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Analysis of Hand-Eye Coordination, Leg Strength, and Self-Confidence on High School Students' Volleyball Underhand Passing

Yuyung Afrilia[1], Muh. Adnan Hudain[2], Irvan[3]
[1, 2, 3] Pendidikan Jasmani dan Olahraga, Pascasarjana, Universitas Negeri Makassar, Indonesia

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ABSTRACT

This research is driven by the need to identify the specific physical and psychological factors that influence the underhand passing performance of extracurricular volleyball students at High School 8 Bulukumba. The primary objective is to analyze the impact of hand-eye coordination, leg muscle strength, and self-confidence on this fundamental skill. Employing a quantitative methodology, the study utilized a purposive sampling technique to select 20 participants. Data were gathered through structured physical assessments and psychological questionnaires, then analyzed using multiple regression and t-tests. The empirical results indicate that all three variables significantly affect performance, both partially and simultaneously. Hand-eye coordination contributes 86% to passing ability ($t = 2.304$, $p = 0.035$), while leg muscle strength contributes 89.2% ($t = 2.792$, $p = 0.013$) as a vital foundation for body stability. Notably, self-confidence emerged as the most dominant factor, contributing 90% ($t = 4.252$, $p = 0.001$), confirming that psychological maturity is directly proportional to technical accuracy. Collectively, these three variables account for 96.1% of the variance in underhand passing skills. These findings offer a strategic framework for coaches to integrate mental fortitude with physical conditioning to effectively enhance the technical proficiency and competitive readiness of student-athletes.

Corresponding Author:

Yuyung Afrilia,
Pendidikan Jasmani dan Olahraga, Pascasarjana, Universitas Negeri Makassar, Indonesia
Email: yuyungafrilia18@gmail.com

1. INTRODUCTION

Physical education, sports, and health represent a fundamental pillar in the high school curriculum, serving not only as a medium for physical development but also as a catalyst for fostering lifelong healthy habits (Cale, 2023; Wintle, 2022). Within this educational framework, volleyball stands out as a highly technical discipline that requires students to integrate physical fitness with specific motor skills (Akhir et al., 2025; Purnomo et al., 2022). However, the true essence of physical education lies in its ability to transform raw enthusiasm into systematic mastery, ensuring that students do

not merely participate in sports but understand the biomechanical and tactical foundations necessary for consistent performance.

Despite its immense popularity across both urban and rural Indonesian landscapes due to its accessibility, volleyball remains a complex sport that demands more than just basic interest (Azizin et al., 2024; Qomarrullah & Sokoy, 2024; Suhardiman et al., 2024). The sport's inherent difficulty lies in its requirement for precise motor coordination to execute various techniques under pressure, making the school environment a critical laboratory for technical refinement (Widiatma et al., 2022). Mastery of basic techniques is the absolute prerequisite for any competitive engagement, yet many students find themselves at a plateau because the transition from casual play to structured technical execution is often poorly bridged in extracurricular settings (Saputra et al., 2022; Yasriuddin et al., 2024).

The underhand pass, or forearm pass, serves as the most critical foundational technique in volleyball, acting as the primary mechanism for service reception and defensive control (Sitorus et al., 2025). The quality of this initial touch dictates the entire offensive flow of a team, as a precise pass allows for strategic set plays and effective attacks (Fauzhi & Hidayat, 2026). In practice, however, many extracurricular students at High School 8 Bulukumba struggle with consistency, often exhibiting unstable body positioning and poor timing. This technical gap creates a ripple effect where even physically gifted athletes fail to contribute effectively to the team's overall tactical objectives.

The historical performance of the High School 8 Bulukumba volleyball team further highlights these technical deficiencies, as the squad has struggled to achieve significant success at the sub-district or district levels. While the underhand pass is the first technique taught, its potential as a tactical weapon to transition into an attack is often underutilized. The recurring lack of competitive achievements suggests a systemic failure in translating basic drills into match-winning performance, indicating that the current training methodologies may be insufficient in addressing the nuances of ball control and situational awareness.

