)

The Relationship Between Agility and Groundstroke Ability

Based on the results of the study, there is a significant relationship between agility and groundstroke ability, with a contribution of 19.22%. This means that the better the agility, the better the groundstroke ability. The research results are supported by (Mawarda & Nurhidayat, 2021) study, which found that the analysis yielded a correlation coefficient between agility and the consistency of forehand groundstrokes and backhand groundstrokes in tennis, with a calculated r value of -0.461 and r(0.05)(35) = 0.329. The results of (Evita et al., 2016) study show that there is a relationship between agility and forehand groundstroke performance with a correlation coefficient of 0.734. Agility is one of the most important biomotor components in tennis. Tennis is a dynamic sport and falls under the category of fast-paced sports, so agility is highly required, especially in performing groundstrokes (Nugroho, 2019).

Agility is the ability to change body position as quickly as possible according to one's intentions. Agility is the ability to change direction quickly and accurately while the body moves from one place to another (Saputra & Yenes, 2019). Agility is one of the important physical conditions in tennis. Agility in tennis is the ability to change direction quickly and maintain balance. Agility is an important ability for tennis players. Athletes must perform quick and multi-directional movements in response to the ball and/or the opponent's position to succeed in a rally. The development of agility is very important for young tennis players who aspire to reach the elite level, as high-level tennis players must be able to perform quick, multi-directional movements to position themselves correctly to return the ball. All these multi-directional movements are performed in response to information drawn from the opposite side of the net (e.g., the incoming ball, the opponent's position) (Jansen et al., 2021).

The Relationship Between Hand-Eye Coordination and Groundstroke Ability

Based on the results of the study, there is a significant relationship between eye-hand coordination and groundstroke ability, with a contribution of 51.56%. This means that the better the eye-hand coordination, the better the groundstroke ability. The research findings are supported by Marrita et al.'s (2024) study, which demonstrated a significant correlation between eye-hand coordination and forehand and backhand groundstrokes (t-value = 2.83 > critical t-value 1.73). Kurdi & Qomarrullah (2020) found in their research that eye-hand coordination has an impact and influence on forehand groundstrokes in tennis.

The results of Lukito et al.'s (2024) study prove that there is a significant relationship between eye-hand coordination and backhand groundstrokes, as evidenced by the product-moment correlation coefficient rx2y of 0.744. Therefore, there is a highly significant

relationship, as indicated by the calculated value rhitung = 0.744 > table value = 0.632. Based on the above findings, it can be understood that good coordination has a significant impact on the precision of tennis strokes, as tennis players move quickly, organized, and dynamically to achieve or receive ball strokes whose direction is not always predictable.

According to Wulandari & Arnando (2019), speed in tennis is determined by the grip of the fingers and palm when holding the racket. The grip must be strong and integrated with the racket so that the racket does not vibrate when it contacts the ball. Hand-eye coordination results in timing and accuracy. This means that the precision of movements performed during the execution of forehand and backhand groundstrokes, and the ability to direct the ball toward the desired target, is supported by the level of coordination possessed.

Based on the above explanation, it is clear that coordination level is an important physical condition for students to possess. It is not easy for someone to achieve good coordination, as many factors influence coordination level, including cognitive ability, skill, and precision of the five senses, motor experience, and motor ability (Marrita et al., 2024). In line with this view, with the presence of cognitive ability, skill, and precision of the five senses, motor experience, and motor ability, an individual will analyze and decide on the actions or movements they should perform, and the response from each movement component—such as nerves and muscles—will also improve.

The Relationship Between Grip Strength, Agility, and Eye-Hand Coordination on Groundstroke Ability

Based on the results of the study, there is a significant relationship between grip strength, agility, and hand-eye coordination and groundstroke ability, with a contribution of 76.10%. Groundstrokes are one of the basic types of strokes that play an important role in tennis. This is because groundstrokes account for at least half of all strokes and can be used for both attacking and defending in tennis. A groundstroke is a stroke made after the ball bounces off the court. A groundstroke involves several stages: swinging the racket backward, the forward swing (at impact), and the follow-through after the racket and ball make contact.

Consistently executed groundstrokes can contribute to scoring in tennis, as this shot is more frequently used to neutralize opponents. Groundstrokes are a type of shot with a relatively high success rate for scoring in tennis, with 47% of groundstroke techniques being executed during a match. From this perspective, it is clear that groundstroke techniques contribute the most to tennis performance compared to other shot techniques.

One of the key elements in tennis is muscle strength. Muscle strength is closely related to the neuromuscular system, which refers to the extent to which the nervous system can activate muscles to contract. The more muscle fibers that are activated, the greater the strength produced by those muscles (Agusrianto & Rantesigi, 2020, p. 62). The ability to grip is one of the most important functions of the hand. Grip strength can be used to reflect overall muscle strength. Handgrip strength requires the combined action of several hand and forearm muscles, and this action plays a significant role in daily activities (Purwitasari, et al., 2020, p. 2).

Harsono (2017, p. 59) explains that agility is the ability to change direction quickly and accurately while moving without losing balance and awareness of body position. Characteristics of agility can be seen in the ability to move quickly, change direction, and adjust position. The ability to move, change direction, and adjust position depends on the

situation and conditions faced in a relatively short and rapid timeframe. Agility is the ability to change direction and body position quickly and accurately while moving, without losing balance and awareness of body position. Additionally, good agility is advantageous for directing the return of the ball from the opponent in the desired direction during a groundstroke as an attack on the opponent's open area, making it difficult for the opponent to reach the ball.

Tennis requires coordination skills to master the ability to hit the ball. Good coordination skills make it easier for someone to learn tennis skills. Dinova et al. (2020) stated that hand-eye coordination significantly impacts tennis skills, with the remainder influenced by other factors. Coordination is important because good body coordination makes diverse movements balanced, efficient, and effective. Specifically, coordination involves using several body parts, combining the accuracy of hand strokes with footwork. Hand-eye coordination with footwork is part of special movement coordination. In tennis, the hand is the dominant moving part that functions as a striking tool, while the eye functions as a receptor.

CONCLUSION

Based on the results of data analysis, description, testing of research results, and discussion, it can be concluded that; 1) There is a significant relationship between grip strength and the groundstroke ability of tennis players, with a r-value of 0.303 and a contribution of 5.32%; 2) There is a significant relationship between agility and the groundstroke ability of tennis players, with a r-value -0.588 and a contribution of 19.22%; 3) There is a significant relationship between hand-eye coordination and the groundstroke ability tennis players, with a calculated r of 0.818 and a contribution of 51.56%; 4) There is a significant relationship between grip strength, agility, and hand-eye coordination and the groundstroke ability of tennis players, with a calculated F of 57.254 and a contribution of 76.10%.

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