Original Article

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# Effects of agility, coordination, and flexibility on dribbling skills in senior high school female field hockey players

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*Authors' Contribution: A – Study Design, B – Data Collection, C – Statistical Analysis, D – Manuscript Preparation, E – Funds Collection*

**Abstract:** Physical condition is an important factor affecting dribbling skills in field hockeys. In this regard, agility, hand-eye coordination, and waist flexibility have not been investigated simultaneously in field hockey players. Therefore, the purpose of this study was to evaluate the effects of agility, hand-eye coordination, and waist flexibility on dribbling skills in senior high school female field hockey players. Thirty female senior high school students in Indonesia were recruited as the research sample. The participants were female students involved in coaching field hockey extracurricular activities at school, average age 17.90 ± 0.80 yrs, height 159.17 ± 1.82 cm, body weight 53.60 ± 3.51 kg, and BMI 21.16 ± 2.89. Data were collected using the agility t-test, throw catch test tennis ball, sit and reach test, and Schmithals-French hockey test. They were then analyzed using correlation and regression. The results showed that agility, hand-eye coordination, and waist flexibility had a significant effect on dribbling skills ($p < 0.05$). Partially, the effects of agility, hand-eye coordination is 37.40%, and waist flexibility were 76.30 %, 37.40 %, 46.20%, and 84.00%, respectively. Of these three components, agility is the most influential component of dribbling skills, without neglecting hand-eye coordination or waist flexibility. In conclusion, the level of agility, hand-eye coordination, and waist flexibility have a significant impact on dribbling skills in senior high school female field hockey players. Coaches should prepare and develop appropriate training programs for these three components to improve hockey dribbling skills. Future studies are needed to incorporate the physical component and other factors related to field hockey dribbling skills, as well as diversity, and a wider sample size.

**Keywords:** field hockey; dribbling; agility; coordination; flexibility; extracurricular activities

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# INTRODUCTION

Field hockey extracurricular activities are carried out outside school hours. Students who participate in this activity are based on their interests and talent in hockey, so they can develop their potential. The role of coaches and trainers in this activity is necessary to provide the right training program [1] so that their achievements in field hockey can be optimal.

Field hockey is categorized as a high-intensity sport interspersed with low-to-moderate periods of combinations of acceleration, deceleration, and changes in direction during the game [2-5]. This game requires high-speed defense and attack skills [3]. During the game, female players must cover between 5300 and 6800 m [6,7], with a 60 minute period covering approximately 20% at high speed [6-8]. High intensity such as running and activities where players are directly involved with the ball (such as dribbling) have been shown to represent between 17.5% and 30% of competition time [9], and are considered important indicators that determine the final outcome of the game. Therefore, field hockey players need a high level of dribbling skill without losing their running speed [10].

A successful hockey player needs to master techniques and possess physical abilities, including balance, strength, endurance, flexibility, hand-eye coordination, and agility [11]. In this regard, players need high agility when dribbling because it requires them to accelerate quickly [12], coordination is required to achieve the desired performance during sporting activities [13], and flexibility is one of the key components along with strength, endurance, speed, and coordination [14]. Therefore, the training provided must be adjusted to the dynamics of the game so that their performance can be optimal [15].

Several studies have investigated hockey, such as comparing on-ice and off-ice agility drills [16], high-intensity interval training [17], strength, agility, and speed performance [18], sprint strength and agility [12], anthropometry, sargent jump test, core endurance and agility performance versus specific tests with and without the ball [19], asymmetry of motor performance of the lower extremities [20], acute effects on hip isometric strength and flexibility [21], the influence of strength and coordination training on selected skills in hockey players [22], selection and experimental substantiation of tests to control physical and technical readiness [23], a test for speed and endurance [24], and flexibility in elite inline hockey players [25]. However, there have been no studies that have focused on hockey extracurricular activities in schools, and investigated and involved concurrent components of agility, hand-eye coordination, and waist flexibility on dribbling skills in field hockey.

This study aimed to evaluate the effects of agility, hand-eye coordination, and waist flexibility on dribbling skills in senior high school female field hockey players. This study is expected to be useful for the evaluation of these components in improving optimal dribbling skills, both for field hockey coaches and coaches in schools, as well as field hockey players and athletes in senior high schools.