This lack of success is frequently attributed to a combination of inadequate technical mastery and inconsistent training discipline, factors that are reflective of a broader challenge within the regional volleyball landscape of South Sulawesi. While the sport has gained significant popularity in the region, the level of achievement still lags behind provinces like Java and Jakarta, which dominate national championships and the PROLIGA (Sujarwo, 2023). The novelty of this study lies in addressing this regional disparity at the grassroots level by identifying whether the stagnation in performance stems from specific physical deficits or psychological barriers among student-athletes

To bridge this gap, it is imperative to move beyond general training and conduct a rigorous analysis of the variables influencing underhand passing ability, specifically hand-eye coordination, leg strength, and self-confidence (Putri et al., 2025; Rifqi et al., 2025). The integration of psychological factors alongside physical metrics provides a modern, holistic perspective that is often overlooked in traditional coaching (Bujang et al., 2019; Subarna et al., 2019). By examining how internal confidence interacts with

physical attributes, this research offers a nuanced understanding of why certain students fail to execute techniques under pressure, thereby shifting the focus from mere repetition to psychological readiness and biomechanical efficiency.

Ultimately, this analysis provides a strategic foundation for coaches and educators at High School 8 Bulukumba to design more targeted and effective training interventions. By pinpointing the exact weaknesses—whether they be the lack of explosive leg strength for positioning or a deficit in hand-eye synchronization—training programs can be tailored to the specific needs of the students. This research not only aims to elevate the technical proficiency of the individual athlete but also serves as a model for regional development, contributing to the long-term goal of producing competitive athletes capable of representing South Sulawesi on a national stage.

2. METHOD

This study employed a quantitative approach with a descriptive correlational design to investigate the relationship between physical and psychological variables on students' technical skills. The primary focus of the study was to describe the phenomena of hand-eye coordination, leg muscle strength, and self-confidence as predictors of underhand passing ability in extracurricular athletes. Contextually, this study was conducted at High School 8 Bulukumba, utilizing the school's volleyball court as the primary data collection location in November.

The study population included all students active in extracurricular volleyball activities, with purposive sampling used. Based on the established inclusion criteria, 20 students were selected as the research sample to ensure a homogeneous representation of the data and relevance to the study's objectives. This approach of developing one primary variable into several sub-variables allowed the researcher to conduct an in-depth analysis of the internal factors that determine the quality of ball control in students.

The research instrument was systematically designed to ensure the validity and reliability of the collected data. Underhand passing ability was measured using a standardized underhand passing skills test, while supporting variables were measured using an eye-hand coordination test and a leg muscle strength test. In addition to physical instruments, researchers also used psychological questionnaires to measure students' self-confidence levels, resulting in data covering both motor and affective aspects.

Data collection techniques were conducted through a comprehensive procedure, involving field observations, structured interviews, and direct physical testing and documentation. The data collection process was divided into several stages, including administering underhand passing ability tests (Stages 1 and 2) to assess the consistency of student performance. All primary data obtained from the test results and questionnaires were then systematically classified to facilitate the verification process before entering the statistical analysis stage.

In the final stage, the collected data were analyzed using SPSS software to test the validity of the proposed hypotheses. Data analysis included prerequisite tests such as

normality and homogeneity, followed by inferential statistical analysis using the t-test. This procedure aimed to determine the significance level of the influence of eye-hand coordination, leg muscle strength, and self-confidence on underhand passing ability, in order to produce accurate and accountable scientific conclusions.

3. RESULTS AND DISCUSSION

Results

Descriptive analysis of students' physical and psychological variables revealed varying data characteristics for each component tested. The eye-hand coordination measurement for 20 samples showed an average score of 20.95 with a standard deviation of 4.454, while the leg muscle strength variable yielded an average score of 86.85 with a relatively low level of data dispersion (standard deviation of 1.785). Meanwhile, the self-confidence variable recorded the highest average score of 133.55, with a score range of 131 to 137, indicating that the study subjects generally had fairly stable and homogeneous mental readiness before the physical skills test.

