

The Relationship of VO2 Max Levels, Flexibility, Arm Power and Speed of Acceleration with the Softball Skills of Male Athletes Palopo City, South Sulawesi

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ABSTRACT

Analysis of VO2 Max level, flexibility, arm power and acceleration speed on the skills of male softball athletes in the city of Palopo, South Sulawesi. Thesis. Physical and Sports Education Study Program, Makassar State University Postgraduate. This study aims to determine the relationship between VO2 Max, flexibility, arm power and acceleration speed on the skills of male athletes in the city of Palopo. This study uses correlational research. The population of this study was 20 softball athletes from the city of Palopo. The research sample is 20 Palopo City softball athletes. The data analysis technique used is the inferential test on the regression test statistic. The results of the study show that 1) There is a sufficient and significant relationship between VO2 Max and the skills of male softball athletes in the city of Palopo. 2) There is a strong and significant relationship between flexibility and the skills of male athletes from the city of Palopo. 3) There is a strong and significant relationship between arm power and the skills of the Palopo City male athletes. 4) There is a sufficient and significant relationship between the speed of acceleration and the skills of the Palopo City male athletes.

Keywords: VO2 Max; Flexibility; Arm Power; Acceleration Speed; Athlete's Skills.

INTRODUCTION

Sports are all systematic activities to encourage, foster, and develop physical and social potential, including covering sports achievements (Cahyono et al., 2021). Achievement sports are sports that nurture and develop athletes (athletes) regularly, tiered and continuously through competition to achieve achievements with the support of endurance science and sports technology (Nizar Zulmi, Supriyono, 2012). The Indonesian National Sports Coaching System is carried out with a tiered coaching system (Judge et

al., 2022). Recreational sports and educational sports are a strong foundation for building national sports achievements (Widowati, 2015). Efforts to make sports activities become a culture, pattern or lifestyle and are carried out by most people is a job that is not easy (Sinurat & Rahayu, 2019). Indonesia's sports coaching system can be described as a pyramid (Bahtiar, 2022). Referring to the part of the pyramid system, sports achievements are positioned as the pinnacle of the sports achievement processing system in Indonesia (Sahabuddin, 2017). Sports coaching must be done with management or management is something that cannot be separated from an activity that is generally stratified with the functions of planning, organizing, controlling, and supervising (Wijaya, 2021).

Softball sports have been developed in Palopo City, this is evidenced by the existence of Perbasi (All-Indonesia Amateur Baseball and Softball Association) Palopo City, and Palopo City softball male athletes and universities that have softball courses such as UMP (University of Muhammadiyah Palopo). Softball also competes in PORDA XVI activities. On October 22-30, 2022, PORPROV XVII (Provincial Sports Week) also held a Men's softball championship in the City/Regency and was attended by Palopo City. In softball games, teams that hit more (hit) are teams that get points and have the potential to win, besides that teams that make many mistakes/errors can result in defeat.

Basic softball techniques are the basis that must be mastered by every player (Rybert, 2010; Nurbiantoro, 2018). The game of softball will be interesting if the players master the basic techniques of the game of softball (Tuti Lestari, 2012; N. D. Nugroho et al., 2018). The skills that must be possessed include throwing the ball, catching the ball, hitting techniques, running techniques to the base, and sliding techniques (Rihatno & Gunawan, 2014; Sopyan, 2018). Therefore, a softball player needs to be able to master basic softball techniques (Fitriyanto, 2014), because the ability of a softball player to master the basic techniques of softball games (Yudha, 2017) will support his performance both individually and in groups (teams) (K. A. Nugroho, 2013; Rahman & Yusmawati, 2018). Athletes are required to have excellent physical conditions in their daily lives in terms of strength, endurance, power, speed, flexibility, agility, coordination, balance, speed, and reaction action (Lestari, 2017). Primarily it is necessary to know the endurance of an athlete to identify the physical condition or fitness of an athlete (Saputro & Susilo, 2020), especially athletes in sports that demand a long duration such as football, basketball, softball, and so on (Rahmad, 2016; Juditya & Agusni, 2018).

