

The Effect of Agility Drill Training towards Agility of Dribbling Techniques Skills in Reviewed of Body Mass Index for Beginners Players of Women Football

El efecto del entrenamiento de ejercicios de agilidad sobre la agilidad de las técnicas de regate en la revisión del índice de masa corporal para jugadoras principiantes de fútbol femenino

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Abstract. Background. Dribbling is a skill that players have to master the game of football, so many football experts say that the greatness of players can be seen from their skills in dribbling. To improve dribbling skills, players need to practice techniques with agility. This includes the body movement capabilities that football players can have because of their high agility, players who dribble can weaken and break through the enemy's defense. Study purpose. This study aims to examine the effect of agility drill training on agility of dribbling techniques skills in terms of body mass index in beginner players of women football. Materials and methods. This research is a quantitative type with experimental method and 2x2 factorial design. The population of the study was amounted to 36 players. The research sample is 32 players. The research instruments are BMI test and Illinois Agility Test with Ball (IATB). The data analysis technique used ANOVA two-way. Result. (1) There is a significant difference in the effect of variations in agility hurdle drill and agility ladder drill training methods on agility of dribbling technique skills. (2) There is a significant difference in agility of dribbling technique skills between players with an upper average body mass index and a lower average body mass index. (3) There is a significant interaction effect between agility hurdle drill and agility ladder drill training methods with body mass index (upper average and lower average) on the agility of dribbling technique skills of beginner players of women football. Conclusions. The agility hurdle drill training method was the more effective method used for players with a lower average body mass index and the agility ladder drill training method was more effective for players with an upper average body mass index.

Keywords: Agility dribbling techniques skills, Agility drill training, Body mass index, women football.

Resumen. Fondo. El regate es una habilidad que los jugadores tienen para dominar el juego de fútbol, por lo que muchos expertos en fútbol dicen que la grandeza de los jugadores se puede ver en sus habilidades para regatear. Para mejorar las habilidades de regate, los jugadores deben practicar técnicas con agilidad. Esto incluye las capacidades de movimiento corporal que pueden tener los jugadores de fútbol debido a su gran agilidad, los jugadores que regatean pueden debilitar y romper la defensa enemiga. Propósito del estudio. Este estudio tiene como objetivo examinar el efecto del entrenamiento de ejercicios de agilidad sobre la agilidad de las técnicas de regate en términos de índice de masa corporal en jugadoras principiantes de fútbol femenino. Materiales y métodos. Esta investigación es de tipo cuantitativa con método experimental y diseño factorial 2x2. La población del estudio ascendió a 36 jugadores. La muestra de la investigación es de 32 jugadores. Los instrumentos de investigación son la prueba de IMC y la prueba de agilidad con pelota de Illinois (IATB). La técnica de análisis de datos utilizó ANOVA bidireccional. Resultado. (1) Existe una diferencia significativa en el efecto de las variaciones en los métodos de entrenamiento del ejercicio de agilidad con obstáculos y del ejercicio de agilidad con escalera sobre la agilidad de las habilidades técnicas de regate. (2) Existe una diferencia significativa en la agilidad de las habilidades técnicas de regate entre jugadores con un índice de masa corporal promedio superior y un índice de masa corporal promedio más bajo. (3) Existe un efecto de interacción significativo entre los métodos de entrenamiento del ejercicio de agilidad con vallas y del ejercicio de agilidad en escalera con el índice de masa corporal (promedio superior y promedio inferior) sobre la agilidad de las habilidades técnicas de regate de jugadoras principiantes de fútbol femenino. Conclusiones. El método de entrenamiento con ejercicios de agilidad con vallas fue el método más efectivo utilizado para los jugadores con un índice de masa corporal promedio más bajo y el método de entrenamiento con ejercicios de agilidad en escalera fue más efectivo para los jugadores con un índice de masa corporal promedio superior.

Palabras clave: Técnicas de regate de agilidad, entrenamiento de ejercicios de agilidad, índice de masa corporal, fútbol femenino.

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Introduction

Good physical and technical ability will have a positive impact on the course of strategy and tactics used in a match (Nugroho et al., 2021; Pratama et al., 2022). This is in line with the opinion of (Amiq, 2014; Jufrianis et al., 2021) which states, excellent physical condition really supports the appearance of a player, poor physical appearance will certainly have a negative or negative impact on the appearance of his own techniques and tactics. If the physical and basic techniques of everyone are good, then however the tactics given by the coach will be carried out by all players (Nasrulloh et al., 2020; Kauki et al., 2024). Football is a very complex sport, because it requires good

technique/skills and tactical strategies. Likewise in terms of physical conditions, one of the characteristics of football is that it requires endurance, strength, speed, agility, balance, flexibility, and explosive power over a long period of time (Sukendro et al., 2021; Amran et al., 2023). These things are part of the factors that affect performance in football games.

