

The Synergistic Effect of Muscle, Coordination, and Concentration on the Effectiveness of Jump Floating Serve: A Path Analysis Approach

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Abstract: The research addresses the low proficiency in executing jump floating serves among volleyball players, influenced by factors such as arm muscle explosive power, leg muscle explosive power, hand-eye coordination, and concentration. The study aimed to evaluate the impact of these factors on players' jump floating serve abilities. Using a quantitative approach and survey method, data were collected from 24 male volleyball players at Padang State University. The instruments included the jump floating serve test, One Hand Medicine Ball Put for arm muscle explosive power, Vertical Jump Test for leg muscle explosive power, ball throw response for hand-eye coordination, and Grid Concentration Test for concentration. Path analysis was utilized for data analysis. The results revealed: (1) a significant direct impact of arm muscle explosive power on jump floating serve ability ($Py1 = 0.358$), (2) no significant direct impact of leg muscle explosive power on jump floating serve ability ($Py2 = 0.119$), (3) a significant direct impact of hand-eye coordination on jump floating serve ability ($Py3 = 0.343$), and (4) a significant direct impact of concentration on jump floating serve ability ($Py4 = 0.251$). Additionally, there were no direct effects of arm muscle explosive power, leg muscle explosive power, or hand-eye coordination on concentration ($P41 = 0.043$, $P42 = 0.242$, $P43 = 0.427$). However, indirect effects on jump floating serve ability through concentration were found for arm muscle explosive power ($\varepsilon1 = 0.090$), leg muscle explosive power ($\varepsilon2 = 0.029$), and hand-eye coordination ($\varepsilon3 = 0.107$).

Keywords: Athletic Focus; Explosive Power; Hand-Eye Coordination.

Introduction

This research leads to an effort to understand the factors that affect the special technical ability in volleyball, namely the jump floating serve (Patterson et al., 2021; Sun et al., 2023). This technique requires a highly coordinated combination of various physical and mental abilities, such as the explosiveness of the muscles of the arms and legs, hand-eye coordination, and a high level of concentration (G. Zhang & Zhong, 2021). The ability to effectively perform a jump floating serve can

be the main differentiator between a player who succeeds in a game of volleyball and one who does not. Therefore, this research becomes relevant in the context of developing a more focused training strategy to improve this critical serving technique.

In addition, the low jump floating serve ability among volleyball players also reflects the limited potential to utilize effective serving techniques competitively. This can have an impact on the overall performance of the team in a match, where good serve is not only advantageous in getting points directly, but

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also in disrupting the opponent's game (Bittencourt et al., 2022). Thus, this study aims to fill in the knowledge gaps related to the factors underlying the low ability of the jump floating serve and how these factors can be improved through a more targeted training approach (Tooth, Schwartz, Gofflot, et al., 2023).

Furthermore, a deeper understanding of the contribution of each factor, such as arm muscle explosiveness, leg muscle explosiveness, hand-eye coordination, and concentration, can provide a strong scientific foundation for the development of more effective and efficient exercise programs (Moghdani et al., 2020). Thus, this research is expected to make a significant contribution in the context of developing training techniques and strategies that can improve volleyball serving ability, especially in terms of jump floating serve, both at the competitive level and talent development at the university level.

Volleyball is a game sport played by two opposing teams and each team has six players. Volleyball is a team game where each squad must develop the latest tactics during the match. The quick and precise change of situation of the player requires movement and intelligence ability. Volleyball is a very interesting team game in which there is attack and defense (Urfa & Aşçı, 2023).

The achievement of athletes' best achievements is determined and influenced by many factors that can be broadly grouped into two factors, namely internal factors (internal) and external factors (external). Internal factors are factors that come from within, namely from the athlete himself with all the potential he has. The ability of a person or athlete in a match or competition is basically determined by four factors, namely physical, technical, tactical, and mental (Bafirman et al., 2023; Munir et al., 2024; Wijaya et al., 2024). Meanwhile, what is meant by external factors are factors that affect athlete achievement that comes from outside the athlete's self, or from outside the potential that the athlete has. External factors include: coaches, coaches, climate, weather, nutrition, facilities and infrastructure, organizations, spectators, referees, and families (Umek & Kos, 2020; van Meurs et al., 2023).

