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THE RELATIONSHIP BETWEEN ABDOMINAL MUSCLE STRENGTH AND LIMB MUSCLE EXPLOSIVENESS TO THE *SMASH* ABILITY OF VOLLEYBALL UNIT MEMBERS MUHAMMADIYAH UNIVERSITY OF SURAKARTA

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Abstract

This study aims to determine the relationship between abdominal muscle strength and leg muscle explosive power with volleyball smash ability. The population in this study was all 20 members of the volleyball unit UMS who found 20 people. The data was collected using the sit-up test to measure the strength of the strength and the vertical jump test to measure the explosive power of the leg muscles, performing the smash accuracy test 3 times in a row. The results of data analysis show that:(1) Abdominal muscle strength has a relationship with smash ability of 0.855 and $r_{\_count\ (20;\ 0.05)} = 0.456$ while $r_{\_count\ (20;\ 0.01)} = 0.575$ it can be concluded that the correlation ability of 58.5%. (2) abdominal muscle strength has a relationship with the ability to smash, the value of $r_{\_count}$ is 0.366 and $r_{\_count\ (20\ ;\ 0.05)}$) is0.456 while $r_{\_count\ (20\ ;\ 0.01)}$ is 0.575. it can be concluded that the correlation coefficient is 36.6% (3) abdominal muscle strength and leg explosive power have a relationship with volleyball smash ability, the value of r_count is 0.462 and $r_{\_count\ (20;\ 0.05)}$ is 0.456 while $r_{\_count\ (20;0.01)}$ is 0.575. it can be concluded that the correlation coefficient is significant at 45.6%.

Keywords: *Abdominal Muscle Strength, Limb Muscle Explosive Power, Smash Ability, Volleyball*.

INTRODUCTION

Volleyball is one of the most popular sports around the world, especially in Indonesia volleyball is becoming a new prima donna whose fans are pretty much just losing to football and better than basketball. In volleyball itself there is a parent organization, according to (Sistiasih, Vera Septi; Nurhidayat; Sudarmanto, 2019)among them is FIVB which is a body that is in the field of sports volleyball globally / internationally around the world, while the parent volleyball in Asia is AVC, in Indonesia itself bad sheltered is PBVSI (Volleyball Association of All Indonesia). Volleyball matches or competitions have been running a lot such as the World Cup, Asian Cup, and Proliga to inter-Village / Tournaments that are very popular with the people of Indonesia. The achievement of volleyball in Indonesia is increasing every year to be able to compete at the global level, it also affects the public's interest in the sport of volleyball increasingly passionate. In volleyball itself has a variety of basic techniques in the game, *service, passing, blocking,* and *smash* is a basic technical game from volleyball (Sistiasih, Vera Septi ; Nurhidayat, ; Sudarmanto, 2019). Researchers see in volleyball matches not only the question of technique and tactics but also the physical aspects. According to (Setiyono et al., 2019) In addition to the technical skills itself is also very much in need of high vertical *jump* ability to support the game to get points and win matches either through attacks or *smashes,* or *blocks.* A person's ability to perform a good *vertical jump* is greatly influenced by the strength of the limb muscles as well as the explosiveness of the limb muscles (Aouadi et al., 2012; Charlton et al., 2017; Martinez, 2017; Sheppard et al., 2008).

UMS Volleyball Unit is one of the student activity units at Muhammadiyah University of Surakarta, an organization that belongs to the category of sports interests followed by active students who have an interest and talent in the sport of volleyball. Volleyball Unit held regular practice as much as 3x in 1 week, namely every Monday, Wednesday and Friday every 18.00-finish, each exercise is divided into 2 sessions, namely the category of students (male) and students (female), at each exercise accompanied by coaches and coaches who will guide and direct.