Excellent physical condition really supports the appearance of a player, football because players are constantly moving and sometimes require sudden acceleration of movement (Nasrulloh et al., 2021; Kogoya et al., 2023). So, the strength and speed of the legs of a football player must be good. That is, a football player must have good agility, especially when doing dribbling

techniques. One of the characteristics of the dominant physical condition component of football is agility. Agility is a person's ability to be able to move and change direction of movement quickly in various directions to open up space and avoid the opponent's guard (Sutapa et al., 2020). Furthermore, Bompa, (2009) argues that agility is a complex set of skills that meet each other for athletes to respond to external stimuli with rapid deceleration, change of direction, and reacceleration. Agility has a very important role in the game of football, especially in avoiding opponents when dribbling, or being used to break through the opponent's defense to score goals (Listyarini et al., 2021). The ability of body agility to outwit opponents is very much needed by football players (Sutapa et al., 2021).

One form of exercise to increase speed and agility is agility hurdle drill. The agility hurdle drill training method is a varied and innovative form of power and coordination training that is modified using simple tools. Agility hurdle drill is a form of exercise method used to increase limb power that serves to increase stamina, coordination, agility, and speed (Ismoko & Putro, 2017; Salafi et al., 2023). As for the training method to increase speed, it is the Ladder Drill. Ladder drill is a form of jumping exercise using one or two feet by jumping over a rope in the form of a ladder placed on the floor or the ground. Following staircase training usually involves a set pattern through stairs that are placed flat or relatively flat on the floor. By moving the legs inside and outside the steps, the goal is to increase the speed (Somerset, 2014). According to Saqurin (2013) argues that ladder drill exercises using ladder tools or dexterity ladders focused on rapid movement and precise reactions can increase running speed. Speed and agility are interconnected in his particular football in dribbling ability (Silassie & Demena, 2016). Padrón-Cabo et al., (2020) suggested that speed and agility contribute to dribbling in football.

One form of exercise to improve agility is agility ladder drills (Saifu et al., 2021). Description Agility ladder drills are footwork exercises using rope obstacles such as ladders designed to improve leg power, agility, and coordination (Hastuti et al., 2021; Adji et al., 2022). This agility ladder drills training method is designed for athletes to be able to move quickly and change direction and pass the ladder rope as a variety of obstacles (Nasrulloh et al., 2022). The agility hurdle drills training method is a varied and innovative form of power and coordination training that is modified using simple tools. Plyometric hurdles can also develop leg muscle strength because this exercise relies on leg strength, in which the legs must continue to jump over the obstacles in front of them in succession with several repetitions (Salafi et al., 2022). Athletes must have dribbling techniques which are supported by good agility aspects in football players. Dribbling is a skill that players have in order to master the game of football, so many football experts say that a player's greatness can be seen from his skills in dribbling the ball.

Dribbling techniques have an important role for a football athlete who has various goals, namely being able to master the game, maintain ball possession, break through the opponent's defense, and prepare to attack or score a goal against the opponent. Dribbling requires good agility and support from elements of good physical condition in order to provide the ability to move faster (Nugroho et al., 2022; Trisnadi et al., 2024). Dribbling agility can be trained through agility training. Dribbling is one of the basic techniques that has quite an important role in the game of football, it is not surprising that football observers in particular say that a player's prowess can be seen in how a player dribbles. To improve dribbling skills, techniques must be trained, such as: strength, speed, flexibility, agility and so on (Yuniana et al., 2023). Now many coaches ignore or consider it unimportant. Dribbling or dribbling is not only trained with one foot, but with both left and right. The purpose of the dribbling technique is to get past the opponent, look for opportunities to pass friends, and hold the ball to keep it in control. The movement of dribbling requires a complex series of movements. The principle of dribbling technique is explained as follows: (a) the ball must always be controlled, close to the feet, (b) the ball must be in protection with the right foot according to the situation and position of the opponent), (c) the view of the ball in motion and the field, (d) get used to the right foot and left foot.

Body Mass Index is defined as a person's weight in kilograms divided by height in meters squared (kg/m^2) (Irianto, 2017). Body Mass Index (BMI) is a simple tool or method to monitor the nutritional status of adults, especially those related to underweight and overweight (Supariasa et al., 2013; Pratama et al., 2024). A high body mass index (fat) can reduce the level of agility of an athlete, thereby reducing his sports performance. Athletes who have a high enough BMI have lower agility. This is because the higher the BMI, the heavier the athlete's body makes the athlete's movement slow down. Dribbling skill is a basic football technique that requires agility in its implementation. Body mass index is also part of agility, because in principle agility is a fast and precise movement with balance. According to Pugh & Allsabab, (2020) in their research stated that body mass index has a close relationship with dribbling. Therefore, efforts to improve the ability to dribble can be done by increasing the body mass index (Ilham et al., 2021). This can be because BMI is more dominant during more unstable movements. A good BMI makes movements more efficient (Kristiyanto et al., 2020). This agility variable is also related to dribbling. Agility is also very necessary in the game of football. With the increasing popularity of women's football around the world and participation numbers, many coaches who previously only coached male players are now also coaching female players. When training female players, these coaches try to use the same physical training loads that they use when training men without considering the special characteristics of female players due to a lack of knowledge in this scope.