# MATERIAL AND METHODS

*Participant*

Thirty female senior high school students in Riau Province, Indonesia were recruited to serve as the research sample. Participants were female students involved in coaching field hockey extracurricular activities at school, participating in regional student sports events, and participating voluntarily. Participants had an average age of 17.90 ± 0.80 years, height 159.17 ± 1.82 cm, weight 53.60 ± 3.51 kg, and BMI 21.16 ± 2.89. This research was conducted after obtaining approval from the Faculty of Sports Science,

Universitas Negeri Padang, and the Riau Provincial Government Education Office, Indonesia (No.800/Disdik/1.3/2022/998).

*Instruments and procedures*

*Agility*

Agility was obtained using the agility t-test [26]. The implementation of this test is the participant running from the starting lines "A" to point "B" by touching his right hand on cone "B," then running towards point "C" and touching the cone with his left hand, then running towards "D" and touching the cone with his right hand. Return to point "B" by touching the cone with your left hand and then head to the finish line (point A) (Figure 1). The classification of the assessment is presented in Table 1.

*Hand-eye coordination*

Hand-eye coordination was obtained through the test of throwing catch and catching a tennis ball against the wall [27]. This test involves placing the target on a wall at the test taker's shoulder height. Participants stood behind the throwing boundary line at a distance of 2.5 meters. The test takers were given the opportunity to throw the ball at the target and catch it. Each participant was given the opportunity to perform the test for 30 seconds (Figure 2). The classification of the assessment is presented in Table 1.

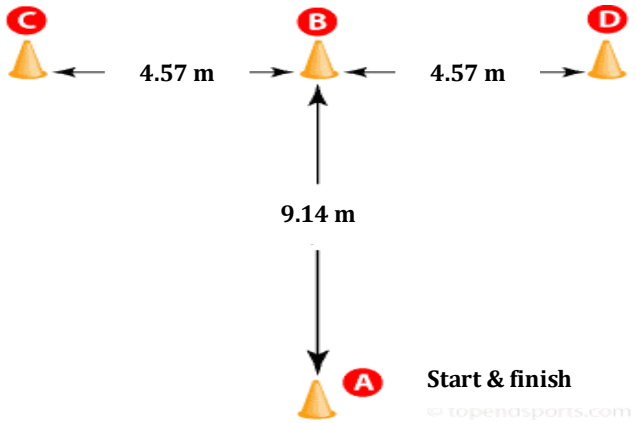



Figure 1. Agility T test.

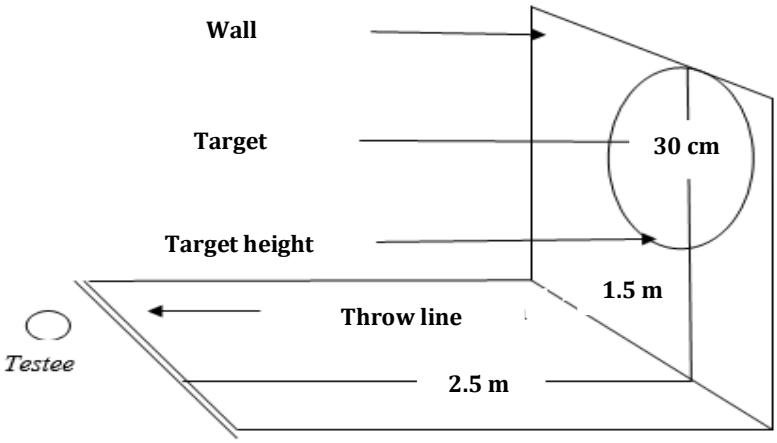



Figure 2. Throw catch test tennis ball.