There are two types of endurance, namely aerobic and anaerobic endurance, both of which synergize with each other (Sugiarto & Rahmatullah, 2019). As mentioned earlier,

precise (valid) measurements with the right tools are necessary, as well as measurements of endurance conditions or aerobic and anaerobic capacity in athletes (Mubarak & Ramadan, 2019). Maximal oxygen consumption (VO2 Max), is a form of aerobic endurance exercise which is the capacity of the heart and lungs to deliver oxygen to the muscles that are working (Pratama & Rismayanthi, 2018), in exercise activities, the Bleep test is a test that is often used to measure aerobic endurance (VO2 Max) because it has an easy procedure, the tools used are simple and in terms of low cost (Hutama & Yuliasrid, 2017).

Flexibility is the ability to perform movements easily, without limitations and free from pain (Aditia & Anam, 2022). Flexibility is the ability of muscle tissue to extend optimally so that the body can move with the full range of motion without pain or obstacles. In physical conditions, flexibility is basic because every form of physical condition requires flexibility (Anggara & Bakti, 2018). Arm power is the most dominant physical attribute required in softball. Most softball skills depend on the physical qualities of this in that the softball player has to move his body or parts of his body quickly so it requires strength and speed (Rizyanto et al., 2019). Arm power is required for throwing and hitting in softball games (Pattujui, 2019). Acceleration speed is also the most dominant attribute required in softball (Rahmat & Wahidah, 2022). Because playing softball requires speed in a certain time. Generally, acceleration is seen as the movement of an object that is getting faster or slower (Rahmat & Rohyana, 2020). But acceleration is a vector quantity, so acceleration has a magnitude and direction (Pradana, 2019).

In consideration of the need for accuracy of actual results from physical condition measurements, VO2 Max, flexibility, arm power as well as acceleration speed (Rauhe, 2022). But valid data from such tests in measuring VO2 Max, flexibility, arm power and acceleration speed remain to be proven (Dwi Ardian Fufu et al., 2021). Thus the game of softball requires physical condition (Aqobah et al., 2021), VO2 Max, flexibility, arm power also sufficient or good acceleration speed (Sudeaz, 2021). Because softball is a game that uses high and low intensity (Harahap et al., 2019). An athlete who has VO2 Max physical condition, flexibility, and arm power as well as good and high acceleration speed will affect softball game skills (Handoko et al., 2020).

METHOD

There are many types of problems in physical education and sports and each type of problem requires a different way of solving. In this study, correlational research is used research intended to determine whether there is a relationship between two or several

variables. Correlational research is a study that relates one or more independent variables with one dependent variable without any attempt to influence the variable. More complex forms of correlational research include multiple correlations, a data analysis technique used by inferential tests. Research design is a design or description that will be used as a reference in conducting a study. The research design can be seen in the following figure:

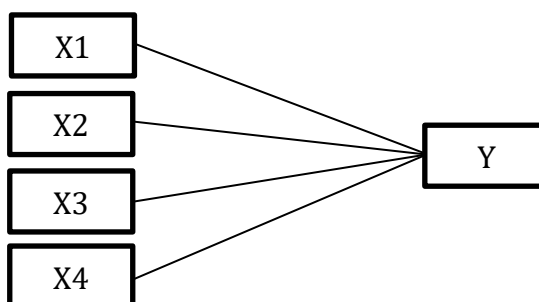


Figure 1.
Research design

The population in this study was all softball athletes in the city of Palopo. The sample is part of the number and characteristics possessed by the population. The sampling technique used is non-probability sampling, namely purposive sampling based on one particular consideration. The number of samples used in this study was 20 athletes. The sample was obtained by taking into account the following inclusion criteria: (1) male who was registered as a Palopo City softball athlete, (2) aged 16 years – 23 years, and (3) not sick.

Here is a table of score intervals and a standard table for scoring all types of tests performed.

Table 1.
General skills assessment interval

Score	Interval Class	Classification
5	$X \geq M + 1,5 \text{ SD}$	Very well
4	$M + 0,5 \text{ SD} \leq X < M + 1,5 \text{ SD}$	Good
3	$M - 0,5 \text{ SD} \leq X < M + 0,5 \text{ SD}$	Currently
2	$M - 0,5 \text{ SD} \leq X < M - 0,5 \text{ SD}$	Less
1	$X \geq M - 1,5 \text{ SD}$	Not good

After all the data is collected, the next step is to analyze the data, to determine whether there is a significant level between the independent variable and the dependent variable, a regression formula with a significant level of 95% is used. Data processing in research activities is one of the most important steps, especially in concluding the problem under study. For this reason, if all the necessary data has been collected, then the next step is to analyze the data from the results of the research that has been done.

