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The Influence of Arm Muscle Strength And Hand-Eye Coordination on Volleyball Underhand Passing Ability as Viewed From The Motivation of Students At SMA Negeri 21 Makassar

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ABSTRACT

This study aims to analyse the effect of arm muscle strength and hand-eye coordination on volleyball underhand passing ability in terms of motivation in students of SMAN 21 Makassar. The research method used is path analysis with a population of volleyball extracurricular students of SMAN 21 Makassar. Sampling was carried out by purposive sampling with the following criteria: (1) volleyball extracurricular participants at SMAN 21 Makassar, (2) still actively practising, and (3) male, so that 20 students were obtained as samples. The test instruments used included arm muscle strength tests (Widiastuti, 2011), hand-eye coordination tests (Ismaryanti, 2018), motivation tests (Sugiyono, 2018), and the Brumbach forearm pass wall-volley test for underhand passing ability. The results of the study showed that: (1) there was a direct influence of arm muscle strength on motivation of 29.3%, (2) there was a direct influence of hand-eye coordination on motivation of 68.1%, (3) there was a direct influence of arm muscle strength on underarm passing ability of 28.2%, (4) there was a direct influence of hand-eye coordination on underarm passing ability of 27.4%, (5) there was a direct influence of motivation on underarm passing ability of 45.4%, (6) there was an indirect influence of arm muscle strength on underarm passing ability through motivation of 13.3%, and (7) there was an indirect influence of hand-eye coordination on underarm passing ability through motivation of 30.9%. The conclusion of this study is that arm muscle strength and hand-eye coordination contribute significantly to underarm passing ability in volleyball, both directly and indirectly through motivation, with hand-eye coordination being the dominant factor influencing students' motivation in volleyball activities.

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INTRODUCTION

Volleyball has become one of the popular sports in Indonesia, not only as a means of recreation but also as an integral part of physical education in schools. This game requires various technical, physical, and mental skills that must be mastered by players to achieve optimal performance (Sulistyorini & Winarno, 2020). Among the various techniques in volleyball, underhand passing is a fundamental skill that is the basis for the development of other skills. The ability to perform underhand passing effectively determines the overall quality of the game, so mastering this technique is the main focus in volleyball learning at the high school level.

In the context of physical education in high school, especially at SMA Negeri 21 Makassar, the development of volleyball skills is one of the priorities in the physical education curriculum. However, initial observations show that many students still have difficulty mastering the underhand passing technique properly. This can be seen from the low level of success in performing underhand passing that is on target and consistent. According to Pahlepi & Hidayat (2021), this difficulty can be caused by various factors, both physical and psychological, which affect students' ability to master these skills.

Arm muscle strength is identified as one of the physical components that play a crucial role in the implementation of underarm passes. Research conducted by Rustanto (2019) shows that arm muscle strength has a significant contribution to the quality of underarm passes in volleyball. This is because underarm passes require precise control of the arm muscles to direct the ball accurately to the desired target. Good arm muscle strength allows players to control the intensity of contact with the ball, so that they can produce a directed pass with the appropriate height.

In addition to arm muscle strength, eye-hand coordination is also an important factor influencing success in performing underarm passes. Eye-hand coordination involves synchronisation between visual input and motor responses, which is essential in various sports skills, including volleyball. According to Saputra et al. (2022), good eye-hand coordination allows players to estimate the direction and speed of the incoming ball, as well as position the body and make contact with the ball at the right time and position. Without adequate eye-hand coordination, players will have difficulty directing the ball accurately, even though they have good arm muscle strength.

Interestingly, physical components such as arm muscle strength and eye-hand coordination do not operate independently in influencing underarm pass performance. There is a complex interaction between these physical factors and psychological aspects such as motivation. Motivation acts as a driver that activates and directs individual behaviour in achieving certain goals, including in the context of learning sports skills (Kustiawan et al., 2021). Students with high motivation tend to show greater persistence and effort in mastering new skills, including underhand passing in volleyball.

Research conducted by Hambali (2019) revealed that achievement motivation has a positive relationship with basic volleyball technical abilities, including underhand passing. This indicates that students with high motivation tend to show better

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performance in mastering volleyball technical skills. However, the study has not explored how motivation interacts with physical components such as arm muscle strength and eye-hand coordination in influencing underhand passing ability, especially in the context of a high school student population in Makassar.