The development and progress of the sport of football

over time has experienced significant rapid and better improvement in all countries in the world, both among parents, adults, teenagers and children, even men and women. Therefore, in general, female football players like this sport. To increase motivation, it is necessary to carry out workouts that have a high content of fun and teamwork, as well as they should pose a challenge for older players (Perez Munoz et al., 2018; Trisnadi et al., 2023). The following results from Serrano et al., (2022) were drawn: (1) what motivates women primarily to play competitive football is the pursuit of their personal well-being -health, physical appearance, psychological balance and social interaction; and (2) gender stereotypes derived from a patriarchal culture, linked to femininity and motherhood, together with the poor economic and working conditions that affect the practice of professional women's football, hinder the professional practice of this sport by women. Due to the multiple benefits that this sport generates, it is necessary to promote measures, and that these be adapted to the characteristics and demands of the female players, that dignify efforts and transform the masculinised vision of this sport that still exists. It is proven by the existence of professional women's football leagues and clubs in Indonesia, even in every region, both in the district and city, there are also many women's football clubs. The problem of coaching and training in women's football, of course, is different from men's football. This is because fostering and coaching women's football is much more difficult than men's, although the training program is not much different from that of men. A person's physical condition greatly affects and even determines the motion of his appearance. A good football player does not only need good technique and mentality in playing, but also must have a good physical condition as well.

In agility training, there are many and varied variations of training methods (Nopembri et al., 2022; Arifin et al., 2024). This research uses agility hurdle drill and agility ladder exercises to improve the physical condition of the players. The study found that the movement pattern is almost the same, but the height is different. The ladder drill training pattern has a flat jump area in the form of an agility ladder. Meanwhile, the hurdle drill pattern exercise has a high obstacle, by lifting both legs even higher to get past the obstacle. This is a similar movement pattern that is believed to increase leg muscle agility and strength. By using a variety of simple movement patterns, it is expected that the trainer can improve the athlete's agility and leg muscle strength so that the agility of the player's dribbling technique can increase. The agility ladder drill and agility hurdle drill exercises used by researchers want to find out whether training with the agility ladder drill and agility hurdle drill methods can improve the agility of dribbling techniques in youth female football players, then associated with the influence of the player's body mass index. In addition, these findings can contribute to football players so they can train effectively with the agility ladder drill and agility hurdle drill methods which can be used as efficient

training activities in agility training as a choice of exercises for agility dribbling techniques for beginner female football players in terms of body mass index.

One form of exercise to increase agility is the agility ladder drill. Description of agility ladder drill is a variant of leg movement training using a rope obstacle in the shape of a ladder which is designed to increase agility, leg power and coordination. This agility ladder drill training method is designed so that athletes can move quickly and change direction by crossing ladder ropes as various obstacles. The aim of implementing this method is so that athletes can develop agility, strength and speed (power) of the legs, as well as coordination. Obstacles are varied to develop various types of training for avoidance, movement coordination, leg power, and changing body direction in various types of sports. Repetitive training aims to improve agility, coordination and explosive power of the legs.

The agility hurdle drill training method is created so that players are able to have movements that are able to pass through obstacles and change direction quickly, where the obstacles are in the form of small hurdles specially made for this training. The obstacles are adapted to develop various types of movement coordination, leg explosive power, changing body direction, and avoidance exercises that are often found in the sport of football. By repeatedly jumping over the obstacles in front of you several times in sequence, this exercise relies heavily on leg strength so that there is a goal of developing leg muscle strength in athletes. So that training results can be optimal, there are plyometric hurdle training principles that must be adhered to and carried out regularly.

Based on other research conducted by researchers Pamungkas (2023), agility has a significant influence on football playing skills, and there is an interaction between hurdle drill and ladder drill training methods and agility (high and low) on football playing skills. The application of the hurdle drill and ladder drill methods has an influence on football playing skills. The method of training hurdle drill and ladder drill in improving football playing skills has been proven. The skill of playing football does not come casually, it requires a long process in the form of continuous training. The willingness to train tenaciously and compete with an unyielding spirit on the field requires an accompanying psychological aspect. The willingness to train and compete is obtained from the high motivation of each player. Achievements will not come alone but with careful planning and take a long time. The application of the hurdle drill and ladder drill methods affects the skills of playing football. The hurdle drill and ladder drill training methods have been proven to improve football playing skills. The skill to play football does not just come, it requires a long process of continuous practice. The will to train diligently and compete with an unyielding spirit on the field requires a psychological aspect to accompany it. The willingness to practice and compete is obtained from the high motivation of each player. Achievements will not come alone but with careful planning and take a long time. Further research

related to the hurdle drill and ladder drill training methods to improve women's football playing skills is urgently needed. Several modifications, innovations, and creativity in applying the method can be used as the main factors in developing training methods.

Materials and methods

Study participants

There were 36 players in the population in this study. Sampling is carried out in such a way that samples are obtained that can truly represent and can describe the actual state of the population. The sample is part of the character and number controlled by the population (Sugiyono, 2015). Therefore, the researchers employed samples for conducting this research. This current study used a random sampling technique to determine 32 people as the research sample. This study does not include the entire population involved in experimental research because it relates to random sampling analysis techniques.

The location of the research was the Putri Surakarta women's football club which has its home base at Jajar field, Laweyan, Surakarta. The research was carried out for seven weeks starting from January 28 2022 for pre-test to March 11 2022 for post-test with 16 treatments, excluding the pre-test and post-test. Treatment was carried out for three days a week.