*Waist flexibility*

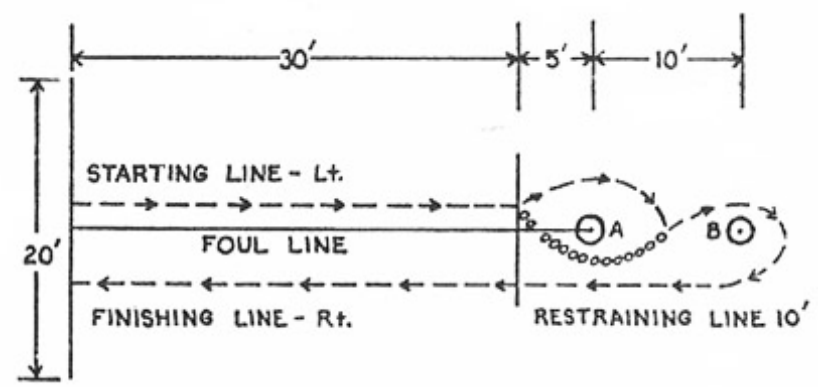
Waist flexibility was obtained through the sit-and-reach test [28]. The implementation of this test was as follows: (1) participants facing the measuring instrument in a sitting position, (2) both legs straight, (3) both ends of the thumb flush with the measuring instrument, (4) the position of the hands is straightened, and (5) both hands reach the measuring instrument and push as far as possible (hold the final position) for three seconds). The classification of the assessment is presented in Table 1.

*Dribbling skills*

Dribbling skills were acquired through the Schmithals-French hockey test [29]. The implementation of this test involves the participant bringing the ball from the start line using the closed dribble technique, in which the ball is brought over the right side of the cone with the body position remaining on the left side of the cone. After passing cone A, the ball is brought to cone B and passed through cone B by bringing the ball to the left side of cone B, around cone B, and the ball is brought back to the start line as a finish (Figure 3). The ball must always be to the left of the foul line as a condition for proper testing. The classification of the assessment is presented in Table 1.

*Statistical analysis*

Descriptive statistics were used to determine the characteristics of each variable (Table 1). The Kolmogorov–Smirnov normality test and regression linearity test were used for analysis. Correlation and regression analyses were then used to prove the relationship between the independent and dependent variables. All stages were analyzed using IBM SPSS version 24.




The field is 6 meters wide and 13.5 meters long (divided into 2 courts as the foul line, the distance from the start-turn cone A is 9 meters, the distance from A to start is 10.5 meters, and the distance from A-B is 3 meters

Figure 3. Schmithals-french hockey test.

Table 1. Assessment classification for each test

| Agility* | Hand-eye coordination* | Waist flexibility* | Dribbling skills* | Classification* |
|---|---|---|---|---|
| ≤ 10.50 | ≥ 19 | ≥ 24 | ≤ 10.50 | Very good |
| 10.51-11.50 | 13-18 | 18-23 | 10.51-12.50 | Good |
| 11.51-12.50 | 7-12 | 12-17 | 12.51-15.50 | Enough |
| ≥ 12.51 | 2-6 | 6-11 | 15.51-17.50 | Less |
| | ≤ 1 | ≤ 5 | ≥ 17.51 | Very less |

The unit for agility is seconds, hand-eye coordination is the score obtained by the participants for 30 seconds, waist flexibility is cm, and dribbling skills is seconds.

# RESULTS

The results of the descriptive analysis are presented in Table 2, where the average for agility is 12.07 or enough classification; hand-eye coordination is 9.60 or enough classification; waist flexibility is 9.84 or less classification; and dribbling skills is 16.14 or less classification (Figure 4).

Table 2. Descriptive statistics and frequency distribution of each variable.