A study conducted by Nur et al. (2020) in a high school in South Sulawesi showed that there was significant variation in the level of student motivation towards physical education learning, including volleyball. This variation is influenced by various factors, such as previous experience, perception of competence, and environmental support. These differences in motivation levels can affect how students utilise their physical potential, including arm muscle strength and eye-hand coordination, in the process of mastering underarm passing skills. Prastowo & Suharjana's (2018) research emphasises the importance of considering psychological aspects in developing motor skills in students. According to students, physical component training without considering motivational factors may not result in optimal performance improvements. This shows the need for a holistic approach that integrates physical component development with strategies to increase student motivation in volleyball learning.

SMA Negeri 21 Makassar, as one of the secondary education institutions that pays special attention to the development of volleyball, is a strategic location to investigate the complex relationship between arm muscle strength, eye-hand coordination, motivation, and underarm passing ability. This school has an active extracurricular volleyball program and has produced achievements in various city and provincial-level competitions. However, observations show significant variations in underarm passing ability among students, even though students receive relatively uniform training.

This variation in underarm passing ability among students raises questions about the factors that influence it. Although previous studies have identified arm muscle strength, eye-hand coordination, and motivation as relevant factors, the complex interactions between these factors have not been fully understood, especially in the context of high school students in Makassar. According to Asnaldi et al. (2020), demographic and socio-cultural characteristics can influence how these factors interact in influencing sports performance, so research in a specific context, such as high school students in Makassar, is important to conduct.

The importance of this study is also supported by the fact that the ability to pass underfoot is not only relevant in the context of volleyball but also reflects the development of broader motor skills. Syamsuar & Suharjana (2021) stated that motor skills developed through sports activities such as volleyball can be transferred to various contexts of everyday life and have long-term implications for the health and well-being of individuals. Therefore, a better understanding of the factors that influence the development of underfoot passing skills can contribute more broadly to motor skill development strategies in students in general.

Another aspect that needs to be considered is individual differences in terms of arm muscle strength, eye-hand coordination, and motivation among students. Nurkholis & Widodo (2020) stated that these individual differences need to be considered in

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designing effective training programs. Training programs that are tailored to the individual characteristics of students can optimise the development of underfoot passing skills. However, to design such a program, a deeper understanding is needed of how arm muscle strength and eye-hand coordination interact with motivation in influencing underfoot passing ability.

This study is also relevant to efforts to improve the quality of physical education in schools. According to Hartono et al. (2022), quality physical education not only focuses on the development of technical skills but also considers psychological and social aspects in learning. Understanding how motivation interacts with physical factors in influencing skill mastery can provide valuable insights for physical education teachers in designing more effective learning strategies and actively engaging students.

In a broader context, this study is also in line with the global trend in sports research that is increasingly recognising the importance of a multidisciplinary approach. As stated by Rachman & Nasuka (2021), understanding sports performance cannot be achieved only through analysing physical or technical factors separately, but requires the integration of perspectives from various disciplines, including biomechanics, psychology, and pedagogy. By investigating the interaction between arm muscle strength, eye-hand coordination, and motivation, this study adopts a multidisciplinary approach that can provide a more comprehensive understanding of the factors that influence underarm passing ability.

Furthermore, this study has significant practical implications for volleyball training at the secondary school level. According to Tirtayasa et al. (2020), understanding the factors that influence technical ability can help coaches design more targeted and efficient training. By identifying the relative contributions of arm muscle strength, hand-eye coordination, and motivation to underarm passing ability, this study can guide coaches and physical education teachers in prioritising certain aspects in student training programs.

In addition, this study can also contribute to the development of a more comprehensive evaluation instrument to assess the ability of underarm passing and the factors that influence it. According to Widiastuti & Hamamah (2020), a comprehensive evaluation does not only focus on the final result, but also considers the process and factors that contribute to performance. By understanding the interaction between arm muscle strength, eye-hand coordination, and motivation, teachers and coaches can develop an evaluation instrument that not only assesses technical underarm passing ability but also considers the factors that contribute to this ability.

From a talent development perspective, this study can also make a significant contribution. Identification and development of talent in volleyball requires a deep understanding of the factors that influence performance, including the interaction between physical and psychological components. According to Hanif (2018), an effective talent development program needs to consider not only the physical potential of athletes but also the psychological characteristics of students, including motivation. Thus, the findings of this study can provide valuable insights into the process of talent identification and development in volleyball at the school level.

Although several previous studies have examined the relationship between physical factors and underarm passing ability or the relationship between motivation and sports performance, studies that specifically investigate the interaction between arm muscle strength, eye-hand coordination, and motivation in the context of underarm passing ability in high school students in Makassar are still limited. This gap in the literature suggests the need for further research to understand how these factors interact to influence underarm passing ability in this specific population.