Testing the linearity of data to determine the linear status of at least a distribution of research data. The results obtained through the linearity test will determine the analytical techniques to be used or not. If from the results of the linearity test, it is concluded that the distribution of research data is categorized as linear, regression analysis can be done. The data in this study is on an interval scale, so in the normality test using the compare means test, the criteria used are if the sig value in deviation from linearity > 0.05, then the distribution of data is said to be linear. To find out whether there is a relationship between the independent variable and the dependent variable, inferential statistical analysis is used using linear and multiple regression tests. The method used is to compare a significant value with a probability of 0.05. If the sig value < 0.05, then the data is said to have an effect. So the overall analysis data used generally uses computer analysis in the SPSS program version 22 with a significant level of 95% or $\alpha = 0.05$.

RESULTS AND DISCUSSION

Table 1.
Description of Research Data

Statistics	Sample	Mean	Median	Standard Deviation	Varians	Range	Min	Max
VO2 Max	20	37.10	37.10	3.05	9,34	9.7	32.1	41.8
Fleksibility	20	15.31	15.50	0.64	0.41	3.0	14.0	17.0
Arm Power	20	10.65	10.00	2.16	4.68	7.0	7.0	17.0
Acceleration Speed	20	14.96	15.00	1.27	1.62	5.0	12.0	17.0
Skills	20	9.35	9.50	2.27	5,18	8	6	14

Table 2.
Data Normality Test.

	Sample	Kolmogorov-Smirnov Z	Asymp. Sig. (2-tailed)
Vo2 max	20	171	128
Flexibility	20	175	108
Arm Power	20	169	137
Acceleration Speed	20	160	191
Skills	20	173	117

Table 3.
Significance and Linearity of Regression Y on X1

		Sum of Squares	df	Mean Square	F	Sig.
Between Groups	(Combined)	76,144	7	10,878	1,287	,334
	Linear	62,800	1	62,800	7,432	,018
	Term	13,344	6	2,224	,263	,944
Within Groups	Deviation	101,394	12	8,450		
Total		177,538	19			

Table 4.

The significance of the VO2 Max correlation coefficient on the skills of the Palopo City softball athletes

Number of Observations (n)	Koefisien Korelasi (r_{y1})	P-value	Sig
20	0.595	0,006**	0.05

Table 5.

Significance and Linearity of Regression Y over X2

	Sum of Squares	df	Mean Square	F	Sig.
Between (Combined)	5,359	7	,766	3,766	,022
Groups Linear Weighted	2,874	1	2,874	14,140	,003
Term Deviation	2,485	6	,414	2,037	,139
Within Groups	2,439	12	,203		
Total	7,798	19			

Table 6.

Significance of the Flexibility correlation coefficient on the Skills of the Palopo City softball athletes

Number of Observations (n)	Koefisien Korelasi (r_{y2})	P-value	Sig
20	0.607	0,005**	0.05

Table 7.

Significance and Linearity of Regression Y over X3

	Sum of Squares	df	Mean Square	F	Sig.
Between (Combined)	50,800	7	7,257	2,278	,101
Groups Linear Weighted	44,893	1	44,893	14,092	,003
Term Deviation	5,906	6	,984	,309	,920
Within Groups	38,230	12	3,186		
Total	89,030	19			

Table 8.

The significance of the arm power correlation coefficient on the skills of the Palopo City softball athletes

Number of Observations (n)	Koefisien Korelasi (r_{y3})	P-value	Sig
20	0.710	0,000**	0.05

Table 9.

Significance and Linearity of Regression Y over X4

	Sum of Squares	Df	Mean Square	F	Sig.
Between (Combined)	14,745	7	2,106	1,569	,235
Groups Linear Weighted	9,910	1	9,910	7,380	,019
Term Deviation	4,835	6	,806	,600	,726
Within Groups	16,114	12	1,343		
Total	30,859	19			

Table 10.

Test the significance of the acceleration speed correlation coefficient on the skills of male softball athletes in Palopo City

Number of Observations (n)	Koefisien Korelasi (r_{y4})	P-value	Sig
20	0.567	0,009**	0.05

Discussion

VO2 Max's relationship with Palopo City's male athletes' softball skills

From the results of testing the first hypothesis, it was found that VO2 Max has a relationship with the skills of Palopo City softball male athletes. Based on the calculation results, a correlation coefficient value of 0.595 is obtained which is explained through the regression equation $\hat{Y} = -7.129 + 0.443X_1$. This finding means that the higher the VO2 Max category, the better the skills of the softball male athlete, conversely, the lower the VO2 Max category, the lower the skill of the softball male athlete.