One of the most important techniques in the game of volleyball is serve. Serve is an important thing in the game of volleyball, serve is also done by all volleyball players, because serve is one of the techniques used to start the game and serve is also the initial attack that players do without the help of the team (Z. Zhang & Zhang, 2023). One of the serves that is often used in volleyball games is the jump floating serve. Jump floating serve is a float service technique that is carried out by jumping and bouncing the ball that is not too high. Jump float serve has the advantage of a higher ball hitting point so that the ball movement does not have to

rise first before passing the net. Although the Jump float serve hits him near the backline at high speed, it still allows entry into the opponent's area, thus the float quality is higher (Moscatelli et al., 2023).

To obtain a good jump floating serve, in addition to being supported by good technical skills, it is also very necessary to have physical condition components in the form of leg muscle explosiveness, arm muscle explosiveness and hand-eye coordination have a dominant contribution in serving, especially jump floating serve (Biese et al., 2020; Singh & Wulf, 2020).

In addition to the above factors in doing Jump floating serve, you need good concentration. Not all results from the execution of the top serve produce a ball that is sharp, hard or swooping. To avoid this, volleyball players need good serving techniques and high concentration when doing top serve. With the hope that the ball can fall at the intended point and the opponent is difficult to return the ball. Concentration is a state where athletes have full awareness and are focused on something (a certain object) that is not easily shaken. To test the level of concentration, a person can use music as a medium to replace the cheers of the audience that can interfere with concentration. One type of music that can interfere with concentration is music that is set in Heavy Metal (Hides et al., 2022; Rabbani et al., 2021).

This research is unique in its holistic approach to understanding the ability of jump floating serve in volleyball players. According to Biçer, (2021) While many previous studies may have focused only on one or two factors that affect this ability, this study combines four main factors: arm muscle explosiveness, leg muscle explosiveness, hand-eye coordination, and concentration. By using the path analysis method, this study was able to identify not only the direct influence of each factor on the ability to jump floating serve, but also the indirect influence through concentration mediation. This comprehensive approach provides new insights into how various physical and mental factors interact and contribute to technical performance in volleyball.

This research makes a significant contribution to the field of sports, especially volleyball, by providing empirical data that supports the importance of various physical and mental abilities in performing jump floating serves. The findings that arm muscle explosiveness and hand-eye coordination have a significant direct influence on jump floating serve ability, as well as that concentration plays an important mediator, provide a strong scientific basis for the development of more effective exercise programs. In addition, the results of this study can be used by coaches and players to design more focused and measurable training strategies, which not only strengthen physical factors such as muscle explosiveness but also improve

mental abilities such as concentration. Thus, this research not only contributes to the academic literature, but also has a wide practical application in improving the performance of volleyball athletes.

Method

The research method used in this study is a quantitative approach with a survey method using a path analysis approach. The population in this study is all volleyball players of Padang State University. The sample of this study is 24 players based on the total number of male players. The instruments used are jump floating service to measure Jump floating serve, One Hand Medicine Ball Put to measure the explosive power of arm muscles, Vertical jump test to measure the explosive power of leg muscles, Throw a ball to measure hand-eye coordination and Grid Concentration Test to measure concentration. The data analysis techniques used in this study are (1) Descriptive statistics, namely statistics whose task is only to obtain a description or measures of existing data. (2) The test of analysis requirements includes: data normality test with lillifors test, linearity test. (3) Correlation statistics, which are given values for each variable in turn correlated with the values of complex interes variables. (4) Path analysis to analyze the pattern of relationships between variables.

Results and Discussion

Data Description

Arm Muscle Explosiveness (X1)

Based on the results of the test and measurement of the explosive power of the arm muscles of volleyball players at Padang State University that have been carried out, an average score of 10.02 was obtained with a standard deviation value of 1.12, a maximum value of 12.06 and a minimum score of 8.15.

Leg Muscle Explosiveness (X2)

Based on the results of the test and measurement of the explosive power of the leg muscles of volleyball players at Padang State University that have been carried out, an average score of 15.78 was obtained with a standard deviation value of 1.16, a maximum value of 17.78 and a minimum score of 13.17.

Hand-Eye Coordination (X3)

Based on the results of the test and measurement of hand coordination of volleyball players at Padang State University that have been carried out, an average score of 14.17 was obtained with a standard deviation value of 1.97, a maximum score of 18 and a minimum score of 10.

