

THE CORRELATION OF BODY ANTHROPOMETRY AND VOLLEYBALL MOVEMENT SKILLS

Gilang Nuari Panggraita¹, Mega Widya Putri², Idah Tresnowati³

Universitas Muhammadiyah Pekajangan Pekalongan^{1,2,3},

panggraita@umpp.ac.id¹, megawidyaputri@umpp.ac.id², idahtresnowati@umpp.ac.id³

Abstract

The purpose of this study was to determine the relationship between body anthropometry and mastery of volleyball movement skills for students at SMA Negeri 1 Kajen. This type of research is Explanatory Research using survey methods. The independent variable is body anthropometry and the dependent variable is volleyball movement skills. The subjects of this study were students of SMA Negeri 1 Kajen who actively participated in volleyball extracurricular activities. The research sample was selected using total sampling technique. The number of samples in this study were 24 subjects. The data collection technique used body anthropometric tests, namely: height, weight, arm length, and leg length as well as volleyball movement skill tests using the American Association for Health, Physical Education Recreation and Dance test guidelines for ages 10-18 years, namely volleyball, service, passing, and set-up tests. Data were analyzed using multiple correlation tests and canonical correlation tests. The results showed that all components of body anthropometry were positively correlated with each component of volleyball movement skills, there was a close relationship between height, arm length and leg length with volleyball, service and set up skills. There is no correlation between all components of body anthropometry and all components of volleyball movement skills together. The conclusion of this study is that the anthropometric components of the body are not correlated with the components of volleyball movement skills together.

Keywords: Anthropometry; Volleyball Movement Skills; Students

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Correspondence Author: Gilang Nuari Panggraita, Universitas Muhammadiyah Pekajangan Pekalongan, Indonesia. E-Mail: panggraita@umpp.ac.id

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INTRODUCTION

Sports extracurricular activities are non-academic activities that schools accommodate in the form of training in specific sports outside formal learning hours. Extracurricular activities function to accommodate and develop students' potential, talents, interests and creativity, develop social interaction skills and recreation and prepare students' careers (Wibowo & Andriyani, 2015). Schools must organize sports extracurricular activities by providing the necessary facilities

and infrastructure and professional companions or instructors so that activities run optimally to accommodate the needs of students (Muehaemin & Fitrianto, 2022).

Volleyball extracurricular is one of the extracurriculars that is often carried out in schools (Utami & Prihanto, 2013). Azizah & Sudarto (2021) stated that internal and external factors influenced students' participation in volleyball extracurricular activities. Internal factors, such as high interest and motivation for extracurricular volleyball. External factors include teachers or trainers, the surrounding environment, facilities and infrastructure, and family. Rahmadi (2014) states that differences in perceptions among education stakeholders in extracurricular activities cause volleyball extracurricular activity programs at schools to be held or not. Education stakeholders include the surrounding community, parents, students, the state and educational professional managers. Other external factors that is the game of volleyball is one of the significant ball materials taught in secondary education units, and volleyball is widely contested starting from the student level to the professional level, so schools organize volleyball extracurricular activities such as coaching and developing student achievement.

The Federation Internationale de Volleyball (2016) states that volleyball is the world's most popular competitive and recreational sport. The object of volleyball is to send the ball over the net to land it on the opponent's court and prevent the opponent from making the same effort. Essential elements in the volleyball game are service, rotation, attack and defence. Prasetya & Sulistyorini (2019) stated that training programs, physical conditions and body structure anthropometry are essential in mastering volleyball game skills.

Anthropometric profiles and motor skills are the dominant factors that influence volleyball performance (Nasuka, 2020). Body anthropometry is a body structure that is capable or supportive, such as height, weight, sitting height, and arm span (Mu'afillah & Yuliastrid, 2021). Fadhli et al. (2021) stated that volleyball players must have a proportional body posture which can be seen from

the results of anthropometric measurements. Radu et al. (2015) stated that anthropometric measurements could be used as a reference in determining the profile of athletes in particular sports and helping coaches and players to determine playing positions. This study aimed to determine the correlation between body anthropometry and mastery of volleyball movement skills for students of SMA Negeri 1 Kajen.