VO2 Max is the maximum volume of oxygen that a person can consume in a matter of one minute and is usually relevant to body mass Hermanto & Robianto, (2020,p.8). VO2 Max is a person's ability to use the heart, respiratory, and circulatory systems effectively and efficiently in carrying out work or exercise or competition for a vulnerable time. Therefore VO2 Max is a very decisive element in making movements in the game of softball because VO2 Max is needed to produce energy in carrying out longer motions. According to Cheng, et al in Hariyanti et al.,(2020,p.17) VO2 Max is a measure of the maximum amount of oxygen in millilitres of 1min/kilogram of body weight. If VO2 Max has a very good category, of course, when going to play softball will help the skills of softball male athletes, so it can be seen that there is an influence from various techniques and tactics in playing softball.

According to (Triansyah & Kushartanti, 2015, p 1569) VO2 Max's the ability to have levelled against decreasing lactic acid in the blood. In research Hanon, et, al (2010, p.237) concluded that VO2Max and speed of decline have positive levels of lactic acid concentration and bicarbonate in the blood. VO2Max is a measure often used in determining fitness and shows the average maximum energy generated by an aerobic energy system. VO2 max influences the body's ability to recover.

If VO2 Max is a concern for every softball player, it will physiologically encourage the skills of male softball athletes from before or more than those around them. VO2 Max is a must-have physical component, including supporting the skills of male softball athletes. These results suggest that to increase VO2 Max towards improving the skills of male

softball athletes, it must have an indicator of increased VO2 Max that supports the skills of male softball athletes. What has been produced in this study, which shows the level of VO2 Max on the skills of male softball athletes, is a reference in improving the skills of Palopo City softball male athletes.

The relationship of flexibility to the softball skills of Palopo City male athletes

From the results of testing the second hypothesis, it was found that flexibility has a relationship with the skills of Palopo City softball male athletes. Based on the calculation results, a correlation coefficient value of 0.607 is obtained which is explained through the regression equation $\hat{Y} = -23.693 + 2.158X_2$. This finding means that the better the flexibility, the better the skills of male softball athletes, conversely, the less good the measure of flexibility, the less good the skills of male softball athletes.

Flexibility is the ability to perform movement in the space of motion of the joint. People who have good flexibility will have a wide joint space, this will also have an impact on the quality of a skill (Harsono in Gunawan & Rusdiana, (2019, p.2). Based on this flexibility, a softball player can bring out his best abilities, including the skills of softball male athletes because good flexibility will certainly support the achievements of the players themselves. If flexibility is owned by players in softball games, it will certainly be graded to provide optimal results for the skills of softball male athletes, where flexibility helps flexibility and makes it easier to move freely. According to Sajoto in Rozikin & Hidayah (2015,p.33) Flexibility is a person's effectiveness in adjusting to carrying out all body activities with the widest extending, especially the muscles, and ligaments around the joints.

If flexibility is a consideration in the skills of male softball athletes, then compositionally flexibility will increase the skills of male softball athletes. Flexibility is one of the factors that sustain physical work related to physical condition in the components of good flexibility, including in the performance of softball male athletes' skills. What has been produced in this study, which shows the level of flexibility in the skills of male softball athletes, is a reference for improving the skills of Palopo City softball male athletes.

The relationship of arm power with the softball skills of Palopo City male athletes

From the results of testing the third hypothesis, it was found that arm power has a relationship with the skills of Palopo City softball male athletes. Based on the calculation results, a correlation coefficient value of 0.710 is obtained which is explained through the

regression equation $\hat{Y} = 1.390 + 0.747X_3$. This finding means that the higher the arm power category, the better the skills of male softball athletes, conversely the lower the arm power category, the skills of male softball athletes decrease.

Arm muscle strength is the ability of arm muscles to generate tension with resistance and lift weights (Harsono in Supriyanto & Martiani, (2019,p.75). Arm muscle strength is the ability to resist resistance carried out by contracting a group of muscles from the shoulder, the base of the arm, and the upper arm to the palm Rihatno & Tobing, (2019,p.4.). Arm power is a very decisive element in making movements in softball games because arm power is needed to produce power explosively.