| Agility* | Frequency | | Classification |
|---|---|---|---|
| | Absolute | % | |
| ≤ 10.50 | 1 | 3.33 | Very good |
| 10.51-11.50 | 6 | 20.00 | Good |
| 11.51-12.50 | 10 | 33.33 | Enough |
| ≥ 12.51 | 13 | 43.33 | Less |
| Amount | 30 | 100.00 | |
| Range score | 10.46 ÷ 13.78 | | |
| Mean ± SD | 12.07 ± 0.98 (enough) | | |
| Hand-eye coordination* | Frequency | | Classification |
| | Absolute | % | |
| ≥ 19 | 0 | 0.00 | Very good |
| 13-18 | 4 | 13.33 | Good |
| 7-12 | 22 | 73.33 | Enough |
| 2-6 | 4 | 13.33 | Less |
| ≤ 1 | 0 | 0.00 | Very less |
| Amount | 30 | 100.00 | |
| Range score | 5 ÷ 13.00 | | |
| Mean ± SD | 9.60 ± 2.43 (enough) | | |
| Waist flexibility* | Frequency | | Classification |
| | Absolute | % | |
| ≥ 24 | 0 | 0.00 | Very good |
| 18-23 | 0 | 0.00 | Good |
| 12-17 | 5 | 16.67 | Enough |
| 6-11 | 25 | 83.33 | Less |
| ≤ 5 | 0 | 0.00 | Very less |
| Amount | 30 | 100.00 | |
| Range score | 6.50 ÷ 12.90 | | |
| Mean ± SD | 9.84 ± 1.78 (less) | | |
| Dribbling skills* | Frequency | | Classification |
| | Absolute | % | |
| ≤ 10.50 | 0 | 0.00 | Very good |
| 10.51-12.50 | 0 | 0.00 | Good |
| 12.51-15.50 | 12 | 40.00 | Enough |
| 15.51-17.50 | 11 | 36.67 | Less |
| ≥ 17.51 | 7 | 23.33 | Very less |
| Amount | 30 | 100.00 | |
| Range score | 13.28 ÷ 18.98 | | |
| Mean ± SD | 16.14 ± 1.71 (less) | | |

The unit for agility is seconds, hand-eye coordination is the score obtained by the participants for 30 seconds, waist flexibility is cm, and dribbling skills is seconds.

The results of the Kolmogorov-Smirnov normality test and linearity test also showed that each variable was normally and linearly distributed ($p > 0.05$) (Table 3). Furthermore, the results of the correlation and regression analyses presented in Table 4 show that the variables of agility, hand-eye coordination, and waist flexibility have a significant relationship with dribbling skills, either partially or simultaneously ($p < 0.05$). The correlation between agility and dribbling skills was 0.874, regression significance was 90.17, and effect was 76.30%. The correlation between hand and eye coordination and dribbling skills was 0.611, the regression significance was 16.69, and the effect was 37.40%. The correlation between waist flexibility and dribbling skills was 0.680, regression significance was 24.02, and effect was 46.20%. Furthermore, the correlation of agility, hand-eye coordination, and waist flexibility on dribbling skills was 0.917, the regression significance was 45.50, and the effect was 84.00%. The regression model of each variable was partially $Y = 6.32 + 0.874X_1$, $Y = 19.44 + 0.611X_2$, and $Y = 16.02 + 0.680X_3$, while it was $Y = 4.41 + 0.599X_1 + 0.230X_2 + 0.260X_3$ (Figure 5).

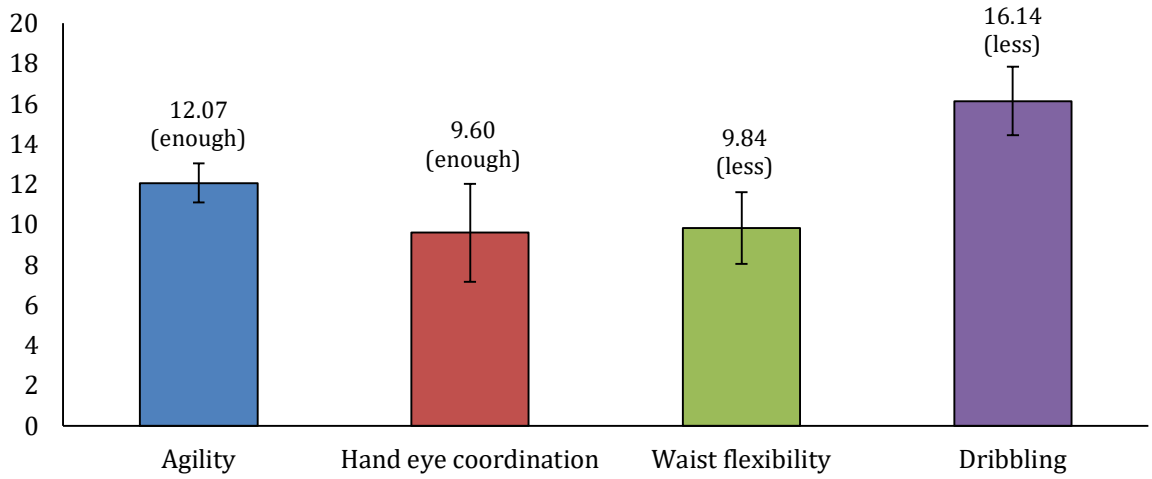



Figure 4. Average score and classification for each variable.

