Correlation between Ankle Stability, Strength and Endurance of Plantar Flexor Muscle in Volleyball Player Agility Skill at UKM Voli Universitas Esa Unggul

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Abstract: **Objective:** Determine the correlation between ankle stability, strength and endurance of plantar flexor muscle in volleyball player agility skill at volleyball students activity unit Esa Unggul University aged 18-25 years. **Method:** This study is a non-experimental study in the form of a correlation study to analyze the relationship between ankle stability, strength and endurance of plantar flexor muscle in volleyball player agility skill. The total sample is 18 volleyball players aged 18-25 years who are members of volleyball students activity unit Esa Unggul University, West Jakarta. The measuring instruments used were single leg balance (ankle stability), 1RM heel raise test (plantar flexor strength), heel raise test (plantar flexor endurance) and hexagonal obstacle test (agility skill). **Result:** Correlation test between ankle stability and agility skill with Spearman-Rank Test obtained a significance value p= 0.XXX, (p>0.05) and r=0.XXX. Strength and agility with Spearman-Rank Test obtained a significance value p= 0.673 (p>0.05) and r=0,10. For correlation test between plantar flexor muscle endurance obtained significance value with p = 0.824 andr=-0.057.

1 INTRODUCTION

Volleyball game is of dynamic sports that requires techniques that players to possess various physical skills. In volleyball games, players need to have strength, speed, accuracy, explosive power and coordination as well as good teamwork. These physical skills in volleyball game if placed in unsupportive conditions, poor technique or lack of physical readiness can cause injuries that mainly occur during landing from blocking and spiking (Hadzic et. Al, 2009). Injuries that occur, as a whole can cause a decrease in player performance. So that one way to prevent sports injuries is to improve stability and muscle performance, like the strength and endurance of the lower leg muscles. In addition to avoiding or preventing injury, with ankle stability, leg muscle strength and endurance, a player's performance or performance in performing volleyball techniques can be more effective in scoring and defending the pitch against an opponent's attack.

Ankle stability has a very important role to stabilize effective lower limb movement techniques during games or training and also to avoid injuries in volleyball games. The meaning of stabilization is the functional stabilization of the ankle which is the result of coordination of mechanical resistance (by joint capsule, articular and musculotendinous structures) with dynamic resistance which is the result of muscle contraction around the joint (Myers et al, 2006). This stabilization can affect the player's skill like the ability to move direction quickly without losing balance or agility skill. Therefore ankle stability must also work together with agility to improve the performance of players. So from the description to determine the ability of ankle stabilization, the measuring instrument used is a single leg balance test.

In addition, other functional components is muscle strength. Muscle strength is a basic bio motor component or activator of the human body. Muscle strength is defined as the ability of a muscle or group of muscles to be able to produce force in maximum contraction (Kisner, 2007). Physiologically, muscle strength is the basic driving force that allows a player to be able to develop other physical skills such as speed, explosive power, coordination, agility and endurance. In volleyball players the ability to move is supported by the strength of the lower leg muscles.

Lower limb muscle strength in volleyball players is stated as one of the critical factors in a player's performance success (Radu et al, 2014).

Plantarflexor muscle is a lower leg muscle that is part of a human calf. This muscle is also a form of posterior lower limb muscle called the triceps surae which consists of the gastrocnemius and soleus muscles. This group has the main function to perform plantar flection and supination movements at the ankle (ankle). In the plantar flection movement, the triceps surae gives a contribution of 80% -90% in the production of the force of motion produced, (Chimera et al, 2010). In volleyball players the resulting movement can be produced with contraction of the plantar flexor muscle which is able to develop into strength for explosive power when jumping, the ability to defend, slide, land and footwork. The presence of adequate plantar flexor muscle strength will produce effective and efficient movements in performing skill techniques in volleyball by providing active stabilization of the ankles and knees from the plantar flection motion. This is based on a component of the skills formed by the presence of good muscle strength (Young et al al, 2002). To measure the ability or strength of the plantar flexor muscle, measurements can be done by carrying out a bilateral heel raise test (HRT) (Monteiro et al, 2016; Mock et al, 2018) with the addition of maximum external load (1RM) (Verdjik et al, 2008).