The appearance of a group of limb muscles to produce work in a very fast time is the definition of power limb muscle explosion (Setiyono et al., 2019); (Fachrezzy et al., 2020; Uzizatun Maslikah et al., 2021) (Fatoni et al., 2021; Jariono et al., 2021; Jariono, Nursubekti, et al., 2020; Nugroho et al., 2021); (Nugroho et al., 2021). Equalmuscle strength is the ability to develop maximum strength to overcome resistance or load with maximum contraction (Argantos, 2017); (Jariono, Fachrezzy, et al., 2020). In knowing the explosiveness of the limb muscles used is the vertical jump *test.* It is a measuring board that is measuring centimeters, dark in color, measuring 30 x 150 cm mounted on a flat wall. The distance between zero on the scale and the floor is 150 cm. (Villalon-Gasch et al., 2020). As for knowing the ability of the abdominal muscles used is a test sit *up* 1 minute, is a test used to measure the ability of the abdominal muscles that are done for 1 minute and how many sit-ups obtained will be recorded (Argantos, 2017). The last is a *smash test,* this *test* used is as a test of accuracy by dividing 1 field of the field into several parts that each have a score that has been divided and determined by 3 repetitions. Researchers hope with this study to be able to know the explosiveness of the limb muscles measured by the *vertical jump test* and the strength of abdominal muscles members of the Volleyball Unit of Muhammadiyah University of Surakarta. Hopefully this research can be a reference and reference from various parties in making a training program that will have a good impact on the achievements of the Volleyball Unit of Muhammadiyah University of Surakarta..

METHOD

The type of research that will be conducted is collation research, According to (Dr. Riduwan, M.Pd., 2019) correlation research is "research to find out whether or not there is a relationship between two or more variables and expressed in the form of correlation coefficients". The free variables are the explosiveness of the limb muscles and the strength of the abdominal muscles, while the bound variable is the precision of the *smash* in the sport of volleyball. Furthermore, this research was conducted at Voltra Trowangsan Volleyball Court, Malangjiwan, province Central Java, and the research time was conducted on May 28, 2021.

The population of the study in this study was a member of the Volleyball UMS Unit as much as 20 or total *sampling* (Dr. Riduwan, M.Pd., 2019) said that total *sampling* is a sampling technique when all members of the population are used as samples. Furthermore, the data collection instrument used in this research the first is a sit-up *test* for 1 minute to measure the strength of the limb muscles, a

vertical jump test to measure the explosiveness of the limb muscles, and the last is a test of precision *smash.*

In this study, researchers conducted a Normality Test with statistical analysis saphirowilk *test* with a value of p > 0.05 then the data is normally distributed. Next Test variance homogeneity to find out whether or not uniform variations of samples taken from the research population. The latter uses the Hypothesis Test to find out if there is an influence and relationship of X_1 to Y, X_2 to Y, and the last X_1, X_2 to Y.

RESULTS AND DISCUSSION

The research took place at Voltra Trawangan volleyball court, Malangjiwan, colorado on Friday, May 28, 2021. The samples in this study are 20 members of UMS Volleyball Unit which will be conducted Abdominal Muscle Strength Test (X1), Limb Muscle Strength Test (X2), and Smash Accuracy Test (Y).

Table 1 Summary of descriptive analysis results of research data

Statistics	Variable		
	Abdominal Muscle Strength (X_1)	Limb Muscle Explosiveness (X_2)	Smash capability (Y)
Number of samples	20	20	20
Mean	42.35	62.35	7.50
Std. Deviation	3.573	8.964	2.705
Range	14	35	10
Minimum	36	45	4
Maximum	50	80	14
Sum	847	1247	150

Based on the data of the results of the study, *smash* ability (Y), from 20 samples in the know the average value is 7.50, For Standard Deviation 2705, obtained a value of *range* 10 from the difference of *minimal* value*s* 4 and value *maximum* 14 and obtained a total value of 150. Then from the data of abdominal muscle strength research (X_1), from 20 samples obtained an average value of 42.35, For Standard Deviation 3573, the *range* value of 14 from the difference between the *minimum* value 36 and *maximum* value 50 and obtained a total value of 847. The last data of auto limb explosive power research (X_2), from 20 samples obtained an average value of 62.35, For Standard Deviation 8964, a *range* value of 35 from the difference between the *minimum* value of 45 and a *maximum* value of 80 and obtained a total value of 1247

Table 2 Normality Test

	Abdominal Muscle Strength (X_1)	Limb muscle explosiveness (X_2)	Smash capability (Y)
N	20	20	20
Kolmogorov-Smirnov Z	.139	.121	.172
Asymp. Sig. (2-tailed)	.200c,d	.200c,d	.122c