METHOD

This type of research is Explanatory Research with a quantitative approach. The research method used is a survey method. The research design used a cross sectional design. The independent variable in this study is body anthropometry and the dependent variable is volleyball movement skills. The subjects in this study were students of SMA Negeri 1 Kajen who actively participated in volleyball extracurricular activities. The research sample was selected by using total sampling technique. The number of samples in this study were 24 subjects, consisting of 12 female and 12 male students.

Data Collection Instruments

The instruments used in this study were tests of anthropometric measurements and tests of mastery of volleyball movement skills. The anthropometric measurement test measures four components of body structure, namely: 1) measuring height using a microtoise, 2) measuring body weight using a digital scale, 3) measuring arm length using an anthropometer, and 4) measuring leg length using an anthropometer. The volleyball movement skill mastery test uses test guidelines from the American Association for Health, Physical Education, Recreation and Dance (AAHPERD) for subjects aged 10-18. The AAHPERD test includes 4 test components, namely 1) the volleying test, 2) the service skills test, 3) the passing skills test, and 4) the set-up skills test (Winarno, 2006).

Data analysis technique

The data in this study are primary data obtained from the results of anthropometric measurement tests and volleyball movement skill tests. The research data were analyzed by using percentage statistical descriptive and multivariate analysis techniques. Statistical descriptive analysis was used to describe each component of body anthropometry (X), namely height (X1), body weight (X2), arm length (X3), leg length (X4) and components of volleyball movement skills (Y), with guidelines AAHPERD tests, namely volleying (Y1), service (Y2), passing (Y3) and set up (Y4). The multivariate analysis used is the multiple correlation test and the Canonical Correlation Wilks Statistic test.

Analysis of multiple correlation tests to determine the correlation between the anthropometric component (X) and each component of volleyball movement skills (Y), namely the correlation between X1, X2, X3, X4 and Y1, the correlation between X1, X2, X3, X4 and Y2, the correlation X1, X2, X3, X4 with Y3, the correlation between X1, X2, X3, X4 with Y4. Analysis of the Canonical Correlation Wilks Statistical Test was used to determine the correlation between a set of independent sub-variables, namely the anthropometric component (X1, X2, X3, X4) and a set of dependent sub-variables, namely the volleyball movement skills component (Y1, Y2, Y3, Y4). The analysis technique uses IBM SPSS Statistics version 26 software.

RESULT AND DISCUSSION

Research on the correlation between body anthropometry and mastery of volleyball movement skills for SMA Negeri 1 Kajen students was carried out in March 2022. The results of the study of body structure anthropometric tests included data on measurements of height, weight, arm length and leg length. The height and weight measurement data results were analyzed based on the Body Mass Index (BMI) value in Kg/m².

Table 1. Results of Anthropometric Analysis of Body Mass Index (BMI)

IMT Scores (Kg/m ²)	Category	Frequency	Percentage
>27	Obesities	2	8.33%
25.1-27	Fat	0	0%
18.6-25	Normal	18	75.00%
17-18.5	Thin	4	16.67%
<17	Very Thin	0	0%
Total		24	100%

Table 1 shows that students who are members of the volleyball extracurricular SMA Negeri 1 Kajen have more BMI scores in the normal category with a percentage of 75% or a total of 18 subjects.

Table 2. Results of Arm's Length Analysis

Scores (cm)	Category	Frequency	percentage
>75.75	Excellent	3	12.50%
72.26-75.75	Good	5	20.83%
68.76-72.25	Fair	7	29.17%
65.26-68.75	Poor	8	33.33%
<65.25	Unsatisfactory	1	4.17%
Total		24	100%

Table 2 shows that the extracurricular volleyball members of SMA Negeri 1 Kajen are more dominant in having less arm length, with a percentage of 33.33%.