Beside from muscle strength, the development of functional abilities of the plantar flexor muscle is endurance. The role of plantar flexor muscle endurance is very important to be able to maintain the condition of the body when playing optimally. This is due to the ability of the plantar flexor muscle endurance to hold back how long the muscle strength can move continuously without pause by providing ability or skills in leg movements The specific skill is the body's skill to move fast and change direction quickly in an efficient and effective pattern. So that in volleyball players plantar flexor muscle strength and endurance and agility skills is a must-have requirement. To find out the endurance ability of plantar flexor muscles, the measuring instrument used was the calf raises test.

Of the various skills needed by players, agility skills include the skills that must be possessed by each player to produce good performance in the field. Agility skills are often interpreted as individual skills to be able to change direction quickly and precisely and without losing balance. On the other hand comprehensively, agility skills must also consider the physical needs, cognitive processes and motor learning and technical abilities (bio mechanics) involved (Sheppard and Young, 2006). This agility skill can be measured using a valid and reliable measure, the Hexagonal Obstacle Test (McCormick, 2014; Sabin and Alexandru, 2015).

Therefore, an observation is needed in order to obtain data from the subject directly and clearly to find out how much the relationship between ankle stability, muscle strength and endurance of the lower limbs, especially in volleyball players at volleyball students activity Esa Unggul University. Observation also illustrates everything related to the object of research, drawing conclusions compiled into a report so that it becomes more relevant.

2 METHODS

The study was conducted descriptively with a quantitative approach that was included in the research analysis. Quantitative research is research that focuses on analysis of numerical data that is processed using statistical tests. This research is a correlation study conducted to determine the relationship between two variables, ankle stability as measured by a single leg balance test, plantar flexor muscle strength as measure-ed by 1RM heel raise test and plantar flexor muscle endurance as measured by calf raise test for agility skills measured by the hexagonal obstacle test on volleyball players at volleyball students activity Esa Unggul University. In this study it is expected that there is a match between the methods used by resear-chers with the goals to be achieved by researchers.

The population in this study were all volleyball players at volleyball students activity Esa Unggul University. Based on field surveys it is known that the total population of ± 20 people. As for the sampling by means of purposive sampling where the samples taken will be representative if they are in accordance with predetermined sampling criteria. The number of samples in the study was determined using the Taro Yamane formula. Based on the formula used, the minimum number of samples taken is 17 people, but in this study a minimum sample of 18 people will be used. Criteria for acceptance of samples in this study include: (1) Volleyball players aged 18-25 years (2) Still and actively participating in training conducted by volleyball students activity Esa Unggul University for approximately 2 years of training (3) Signing informed consent. While the criteria for rejection of samples in this study include: (1) There are acute injuries and other musculoskeletal disorders in the upper limb such as subluxation, fractures and tendon injuries (2) There are acute injuries and other musculoskeletal disorders in the lower extremities such as meniscus tears and knee ligament injuries. (ACL, PCL, MCL, LCL),

sprained, or had a fracture. There are acute injuries and other musculoskeletal disorders in the upper limb such asubluxation, fractures and tendon injuries (2) There are acute injuries and other musculoskeletal disorders in the lower extremities such as meniscus tears and knee ligament injuries. (ACL, PCL, MCL, LCL), sprained, or had a fracture.

Data analysis was processed using the SPSS (Statistical Product and Service Solution) system. Analysis of the data used in this study include the normality test and hypothesis testing. Normality test to determine sample distribution. Test for normality using the Shaphiro-Wilk Test, with the provisions that $p > 0.05$ data are normally distributed and $p < 0.05$ data are not normally distributed. Hypothesis analyzed using Pearson Product Moment correlation test to determine the direction of the relationship between two variables. This test is carried out if the data is normally distributed. If the data is not normally distributed, a Spearman Rank Correlation Coefficient test will be performed. The test was carried out at a significance level (α value) of 0.05.

3 RESULT

3.1 Sample Characteristics

The sample characteristics in the study included gender, age, body weight, height, body mass index (BMI), leg length, leg circumference (thigh and leg), blood pressure, respiration rate and heart rate. Categorical data are presented in the form of proportions (percentages) and data in numerical form are presented in the form of mean, SD, median, minimum and maximum values. Presentation of research characteristic data can be seen in table 1.

Table 1: Sample Characteristics.

