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Psychomotor skill variations among university-level volleyball players: A comparative analysis of setters, hitters, and liberos

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Abstract

This study explores the differences in psychomotor abilities among university-level volleyball players across different playing positions: setters, hitters, and liberos. Psychomotor abilities such as kinesthetic perception, speed of movement, and response time are critical for volleyball performance. Using the Horizontal Space Test, Nelson Speed of Movement Test, and Four-Way Alternate Test, we assessed these abilities in a sample of 60 players. ANOVA results revealed significant differences in kinesthetic perception and response time, with setters outperforming hitters and liberos, while no significant differences were observed in speed of movement. These findings underscore the need for position-specific training to enhance performance. The study contributes valuable insights for coaches and trainers in optimizing training regimens tailored to the distinct psychomotor demands of each playing position.

Keywords: Psychomotor abilities, kinesthetic perception, speed of movement, response time, volleyball players, playing positions, university-level athletes

Introduction

The study of psychomotor abilities among athletes is crucial for understanding how different physical and cognitive skills impact performance across various sports. Psychomotor abilities, such as kinesthetic perception, speed of movement, and response time, play a significant role in the performance of volleyball players, particularly given the sport's high demands for precision, agility, and quick reflexes (Schmidt & Lee, 2011) ^[12]. Previous research has shown that these abilities can vary significantly among players occupying different positions on the volleyball court, such as setters, hitters, and liberos (Gabbett & Georgieff, 2007) ^[6].

Kinesthetic perception, or the ability to perceive the position and movement of the body, is critical for volleyball players to execute precise movements and maintain balance (Adams, 1971) ^[1]. Studies have indicated that enhanced kinesthetic perception is associated with better performance in tasks requiring fine motor control (Bakker *et al.*, 2011) ^[2]. Speed of movement, another essential psychomotor ability, influences a player's ability to perform rapid and accurate movements, which is particularly important in a fast-paced sport like volleyball (Miller, 2006) ^[10]. Response time, or the time it takes to react to a stimulus, is also crucial as it determines how quickly a player can respond to the dynamic play situations on the court (Schmidt *et al.*, 2018) ^[13].

The aim of this study is to explore the differences in psychomotor abilities among university-level volleyball players across different playing positions. Understanding these differences can provide valuable insights for coaches and trainers to tailor training programs that enhance the specific psychomotor skills required for each position (Koch & Kofler, 2009) ^[9]. The positions of setter, hitter, and libero have distinct roles and responsibilities that likely influence their psychomotor abilities. Setters require precise and quick hand movements to accurately set the ball for attackers, hitters need powerful and fast movements to execute spikes, and liberos require rapid and agile movements to effectively receive and defend against attacks (Rivilla-García *et al.*, 2011) ^[11].

Research has demonstrated that targeted training can significantly improve psychomotor abilities (Hoffman *et al.*, 2005) [8]. For example, specific drills designed to enhance kinesthetic perception have been shown to improve athletes' ability to judge distances and execute movements with greater accuracy (Williams *et al.*, 2011) [14]. Similarly, speed and agility drills can enhance the speed of movement and response time, leading to better overall performance (Gabbett, 2002) [6].

This study utilizes the Horizontal Space Test to measure kinesthetic perception, the Nelson Speed of Movement Test to assess speed of movement, and the Four-Way Alternate Test to evaluate response time. By comparing these psychomotor abilities among setters, hitters, and liberos, this research aims to identify significant differences that can inform training practices and contribute to the overall development of volleyball players (Cox *et al.*, 2002) [4].

In summary, the investigation of psychomotor abilities in volleyball players is essential for optimizing performance. The findings of this study are expected to provide valuable insights into how different playing positions influence these abilities and how targeted training can enhance them (Fleck & Kraemer, 2004) [5]. The study will contribute to the existing body of knowledge by offering a comprehensive analysis of the psychomotor profiles of university-level volleyball players, thereby helping coaches and trainers to design more effective training programs (Bompa & Haff, 2009) [3].

Material and Methods

Sample

The sample for the contemporary study consisted of N=60 participants, categorized into the following groups:

Group A: Setter (n1 = 25).