Table 3. Results of Leg Length Analysis

Scores (cm)	Category	Frequency	percentage
>97.50	Excellent	6	25.00%
93.18-97.50	Good	6	25.00%
88.84-93.17	Fair	1	4.17%
84.51-88.83	Poor	5	20.83%
<84.50	Unsatisfactory	6	25.00%
Total		24	100%

Table 3 shows that the extracurricular volleyball members of SMA Negeri 1 Kajen have long limbs in the excellent, good, and poor categories with a 25.00% each or a total of 6 subjects. The results of the AAHPERD test were used to determine the volleying skills of the extracurricular students at SMA N 1 Kajen.

The research data includes 4 test components: volleying skills, service skills, passing skills, and set-up skills.

Table 4. Results of Volleying Skills Analysis

T Score	Category	Frequency	Percentage
>80	Excellent	5	20.83%
60-80	Good	5	20.83%
40-60	Fair	6	25.00%
20-40	Poor	4	16.67%
<20	Unsatisfactory	4	25.67%
Total		24	100%

The data in table 4 states that the mastery of volleying skills by members of the volleyball extracurricular activities at SMA Negeri 1 Kajen is in the moderate category with a percentage of 25.00% or a total of 6 subjects.

Table 5. Service Skills Analysis Results

T Score	Category	Frequency	Percentage
>80	Excellent	9	37.50%
60-80	Good	8	33.33%
40-60	Fair	3	12.50%
20-40	Poor	4	16.67%
<20	Unsatisfactory	0	0%
Total		24	100%

The results of the analysis of serving skills in table 5 explain that the mastery of serving skills of students who are members of the volleyball extracurricular SMA Negeri 1 Kajen is in the excellent category with a percentage of 37.00% or a total of 9 subjects.

Table 6. Results of Passing Skills Analysis

T Score	Category	Frequency	Percentage
>80	Excellent	8	33.33%
60-80	Good	7	29.17%
40-60	Fair	5	20.83%
20-40	Poor	3	12.50%
<20	Unsatisfactory	1	4.17%
Total		24	100%

Based on table 6 shows that the extracurricular volleyball members of

SMA Negeri 1 Kajen have an excellent level of mastery of passing skills with a percentage of 25.00% or a total of 8 subjects.

Table 7. Results of Analysis of Set-Up Skills

Score of T Score	Category	Frequency	Percentage
>80	Excellent	8	33.33%
60-80	Good	6	25.00%
40-60	Fair	5	20.83%
20-40	Poor	3	12.50%
<20	Unsatisfactory	2	8.33%
Total		24	100%

Table 7 shows that the extracurricular volleyball members of SMA Negeri 1 Kajen have an outstanding mastery of set-up skills with a percentage of 25.00% or a total of 8 subjects. The correlation between body anthropometry and the mastery of volleyball movement skills of the extracurricular members of SMA Negeri 1 Kajen was analyzed using multiple correlation tests and canonical correlation tests. The results of the data normality test with the One-Sample Kolmogorov-Smirnov Test obtained the Asymp value. Sig. (2-tailed) $0.200 < 0.5$, it indicates that the data is normally distributed.

Table 8. Results of Multiple Correlation Test Analysis

Type of Correlation	Scores				
	R	R Square	Sig. F Change	Analysis Results	Degree of Correlation
The correlation among height, weight, arm length and leg length with volleyball.	.737 ^a	.544	.004	Correlated	Strongly correlated
The correlation among height, weight, arm length and leg length with serve.	.624 ^a	.389	.043	Correlated	Strongly correlated
The correlation among height, weight, arm length and leg length with passing.	.632 ^a	.400	.038	Correlated	Strongly correlated

The correlation among height, weight, arm length and leg length with set up.	.622 ^a	.387	.045	Correlated	Strongly correlated
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Based on the data in table 8, it is explained that the Sig. of F value <0.05 means that all components of body anthropometry have a positive correlation with each component of volleyball movement skills. The degree of correlation or level of correlation can be determined by looking at the value of R. Based on the analysis results. It shows that the correlation between all components of body anthropometry and each component of volleyball movement skills is in a strong category. The correlation between height, weight, arm length and leg length with volleyball skills has the most substantial correlation, equal to 73.7%.