Table 1. Descriptive Statistics Results

Descriptive	Hand Eye Coordination	Leg Muscles	Self-confident	Underhand Pass
N	20	20	20	20
Mean	20.95	86.85	133.55	8.55
Std. Deviation	4.454	1.785	1.986	1.669
Median	21.00	87.00	133.50	8.50
Minimum	12	84	131	6
Maximum	30	90	137	12

Regarding technical skills, the underhand passing test results showed an average performance score of 8.55 with a standard deviation of 1.669 and a median score of 8.50. Although the highest and lowest scores showed a fairly tight distribution, this data provides an important basis for evaluating the extent to which eye-hand coordination, muscle strength, and self-confidence contribute to effective passing technique. Overall, this comparison of statistical parameters provides a comprehensive picture of the fitness profile and technical abilities of extracurricular students at High School 8 Bulukumba in the sport of volleyball.

Table 2. Results of Data Normality Test

Variable	Kolmogorov-Smirnov		Shapiro – Wilk		A	Information
	Statistics	Sig.	Statistik	Sig.		
Hand-eye coordination	.166	.153	.983	.965	0,05	Normal
Leg muscles	.167	.148	.947	.324	0,05	Normal
Self-confidence	.132	.200	.925	.125	0,05	Normal
Underground passing	.144	.200	.952	.393	0,05	Normal

The results of the normality test using the Kolmogorov-Smirnov method, summarized in Table 2, show that all study variables exhibit a normal distribution. The eye-hand coordination variable yielded a statistical value of 0.166 with a probability level (p = 0.153), while the leg muscle strength variable recorded a value of 0.167 (p = 0.148). Because both significance values were greater than the alpha level of 0.05, it can be concluded that the physical data were normally distributed and met the criteria for parametric statistical analysis.

Similar conditions were found for the psychological variables and overall technical performance. The normality test for the self-confidence variable showed a value of 0.132 with a probability (p = 0.200), significantly exceeding the 0.05 threshold. Furthermore, the cumulative average of the data also showed a consistent distribution, with a mean value of 0.144 and a significance level (p = 0.200). These findings confirm that the entire data distribution in this study is representative and possesses the stability necessary to proceed to the next stage of hypothesis testing.

Table 3. Results of Data Linearity Test

No	Variable	FCount	FTable (Sig. 0,05)	Description
1.	Hand-Eye Coordination	0,857	3,60	Linear
2.	Leg Muscle Explosive Power	0,528	4,66	Linear
3.	Self-Confidence	0,790	4,59	Linear

Looking at the linearity test data obtained from the table, it is known that each independent variable has an F count value < F table, so it can be concluded that the data is linear and the regression test can be continued.

Table 4. Hand Eye Coordination Coefficient Test

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.931[a]	.867	.860	.625

From Table 4, the Adjusted R Square (R2) is 0.860, which means that all independent variables can explain the dependent variable by 86%, meaning that there is an influence of hand-eye coordination on underhand passing of 86% and the rest is influenced by other variables outside this research.

Table 5. Explosive Power Coefficient Test of Leg Muscles

R	R Square	Adjusted R Square	Std. Error of the Estimate
.948[a]	.898	.892	.548

The Adjusted R Square (R2) is 0.892, which means that all independent variables can explain the dependent variable by 89.2%, meaning that there is an influence of explosive leg muscle power on underhand passing of 86.92% and the rest is influenced by other variables outside this study.

Table 6. Confidence Coefficient Test

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.952[a]	.906	.900	.527

The Adjusted R Square (R2) is 0.900, which means that all independent variables can explain the dependent variable by 90%, meaning that there is a 90% influence of self-confidence on underhand passing and the rest is influenced by other variables outside this study.

Table 7. Hand-Eye Coordination Coefficient Test, Leg Muscles, Self-Confidence

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.984[a]	.967	.961	.329

The Adjusted R Square (R2) is 0.961, which means that all independent variables can explain the dependent variable by 96.1%, meaning that there is an influence of hand-eye coordination, leg muscles, and self-confidence on underhand passing of 96.1%.