Arm muscle strength is an important part because in softball playing techniques, arm muscle strength is a basic technique that softball athletes must have, judging from basic techniques such as throwing, catching and hitting require arm strength. If the arm power has a very good category, of course when going to play softball will help the skills of softball male athletes, so it can be seen that there is an influence of various techniques and tactics in playing softball.

If arm power is a concern for every softball player, it will physiologically encourage the skills of male softball athletes from before or more than those around them. Arm power is a physical component that must be possessed, including in supporting the skills of softball male athletes. These results suggest that to increase arm power towards improving the skills of male softball athletes, it must have an indicator of increased arm power that supports the skills of male softball athletes. What has been produced in this study, which shows the level of arm power on the skills of male softball athletes, is a reference in improving the skills of Palopo City softball male athletes.

The relationship of acceleration speed with the softball skills of Palopo City male athletes

From the results of testing the fourth hypothesis, it was found that the speed of acceleration has a relationship with the skills of Palopo City softball male athletes. Based on the calculation results, a correlation coefficient value of 0.567 is obtained which is explained through the regression equation $\hat{Y} = -5.807 + 1.013X_4$. This finding means that the higher the acceleration speed category, the better the skills of softball male athletes, conversely, the lower the acceleration speed category, the skills of softball male athletes decrease.

Speed is the ability to move or move from the body or limbs from one point to another or to perform the same and continuous repetitive activity in the shortest time in the Nala in Bagia, (2015,p97.). Acceleration speed is a very decisive element in making speed changes at a certain time because acceleration speed is needed to produce an increase in speed in making certain movements when carrying out an attack back time to defend. The acceleration speed has a very good category, of course, when going to play softball will help the skills of softball male athletes, so that there is an influence on playing softball. If speed acceleration is a concern for every softball player, it will physiologically encourage the skills of male softball athletes from before or more than those around them. Acceleration speed is a physical component that must be possessed, including in supporting the skills of softball male athletes in changing acceleration or accelerating at certain times.

These results suggest that to increase the speed of acceleration to improve the skills of male softball athletes, it must have an indicator of increased acceleration speed that supports the skills of male softball athletes. What has been produced in this study, which shows the level of acceleration speed in the skills of male softball athletes, is a reference for improving the skills of Palopo City softball male athletes.

The relationship of *VO2 Max* Flexibility Arm power and acceleration speed with the softball skills of Palopo City male athletes

What has been produced in this study, which shows a relationship between *VO2 Max* on the skills of male softball athletes, is a reference for improving the skills of Palopo City softball male athletes.

Flexibility is one of the factors that sustain physical work related to physical condition in the components of good flexibility, including in the performance of softball male athletes' skills. What has been produced in this study, which shows the level of flexibility in the skills of male softball athletes, is a reference for improving the skills of Palopo City softball male athletes. These results suggest that to increase arm power towards improving the skills of male softball athletes, it must have an indicator of increased arm power that supports the skills of male softball athletes. What has been produced in this study, which shows the level of arm power on the skills of male softball athletes, is a reference in improving the skills of Palopo City softball male athletes.

These results suggest that to increase the speed of acceleration to improve the skills of male softball athletes, it must have an indicator of increased acceleration speed that

supports the skills of male softball athletes. What has been produced in this study, which shows the level of acceleration speed in the skills of male softball athletes, is a reference for improving the skills of Palopo City softball male athletes.

CONCLUSIONS AND SUGGESTIONS

The relationship between acceleration speed and the skills of male softball athletes in Palopo City. Based on the results of data analysis and discussion of research results, it can be concluded as follows:

1. The VO2 Max level has a significant effect on the skills of the Palopo City male athletes
2. The level of flexibility has a significant effect on the skills of the Palopo City male athletes
3. The level of arm power has a significant effect on the skills of the Palopo City male athletes.
4. The level of acceleration speed has a significant effect on the skills of the Palopo City male athletes.

Based on the research conclusions that have been described, the following suggestions can be enforced.

1. Coaches are expected to be able to pay attention to VO2 max, flexibility, arm power and acceleration speed in supporting the quality of the skills of the male athletes of the city of Palopo.
2. The coach is expected to be able to increase and optimize VO2 max, flexibility, arm power and acceleration speed through organizing exercises to improve the quality of the skills of the male athletes of the city of Palopo.

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