The research data were analyzed using the canonical correlation test to determine the correlation between a set of independent sub-variables, namely the anthropometric component (X1, X2, X3, X4) and a set of dependent variable sub-groups, namely the volleyball movement skills component (Y1, Y2, Y3), Y4). The first step is to jointly analyze the canonical correlation test (multivariate) using the Canonical Correlation Wilks Statistic to obtain a Sig. of F of 0.004. Sig. A value of F of 0.004 <0.05 means a significant canonical correlation exists between the components of body anthropometry and the components of volleyball movement skills together so that the test can proceed to the next stage. The analysis process is continued with the individual (partial) canonical correlation test by looking at each function's dimensional coefficient value of Sig. of F. The basis for decision-making is that the dimension value Sig. of F <0.005 means that each component between sub-variables has a significant canonical correlation.

Table 9. Canonical Correlation Test Analysis Results

Function	Eigenvalue	Canonical Correlation	Dimension Sig. of F	Proportion of Diversity
1	1.35325	0.75832	0.004	75.8%
2	1.05292	0.71616	0.024	71.6%

3	0.37407	0.52176	0.202	52.1%
4	0.00464	0.06797	0.770	6.7%

Table 9 explains that the canonical functions formed from the four components of body anthropometry and the four components of volleyball movement skills studied are four functions. The results of the canonical correlation test individually obtained the dimensional coefficient value of Sig. of F in the first function and the second function <0.005 , which means there is a significant correlation, while in the third function and fourth function, there is no correlation because the dimension value of Sig. of F > 0.005 . These results mean that the third and fourth functions are ignored or not used. The level of canonical correlation can be seen from the value of the Canonical Correlation coefficient. The first function accommodates the canonical correlation correlation of 0.75832 with a proportion of diversity of 75.8%. The second function accommodates the canonical correlation correlation of 0.71616 with a proportion of diversity of 71.6%. The level of canonical correlation in the first function is greater than in the second function, so the interpretation of the data in this study uses the first function.

Table 10. Interpretation of First Function Canonical Correlation Test Data

Variables	Components	Canonical Weight	Canonical Loading	canonical cross loadings
Body Anthropometry	Height	1.83251	0.94250	0.24026
	Weight	-0.17153	0.31199	-0.02380
	Sleeve Length	-0.09894	0.77665	-.02088
	Leg Length	-0.80692	0.73958	-.10538
Volleyball Movement Skills	Volleying	0.77800	0.95460	0.11105
	Service	0.33888	0.66927	0.08127
	Passing	-0.01103	-0.15638	-.00351
	Set Up	0.05370	0.53615	0.01193

Based on Table 10 explains that the results of the analysis of the canonical weight coefficient values state that the canonical pair has the strongest correlation, namely height with volleying and the second leg length with volleying skills. Based on the value of the canonical loading coefficient, it shows that there is the closest correlation between height and volleyball. The overall canonical loading

value explains a close correlation between height, arm length and leg length with volleying, service and set-up skills. The canonical cross-loading coefficient value < 0.5 means that there is no canonical cross-loading in the anthropometric component and the volleyball movement skills component.

Discussion

This study aims to determine the correlation between body anthropometry and mastery of volleyball movement skills for students who are members of the volleyball extracurricular activity at SMA Negeri 1 Kajen. The potential of students who are members of the volleyball extracurricular activities at SMA Negeri 1 Kajen in playing volleyball can also be known by conducting body anthropometric studies and mastering volleyball movement skills.

The components of the anthropometric measurement test for body structure include measuring height, body weight, arm length, and leg length. Data from research on height and weight were converted into body mass index values in units of Kg/m^2 . The analysis results show that most Kajen 1 Public High School extracurricular members have average body mass index values with a percentage of 75% (a total of 18 subjects). Prasetya & Sulistyorini (2019) stated that the supporting factors for volleyball players are ideal height and weight because these factors affect the athlete's biomotor abilities in performing volleyball technique movements. Masanovic et al. (2019) stated that height and body mass are essential in defence and attack strategies. Taller players can quickly spike and block for points. Milic et al. (2017) stated that a high body mass index causes players to move slower. Determining playing positions in volleyball clubs is chosen chiefly based on height and the maximum jump height. The position of the libero and setter does not get much attention because they do not play in the front row. Based on these findings, it can be concluded that the height and weight of the extracurricular members of SMA Negeri 1 Kajen are very supportive of volleyball.