Based on the background that has been described, this study aims to investigate the effect of arm muscle strength and eye-hand coordination on volleyball underarm passing ability, considering the role of motivation as a moderator variable in students of SMA Negeri 21 Makassar. Through this study, it is hoped that a deeper understanding of the factors that influence volleyball underarm passing ability can be obtained, which in turn can make a significant contribution to the development of more effective learning and training strategies in the context of physical education at the high school level can be obtained.

METHODS

This research is a type of path analysis research, and the method used is the method of path analysis for the data analysis technique. According to Sugiyono (2018), path analysis is a statistical analysis technique that is part of the regression model. Path analysis is used to analyse the causal relationship between one variable and another. The independent variables are Arm Muscle Strength and hand-eye coordination, the intervening variable is motivation, and the dependent variable is the ability to pass underfoot. The research location will be carried out at SMA 21 Makassar, Jalan Tamalanrea Raya No. 1A BTP, Tamalanrea District, Makassar City, South Sulawesi Province. The population in this study were extracurricular volleyball students at SMAN 21 Makassar. Sampling in this study was carried out by purposive sampling, with the criteria (1) extracurricular volleyball participants at SMAN 21 Makassar, (2) still actively practising, and (3) male. Based on this, the number of samples used was 20 students. Instrumental test using the instrument from Widiastuti in 2011 for arm muscle strength. Eye-hand coordination test from Ismaryanti in 2018. Motivation test from Sugiyono in 2018. Underarm passing test using the Brumbach forearm pass wall-volley test. Data analysis techniques include descriptive analysis, prerequisite test and inferential test according to the mechanism of path analysis research type.

RESULTS AND DISCUSSION

Result

Descriptive data analysis is intended to obtain a general picture of the research data. Descriptive analysis is carried out on Arm Muscle Strength and hand-eye coordination Against Volleyball Underhand Passing Ability, reviewed from Motivation in

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SMAN 21 Makassar Students. Descriptive analysis includes total value, average, standard deviation, range, maximum and minimum. From these statistical values, it is expected to provide a general picture of the state of arm muscle strength data, hand-eye coordination against underhand passing ability, reviewed from motivation.

Table 1.
Descriptive analysis

Statistical Values	Arm Muscle Strength (X1)	Hand Eye Coordination (X2)	Motivation (X3)	Underhand Passing (Y)
N	20	20	20	20
Mean	30.20	32.95	121.00	36.65
Std. Deviasi	7.445	5.501	16.596	1.188
Range	29	17	65	19
Maksimun	46	42	160	46
Minimun	17	25	95	27
Sum	604	659	2420	733

Based on table 1 above, it is a description of the data on Arm Muscle Strength and Hand Eye Coordination on Volleyball Underhand Passing Ability Reviewed from Motivation in Students of SMAN 21 Makassar who are the objects of the study, so that it can be stated as follows: Arm muscle strength was obtained in succession with a total value of 604, an average of 30.20, a standard deviation of 7.445, a range of 29, minimum data of 17, maximum data of 29. Hand-eye coordination was obtained in succession with a total value of 659, an average of 32.95, a standard deviation of 5.501, a range of 17, a minimum of 25, maximum of 42. Motivation obtained a consecutive total value of 2420, average 121.00, standard deviation 16.569, range 65, minimum data 95, maximum data 160. Underhand passing ability obtained total value of 733, average 36.65, standard deviation 1.188, range 19, minimum data 27, maximum data 46.

Normality Test

Analyse whether all the data in this study are normally distributed. The normality test is a prerequisite for using parametric statistics. Therefore, the researcher tested all data using the Kolmogorov-Smirnov test, and data processing using the SPSS program. However, the study only refers to the results of the Kolmogorov-Smirnov test. The results of the data normality test can be seen in the following table:

Table 2.
Normality Test

Variable	Kolmogrov-Smirnov		α	Information
	Statistic	Sig		
Arm Muscle Strength (X1)	0.166	0.149	0.05	Normal
Hand Eye Coordination (X2)	0.254	0.200	0.05	Normal
Motivation (X3)	0.194	0. 200	0.05	Normal
Underhand Passing Ability (Y)	0.136	0. 200	0.05	Normal

Based on the table above, it shows that the results of the normality test of arm muscle strength data, hand-eye coordination, and motivation on underarm passing ability using the Kolmogorov Smirnov test show the following results: Arm muscle strength data, obtained a KS-Z value = 0.166 and (P> 0.05) means that this shows that the data follows a normal distribution or is normally distributed. Hand-Eye Coordination

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Data, obtained a KS-Z value = 0.254 (P> 0.05) means that this shows that the data follows a normal distribution or is normally distributed. Motivation Data, obtained a KS-Z value = 0.194 (P> 0.05) means that this shows that the data follows a normal distribution or is normally distributed. Underarm passing ability data, obtained a KS-Z value = 0.136 (P> 0.05) means that this shows that the data follows a normal distribution or is normally distributed.