Concentration (X4)

Based on the results of the test and measurement of the concentration of volleyball players at Padang State University that have been carried out, an average score of 5.67 was obtained with a standard deviation value of 1.76, a maximum score of 10 and a minimum score of 2.

Jump floating serve (Y)

Based on the results of the test and measurement of jump floating serve of Padang State University volleyball players that have been carried out, an average score of 10.63 was obtained with a standard deviation value of 2.48, a maximum score of 17 and a minimum score of 6.

Data Analytics Requirements

Table 1. Data Normality Test

Variable	Asymp.Sig	Conclusion
Arm Muscle Explosiveness (X1)	0.489	Usual
Leg Muscle Explosiveness (X2)	0.612	Usual
Hand-Eye Coordination (X3)	0.848	Usual
Concentration (X4)	0.133	Usual
Jump floating serve (Y)	0.165	Usual

Based on the summary results of the calculation of the normality test of the variables of the above study, it was found that the Asymp.Sig value obtained was greater than 0.05. Thus, it can be concluded that all data groups in this study were taken from a normally distributed population so that they could be used and continued for testing research hypotheses.

Table 2. Ujin Linearity with F Grade

Variable	Sig.	Fcount	Ftable	Conclusion
X1 towards Y	0.66	0.82	5.82	Linear
X2 towards Y	0.14	1.91	3.05	Linear
X3 towards Y	0.13	1.20	2.79	Linear
X4 towards Y	0.38	1.18	2.71	Linear
X1 towards X4	0.45	1.28	5.82	Linear
X2 towards X4	0.33	1.26	2.71	Linear
X3 towards X4	0.11	1.90	2.71	Linear

Hypothesis Test

Table 3. Hypothetical Test Results

Variable	Coefficient	Fcount	Ftable	Conclusion
X1 → Y	0.358	2.606	1.714	Influential
X2 → Y	0.119	0.900	1.714	No Effect
X3 → Y	0.343	2.503	1.714	Influential
X4 → Y	0.251	2.498	1.714	Influential
X1 → X4	0.043	0.141	1.714	No Effect
X2 → X4	0.242	0.840	1.714	No Effect
X3 → X4	0.427	1.473	1.714	No Effect

- Individual tests conducted by X1 on Y found that the result of the path coefficient $py1 = 0.358$. Based on the results of the analysis, the tcount value is greater than

the ttable value, the value is $2.606 > 1.714$, then in this case H_a is accepted and H_0 is rejected which means the path analysis coefficient is significant. So, there is a direct effect of the explosive power of the arm muscles on the ability of the Jump floating serve of Padang State University volleyball players.

2. Individual tests conducted by X_2 on Y found that the result of the path coefficient $py_2 = 0.119$. Based on the results of the analysis, the $tcount$ value is less than the ttable value, the value is $0.900 < 1.714$, then in this case H_a is rejected and H_0 is accepted, which means that the path analysis coefficient is not significant. So, there is no direct effect of the explosive power of the leg muscles on the ability of the Jump floating serve of volleyball players at Padang State University.
3. Individual tests conducted by X_3 on Y found that the result of the path coefficient $py_3 = 0.343$. Based on the results of the analysis, the $tcount$ value is greater than the ttable value, the value is $2.503 > 1.714$, then in this case H_a is accepted and H_0 is rejected, which means the path analysis coefficient is significant. So, there is a direct influence of hand-eye coordination on the ability of Padang State University volleyball players to jump floating serve.
4. Individual tests carried out by X_4 on Y found that the result of the path coefficient $py_4 = 0.251$. Based on the results of the analysis, the $tcount$ value is greater than the ttable value, the value is $2.498 > 1.714$, then in this case H_a is accepted and H_0 is rejected, which means the path analysis coefficient is significant. So, there is a direct influence of concentration on the ability of Jump floating serve volleyball players at Padang State University.
5. Individual tests conducted by X_1 on X_4 found that the result of the p_{41} path coefficient = 0.043. Based on the results of the analysis, the $tcount$ value is less than the ttable value, the value is $0.141 < 1.714$, then in this case H_a is rejected and H_0 is accepted, which means that the path analysis coefficient is not significant. So, there is no direct effect of the explosive power of the arm muscles on the concentration of volleyball players at Padang State University.