Characteristics	Result
Sex	
Male	50%
Female	50%
Age (years)	
Mean	19,61
SD	1,78
Median	19,50
Minimum	18
Maximum	23
Weight (kg)	
Mean	64,60
SD	11,22
Median	64,60
Minimum	49,00
Maximum	96,00
Height (cm)	
Mean	164,43
SD	7,99
Median	162,00
Minimum	152,00
Maximum	179,00
Body Mass Index (BMI)	
Mean	23,73
SD	3,63
Median	23,05
Minimum	19,00
Maximum	31,00
Leg Length (cm)	
Mean	86,74
SD	4,48
Median	85,75
Minimum	81,00
Maximum	98,00
Lingkar Otot (cm)	
Thight	
Mean	49,96
SD	5,91
Median	49,73
Minimum	42,00
Maximum	64,00
Leg	
Mean	36,45
SD	2,97
Median	35,75
Minimum	32,00
Maximum	42,00
Blood Pressure (BP) (mmHg)	
Mean	119,99/78,89
SD	9,38/9,63
Median	120,.00/75,00
Minimum	100,00/70,00
Maximum	130/90,00
Respiration Rate (RR) (x/menit)	
Mean	31,22
SD	6,51
Median	30,00
Minimum	24,00
Maximum	46,00
Heart Rate (HR) (x/menit)	
Mean	81,78
SD	13,01
Median	84,00
Minimum	60,00
Maximum	100,00

3.2 Data Prerequisites Test

Data normality test is needed to find out whether the data is normal or abnormal distribution. In addition, the normality test is also used to determine the type of statistics used in the research hypothesis. In this study the normality test was performed using the Shapiro-Wilk Test. Based on the results of data processing using SPSS 24.0, the test results are presented in table 2.

Table 2: Shapiro-Wilk Normality Test Results.

Variable	p	Interpretation
Ankle Stability Sinistra Dextra	0.543 0.521	Normal Normal
Plantar Flexor Muscle Strength	0.462	Normal
Plantar Flexor Muscle Endurance	0.117	Normal
Agility Skill	0.001	Abnormal

In testing the normality of research variable data, the results of data processing from the independent variable are ankle stability, plantar flexor muscle strength and endurance with p value of > 0.05 which means data were normally distributed. Meanwhile, the dependent variable, agility skills, also obtained a p value of 0.001, which means $p < 0.05$ or data not normally distributed. From the results in normality test, it can be concluded that the hypothesis test in this study is a non-parametric test using the Spearman-Rank correlation test.

3.3 Hypothesis Test

Hypothesis testing data analysis consists of correlation analysis with the aim of analyzing the meaning of the relationship between variables, the strength of the relationship between variables and the direction of the relationship between variables. In accordance with the conclusion of the normality test, in this study a non-parametric test with the Spearman-Rank correlation test with the terms of the hypothesis testing result H_o is rejected if the p value $< \alpha$ value (0.05) and H_o is accepted if the p value $> \alpha$ value (0.05). The hypothesis established on the relationship between ankle stability and agility skills were:

H_0 There is no correlation between ankle stability and agility skills in volleyball players at Volleyball Students Activity Unit of Esa Unggul University.

H_1 There is a correlation between ankle stability and agility skills in volleyball players at Volleyball Students Activity Unit of Esa Unggul University.

Furthermore, in the relationship between plantar flexor muscle strength variables and agility skills, the established hypothesis was:

H_0 There is no correlation between plantar flexor muscle strength and agility skills in volleyball players at Volleyball Students Activity Unit of Esa Unggul University.

H_1 There is a correlation between plantar flexor muscle strength and agility skills in volleyball players at Volleyball Students Activity Unit of Esa Unggul University.

In the following discussion the relationship between muscular endurance and agility skills have the following hypothesis:

H_0 There is no correlation between plantar flexor muscle endurance and agility skills in volleyball players at Volleyball Students Activity Unit of Esa Unggul University.

H_1 There is a correlation between plantar flexor muscle endurance and agility skills in volleyball players at Volleyball Students Activity Unit of Esa Unggul University.

The results of processing the hypothesis test data with the Spearman-Rank correlation test represented in table 3.

Table 3: Result of Spearman-Rank Correlation Test.