Referring to the total population number of 36 female beginner football players. The sample criteria were young female football players (15 – 19 years old), physically and psychologically healthy, and willing to be research subjects. Because 1 player did not fit into the age criteria, then the following were taken according to the research criteria, namely a total of 35 players using the Slovin formula above and a significance level of 5%, so that the results obtained were a minimum sample size of 32 people using an accuracy rate of 95%. Then based on the sum of the results from the formula, the results of the sum are divided into two groups which had been identified between the group of BMI players at the level upper the average and the group of BMI players at the level lower the average using the overall value of BMI data that players have with the ranking line. Based on this matter, it is obtained the number of 16 players who have a BMI level upper the average and the number of 16 players who have a BMI level lower the average. Then analyzed using the ordinal pairing technique to identify the experimental group, then the number of 16 players who had a BMI level upper the average was obtained given the treatment method with agility hurdle drills and agility ladder drills, the same thing was done for the experimental group of players who had BMI level lower average. After being divided into four groups, each group had 8 players and then carried out a pretest using the Illinois Agility Test with Ball (IATB) test instrument before being given treatment.

Study organization

The researchers utilized a quantitative approach to conduct this study, while this present research employed the experimental method as the research design. Moreover, the research type of this study was a 2x2 factorial design. The 2 x 2 factorial design was used because the experimental method in this study involved two independent variables (agility hurdle drill training method and agility ladder drill training method), each of which each consisting of two independent attributive variables based on body mass index (divided only into upper average and lower average). A factorial experiment is a design that analyzes two independent variables in giving an impact/influence on the dependent variable simultaneously or partially and discusses the interaction of research variables (Sudjana & Ibrahim, 2012). The researchers collaborate with the coach to implement two treatments in two groups in this experimental study to know the effectiveness of the agility ladder drill and agility hurdle drill to the agility of the dribbling technique of beginners players of women football.

Table 1.
Factorial Design

Training Method		Agility Hurdle Drill (a1)	Agility Ladder Drill (a2)
Agility-Dribbling (A)	BMI (B)		
Upper Average Level (b1)		a1.b1	a2.b1
Lower Average Level (b2)		a1.b2	a2.b2
a1.b1:	Group of players with BMI upper average level are given the treatment of agility hurdle drill training method		
a2.b1:	Group of players with BMI upper average level are given the treatment of agility ladder drill training method		
a1.b2:	Group of players with BMI lower average level are given the treatment of agility hurdle drill training method		
a2.b2:	Group of players with BMI lower average level are given the treatment of agility ladder drill training method		

This present research employed the Illinois Agility Test with Ball / IATB as the instrument for collecting the data from the dribbling skills and agility test (Reina et al., 2017). Therefore, football and agility dribbling skills from the football player were identified through the implementation of the data collection technique.

The procedure for carrying out the test is that the length of the test area is 60 meters (the distance from the start point to the finish), and the width is 5 meters. Several cones are used as a start sign, then at 10 meters, there is a turning point, passing 4 cones each 2.5 meters from the starting point forward to the very end cone. The test by passing each cone, and after that, it goes to the next point as the turning point used to get to the finish. The time stopwatch runs after receiving a signal, and the subject dribbles as quickly as possible and then changes the direction of movement according to the path shown in the image below without bumping or bumping the existing cones to the finish. The test can be done 2 times in the same or different directions (right and left), then the fastest time is taken between the 2 tests.

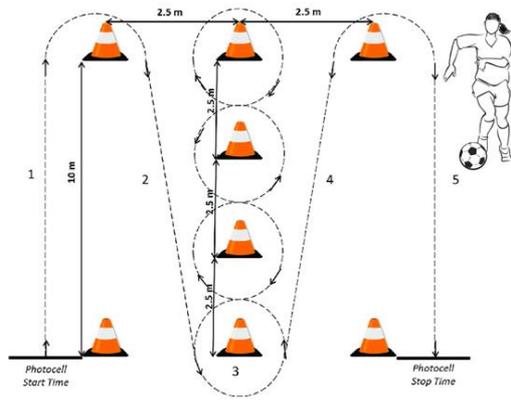


Figure 1. Illinois Agility Test with Ball / IATB (Reina et al., 2017)

Table 2. Dose of Training Program

Treatment meeting	Intensity	Volume	Reps	Rest Interval
1-8	70 %	4 sets	3 times	2 minute
9-16	80 %	4 sets	2 times	1 minute

Statistical analysis

The analysis technique used by ANOVA was two ways (two ways ANOVA) at the significance level of significance $\alpha = 0.05$. Before the variance analysis technique is used, the analysis prerequisite test is first carried out, including the normality and homogeneity tests. The normality test uses the Shapiro-Wilk test. The variance homogeneity test uses Levene’s test. To test the hypothesis using a two-way ANOVA (ANOVA two-way), and if there is evidence of interaction, a follow-up test will be carried out, namely the Tukey test, using the SPSS version 20.0 for windows software program with a significance level of 5% or 0.05.

Results

Descriptive statistics of pretest and posttest on agility of dribbling technique skills are described in are presented in Table 2.