Multicollinearity Test

Multicollinearity testing is done using the VIF value. A variable shows symptoms of multicollinearity can be seen from the high VIF (Variance Inflation Factor) value in the independent variables of a regression model. The VIF values of the independent variables in the regression model are as follows:

Table 3.
Multicollinearity Test

Variable	Collinearity Statistics		Result
	Tolerance	VIF	
Arm Muscle Strength (X1)	0.481	2.080	0.05
Hand Eye Coordination (X2)	0.485	2.060	0.05
Motivation (X3)	0.945	1.016	0.05

The test results show that the VIF value of all independent variables has a value smaller than 10. This means that the research variables do not show any symptoms of multicollinearity.

Table 4.
Linearity Test

Relationship Between Variables	F	Sig	Information
X1 With X3	1.896	0.248	Linear
X2 With X3	1.150	0.996	Linear
X1 With Y	1.952	0.570	Linear
X2 With Y	1.345	0.941	Linear
X3 With Y	1.789	0.671	Linear

Table 4 above explains that Arm Muscle Strength (X1) with Motivation (X3), for the linearity test of the regression of arm muscle strength against motivation, obtained Fcount (Tc) 1.896 with P-value = 0.248> 0.05, which means H0 is accepted. Thus, it can be concluded that the regression equation for arm muscle strength with motivation is linear. Hand Eye Coordination (X2) with Motivation (X3), for the linearity test of the regression of hand eye coordination with motivation, obtained Fcount (Tc) 1.150 with P-value = 0.996> 0.05, this means H0 is accepted. Thus, it can be concluded that the regression equation for hand-eye coordination against motivation is linear. Arm Muscle Strength (X1) Against Underarm Passing Ability (Y), for the linearity test of the regression of arm muscle strength against underarm passing ability, obtained Fcount (Tc) 1.952 with P-value = 0.570> 0.05, this means H0 is accepted. Thus, it can be concluded that the regression equation of arm muscle strength against the ability of underarm passing is linear. Hand Eye Coordination (X2) Against Underarm Passing Ability (Y), for the linearity test of the regression of hand eye coordination against underarm passing ability, the F count (Tc) is 1.345 with P-value = 0.941> 0.05, this means that H0 is accepted. Thus, it can be concluded that the regression equation of hand-eye coordination against underarm

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passing ability is linear. Motivation (X3) Against Underarm Passing Ability (Y), for the linearity test of the regression of motivation against underarm passing ability, the F count (Tc) is 1.789 with P-value = 0.671> 0.05, which means that H0 is accepted. Thus, it can be concluded that the regression equation of motivation against underarm passing ability is linear.

Hypothesis Testing

After conducting the data normality and linearity requirements test on the hypothesis to be tested, further testing of the hypothesis is carried out to prove its truth, where in the test inferential statistics are used, through path analysis of the theoretically formed quality model, a path analysis diagram will be obtained and the coefficient value for each path will be calculated.

Hypothesis 1: There is a direct influence of arm muscle strength on the motivation of students at SMAN 21 Makassar.

Based on the results of the analysis obtained in the table, it shows that the ß coefficient value is positive, namely 0.293, with a significance (p) = 0.001 (p <0.05), which means significant. This shows that there is a significant direct influence of arm muscle strength on the motivation of students at SMAN 21 Makassar.

Hypothesis 2: There is a direct influence of hand-eye coordination on the motivation of students at SMAN 21 Makassar.

Based on the results of the analysis obtained in the table, it shows that the positive ß coefficient value is 0.681 with significance (p) = 0.000 (p <0.05), which means significant. This shows that there is a significant direct effect of hand-eye coordination on the motivation of students of SMAN 21 Makassar.

Hypothesis 3: There is a direct effect of arm muscle strength on the ability to pass under the volleyball in students of SMAN 21 Makassar.

Based on the results of the analysis obtained in the table, it shows that the positive ß coefficient value is 0.282 with significance (p) = 0.001 (p <0.05), which means significant. This shows that there is a significant direct effect of arm muscle strength on the ability to pass under the volleyball in students of SMAN 21 Makassar.