The results of the research data analysis showed that the extracurricular volleyball members of SMA Negeri 1 Kajen were more dominant in having less arm length with a percentage of 33.33% (8 subjects). Kamuk et al. (2019) stated that the arm's length affects the length of the working arm's reach when serving, especially the ability to serve aces. Based on the analysis results, the length of the arms of extracurricular member students is less supportive of volleyball skills.

Data on the results of measuring the length of the limbs of students who are members of the volleyball extracurricular SMA Negeri 1 Kajen show that students have a balanced category level between very good, good and very poor with a percentage of 25.00% each or a total of 6 subjects. Nasuka (2020) states that there is a significant correlation between leg length and maximum vertical jump results for players who are spikers and setters to perform spike and block movements in volleyball games. Based on the study results, most students have long limbs that can support them in playing volleyball.

The anthropometric profile of students who are members of the volleyball extracurricular based on the results of the comprehensive body anthropometry test can support playing volleyball. The length of the arm is less supportive for performing volleyball technique skills. The anthropometric profile is the dominant factor influencing volleyball players' performance. Body anthropometry supports movements in volleyball games, such as standing reach, vertical jump, approach jump, ball throw, forline agility run and athletics (Nasuka, 2020).

Mastery of students' volleyball movement skills was measured using the AHPHERD test guidelines. The components of the AHPHERD test series that are measured are volleyball, service, passing, and set-up skills. Data from the analysis of volleyball skills shows that the extracurricular volleyball members of SMA Negeri 1 Kajen are in the moderate category with a percentage of 25.00% (6 subjects). The volleyball test can be done by bouncing the ball against a wall or wall according to the hand in a predetermined target area. Factors to note are the accuracy of the ball and the number of reflections (Winarno, 2006). Good

volleying ability can support the game of volleyball, which is related to the elements of volleying the ball, the accuracy of determining the ball's direction in giving a pass or smash and the power of hitting the ball. The study results show that the students' volleyball skills are average enough to play volleyball.

The results of the analysis of the service skills test explained that the extracurricular volleyball members of SMA Negeri 1 Kajen had more mastery of excellent service skills with a percentage of 37.00% (a total of 9 subjects). Kamuk et al. (2019) stated that the ability to serve, smash and block techniques is influenced by anthropometric factors, they are height, weight, arm length, and leg length. Jariono et al. (2021) stated that strategies to improve service skills could be carried out with preparatory physical condition training programs, pre-competition physical condition training programs, main competition physical condition training programs, transitional physical condition training programs, and compilation training programs. The dominant physical components needed for serving are leg muscle strength, abdominal muscle strength, arm muscle strength, and shoulder muscle strength. Based on the study results, students have excellent service skills, so they can support them in playing volleyball.

The results of the research on the passing skill test stated that the extracurricular volleyball members of SMA Negeri 1 Kajen were more dominant in mastering the passing technique in the excellent category with a percentage of 25.00% (8 subjects). (Ilham et al., 2019) states that passing skills aim to provide ball passes to teammates to arrange attacks into the opposing team's area. A teammate must quickly receive the ball that is passed. Raihanati & Wahyudi (2021) state that the lack of optimal ball results from under passing is caused by the body not leaning forward but instead upright and the foot movements not being agile. Inadequate top passing is caused by poor ball control. The feet and body position do not match, the ball bounces off the fingers, and the gaze is focused on the ball.

The data analysis on the set-up skills test showed that the extracurricular volleyball members of SMA Negeri 1 Kajen had an outstanding level of mastery of set-up skills with a percentage of 25.00% (8 subjects). The correlation between body anthropometry and the mastery of volleyball movement skills of the extracurricular members of SMA Negeri 1 Kajen was analyzed using multiple correlation tests and canonical correlation tests. The analysis of multiple correlation tests aims to determine the correlation between the anthropometric components and each component of volleyball movement skills. Analysis of the Canonical Correlation Wilks Statistical test was used to determine the correlation between the anthropometric sub-variable group sets and the volleyball movement skill sub-variable groups. The analysis of multiple correlation tests shows that all components of body anthropometry are positively correlated with each component of volleyball movement skills with a substantial degree of correlation.