Table 2a. Descriptive statistics of pretest and posttest on agility of dribbling technique skills

Group	Minimum	Maximum	Mean	Std. Deviation
Pretest a ₁ b ₁	23.30	35.40	29.91	3.71
Posttest a ₁ b ₁	21.12	33.14	27.72	3.56
Pretest a ₂ b ₁	26.06	34.80	30.41	2.90
Posttest a ₂ b ₁	24.09	31.23	28.39	2.53
Pretest a ₁ b ₂	22.16	36.60	28.72	5.47
Posttest a ₁ b ₂	20.12	30.13	24.13	3.93
Pretest a ₂ b ₂	22.87	35.43	28.69	4.98
Posttest a ₂ b ₂	21.74	32.30	26.56	4.20

Table 2b. Summary of Research Data

Method	BMI	Statistics	Pretest	Posttest
Hurdle Drill	Upper	Mean	29.91	27.72
		SD	3.71	3.56
	Lower	Mean	28.72	24.13
		SD	5.47	3.93
Ladder Drill	Upper	Mean	30.41	28.39
		SD	2.90	2.53
	Lower	Mean	28.69	26.56
		SD	4.98	4.20

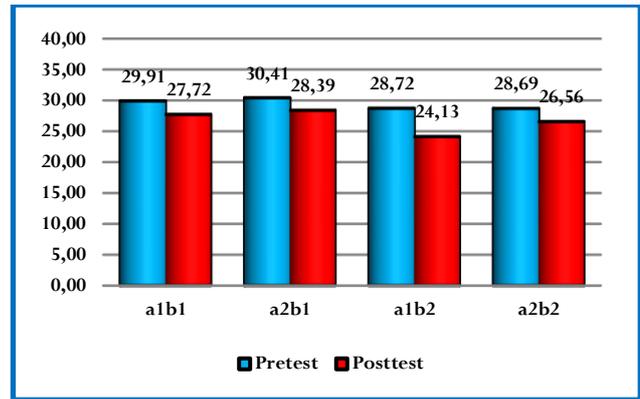


Figure 2. Bar Chart of Pretest and Posttest Agility Dribbling Technique Skills

Prerequisite Test Results

- a1.b1: Group of players with BMI upper average level are given the treatment of agility hurdle drill training method
- a2.b1: Group of players with BMI upper average level are given the treatment of agility ladder drill training method
- a1.b2: Group of players with BMI lower average level are given the treatment of agility hurdle drill training method
- a2.b2: Group of players with BMI lower average level are given the treatment of agility ladder drill training method

Normality Test

The data normality test in this study used the Shapiro-Wilk method. Normality test results presented in Table 3:

Table 3. Normality Test

Group	Signifikansi	Notes
Pretest a ₁ b ₁	0.884	Normal
Posttest a ₁ b ₁	0.815	Normal
Pretest a ₂ b ₁	0.925	Normal
Posttest a ₂ b ₁	0.578	Normal
Pretest a ₁ b ₂	0.232	Normal
Posttest a ₁ b ₂	0.112	Normal
Pretest a ₂ b ₂	0.193	Normal
Posttest a ₂ b ₂	0.192	Normal

Based on table 3 above, all pretest and posttest data were obtained from the normality test results of the data significance value $p > 0.05$, which means the data is a normal distribution.

Homogeneity Test

The homogeneity test is intended to test the similarity of variants between pretest and posttest. The homogeneity test in this study was the Levene Test. Homogeneity test results are presented in Table 4:

Table 4. Homogeneity Test

Data	Test of Homogeneity of Variances			
	Levene Statistic	df1	df2	Sig
Pretest	8.121	1	30	0.108
Posttest	1.486	1	30	0.232

Based on table 4, the calculation results obtained a significant value of $0.341 \geq 0.05$. This means that the data group has a homogeneous variant. So that the population has the same variance or homogeneity.

Hypothesis Test Results

Research hypotheses are tested based on data analysis and two-track ANOVA (ANOVA two-way) analysis interpretation. Hypothesis Test Results are presented in table 5:

Table 5.
ANOVA Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Training Methode	13.794	1	13.794	9.498	0.005
Body Mass Index	12.713	1	12.713	8.754	0.006
Training Methode* Body Mass Index	10.477	1	10.477	7.214	0.012

Research hypothesis testing was conducted based on the results of data analysis and interpretation of two-way ANOVA analysis.

The first hypothesis to examine the difference in the effect between variations of agility hurdle drills and agility ladder drills training methods on the agility of the dribbling technique of beginners players of women football shows that the F value is 9.498 and the p significance value is $0.005 < 0.05$, meaning H_0 is rejected. So, there is a significant difference in influence. Based on the results of the analysis, it turns out that the agility hurdle drills training method group with an average difference of 3.39 seconds is higher (good) than the agility ladder drills training method group of 2.08 seconds, the average difference between the two groups is 1.31. This means that the research hypothesis which states that "There is a significant difference in the effect of variations of agility hurdle drills and agility ladder drills training methods on the agility of the dribbling technique of beginners players of women football", has been proven.