Based on table 2 the results of the data normality test can be described as follows;

1) In the *smash* capability data normality test, from 20 samples obtained the value KS-Z = 0.172 probability level = 0.122 and greater than the value of 0.05 or at a significant level of 95%. With these results, the α *smash* capability obtained is normally distributed.
2) In the normality test of abdominal muscle strength data, from 20 samples obtained KS-Z value = 0.139 probability level = 0.200 and greater than the value of 0.05 or at a significant level of 95%. With these results the abdominal muscle strength data obtained is normally distributed;α
3) In the normality test of *limb muscle explosiveness* data, from 20 samples obtained the value KZ-S = 0.121 probability level = 0.200 and greater than the value of α0.05 or at a significant level of 95%. With these results, the balance data is obtained at normal distribution.

Furthermore, analysis is performed to find out the relationship of each free variable with a bound variable. Analysis regression (R) at a significant level of 95% or 0.05 is used forα analysis correlation. The goal is to know the relationship together with the explosiveness of the limb muscles as well as the strength of the abdominal muscles with the smash ability of members of the UMS Volleyball Unit. Here is the result from the calculation of the statistical research hypothesis:

Table 3 Test results of significance and linearity of Y regression over X_1
$\hat{Y}$ = -11,270 + 0.443 X_1

Type		Unstandardized Coefficients		Standardized Coefficients
		B	Std. Error	Beta
1	(Constant)	-11.270	6.147	
	Abdominal muscle strength (X1)	.443	.145	.585

Analysis of the coefficient of regression obtained value $\hat{Y}$= -11,270 + 0.443 X_1 can be stated that each increase in the average score of abdominal muscle strength of 0.443 units will be followed by Constanta volleyball smash ability of -11,270. The constant value of -11,270 regression equation above is a fixed value, which means that if the abdominal muscle strength variable is worth 0.443 then the *smash* capability has a value of 0.443. Furthermore, a positive regression coefficient (0.585) means that there is a direct proportional influence between the strength of the abdominal muscles and *the smash* ability. This means that any increase in one abdominal muscle strength score will also be followed by a volley *smash* ability score of 0.585 at -11,270.

Table 4 tests the significance of the relationship of abdominal muscle strength with *the smash* ability test

Sample number (n)	r_{-count}	r_{-table}	
		0,05	0,01
20	0,585	0,456	0,575

Based on the analysis correlation coefficient above obtained a value of $r_{\_count}$ of 0.585 and $r_{\_count\ (20;\ 0.05)}$ of 0.456 while $r_{\_count\ (20;\ 0.01)}$ 0.575 Based on that result, it can be concluded that the correlation coefficient between abdominal muscle strength and significant *smash* capability.

Table 5 Test results of significance and linearity of Y regression over X_2
$\hat{Y} = 0.618 + 0.366\ X_2$

Type		Unstandardized Coefficients		Standardized Coefficients
		B	Std. Error	Beta
1	(Constant)	.618	4.168	
	Limb muscle explosiveness (X1)	.110	.066	.366

Based on the results of the analysis of the regression coefficient above obtained value $\hat{Y}$= 0.618 + 0.110 X_2 can be stated that each increase in the average score of limb muscle explosiveness of 0.110 units will be followed by a volleyball *smash* capability of 0.618. Constanta value of 0.618 in the above regression equation is a fixed value, which means that if the balance variable is worth 0.110 then the *smash* capability has a value of 0.110 Furthermore the regression coefficient positive value (0.366) means that there is a direct influence between the explosiveness of the limb muscles and the ability to *smash* volleyball. This means that each increase in one limb muscle explosiveness score will be followed by a volleyball *smash* ability score of 0.110 at 0.618.