Agility Skill Score	
Ankle Stability Sinistra	r = -0.219 p = 0.383 n = 18
Dextra	r = -0.140 p =0.581 n = 18
Plantar Flexor Muscle Strength	r = 0,107 p = 0,673 n = 18
Plantar Flexor Muscle Endurance	r = -0.057 p = 0.824 n = 18

4 DISCUSS

4.1 Ankle Stability

The description of ankle stabilization in volleyball players in s volleyball students activity od Esa Unggul University, on dextra ankle has an average value of 54.64 seconds and an average of 56.88 seconds in the ankle sinistra. The results of observational data that have been carried out using this single leg balance test have passed the normal time that has been set, ie the average value between the ankle dextra and sinistra groups has passed 30 seconds for the normal time of individuals aged 18-49 years (Martin et al, 2013). But there is an average difference between the ankle dextra and ankle sinistra groups. The stabilization value of the ankle is greater, this can be due to the dominant ankle in the sample in UEU Volleyball SMEs.

In the International Foot and Ankle journal entitled "Influence of Age, Body Mass Index and Leg Dominance of Functional Ankle Stability", this journal explains that for the dominant group of the right leg has better results on the left leg when doing single leg stance and vice versa, on the left leg group the single leg stance results are better on the right leg. One reason that has been presented in this journal is that the non-dominant leg has a postural function in daily life, which might lead to better postural balance and stabilization.

4.2 Plantar Flexor Muscle Strength

The description of the plantar flexor muscle strength of the sample has an average value of 24.18 kg, there are mean differences between male and female groups where the mean value of the plantar flexor muscle strength of the male group is greater, namely 26, 22 kg compared with a group of women weighing 22.44 kg. The 1RM load obtained from observational data with the 1RM Heels Raise Test reveals that the strength of the plantar flexor muscle is still insufficient to a predetermined standard where 1RM load removal is adjusted and calculated by submaximal load or 50% sample weight distribution. This can be caused by various factors such as weight training experience or sample muscular composition (Rosemary et al, 2011; Kathleen et al, 2014).

According to the type of measuring device, 1RM is used for athletes or players at the beginning of the training season to find out the maximum dynamic training load (maximal strength) along with the progress of the training. At the beginning of the measurement, the value or result is relatively low compared to the initial load that should be used because the nervous system cannot withstand the pressure or resistance with heavy loads. The theory is in accordance with the ability of muscles called muscle memory where recent evidence identifies an increase in morphological adaptation for weight training can be seen for 7 weeks, thereafter and the detraining phase (Seaborn et al, 2018).

4.3 Plantar Flexor Muscle Endurance

Plantar flexor muscle endurance samples of volleyball players at Esa Unggul University obtained an average value of 22.22 x / 30 seconds. From 9 male and 9 female samples, the average value of endurance is normal, for the endurance of 9 male samples is 23.88 x / 30 seconds, while for 9 female samples is 20.55 x / 30 seconds. In the observational data obtained in the field with the Calf Raises Test measuring instrument has reached the standard of good value, wherein seen from the research literature generally set a value of 25 as a normal target for good subjects (Amy D. Sman, 2014).

Measurement of endurance aims to see how much a person's ability to do repetitive movements without significant fatigue so that in volleyball players need endurance when the game is in progress because there are movements such as jumping, landing, and footwork which are repetitive movements. Calf Raises Test is used to find out how well the player is able to raise and lower the heel. On the measurement of the Calf Raises Test the sample is able to make stable heel movements with normal values or results. Therefore, sufficient plantarflection endurance is very important for basic mobility, such as walking and running (Amy D. Sman, 2014).

4.4 Agility Skill

The picture of agility skill or volleyball player in UKM Volleyball University of Esa Unggul has an average value of 21.93 seconds. Based on sex, an average value of 19.13 seconds was obtained in the male group and 24.72 seconds in the female group. Data taken based on measurements with the Hexagonal Obstacle Test revealed that overall the value of the volleyball player's skill skill was in the weak category (Widiastuti, 2015). This phenomenon can be caused by various factors according to its supporting components such as cognitive, technical and physical quality of the sample.