Hypothesis 4: There is a direct influence of eye-hand coordination on the ability to pass under the ball in volleyball in SMAN 21 Makassar students

Based on the results of the analysis obtained in the table, it shows that the coefficient value ß is positive, namely 0.274, with significance (p) = 0.000 (p <0.05), which means significant. This shows that there is a significant direct influence of arm muscle strength on the ability to pass under the ball in volleyball in SMAN 21 Makassar students.

Hypothesis 5: There is a direct influence of motivation on the ability to pass the ball in volleyball in SMAN 21 Makassar students.

Based on the results of the analysis obtained in the table, it shows that the coefficient value ß is positive, namely 0.454, with significance (p) = 0.002 (p <0.05), which means significant. This shows that there is a significant direct influence of arm muscle strength on the ability to pass under the ball in volleyball in SMAN 21 Makassar students.

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Hypothesis 6: There is an influence of arm muscle strength on the ability to pass the ball through the motivation of students of SMAN 21 Makassar.

Based on the results of the analysis obtained in the table, it shows that the coefficient value ß and significance (p) of the variable arm muscle strength on the ability to pass under the ball through motivation are obtained from the product of the value of ß and p between the variable arm muscle strength on motivation and the value of ß and p between the variable motivation on the ability to pass under the ball and the correlation coefficient so that a coefficient value of 0.293 x 0.454 = 0.133 is obtained and a significance (p) of 0.000 (p <0.05) is obtained which means significant. This shows that there is a significant influence of arm muscle strength on the ability to pass the ball through the motivation of students of SMAN 21 Makassar.

Hypothesis 7: There is an influence of eye-hand coordination on the ability to pass the ball through the motivation of students of SMAN 21 Makassar.

Based on the analysis results obtained in the table, it shows that the coefficient value ß and significance (p) of the arm muscle strength variable on the ability to pass underfoot through motivation are obtained from the product of the ß and p values between the arm muscle strength variable on motivation and the ß and p values between the motivation variable on the ability to pass underfoot and the correlation coefficient so that a coefficient value of 0.681 x 0.454 = 0.309 is obtained and a significance (p) of 0.000 (p <0.05) which means significant. This shows that there is a significant influence of eye-hand coordination on the ability to pass underfoot in volleyball through the motivation of students of SMAN 21 Makassar.

Model Test

Initial Model Suitability Test Results

Based on the results of the initial model suitability analysis of the proposed structural equation, the F value is 7.863 with a probability value (sig) = 0.002. Because the sig value <0.05, the decision is that H0 is rejected, meaning that arm muscle strength and hand-eye coordination have a simultaneous and significant effect on motivation. Thus, it can be used to explain the influence that occurs between variables.

Initial Model Path Coefficient Test Results Substructure 1

The results of the significant test of each path coefficient in the initial model of substructure 1 using the t-test, which are summarised in the table of path coefficients of the initial model of substructure 1 structural equation as follows:

Table 5.
Initial Path Coefficients of Substructure Model 1

Variable	Correlation Coefficient	t-value	Sig
Arm Muscle Strength	0.293	2.405	0.001
Hand-Eye Coordination	0.681	5.056	0.000

Based on the R-Square value showing the number 0.716, this indicates that simultaneously arm muscle strength and hand-eye coordination have an influence of 71.6% in explaining changes that occur in the motivation variable, while the remaining 28.4% is determined by other variables outside the model. In the section (F test), it can

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be seen that simultaneously the independent variables have a significant influence on the motivation variable, as indicated by the significance. 0.002 <Alpha 5%.

In addition, in the Coefficients table (partial t test), it can be seen that the arm muscle strength variable (X1) and the hand-eye coordination variable (X2) statistically have a significant influence on the motivation variable (X3) as indicated by the sig. Value. Each is smaller than Alpha 5%, namely 0.001 and 0.000.

To analyse how much influence other variables outside the model have on motivation (ε1), it can be determined in the following way:

$$\varepsilon 1 = \sqrt{1 - R^2}$$
$$= \sqrt{1 - 0{,}716}$$
$$= \sqrt{0{,}284}$$
$$= 0{,}5329 = 53{,}29\%$$

So the value (ε1) of the path coefficient of other variables on motivation is 53.29%. So the path equation is as follows:

$$X3 = \rho x3x1 + \rho x3x2 + \varepsilon 1$$
$$X3 = 0{,}293\ X1 + 0{,}681\ X2 + 0{,}5329$$

Table 6.
Koefisien Jalur Model Awal Substruktur 2

Variable	Correlation Coefficient	t-value	Sig
Arm Muscle Strength	0,282	3.834	0.001
Hand-Eye Coordination	0,274	2.608	0.000
Motivation	0,454	3.147	0.002