Table 3. Summary of normality and linearity tests.

| Variable | Normality (p*) | Linierity (p*) |
|---|---|---|
| Y-X1 | 0.200 | 0.078 |
| Y-X2 | 0.200 | 0.114 |
| Y-X3 | 0.052 | 0.079 |

Normal and linear (p > 0.05)

Table 4. Summary of hypothesis testing.

| Variable | B* | R* | $R^2$* | F* | p* | t* | p* |
|---|---|---|---|---|---|---|---|
| Agility with dribbling skills | 6.32<br>0.874 | 0.874 | 0.763 | 90.17 | 0.000 | 9.496 | 0.000 |
| Hand-eye coordination with dribbling skills | 19.44<br>0.611 | 0.611 | 0.374 | 16.69 | 0.000 | 4.086 | 0.000 |
| Wait flexibility with dribbling skills | 16.02<br>0.680 | 0.680 | 0.462 | 24.02 | 0.000 | 4.901 | 0.000 |
| Overall (agility, hand-eye coordination, and waist flexibility with dribbling skills) | 4.41<br>0.599<br>0.230<br>0.260 | 0.917 | 0.840 | 45.50 | 0.000 | | |

Regression and the relationship is significant (p < 0.05), "B" is the regression model, "R" is the magnitude of the relationship, "$R^2$" is the magnitude of the effect, "F" is the significance of the regression, and "t" is the significance of the relationship.

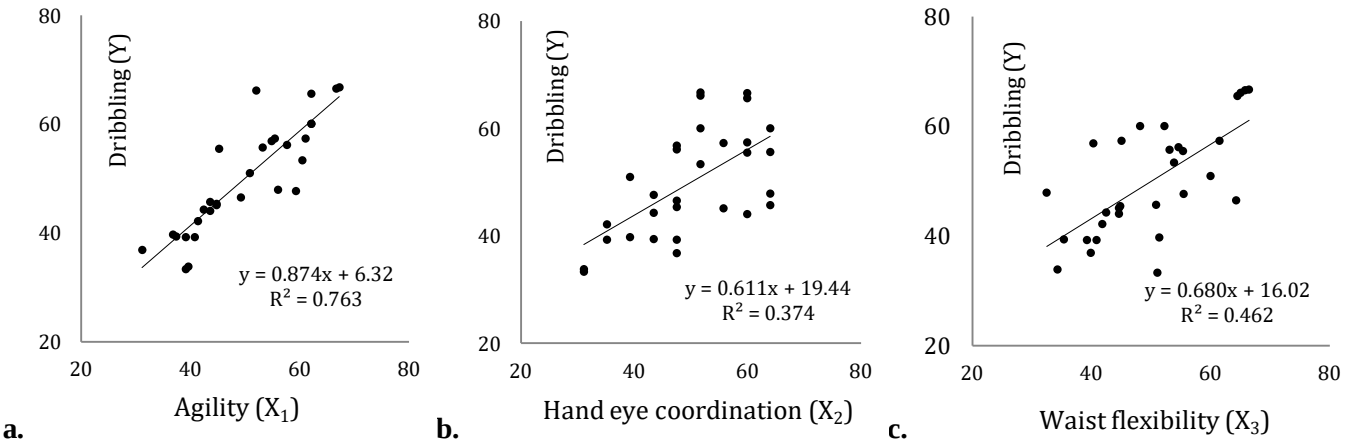



Figure 5. Linearity curve dribbling skills with: a. agility, b. hand-eye coordination with dribbling skills, c. waist flexibility.