Table 6 test the significance of the relationship between limb muscle explosiveness and *smash* capability

Number of samples (n)	$r_{\text{-count}}$	$r_{\text{-table}}$	
		0,05	0,01
20	0,366	0,456	0,575

From the result of analysis correlation coefficient above obtained value of $r_{\_count}$ of 0.366 and $r_{\_count(20\ ;\ 0.05)}$ of 0.456 while $r_{\_count(20\ ;\ 0.01)}$ 0.575. Based on these results, it can be concluded that the correlation coefficient between the explosiveness of the limb muscles and the ability to *smash*. Thus the hypothesis that exists of a link between the explosiveness of the limb muscles and the *smash* ability of members of the UMS Volleyball Unit is accepted. Or it can also be concluded that the higher the explosiveness of the limb muscles, the better the ability to *smash* volleyball. To know the level of relationship used guidelines for interpretation of correlation coefficients in (Sugiyono, 2017) between the explosiveness of limb muscles with *smash* ability of 0.366 in the interpretation of correlation coefficients in the high category. This value is in the interval class between 0.20 – 0.399 It shows a low relationship between the explosiveness of the limb muscles and the *smash* ability. While the significant level of one-sided correlation confession (1-tailed) of *the output* is *measured* from probability resulting

in a significance value of 0.000. Because the probability is below α 0.05, between the explosiveness of the limb muscles and the ability to *smash* significantly.

Table 7 Test results of significance and linearity of Y regression over X_1 and X_2
$\hat{Y}$= -17,378+ 0.434 X_1 + 0.104 X_2

Type		Unstandardized Coefficients		Standardized Coefficients
		B	Std. Error	Beta
1	(Constant)	-17.378	6.531	
	Abdominal Muscle Strength X1	.434	.135	.573
	X2 limb muscle explosiveness	.104	.054	.345

Based on the results of the analysis of the regression coefficient above obtained the value of $\hat{Y}$= -17.378+ 0.434 X_1 + 0.104 X_2 can be explained that each the average increase in the abdominal muscle strength score of 0.434 for the limb explosiveness score of 0.104 units means that it will be followed by a *smash* capability of -17,378. The Constanta value of -17,378 in the above regression equation is a fixed value, giving the meaning that if the abdominal muscle strength variable is worth 0.434, the leg muscle strength score is worth 0.104 then the *smash* capability has a tilapia of -17,378. Furthermore, a positive regression coefficient (0.462) thus means that there is a direct proportional influence between the strong relationship of the abdominal muscles of the limbs, with the ability to *smash* volleyball. which means that each increase in one abdominal muscle strength of the limb muscle explosiveness score, will be followed by an increase in the volleyball *smash* ability score of 0.462 at -17,378.

Table 8 test the significance of the relationship between abdominal muscle strength, limb muscle explosiveness with *smash* capability

Sample number (n)	r_{-count}	r_{-table}	
		0,05	0,01
20	0,462	0,456	0,575

Based on the analysis of correlation coefficients above obtained $r_{\_count}$ value of 0.462 and $r_{\_count\ (20;\ 0.05)}$ of 0.456 while $r_{\_count\ (20\ ;\ 0.01)}$ 0.575. Then it can be concluded that the correlation coefficient between the strength of the abdominal muscles and the explosiveness of the limbs, with the ability to *smash* volleyball, is significant. Thus it can be concluded that the hypothesis exists jointly - the relationship between the strength of the abdominal muscles and the explosiveness of the limbs, with the ability to *smash* volleyball UMS Volleyball Unit Members accepted. Or in other words the higher the strength of the abdominal muscles and the explosiveness of the limb muscles the better the ability to *smash* volleyball

Based on the results of the first hypothesis testing it is explained that "there is a relationship of abdominal muscle strength with the ability to *smash* volleyball members of the UMS Volleyball Unit". This is evidenced by the results of the analysis with a correlation value (r) of 0.585 probability level of 0.000 < 0.05 described by the regression equation α -11.279 + 0.5443 X_1. Based on the result it appears

that the strength of the abdominal muscles is an important component of the body for the ability to *smash* volleyball. Here the strength of the abdominal muscles in the hypothesis test shows a value that indicates that the strength of the abdominal muscles has an influence that is in the moderate category of smash *ability*. Thus it can be said that the strength of the abdominal muscles has a role also in the ability to *smash* volleyball players, although in this study the influence is not significant. This can be due to various influences such as the condition of the player's fitness, the condition of the field, and so on. Can be seen from the results of the sit-up *test* that shows that most of the objects have abdominal muscle strength that is good enough and above the minimum limit, although at the time of the test *smash* many of them are not maximal at the time of doing.