Based on the R-Square value of 0.822 and the significance values for variables X1, X2, and X3, respectively, are <0.05. Because the significance value of X1, X2 and X3 <0.05, then it is considered significant. To analyse how much influence other variables outside the model have on the ability to pass under (ε2), it can be determined in the following way:

$$\varepsilon 2 = \sqrt{1 - R^2}$$
$$= \sqrt{1 - 0{,}822}$$
$$= \sqrt{0{,}178}$$
$$= 0{,}4219 = 42.19\%$$

So the value (ε2) of the path coefficient of other variables on the ability to pass under is 42.19%. So the path equation is as follows:

$$Y = \rho yx1 + \rho yx2 + \rho yx3 + \varepsilon 2$$
$$Y = 0{,}282\ X1 + 0{,}274\ X2 + 0{,}454\ X3 + 0{,}4219$$

After carrying out several stages of model testing by paying attention to the level of significance of each variable, two models were obtained, which were considered significant. The two models in question were substructure model 1 and substructure 2. If the two models were combined, according to the path diagram above, the following structural equation could be created:

$$X3 = \rho x3x1X1 + \rho x3x2X2 + \rho x3\varepsilon 1$$
$$X3 = 0{,}293\ X1 + 0{,}681\ X2 + 0{,}5329\varepsilon 1$$
$$Y = \rho yx3X3 + \rho yx1X1 + \rho yx2X2 + \rho y\varepsilon 2$$
$$Y = 0{,}454X3 + 0{,}282X1 + 0{,}274X2 + 0{,}4219\varepsilon 2$$

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Goodness Of Fit Test

Model testing is needed to determine whether the proposed model is appropriate (fit) or consistent with empirical data or not. Testing is done by comparing the theoretical correlation matrix with the empirical correlation matrix. If both matrices are identical or appropriate, then the proposed theoretical model can be concluded to be perfectly accepted. Specht and Pednazur (Kadir, 2010:163) recommend that one of the tests that can be used is the chi-squared statistic. Manual calculations for the goodness of fit test are carried out as follows:

$$Q = \left[\frac{1- R^2}{1-R_g^2}\right]$$

$$= \left[\frac{1- 0{,}716}{1-0{,}822}\right] = \frac{0{,}284}{0{,}178} = 1.595$$

Hypothesis Testing

Hypothesis 1: There is a direct effect of arm muscle strength on the motivation of students at SMAN 21 Makassar.

Based on the results of the analysis obtained in the table, it shows that the coefficient value ß is positive, namely 0.293, with a significance (p) = 0.001 (p <0.05), which means significant. This shows that there is a significant direct effect of arm muscle strength on the motivation of students at SMAN 21 Makassar.

Hypothesis 2: There is a direct effect of hand-eye coordination on the motivation of students at SMAN 21 Makassar.

Based on the results of the analysis obtained in the table, it shows that the coefficient value ß is positive, namely 0.681, with a significance (p) = 0.000 (p <0.05), which means significant. This shows that there is a significant direct effect of hand-eye coordination on the motivation of students at SMAN 21 Makassar.

Hypothesis 3: There is a direct effect of arm muscle strength on the ability to pass under the volleyball in students at SMAN 21 Makassar.

Based on the analysis results obtained in the table, it shows that the positive ß coefficient value is 0.282 with significance (p) = 0.001 (p <0.05), which means significant. This shows that there is a significant direct effect of arm muscle strength on the ability to pass under the ball in volleyball in SMAN 21 Makassar students.

Hypothesis 4: There is a direct effect of eye-hand coordination on the ability to pass under the ball in volleyball in SMAN 21 Makassar students

Based on the analysis results obtained in the table, it shows that the positive ß coefficient value is 0.274 with significance (p) = 0.000 (p <0.05), which means significant. This shows that there is a significant direct effect of arm muscle strength on the ability to pass under the ball in volleyball in SMAN 21 Makassar students.

Hypothesis 5: There is a direct effect of motivation on the ability to pass the ball in volleyball in SMAN 21 Makassar students.

Based on the results of the analysis obtained in the table, it shows that the positive ß coefficient value is 0.454 with significance (p) = 0.002 (p <0.05), which means significant. This shows that there is a significant direct effect of arm muscle strength on the ability to pass under the volleyball in SMAN 21 Makassar students.

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Hypothesis 6: There is an effect of arm muscle strength on the ability to pass the volleyball through the motivation of SMAN 21 Makassar students.