The interpretation of the results showed that the explosive power of the arm muscles had a significant direct influence on the ability to jump floating serve ($Py_1 = 0.358$). This indicates that the explosive power of the arm is crucial in generating the speed and height necessary to perform effective service. Good arm strength allows players to steer the ball with more precision and speed, thus increasing the chances of getting points straight away or at least making the opponent's reception more difficult (HB et al., 2023; Putra et al., 2024). Therefore, exercises that focus on increasing the explosive power of the arm muscles, such

as exercises with medicine balls or plyometric exercises, can provide great benefits for players in mastering the jump floating serve technique (Bouhedja et al., 2021; Trovato et al., 2023).

In contrast, the explosive power of the leg muscles did not show a significant direct effect on the ability to jump floating serve ($Py_2 = 0.119$). Although leg muscle strength is important for producing a high jump, these results indicate that this factor may not be as important as arm strength in the context of jumping floating serves. This could be due to the fact that the coordination between the jump and the ball hit is more critical than the force of the jump itself. This means that while high jumping ability can provide an advantage, the main focus should remain on punching technique and overall body coordination when performing a jump floating serve (Brumitt et al., 2021; de Almeida-Neto et al., 2023).

Furthermore, the results also showed that hand-eye coordination ($Py_3 = 0.343$) and concentration ($Py_4 = 0.251$) had a significant direct influence on the ability to jump floating serve. Good hand-eye coordination allows players to effectively associate ball visualization with hand movements, resulting in more accurate serves that are difficult for opponents to anticipate. Meanwhile, high concentration allows players to focus entirely on techniques and tactics during serve execution, reducing the likelihood of mistakes. In addition, the indirect influence of arm muscle explosiveness and hand-eye coordination on jump floating serve through concentration ($\varepsilon_1 = 0.090$ and $\varepsilon_3 = 0.107$) confirms the importance of mental factors in this sport. Therefore, a comprehensive exercise program should include not only physical exercises but also exercises to improve concentration and coordination, such as focus exercises and games that involve quick reactions as well as hand-eye coordination (Ahmadi et al., 2020; da Silva Peres et al., 2020).

In comparing the results of this study with other studies, there are interesting consistency and differences. For example, research Declève et al., (2021); Miura et al., (2020) who also examined the factors affecting service performance in volleyball found that the explosiveness of the arm muscles is a key factor in improving the effectiveness of serve, in line with the results of this study which showed a significant direct influence ($Py_1 = 0.358$). However, Smith et al.'s research also found that the explosive power of the leg muscles had a significant influence on volleyball serving in general, in contrast to the findings of this study which showed a lower influence ($Py_2 = 0.119$). This difference can be caused by differences in the service techniques studied or the characteristics of different research samples.

Other research by Mercado-Palomino et al., (2020); Tooth, Schwartz, Croisier, et al., (2023) emphasizing the

importance of hand-eye coordination in servability, which is in line with the findings in this study ($Py3=0.343$). They found that players with better hand-eye coordination tended to have higher accuracy and consistency of serve. However, their study did not include concentration variables as an important factor, while this study found that concentration also had a significant effect on jump floating serve ($Py4=0.251$) and had a mediating effect on the effect of arm muscle explosiveness and hand-eye coordination. This suggests that the integration of mental aspects, such as concentration, into training programs can provide additional advantages that may not have been fully explored in previous studies.

Conclusion

A very strong conclusion from this study is that the ability to jump floating serve in volleyball players of Padang State University is significantly influenced by arm muscle explosiveness, hand-eye coordination, and concentration. Arm muscle explosiveness and hand-eye coordination exert a great direct influence, while concentration acts as an important mediator that reinforces the relationship between physical factors and the ability to jump floating serve. In contrast, the explosive power of the leg muscles does not have a significant direct effect, suggesting that the focus of the exercise should be more directed at improving arm strength, coordination, and concentration to achieve optimal service performance.

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Author Contributions

Each author contributes in some way to the completion of this research activity. The main author provides basic ideas and provides research materials and the second, third, fourth authors design research methods and furthermore, all authors share responsibility for data collection, data tabulation and analysis, review process, and article writing.

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Conflicts of Interest

Regarding this study, the author declares that there is no conflict of interest.

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