The correlation between height, weight, arm length and leg length with volleyball skills has the most substantial degree of correlation, equal to 73.7%. These results mean that the magnitude of the influence of the anthropometric component measured on volleyball skills is 73.7%, while the remaining 26.3% is influenced by other factors not examined. Joniton & Gopinath (2017) states that there is a positive correlation between body anthropometry, namely height, weight, upper arm circumference, forearm circumference, chest circumference, waist circumference, waist circumference, thigh circumference, calf circumference, angle circumference, leg length and long soles with the ability to play volleyball. Based on the analysis results, all components of body anthropometry are positively correlated with each component of volleyball movement skills.

The results of the analysis of the canonical correlation test with the Canonical Correlation Wilks Statistic have met the prerequisites that must be met, marked by the results of the canonical correlation test together and the canonical correlation test individually having a significant correlation. The first function in

the analysis process can have a canonical correlation, the proportion of diversity and the highest level of correlation among the other functions so that it is valid. Data analysis results are interpreted based on the criteria of canonical weight, canonical loadings, and canonical cross-loadings. The canonical weight is the canonical coefficient to indicate the closeness of the correlation between the original variable and the canonical variable. Canonical load or canonical structure correlation shows a simple linear correlation between the original variable and each canonical variable. The canonical cross-load value shows the correlation between the dependent and independent variables (Irianingsih et al., 2016).

Based on the interpretation of the data, it shows that the canonical pair has the strongest correlation, namely height with volleyball and the second is leg length with volleyball. There is the closest correlation between height and volleyball skills. The overall canonical loading value explains that there is a close correlation between height, arm length and leg length with volleyball, service and set up skills. There is no canonical cross-load on the anthropometric component and the volleyball movement skill component, which means that there is no correlation between the anthropometric component and the volleyball movement skill component together. Pandey et al., (2016) stated that there was a significant correlation between body anthropometry, height and leg length, and the skills and performance of volleyball players. There is no significant correlation between body anthropometry, namely arm weight and length, and the skills and performance of volleyball players. Based on the results of canonical crossload analysis, there is agreement with the results of previous studies.

The study of the correlation between body anthropometry and volleyball movement skills for students of extracurricular volleyball members at SMA Negeri 1 Kajen can provide benefits to the coaching team, accompanying teachers and the school as a provision to find out students' potential in playing volleyball, develop appropriate training programs and improve abilities. Students in playing volleyball so that they can get achievements in the championships that the school

follows. Joniton & Gopinath (2017) stated that body anthropometry research has a significant impact on updating player data to help coaches, clubs, and federations select talent and potential athletes and develop training programs and material for consideration of athlete promotion. Factors that influence the success of playing volleyball, namely anthropometric performance, optimal physical condition, quantity and quality of training, perception, tactical cognitive and technical skills, and mental quality (Milic et al., 2017). The minimal achievement of volleyball athletes can be caused by the level of physical condition and body anthropometry that could be better (Candra & Farhanto, 2021).

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CONCLUSION

This study reveals that there is no correlation between all components of body anthropometry and components of volleyball movement skills. The anthropometric component of the body has a positive correlation with each component of volleyball movement skills with a substantial degree of correlation. There is a significant correlation between height, arm length, and leg length with

volleyball, serve and set-up skills. The canonical pair with the strongest correlation is the height with volleyball skill. Students who are members of the volleyball extracurricular activity at SMA Negeri 1 Kajen have average body mass index values. Arm length is more dominant in the less category. Leg length has the same ratio for excellent, good and poor categories. Students who are members of the volleyball extracurricular SMA Negeri 1 Kajen have volleyball skills in the medium category. Service, passing, and set-up skills for each category are outstanding. This study suggests that further research should be carried out to measure basic volleyball technical skills by adding smash and block skills according to the player's position and using different volleyball skill test methods.

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