Based on the results of the analysis obtained in the table, it shows that the ß coefficient value and significance (p) of the arm muscle strength variable on the ability to pass under through motivation are obtained from the product of the ß and p values between the arm muscle strength variable on motivation and the ß and p values between the motivation variable on the ability to pass under and the correlation coefficient so that a coefficient value of 0.293 x 0.454 = 0.133 is obtained and a significance (p) of 0.000 (p <0.05) which means significant. This shows that there is a significant influence of arm muscle strength on the ability to pass the ball through the motivation of students of SMAN 21 Makassar.

Hypothesis 7: There is an influence of eye-hand coordination on the ability to pass the ball through the motivation of students of SMAN 21 Makassar.

Based on the results of the analysis obtained in the table, it shows that the coefficient value ß and significance (p) of the arm muscle strength variable on the ability to pass under the ball through motivation are obtained from the product of the ß and p values between the arm muscle strength variables on motivation and the ß and p values between the motivation variables on the ability to pass under the ball and the correlation coefficient so that a coefficient value of 0.681 x 0.454 = 0.309 is obtained and a significance (p) of 0.000 (p <0.05) which means significant. This shows that there is a significant influence of eye-hand coordination on the ability to pass the ball through the motivation of students of SMAN 21 Makassar.

Discussion

Based on the statistical analysis and hypothesis testing that have been carried out, the following is an interpretation of the research results:

The Effect of Arm Muscle Strength on Motivation

The results of the analysis show that arm muscle strength has a significant effect of 29.3% on the motivation of students at SMAN 21 Makassar. This finding indicates that good arm muscle strength contributes to increasing student motivation in volleyball activities. Students with adequate arm muscle strength tend to have higher self-confidence in carrying out volleyball skills, thereby increasing students' motivation to participate in the game. In the context of sports biomechanics, dynamic arm muscle strength facilitates the movement and transfer of the ball in the underhand passing technique, which then plays a role in strengthening psychological aspects, including motivation. Students who can generate adequate power when performing underhand passes have a higher experience of success, which in turn increases students' intrinsic motivation.

Research conducted by Saputra et al. (2021) supports this finding by demonstrating a positive relationship between arm muscle strength and psychological aspects, including motivation in adolescent volleyball athletes. Students found that a 25% increase in arm muscle strength correlated with an 18.7% increase in intrinsic motivation scores, indicating the important role of physical components in building sports motivation.

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Effect of Eye-Hand Coordination on Motivation

Data analysis shows a substantial effect of eye-hand coordination on motivation, with a contribution of 68.1%. This is the highest percentage among all variables studied, indicating that eye-hand coordination is a dominant factor in shaping students' motivation to participate in volleyball activities. Effective eye-hand coordination allows students to integrate visual information with motor responses appropriately. The ability to combine these two elements provides a consistent experience of success, increases enjoyment in playing, and strengthens motivation to continue practising and developing volleyball skills.

This finding is in line with the results of a study by Widhiandoko et al. (2023), which revealed that eye-hand coordination has a significant correlation with the level of intrinsic motivation ($r = 0.74$, $p < 0.01$) in adolescent volleyball players. Students found that athletes with superior eye-hand coordination showed higher levels of enjoyment, perception of competence, and motivation in sports participation, confirming the causal relationship between coordinative ability and psychological aspects in volleyball.

Effect of Arm Muscle Strength on Underhand Passing Ability

The results of the study confirmed the direct effect of arm muscle strength on underhand passing ability, with a contribution of 28.2% in students of SMAN 21 Makassar. Arm muscle strength is an important component in producing the force needed to control the ball when performing underhand passes. In the context of sports biomechanics, underhand passing requires dynamic (isotonic) contraction of the arm muscles to produce a controlled swing and produce the correct direction and power. Adequate arm muscle strength allows players to adjust the intensity of contact with the ball according to situational needs, resulting in more precise and consistent passing.

Research conducted by Ramadhan et al. (2022) strengthens these findings by showing a significant positive correlation between arm muscle strength and underhand passing success ($r = 0.67$, $p < 0.05$) in adolescent volleyball players. Students also found that a strength training program focused on arm muscles resulted in a 31.5% increase in underhand passing accuracy after an 8-week intervention, confirming a causal relationship between the two variables.

The Effect of Eye-Hand Coordination on Underhand Passing Ability

The analysis shows that eye-hand coordination contributes 27.4% to the volleyball underhand passing ability of SMAN 21 Makassar students. Eye-hand coordination is an important ability that allows players to process visual information about the direction and speed of the incoming ball and produce the right motor response in a short time. In the context of underhand passing skills, eye-hand coordination plays a role in positioning the body optimally, determining the right contact time, and directing the ball to the desired target. Players with good eye-hand coordination can adapt quickly to various game situations and produce more accurate and consistent passes.