The second hypothesis to test the differences in the agility of women football players' dribbling techniques between athletes with an upper average body mass index and a lower average body mass index shows that F is 8.754 and a significance value of p is $0.006 < 0.05$, meaning H_0 is rejected. Based on this, it means that there is a significant difference in influence. Based on the results of the analysis, it turns out that athletes who have a lower average body mass index with an average difference of 3.37 seconds are higher (good) compared to athletes who have an upper average body mass index of 2.11, with an average difference of 2.11. an average of 1.26. This means that the research hypothesis which states that "There is a significant difference in the agility of women football players' dribbling techniques between athletes with an upper average body mass index and a lower average body mass index", has been proven.

The third hypothesis is to test the interaction between agility hurdle drills and agility ladder drills training methods with body mass index (upper average and lower average) on the agility of the dribbling technique of beginners players of women football showing that the F value is 7.214 and the p significance value is $0.012 < 0.05$, it means that H_0 is rejected. Based on this, it means that the hypothesis which

states "There is a significant interaction effect between the agility hurdle drills training method and agility ladder drills with body mass index (upper average and lower average) on the agility of the dribbling technique of beginners players of women football", has been proven. A Diagram of the results of the interaction effect between the training method (agility hurdle drills and agility ladder drills) with body mass index (upper average and lower average) on the agility of the dribbling technique skills of beginners players of women football can be seen in Figure 2:

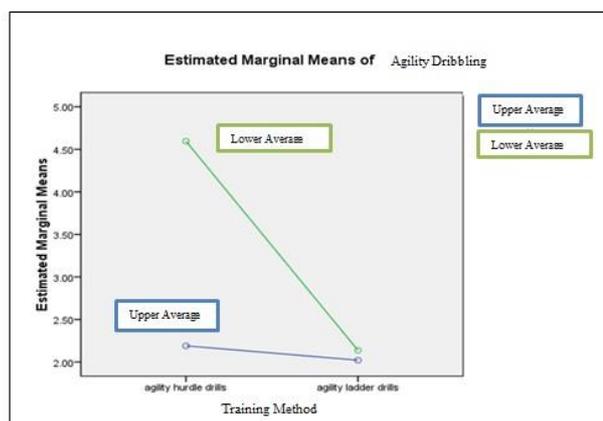


Figure 3. Results of Interaction Between Training Method (Agility Hurdle Drills and Agility Ladder Drills) with Body Mass Index (Upper Average and Lower Average)

After testing, there is an interaction effect between the agility hurdle drills and agility ladder drills training methods with body mass index (upper average and lower average) on the agility of the dribbling technique skills of beginners players of women football, it is necessary to carry out further tests using the Tukey test. Further test results can be seen in Table 7 below:

Table 6.
Tukey Test

Group	Interaction	Mean Difference	Std. Error	Sig.
a1b1	a2b1	.1687	.60256	.992
	a1b2	-2.4050*	.60256	.002
	a2b2	.0525	.60256	1.000
a2b1	a1b1	-.1687	.60256	.992
	a1b2	-2.5737*	.60256	.001
	a2b2	-.1162	.60256	.997
a1b2	a1b1	2.4050*	.60256	.002
	a2b1	2.5737*	.60256	.001
	a2b2	2.4575*	.60256	.002
a2b2	a1b1	-.0525	.60256	1.000
	a2b1	.1162	.60256	.997
	a1b2	-2.4575*	.60256	.002

Based on Table 6 the results of Tukey's test calculations on the asterisk sign (*) show that pairs that have significantly (significant) different interactions or pairs are: (1) a1.b1-a1.b2, (2) a2.b1- a1.b2, (3) a2.b2-a1.b2, while the other pairs that are declared to have no difference in influence are: (1) a1.b1-a2.b1, (2) a1.b1-a2.b2, and (3) a2.b1-a2.b2.

The results of the Tukey HSD analysis to find out which training group has a better increase in agility are in Table 7 below: Based on the results of the Tukey HSD test in Table

7 above, it can be explained that the differences in each group can be viewed from the harmonic mean value obtained by each group in the subset column. The test results above show that group a2.b1 (a group of players with a BMI the upper average level doing the agility ladder drill training method) is in a different subset column (column subset 2). Based on this, it can be concluded that the increase in the agility of the dribbling technique skills of the a2.b1 group (a group of players with a BMI the upper average level doing the agility ladder drill training method) is better than the groups a1.b1, a2.b2, a1.b2.

Table 7.
Tukey HSD* Test Result

Agility of Dribbling				
Tukey HSD		Subset		
Group	N	1	2	
a2.b2	8	2.02		
a1.b1	8	2.14		
a1.b2	8	2.19		
a2.b1	8		4.60	
Sig.		0.992	1.00	

Discussion

The discussion of the results of this study provides further interpretation of the results of data analysis that have been presented. Based on the hypothesis testing resulted in two groups of analytical conclusions, namely: (1) there is a significant difference in the effect between the main research factors; and (2) there is a significant interaction effect between the main factors in the form of two-factor interaction.

The difference in the effect of agility hurdle drills and agility ladder drills training methods on agility dribbling techniques. Based on hypothesis testing, it is known that there is a significant difference in the effect of variations in the agility hurdle drills and agility ladder drills training methods on the agility of the dribbling technique of beginner female football players. Based on the results of the analysis, it turns out that the agility hurdle drills training method group is higher (good) than the agility ladder drills training method group. Agility hurdle drills are a form of plyometric exercise. The results of this study are in accordance with the research of Mohanta et al., (2019) that circuit training is an important method to increase upper and lower extremity strength, running speed and agility in tennis players. Furthermore, (Kaur, 2018) study showed that the experimental group (Plyometric & SAQ) of handball players improved agility performance compared to the control group. (Tendulkar et al., 2018) stated that "Plyometric training is very helpful in increasing agility in football players. So this training method is recommended for football players to improve their speed and skillful performance".