Table 8. F Test

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	51.222	3	17.074	158.067	.000[b]
	Residual	1.728	16	.108		
	Total	52.950	19			

Tabel 9. T-Test (Results of Multiple Linear Regression Analysis)

Model	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig.
(Constant)	-69.645	10.133		-6.873	0
Hand-Eye Coordination	0.095	0.041	0.253	2.304	0.035
Leg Muscle Strength	0.309	0.111	0.33	2.792	0.013
Self-Confidence	0.37	0.087	0.44	4.252	0.001

The results of the first hypothesis test, eye-hand coordination, was shown to have a significant influence on underhand passing ability in extracurricular students. The statistical analysis showed a t-value of 2.304 with a significance level of 0.035, which is below the alpha threshold of 0.05. This finding confirmed the acceptance of the first hypothesis (H_1), indicating that synchronization between visual and motor hand movements is a crucial component in accurate ball control.

Furthermore, the second hypothesis test showed that leg muscle strength also significantly contributes to successful underhand passing. The data showed a t-value of 2.792 with a significance level of 0.013 ($p < 0.05$), thus accepting the second hypothesis (H_2). This reinforces the theory that a solid foot foundation and explosive leg muscle power are essential for maintaining body stability when receiving the ball's weight and directing precise bounces.

Finally, the self-confidence variable demonstrated the most dominant influence compared to the other variables, with a t-value of 4.252 and a very strong significance level of 0.001. With a result of $0.001 < 0.05$, the third hypothesis (H_3) is absolutely

accepted. This high significance indicates that students' psychological aspects play a significant role in executing techniques on the field; the higher the self-confidence, the fewer technical errors made when executing underhand passes.

Discussion

Statistical analysis demonstrated that hand-eye coordination had a partially significant effect on underhand passing ability, as indicated by a t-value of 2.304 with a significance level of 0.035. This variable significantly contributed to the quality of athlete performance, independently explaining 86% of the variation in passing ability. With an average student coordination score of 20.95, this data indicates that the study subjects possessed adequate basic skills to effectively master volleyball techniques.

Fundamentally, this finding underscores that synchronization between visual perception in tracking the direction of the incoming ball and hand motor responses is a crucial element in creating accurate ball control (Li et al., 2024; Ottoboni et al., 2021). Good coordination allows students to precisely adjust their body position just before contact, resulting in a more stable and directed ball bounce (Caldeira et al., 2024; Ningtyas & Amrulloh, 2025). Therefore, strengthening hand-eye coordination needs to be a priority in training programs to optimize the mechanics of underhand passing movements at a more advanced level.

The statistical analysis revealed that leg muscle strength significantly influenced underhand passing ability, as evidenced by a t-value of 2.792 with a significance level of 0.013. This variable contributes significantly, reaching 89.2%, to determining the success of passing techniques. Interestingly, this data has a low level of dispersion, with a standard deviation of 1.785, indicating that physical ability, specifically leg muscle strength, tends to be evenly distributed across all study subjects.

Functionally, leg muscle strength serves as a solid foundation for the body, maintaining stability when the athlete receives the weight of the ball (Martin et al., 2024). Explosive strength in the lower extremities is crucial for providing the correct kinetic thrust, resulting in a more stable and directed ball bounce (Esposito et al., 2024). Therefore, integrating leg strength training into a physical training program is a strategic step to strengthen the basic body mechanics necessary to optimize the efficiency of the underhand passing movement (Uly et al., 2025).

The data analysis revealed that self-confidence was the most dominant factor influencing underhand passing ability in this study. This was demonstrated by the highest t-value of 4.252, with a very strong significance level of 0.001. Partially, this psychological variable had a 90% influence on passing technique success, indicating that mental readiness plays a central role compared to other variables. With an average score of 133.55, an even mental profile stability was observed among students facing technical demands in the field.