# DISCUSSION

*Effect of agility on dribbling skills in field hockey*

These findings indicate that agility affected dribbling skills ($p < 0.05$). The results of this study are in accordance with previous studies, which reported that agility is very important in field hockey competition, and training that increases sprint and athlete strength is often applied in addition to endurance training [30]. Agility is a skill that must be trained separately [31] and is a key factor for developing technical skills, such as dribbling the ball [32].

Players with a ball can advance towards the goal by dribbling. This is a basic indicator for evading the opponent and disrupting the opponent's defense [33]. Speed-to-dribble requires high agility because it requires fast acceleration [12]. Field hockey is associated with a high number of short sprints and accelerations, and high anaerobic power with acceleration-deceleration ability is essential for better performance [34, 35]. Thus, this sport involves players' agility of the players [12].

*Effect of hand-eye coordination on dribbling skills in field hockey*

These findings indicate that hand–eye coordination affects dribbling skills ($p<0.05$). The results of this study are in accordance with those of previous studies that reported that the level of special coordination skills (hand-eye coordination) is an important factor in achieving the desired performance results during sports activities [36]. Some movements that are felt beforehand and carried out with the right timing (hand-eye coordination) have been proven to provide many benefits for athletes during matches [37].

Handeye coordination is a complex neurological process. This is the ability to combine hand movements with the eyes, thereby activating the eyes to send important signals to the brain to make hand movements [38]. Previous studies have also reported that hand-eye coordination can improve players' skills to perform complex movements and respond to external stimuli efficiently [39].

Sports rely on excellent hand-eye coordination, which in turn is directly related to visual reaction time, speed, and motor response [40]. Reaction time refers to the decision-making process and the speed of starting the movement, which is an important part of sports activities. Hand-eye coordination is important in both individual and team sports, where motor skills are shared. It has been proven that hand dexterity requires sensitivity and gross muscle strength [41].

*Effect of waist flexibility on dribbling skills in field hockey*

These findings indicate that waist flexibility affects dribbling skills ($p < 0.05$). The results of this study are in accordance with those of previous studies that reported that repeated actions require short stride lengths and high stride frequencies to increase the speed obtained from ROM [42]. In addition, limited ROM can increase the risk of injury in sports [43]. Several studies have confirmed flexibility for every sport [44] and tactical position [45], and may also depend on the player's competitive level [25]. ROM has been evaluated in sports, and it has been observed that the variations are large between different sports [44] and even within the same sport, depending on the joints and movement [46], gender [25], age [47], and competitive level [48]. Different studies have shown that limiting this ROM value can negatively affect sports performance [49, 50]. Based on the results of this study, dribbling in field hockey requires good waist flexibility for optimal implementation.

Based on the data obtained in the field, dribbling skills in field hockey are influenced by several physical components such as agility, hand-eye coordination, and waist flexibility. However, there are some limitations that need to be validated in future research. The physical components studied are still very limited; therefore, it is necessary to involve physical components and other factors related to dribbling skills in field hockey. The sample included 30 senior high school females who took part in hockey extracurricular coaching at school, so a wider sample size and diversity were needed, such as gender and athlete level.

# CONCLUSION

Based on these findings, agility, hand-eye coordination, and waist flexibility are the physical components that influence the dribbling skills of senior high school female field hockey players ($p < 0.05$). Partially, the effects of agility, hand-eye coordination is 37.40%, and waist flexibility were 76.30 %, 37.40 %, 46.20%, and 84.00%, respectively. Of these three components, agility is the most influential component of dribbling skills, without neglecting hand-eye coordination or waist flexibility. That is, the level of agility, hand-eye coordination, and flexibility possessed by field hockey players influence the results of their dribbling skills. This research is expected to be useful as an evaluation of the importance of these components to obtain optimal dribbling skills, both for coaches and coaches of field hockey extracurricular activities at schools, as well as field hockey players and athletes. Future studies are needed to incorporate the physical components and other factors related to dribbling skills in field hockey as well as diversity and a wider sample size.

**Institutional Ethical statement:** Ethical approval for this research was obtained in advance through the Faculty of Sports Science, Universitas Negeri Padang (No.8391/UN35.3/PG/2021), and the Riau Provincial Government Education Office, Indonesia (No. 800/Disdik/1.3/2022/998).

**Conflicts of Interest:** The authors declare no potential conflicts of interest.

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