Group B: Hitter (n2 = 20).

Group C: Libero (n3 = 15).

Research Question

To explore the differences in psychomotor abilities (*viz.*, kinesthetic perception, speed of movement, and response time) among different playing positions of university-level volleyball players.

Method

Psychomotor Abilities

Kinesthetic Perception (Horizontal Space Test)

Kinesthetic perception was measured using the Horizontal Space Test. A yardstick was placed on the wall at eye level while the subjects were in a sitting position. The subject was seated facing the yardstick and instructed to mentally establish its position. While blindfolded and without a practice trial, the subject pointed the index finger of the right hand to the point indicated by the tester. The score was

determined by the deviation from the desired mark, measured to the nearest centimeter. The final score was the total deviation across three trials.

Speed of Movement (The Nelson Speed of Movement Test):

Speed of movement was assessed using the Nelson Speed of Movement Test. The subjects sat at a table with their hands resting on the edge, palms facing each other, with the little fingers aligned along two lines marked on the table, 12 inches apart. The tester held a timer near its top, hanging midway between the subject's palms. The score for the combined response movement was recorded from the timer at the point just above the upper edge of the hand after the catch. The average of the middle ten trials, after discarding the slowest and fastest five trials, was recorded.

Response Time (Four-Way Alternate Test)

Response time was evaluated using the Four-Way Alternate Test. The subject stood at point 'X' on the floor, facing point 'Y'. Upon the command "ready," the tester made an obvious hand movement in one of four directions. Upon receiving the signal, the subject moved in the designated direction as rapidly as possible, crossing a line 5 yards away. If the tester moved their hand up, the subject ran forward across the line; if down, the subject moved backward. If the hand moved to the side, the subject moved accordingly. The subject was given three trials, five times in each direction, in an order decided by the tester. The tester timed the movements with a stopwatch, starting at the beginning of each hand movement and stopping as soon as the subject crossed the correct line, recording the time to the nearest 1/10th second. The score was the total time for all three trials.

Sampling

The target population for this study consisted of setters, hitters, and liberos from university-level volleyball teams at colleges affiliated with Guru Nanak Dev University, Amritsar, Punjab. A convenience sampling method, also known as availability sampling, was employed. This non-probability sampling technique was chosen for its practicality and ease of access to participants.

Statistics

To compare the psychomotor abilities among the sample groups - Group A: Setters (n1=25), Group B: Hitters (n2=25), and Group C: Liberos (n3=15) - Analysis of Variance (ANOVA) was employed. The ANOVA results included calculations of the F-statistic and corresponding p-values. These statistics were used to determine whether the observed differences in means between groups were statistically significant or occurred by chance.

Results

Table 1: ANOVA data for Kinesthetic Perception

Source	SS	DF	MS	
Between-treatments	514.5984	2	257.2992	F = 17.68858
Within-treatments	829.1256	57	14.5461	
Total	1343.724	59		

The f-ratio value is 17.68858. The p-value is < .00001. The result is significant at $p < .05$. Tukey's HSD Post hoc test will be used.

Table 2: The Tukey's HSD (honestly significant difference) procedure facilitates pairwise comparisons within your ANOVA data

Pairwise Comparisons		HSD _{.05} = 2.9661 HSD _{.01} = 3.7399	Q _{.05} = 3.4032 Q _{.01} = 4.2910
T ₁ :T ₂	M ₁ = 13.38 M ₂ = 19.40	6.02	Q = 6.91 (p = .00003)
T ₁ :T ₃	M ₁ = 13.38 M ₃ = 19.20	5.82	Q = 6.68 (p = .00005)
T ₂ :T ₃	M ₂ = 19.40 M ₃ = 19.20	0.20	Q = 0.23 (p = .98559)

Pairwise Comparisons Results

There is a significant difference in kinesthetic perception between Group T1 (Setter) and Group T2 (Hitter) with a p-value of .00003. There is a significant difference in kinesthetic perception between Group T1 (Setter) and Group T3 (Libero) with a p-value of .00005. There is no significant difference in kinesthetic perception between Group T2 (Hitter) and Group T3 (Libero) with a p-value of .98559.