A study conducted by Pranyoto & Suharjana, (2019) that the agility hurdle drill training method can increase the agility of players. Agility hurdle drills will increase the muscles around the legs. (Sudarmanto, 2018) state that hurdle training is considered an aerobic activity because it

requires rhythmic contractions of large muscle groups from the legs to transfer the entire body weight. This exercise can improve the gluteals, gastrochemins, guadricept, hamstrings, hip fuxors, lower back and abdominal muscles. Based on this, the muscles will become strong and become flexible, so that the athlete's agility will increase. As stated by (Irawadi, 2011) that "agility is one element of special physical conditions, which is a combination of elements of strength, speed, and flexibility". These three combinations will produce agility.

Hariyanta et al., (2014) that applying the basic principles of training systematically, repeatedly over a long period of time, will stress the muscles, so that the muscles will undergo physiological adaptation. Physiological adaptations that occur in the leg muscles that involve almost all muscles, especially the muscles of the legs such as the quadriceps, hamstring, gluteus, gastrocnemius, and abductor hip muscles with hypertrophy. The occurrence of hypertrophy is due to an increase in the number of myofibrils in each muscle fiber, an increase in capillary density in muscle fibers and an increase in the number of white muscle fibers or fast twitch, so that the leg muscles will become stronger which makes the speed increase (Anantawijaya et al., 2018).

Agility is related to neural adaptation; the mechanism of neural adaptation occurs due to exercise that causes an increase in the force of muscle contraction that is realized directly. This increase occurs due to increased activation of the prime mover muscles, synergistic muscles contracting more precisely and increased inhibition of antagonistic muscles. The implication is that athletes who are trained can activate their muscles to the maximum under normal conditions so that functionally their energy stores can be immediately used as a conscious maximum effort (Astrawan, 2020). Regular physical training will cause physiological hypertrophy of muscles, which is due to the number of myofibrils, myofibril size, density of capillaries, nerves, tendons and ligaments, and the total number of contractile proteins, especially myosin, is proportionally increased. Changes in muscle fibers do not all occur at the same rate, a greater increase occurs in white muscle fibers (fast twitch), resulting in an increase in the speed of muscle contraction. Increasing the size of muscle fibers which in turn will increase the speed of muscle contraction, thus causing an increase in agility (Womsiwor & Sandi, 2014).

Previous research conducted by (Pamungkas, 2023), the results of the study are as follows: (1) There is an influence of the hurdle drill training method, ladder drill on football playing skills ($p > 0.05$) because the significance value of p for the posttest is $0.000 < 0.05$. (2) There is a significant difference in the effect of low agility and high agility on football playing skills ($p < 0.05$) because the significance value shows p of $0.007 < 0.05$. (3) There is an interaction between hurdle drill training methods, ladder drill and agility (high and low) to football playing skills ($p > 0.05$) posttest results of $0.001 < 0.05$

the results show that after treatment or training there is an interaction between method with football playing skills. Based on research conducted by researchers, agility has a significant influence on football playing skills, and there is an interaction between hurdle drill and ladder drill training methods and agility (high and low) on football playing skills. The application of the hurdle drill and ladder drill methods has an influence on football playing skills. The method of training hurdle drill and ladder drill in improving football playing skills has been proven.

Differences in the agility of female football players' dribbling techniques between athletes with an upper average body mass index and a lower average body mass index. The results of the analysis show that there is a significant difference in the agility of female football players' dribbling techniques between athletes with an upper average body mass index and a lower average body mass index. Based on the results of the analysis, it turns out that athletes who have a lower average body mass index are higher (good) than athletes who have an upper average body mass index. VO₂ Max can be increased with exercise, however, the increase is only around 25% of the initial condition of the exercise, the rest is determined by the physical potential of each individual (Budiwanto, 2012). Other factors that affect cardiorespiratory endurance are heredity, exercise, gender, age, body fat, and physical activity. Physical activity is the thing that most affects a person's level of fitness. Activities carried out day after day will shape health, vitality, and quality of life.

These results are in line with previous studies where there has been a significant negative correlation between BMI and VO₂ Max with significant results. Research conducted found a significant negative correlation between BMI and cardiorespiratory endurance $r = 0.45$ and $p = 0.001$. The results of Andrastea et al., (2018) research show that there is a significant relationship between BMI and cardiovascular fitness in students of the Medical Education Study Program, FK Unud aged 18-21 years, where the higher the BMI value, the lower the cardiovascular fitness. Abnormal or excessive accumulation of fat will have adverse effects on health, because adipose tissue is not only a storage organ for triglycerides, but also as a producer of bioactive substances, namely leptin which will affect the physiology in the body including the cardiovascular system (Watulingas, 2014).