Based on the findings in the field, the sample has a BMI level with overweight category, this condition can result in additional loading when carrying out a

process of movement or special activities such as agility skills causing low performance and ultimately decreasing the level of individual skill agility. This is supported by the results of research by Dhapola et al (2017) where there is a significant relationship between BMI and agility skills (r = 0.543; p <0.05). The findings of other sample data processing results also revealed that there was a significant value between the lengths of the legs with the level of agility of the sample skills with r = -0.503 and p <0.05. These findings state that the longer the leg will be followed by a longer range of steps so that the time needed to cover a certain distance will be shorter, in other words the travel time will be faster and the energy expended will be less and ultimately increase the ability of agility skills in individuals (Putri, 2016; Lyle et al, 2015).

4.5 Correlation between Ankle Stability and Agility Skill

Based on the hypothesis test used using Rank-Correlation Coefficient obtained the relationship between ankle stabilization and skill dexterity has no insignificant relationship (p> 0.05) with the value of the relationship between dextra and sinistra ankle stabilization. As well as the negative direction of change, where it worsens the ankle, the less or faster the time needed for the individual to execute the agility of his skills.

The results of this study found that ankle stabilization does not affect the agility skill, where the ability of the sample agility into the weak category so that it results in an insignificant correlation between ankle stabilization and agility skill. This could be due to the relatively large value of the sample skill agility, which means that the poor or poor ability of the sample agility. Stabilization of volleyball players serves to ensure that the feet, ankles and toes function properly and are not only important for injury prevention, but also to maximize speed, mobility, agility, strength, power production and explosions (Seedman, 2015). Ankle stability is not the only component needed by the agility skill, the agility skill component is a multifactorial component which is influenced by cognitive, technical ability and physical quality. 2017).

4.6 Correlation between Plantar Flexor Muscle Strength and Agility Skill

Based on the Spearman-Rank correlation hypothesis test results show that the relationship between plantar flexor muscle strength variables and agility skills has an insignificant relationship (p> 0.05) which means that plantar flexor muscle strength (maximal strength) does not affect the ability of agility skills in volleyball players. In addition, the results of data processing get the strength of the relationship strength in a very weak category with a positive correlation direction (r = 0.107) where it is interpreted that the higher the strength of the plantar flexor muscle the longer the time it takes for someone to execute individual skill agility. This is like the findings by Cornie et al (2010) where an increase in body mass obtained through strength training will increase cross-sectional areas and hypertrophy. This finding indicates that muscle strength does not have a strong relationship with overall performance of agility skills, the amount of strength capacity needed to carry out movement, and is aided by anthropometric characters that positively affect performance.

From the findings of this study, the strength of plantar flexor muscle that does not affect the agility skill can be caused by the agility skill of the sample which is low enough so that to assess one of its components, namely the quality of leg muscle strength especially in plantar flexor muscle does not get significant results. The results of this study are supported by the findings of Chaouachi (2009) about the relationship of maximum dynamic strength with agility skills to get similar results (r = 0.18, p = 0.29) besides that the results of Penailillio (2016) results that do not have that relationship can be caused by the low coordination of players compared to their strengths. So that agility skills can be considered as physiological variables which may be more dependent on the performance of the neuromuscular coordinating aspects.

4.7 Correlation between Plantar Flexor Muscle Endurance and Agility Skill

Based on the Spearman-Rank correlation hypothesis test results show that the relationship between endurance variables of plantar flexor muscle with agility skill does not have a significant relationship (p> 0.05) which means that endurance of plantar flexor muscle does not affect the ability of agility skills to the sample. the results of data processing get a relationship value with a very weak category with a negative correlation direction (r = -0.057) where it is interpreted that the higher the endurance of the plantar flexor muscle the longer the time required for someone to have agility skills.

From these findings the endurance of plantar flexor muscle cannot influence the agility skill due to the low number of samples studied and the

acquisition of small sample agility skills because the interpretation of the correlation test is always related to the number of samples used to see the direction of the relationship between the two variables measured. Furthermore, agility skills are seen as the ability to change direction quickly, without losing balance, using neuromuscular power and coordination. In volleyball games, it takes reaction speed to make movements quickly, so agility skills are needed in changing positions or direction of body movements quickly when is moving fast without the desired balance or awareness of body position.

5 CONCLUSION

Based on the results of the research and discussion above, it is concluded that there are no relationship between ankle stabilization, strength and endurance of plantarflexor muscles (maximal strength) to agility skills in volleyball players at volleyball students activity Esa Unggul University. This study also suggests the need for further research on aspects other than physical quality that affect agility skills and other variables, especially in volleyball players in both the beginner and athlete groups.

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