Table 3: ANOVA data for speed of movement

Source	SS	DF	MS	
Between-treatments	2.0233	2	1.0117	F = 0.36276
Within-treatments	158.96	57	2.7888	
Total	160.9833	59		

The f-ratio value is 0.36276.

The p-value is .697345, indicating that the result is not significant at p < .05.

Table 4: ANOVA data for Response Time

Source	SS	DF	MS	
Between-treatments	37.4805	2	18.7402	F = 5.10346
Within-treatments	209.308	57	3.6721	
Total	246.7885	59		

The f-ratio value is 5.10346. The p-value is .009144. The result is significant at p < .05. Tukey's HSD Post hoc test will be used.

Table 5: The Tukey's HSD (honestly significant difference) procedure facilitates pairwise comparisons within your ANOVA data

Pairwise Comparisons		HSD _{.05} = 1.4903 HSD _{.01} = 1.8791	Q _{.05} = 3.4032 Q _{.01} = 4.2910
T ₁ :T ₂	M ₁ = 8.02 M ₂ = 9.64	1.62	Q = 3.70 (p = .03012)
T ₁ :T ₃	M ₁ = 8.02 M ₃ = 9.60	1.58	Q = 3.61 (p = .03534)
T ₂ :T ₃	M ₂ = 9.64 M ₃ = 9.60	0.04	Q = 0.09 (p = .99770)

Pairwise Comparisons Results

There is a significant difference in response time between Group T1 (Setter) and Group T2 (Hitter) with a p-value of .03012. There is a significant difference in response time between Group T1 (Setter) and Group T3 (Libero) with a p-value of .03534. There is no significant difference in response time between Group T2 (Hitter) and Group T3 (Libero) with a p-value of .99770.

Conclusions

The present study aimed to examine the differences in psychomotor abilities - specifically kinesthetic perception, speed of movement, and response time - among university-level volleyball players in different playing positions: setters, hitters, and liberos. Our findings provide valuable insights into the distinct psychomotor profiles associated

with these positions, which can significantly inform training practices and performance optimization.

The results indicate significant differences in kinesthetic perception among the three groups, with setters demonstrating superior kinesthetic perception compared to hitters and liberos. This suggests that the role of setters, which requires precise and quick hand movements for accurate ball setting, may cultivate or necessitate enhanced kinesthetic abilities (Adams, 1971; Bakker, Whiting, & Van der Brug, 2011) ^[1, 2]. Such abilities are crucial for maintaining balance and executing precise movements, which are essential for the setter's role (Rivilla-García *et al.*, 2011) ^[11].

In contrast, no significant differences were observed in the speed of movement among the three groups. This finding indicates that the rapid and accurate movements required in volleyball might be equally developed across all playing positions through general training routines, rather than position-specific practices (Miller, 2006) ^[10]. This aligns with previous research suggesting that basic speed of movement may be a common requisite across different athletic roles in volleyball (Gabbett & Georgieff, 2007) ^[7].

Response time, however, showed significant variation, with setters exhibiting faster response times than hitters and liberos. The quick decision-making and rapid execution required by setters to effectively manage play dynamics appear to be reflected in their enhanced response times (Schmidt *et al.*, 2018) ^[13]. The distinct demands placed on setters to rapidly adjust to the changing conditions on the court likely contribute to their superior response capabilities (Koch & Kofler, 2009) ^[9].

These findings underscore the importance of tailored training programs that address the specific psychomotor demands of each playing position. For setters, training that further enhances kinesthetic perception and response time could be particularly beneficial. Hitters and liberos might benefit from drills that focus on improving other aspects of performance, such as strength and agility, to complement their existing skill sets (Hoffman *et al.*, 2005) ^[8].

Overall, this study contributes to the body of knowledge on psychomotor abilities in volleyball players by highlighting the nuanced differences across playing positions. The insights gained can help coaches and trainers develop more effective, position-specific training regimens that enhance the overall performance of their athletes (Bompa & Haff, 2009; Fleck & Kraemer, 2004) ^[3, 5]. Future research could expand on these findings by exploring additional psychomotor dimensions and incorporating longitudinal studies to assess the impact of targeted training over time.

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