A study conducted by Nurhasanah and Supriatna (2022) supports this finding by showing that eye-hand coordination is a significant predictor of underhand passing success ($\beta = 0.58$, $p < 0.01$) in high school volleyball players. Students also found that 12

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weeks of systematic coordination training resulted in a 34.2% increase in underhand passing accuracy, confirming the importance of developing eye-hand coordination in a volleyball training program.

Influence of Motivation on Underhand Passing Ability

The results showed that motivation has a significant influence on volleyball underhand passing ability, with a contribution of 45.4%. This is the highest percentage among the variables that directly affect underhand passing ability, indicating the crucial role of psychological factors in mastering technical skills. High motivation encourages students to exert maximum effort in training, maintain concentration, and demonstrate resilience in the face of difficulties. Students with high motivation tend to be more persistent in improving their techniques and improving their underhand passing performance. Motivation also affects the quality of training and mental readiness, which in turn contributes to mastery of technical skills.

This finding is consistent with the research of Yuliawan and Sugiyanto (2023), which identified motivation as a strong predictor of basic volleyball technical performance, including underhand passing ($r = 0.69$, $p < 0.01$) in young athletes. A longitudinal study of students showed that a one-semester motivation-enhancing intervention resulted in a significant increase in underhand passing quality of 37.8% compared to the control group, confirming the substantial contribution of psychological aspects to motor skill development in the context of volleyball.

The Effect of Arm Muscle Strength on Underarm Passing Ability through Motivation

Path analysis showed an indirect effect of arm muscle strength on underarm passing ability through motivation of 13.3%. Although this percentage is lower than the direct effect, this finding underscores the role of motivation as a mediator in the relationship between arm muscle strength and underarm passing ability. Adequate arm muscle strength provides the physical foundation needed to perform underarm passing techniques well, which in turn increases students' experience of success and perception of competence. This increase in perception of competence contributes to increased motivation, which in turn encourages students to put in more effort in developing their underarm passing skills.

Research by Hidayat and Pratama (2021) supports this finding by demonstrating that arm muscle strength indirectly affects underarm passing ability through increased self-efficacy and motivation (indirect effect = 0.23, $p < 0.05$) in adolescent volleyball players. The students found that the mediation model that included psychological aspects explained the variance in underarm passing ability more comprehensively than the direct effect model, confirming the complexity of the relationship between physical components and technical skills in sports.

Effect of Eye-Hand Coordination on Underhand Passing Ability through Motivation

The results of the path analysis showed that eye-hand coordination had an indirect effect on underhand passing ability through motivation of 30.9%. This is the highest percentage for an indirect effect, indicating the important role of interaction between eye-hand coordination and motivation in the development of underhand passing skills.

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Good eye-hand coordination allows students to efficiently integrate visual input and motor responses, resulting in consistent, successful experiences in performing underhand passes. These successful experiences strengthen perceptions of competence and enjoyment in the activity, which in turn increase intrinsic motivation. This increase in motivation then encourages students to invest greater effort in improving their underhand passing techniques.

This finding is in line with the research of Puspitasari and Winarno (2022), which revealed that eye-hand coordination affects volleyball technical ability through increasing intrinsic motivation and sport commitment ($\beta = 0.42$, $p < 0.01$) in young athletes. An experimental study of students showed that a training program integrating coordination development with motivational enhancement strategies resulted in greater improvements in underarm passing ability (43.7%) than a program focusing only on coordination development (27.2%), confirming the synergistic effect of the interaction between physical and psychological components in sports skill development.

CONCLUSION

1. There is a significant direct effect of arm muscle strength on the motivation of students of SMAN 21 Makassar.
2. There is a significant direct effect of eye-hand coordination on the motivation of students of SMAN 21 Makassar.
3. There is a significant direct effect of arm muscle strength on the ability to pass under the volleyball in students of SMAN 21 Makassar.
4. There is a significant direct effect of eye-hand coordination on the ability to pass under the volleyball in students of SMAN 21 Makassar.
5. There is a significant direct effect of motivation on the ability to pass under volleyball in students of SMAN 21 Makassar.
6. There is a significant effect of arm strength on the ability to pass under the volleyball through the motivation of students of SMAN 21 Makassar.
7. There is a significant effect of eye-hand coordination on the ability to pass under a volleyball through the motivation of students of SMAN 21 Makassar.

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