Based on the results of the second hypothesis test can be explained that "the influence of limb muscle explosiveness with the ability to *smash* volleyball members of the UMS Volleyball Unit". It is known from the results of the analysis obtained correlation value (r) 0.366 with a probability rate of $0.000 < 0.05$ αdescribed through the regression equation $=\hat{Y}$ $0.618 + 0.110\ X_2$. Based on this result it can be known that the explosiveness of limb muscles is an important component of the body so that the ability to *smash* volleyball can be done properly and correctly. These results indicate that to increase the explosiveness of the limb muscles with volleyball *smash* ability, it must have an indicator of increased limb muscle explosiveness that supports the occurrence of contractions to the maximum in producing a high *vertical jump* and can improve the ability of *volleyball smash.* Based on the results in this study shows the relationship of limb explosive power by producing a high *vertical jump* that can increase the ability of *smash*, becoming a reference in improving *vertical jump* that *encourages smash* ability.

Based on the results of the third hypothesis test can be known that "the relationship of abdominal muscle strength, limb muscle explosiveness with the test of volleyball *smash* ability of members of the UMS Volleyball Unit. " It is known from the results of the analysis obtained correlation value (r) of 0.462 with a probability level of $0.000< 0.05$ is explained through the equation of regression value $\alpha Y = -17.378+ 0.434\ X_1 + 0.104\ X_2$ These results show that the strength of the abdominal muscles and the explosiveness of the limb muscles are important body components so that the ability to *smash* volleyball can be done well. Here the influence of abdominal muscle strength and limb muscle explosiveness is in the moderate category based on the norms of the table presented by Sugiyono, thus from the results of this study can be said that there is still an influence of abdominal muscle strength and limb muscle explosiveness on the ability to *smash* although not significant.

A volleyball game is a game played by 2 teams, each team consisting of 6 people or players. The volleyball court is rectangular with a length of 18 meters and a width of 9 meters. Both sides of the field or midpoint are separated by a net that has a measure of 2.43 for men and 2.24 for women (Sistiasih, Vera Septi; Nurhidayat, Sudarmanto, 2019). Volleyball is a game played by 6 (six) people in 1 team each team tries to play as well as possible and can attack, turn the ball off to the opponent's

area and defend in their field area". Thus it can be interpreted that players in a squad must be able to attack to get numbers and defend in their area.

Smash is one of the techniques in volleyball that is the most widely used form of attack to attack to score a team in a volleyball game (Sistiasih, Vera Septi; Nurhidayat, Sudarmanto, 2019) Of some of the above types of smashes, then in this study only done is a normal *smash* (*open smash*). This means that the way to play the ball efficiently and effectively following the rules of the game to achieve a typically deadly hard hit to the opponent's area is by using a normal smash (open smash).

The explosiveness of the limb muscles can be defined as the ability of a group of limb muscles to produce work in a very fast time. Limb explosiveness is the ability of muscles to cope with loads or prisoners at very high contraction speeds (Yulifri et al., 2018); (Cormie et al., 2011; Cronin &Hansen, 2005; João et al., 2010; Saddle, 2019; Sheppard et al., 2008; Subekti et al., 2021; Vanhatalo et al., 2011). Muscle strength is the ability to develop maximum power in maximum contraction to overcome prisoners or loads (Argantos, 2017); (Aytar et al., 2012; Cronin &Hansen, 2005; De Salles et al., 2009; Häkkinen et al., 2003; Pereira et al., 2015; Sahlberg et al., 2008).

CONCLUSION

Based on the results of data analysis, description, testing of research results, and discussion can be concluded are: (1) From the results of the hypothesis test there is a relationship of abdominal muscle strength to the ability of volleyball *smash* with signification 0.585. (2) From the hypothetical test results there is a relationship of limb muscle explosiveness to the ability of volleyball *smash* with signification 0.366. (3) From the hypothetical test results there is a relationship of abdominal muscle strength and limb muscle explosiveness to volleyball *smash* ability with a signification of 0.462.

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