The percentage of excess body fat is detrimental to health because of the risk of suffering from degenerative diseases. Obesity is defined by a BMI greater than 25 kg/m². The research conducted found a significant negative correlation between BMI and VO₂ Max with $r = -0.334$ and $p < 0.001$ (Pribis et al., 2010). The study showed that the higher the BMI, the lower the level of cardiorespiratory endurance. The amount of fat deposits correlated with the level of cardiorespiratory endurance. Research by (So & Choi, 2010) found a significant decrease in the level of VO₂ Max in obese respondents, namely the average VO₂ Max of normal respondents was $37.26 \pm$

6.32, overweight 33.08 ± 5.53 and obese 31.37 ± 6.21 with p value = < 0.001 .

The results of this study are in accordance with research conducted by Mondal & Mishra, (2017) on 54 medical students at MKCG Medical College, Odisha, India aged 18-25 years. The study concluded that there was a significant negative relationship between BMI and cardiovascular fitness (VO₂ Max) with r value = -0.323 and p value = 0.0171 . A study involving 288 students aged 10-14 years in Brazil in 2015 by De Araujo et al (2015) found that there was a strong and opposite relationship between the level of cardiovascular fitness and BMI in children and adolescents. The results of the research by Hsieh et al (2014) showed the OR value = 2.68 with 95% confidence interval (CI) = 1.34-5.33 for girls and the OR value = 3.24 with 95% confidence interval (CI) = 1.40-7.49 for boys which means that BMI significantly affects the level of cardiovascular fitness for boys and girls.

The study showed that the higher the BMI, the lower the cardiorespiratory resistance. Individuals who are overweight and obese, the body will become less sensitive and there will be limitations of the body in carrying out various daily activities freely. Obesity will give too heavy burden to the heart by increasing low density lipoprotein or abbreviated as LDL and decreasing high density lipoprotein or abbreviated as HDL. Loads that are too heavy will interfere with heart function, and can even cause heart failure. This can be interpreted as a decrease in cardiorespiratory fitness (Lubis, et al, 2015; Utami et al., 2023).

Body Mass Index (BMI) is one of the factors that affect the level of cardiovascular fitness. People with a high BMI or included in the overweight and obese categories have an increase in fat tissue in the body (Alimardani, et al, 2012). The increase in body fat tissue mass will decrease the physiological function of the heart due to thickening of the walls of the heart ventricles, resulting in a decrease in cardiac output. This results in less blood being pumped, so that less oxygen is circulated to the muscles (Andrastea et al., 2018; Hardianto et al., 2022). Increased fat tissue is also associated with decreased vascular endothelial function, especially in the production of Nitric Oxide (NO). Reduced NO synthesis causes failure of oxygen extraction, increased permeability and decreased vasodilation ability of blood vessels, which inhibits the distribution of oxygen to all cells in the body. Individuals who are obese have an increase in free fatty acids secreted from fat cells that play a role in insulin resistance. Insulin resistance causes disruption of regulation of anion transporter function in mitochondria and this will have an impact on decreasing the value of VO₂ Max. Obese people have an increase in the release of cytokines, especially interleukin 6 (IL-6) which stimulates proinflammatory factors and also an increase in the secretion of prothrombin activator inhibitor-1 which increases the risk of heart disease and hypertension in obese people (Ciesla et al., 2014; Yudhistira et al., 2021).

Effect of Interaction between agility hurdle drills and

agility ladder drills training methods with body mass index (upper average and lower average) on agility. Based on the results that have been stated in the results of this study that there is a significant interaction between agility hurdle drills and agility ladder drills training methods with body mass index (upper average and lower average) on the agility of the dribbling technique of beginner female football players. The results showed that the agility hurdle drills training method group was the more effective method used for athletes with a lower average body mass index and the agility ladder drills training method group was more effective for athletes with an upper average body mass index.

These results are indicated by the pairs that have interactions or pairs that are significantly different (significantly) are: (1) a1b1-a1b2, (2) a2b1-a1b2, (3) a2b2-a1b2, while the other pairs are declared not to have the difference in influence is: (1) a1b1-a2b1, (2) a1b1-a2b2, and (3) a2b1-a2b2. The results of the interaction form show that the main factors of the study in the form of two factors show a significant interaction. The results of this study are interactions which mean that in each cell or group there is a difference in the effect of each paired group.

Conclusion

Based on the results of the research and the results of data analysis that has been carried out, the following conclusions are obtained. There is a significant difference in the effect of variations in the agility hurdle drills and agility ladder drills training methods on the agility and dribbling technique skills of beginner female football players. Based on the results of the analysis, it turns out that the agility hurdle drills training method group is higher (good) than the agility ladder drills training method group. There is a significant difference in agility and dribbling technique skills of female football players between athletes with an upper average body mass index and a lower average body mass index. Based on the results of the analysis, it turns out that athletes who have a lower average body mass index are higher (good) than athletes who have an upper average body mass index. There is a significant interaction effect between agility hurdle drill and agility ladder drill training methods with body mass index (upper average and lower average) on the agility of dribbling technique skills of beginner players of women football. The results showed that the agility hurdle drills training method group was the more effective method used for athletes with a lower average body mass index and the agility ladder drills training method group was more effective for athletes with an upper average body mass index.

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Conflict of interest

The researcher declares that there is no conflict of interest in this research.

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