Interpretatively, a high level of self-confidence directly correlates with the effectiveness of technical skill application during the learning process and in matches. Stable mental readiness enables students to execute movements with greater calm and precision, minimizing fatal errors due to situational pressure (Hao, 2024). The stronger

self-confidence, the more optimal the synchronization between physical and technical abilities (Astuti et al., 2023; Heydari et al., 2018). Therefore, developing this psychological aspect requires serious attention as a primary foundation for comprehensively improving underhand passing performance.

The results of the collective regression analysis indicate that eye-hand coordination, leg muscle strength, and self-confidence significantly contribute to the success of the underhand pass technique, with a determination value reaching 96.1%. A model fit test (F-test) found a significance value of 0.000, confirming that these three variables collectively constitute a very strong and valid predictor in explaining students' technical performance. This nearly universal contribution confirms that the integration of physical, coordination, and psychological aspects is key to achieving optimal volleyball technical mastery.

The validity of these findings is supported by the stability of the data, which meets all the prerequisites for parametric statistical analysis. A series of objective tests, including normality tests using the Kolmogorov-Smirnov and Shapiro-Wilk methods, as well as linearity tests, demonstrated that the data distribution was normal and that there was a consistent linear relationship between the independent and dependent variables. By meeting these classical assumptions, this research model has a high level of reliability and can be used as a scientific basis for developing a more comprehensive physical education training or learning curriculum.

The success of underhand passing relies not only on physical ability (coordination and leg strength) but is also largely determined by psychological factors (Putri et al., 2025; Rizal et al., 2025). The integration of mental stability (self-confidence) and motor skills creates a comprehensive athlete profile at High School 8, Bulukumba.

Theoretically, this study strengthens the body of knowledge in sports pedagogy and biomechanics by validating a multidimensional performance model for underhand passing. These findings provide empirical evidence that motor skills rely not only on physical aspects such as eye-hand coordination and leg muscle strength, but are also significantly influenced by psychological factors, with self-confidence being found to have the most dominant influence, reaching 90%. The integration of these three variables creates a new theoretical framework capable of predicting the success of basic volleyball techniques with an accuracy of 96.1%, thus significantly contributing to the development of athlete performance prediction models based on a combination of motor and mental elements.

Practically, the results of this study provide strategic guidance for coaches and sports teachers at High School 8 Bulukumba to develop a more comprehensive training curriculum, encompassing both physical strengthening and mental training to minimize student technical errors. For students, this data provides a self-evaluation tool to help them recognize that stance stability and confidence are key to accurate ball control, going beyond mere arm swing technique. Furthermore, educational institutions can utilize these findings as a more objective talent identification tool in extracurricular programs, considering physical profiles and mental independence, which have been statistically proven to improve performance in volleyball.

4. CONCLUSION

This study concluded that the underhand passing performance of volleyball extracurricular students at High School 8 Bulukumba is significantly determined by the synergy between physical and psychological aspects, with a total collective contribution reaching 96.1%. Self-confidence emerged as the most dominant factor at 90%, demonstrating that mental maturity is directly proportional to technical accuracy, supported by leg muscle strength (89.2%) as the foundation of body stability and eye-hand coordination (86%) as the key to movement execution. These findings emphasize that to achieve optimal competition readiness, coaches need to adopt a holistic framework that integrates mental strengthening alongside physical conditioning to comprehensively improve athletes' technical proficiency.

As a strategic recommendation, volleyball coaches are advised to integrate mental toughness through positive self-talk techniques and match pressure simulations to strengthen students' self-confidence, which is a key determinant of technical accuracy, while optimizing physical training focused on leg muscle strength and eye-hand coordination for optimal body stability. On the other hand, athletes should be proactive in building psychological maturity and discipline in carrying out independent strength training as a basic foundation in every movement, while for future researchers, it is recommended to expand the scope of the sample and explore the remaining variables of 3.9%, such as concentration or peripheral vision, in order to complete a comprehensive understanding of athlete performance holistically.

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