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Evaluating Kinesthetic Perception Among Female Basketball Players At The Sports Authority Of India, Dharamshala

Sakshi Singh[1*], Dr. Akhil Mehlotra[2], Prof. (Dr.) Abhimanyu Singh[3]
Research Scholar, Department Of Physical Education, Banaras Hindu University, Varanasi, 221005,
Professor (Associate), Department Of Physical Education, Banaras Hindu University, Varanasi, 221005,
Professor, Department Of Physical Education, Banaras Hindu University, Varanasi, 221005

Abstract
Background: Kinaesthetic, synonymous with proprioception, involves sensory input from muscle spindles and Golgi tendon organs, providing information about body movements, positions, muscle stretch, and force. It plays a vital role in body awareness and coordination. (Taylor, 2022)
Objective: The central aim of this research study was to investigate the intricate connection between the kinesthetic abilities of female basketball players at the Sports Authority of India and their performance in basketball skills. This research delved into understanding how a player's kinesthetic acumen, encompassing their sense of body position, movement, and muscle force perception, influences their overall prowess in the sport.
Methodology: The nature of this research study was experimental. In this, 20 national-level female basketball players were selected based on subjects through a purposive sampling method. The age of the subjects was limited to 18 to 25 years. To measure the kinesthetic perception ability of all the selected players, the researcher chose the Kinesthetic Obstacle Test and Johnson Basketball Skill Test.
Data Collection and Analysis: Quantitative data from both tests was collected and further analyzed with the help of SPSS software.
Main Results: Basketball skill test: Mean 28.08 (SD 3.229). Obstacle test: Mean 58.46 (SD 6.927). A strong, significant correlation ($r = 0.700$, $p < .05$) among basketball skill tests, throw accuracy, and dribble tests. Mixed correlations between obstacle variables and basketball skills, with some significant, and others not statistically significant.
Author's Conclusions: In conclusion, the study highlighted performance variations between the basketball skill and obstacle tests. It established a strong, significant correlation among basketball skill components. Some obstacle variables correlated with basketball skills, while others were not significant, suggesting the need for further analysis. These findings have important implications for basketball skill development and training strategies.

Keywords: *Kinesthetic Perception, Sense, Ability, Basketball Skills, Johnson Basketball Test and Imagery.*

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I. Introduction

Kinesthetic Motor Imagery (KMI) is a technique used by athletes to improve motor skills mentally, relying on internal anticipatory action images. (Ridderinkhof & Brass, 2015) Traditional perception theory posits that sensory receptors, like rods and cones, convert physical stimuli into action potentials, forming the basis for our sensory experiences. These receptors can even respond to unconventional stimuli, showcasing the intricate nature of perception. (Latash, 2020) This chapter explores these aspects using an information processing model, focusing on practical applications like baseball batting, leading to improved training approaches. (Erickson, 2022) Our perception of the world is shaped by our senses-vision, hearing, taste, touch, and smell-forming a comprehensive internal map. (CARREIRO, 2009)

The literature reveals that kinesthetic motor imagery (KMI) induces distinct brain patterns, enabling detection through EEG signals for Brain-Computer Interface (BCI) applications. Despite the promise of KMI-based BCIs in fields like sports training and rehabilitation, there's a gap in understanding long-term interactions and intrapersonal influences. This study addresses this gap, showcasing neural efficiency in prolonged KMI practice and suggesting implications for BCI stimulation and instructional design. (Rimbert & Fleck, 2023) The literature underscores motor imagery deficits in Developmental Coordination Disorder (DCD), encompassing visual and kinesthetic components. This study examined 334 neurotypical adults, revealing distinct patterns of imagery difficulties among groups with varying self-reported motor coordination issues. These findings have implications for evaluating candidates for motor imagery training interventions. (Baiano et al., 2023) This study investigated kinesthetic perception during simultaneous tendon vibration of antagonistic muscles and motor imagery of wrist flexion. Despite a zero-frequency difference in muscle vibration, participants experienced enhanced kinesthetic sensations during motor imagery. The findings highlight the interaction between afferent inputs and motor imagery in generating kinesthetic perceptions, influenced by vibration frequencies in antagonistic muscles. (Shibata & Kaneko, 2013) This study examined the impact of visual deprivation (eyes open [EO] vs. eyes closed [EC]) on brain wave oscillations during kinesthetic and visual-motor imagery tasks. Enhanced visual stimuli processing was observed in occipital areas under EC conditions during visual-motor imagery, while motor areas exhibited stronger alpha desynchronization in EO, resembling real movements. These findings underscore the influence of imagery perspective on brain oscillations and their practical implications for motor imagery brain-computer interfaces. (Zapała et al., 2023) This study aimed to assess kinesthetic sensitivity in children aged 6-11 with developmental coordination disorder (DCD) and typically developing (TD) children. Using a passive motion apparatus, children detected arm motion and pressed a trigger. Results showed that children with DCD, especially those above six years old, exhibited significantly poorer kinesthetic sensitivity compared to TD children, highlighting a developmental lag in kinesthetic perception in DCD. (Li et al., 2015) This study investigated the impact of Kinesthetic Illusions by Visual Stimulation on muscular output function following short-term immobilization. Subjects were divided into three groups: immobilization only, immobilization with Kinesthetic Illusions by Visual Stimulation, and control. The immobilization group exhibited decreased maximum voluntary contraction (MVC) and increased force fluctuation after immobilization. (Inada et al., 2016) This study challenges the predominant focus on visual and auditory processes in psychology, exploring the relationship between tactile, kinesthetic, and intellectual abilities. Structural equation modeling revealed independent kinesthetic sensitivity (KS) and tactile sensitivity (TS) factors, distinct from visual-spatial processes, and both correlated differentially with fluid intelligence (Gf). KS pertains to arm position and movement perception without vision, while TS involves discriminating stimuli on the skin. These findings highlight unique perceptual mechanisms encapsulated by specific factors, shedding light on the diversity of human intelligence. (Stankov et al., 2001) This article highlights the rising importance of bodywork and movement therapies in healthcare article explores the role of bodyworkers as educators, traces the history of physical education, and suggests updating education with modern touch and movement therapy approaches to meet future somatic needs. (Myers, 1998) This study explores the combined effects of action observation (AO) and motor imagery (MI) on golf-putting performance. The research shows that when golfers with good kinesthetic imagery ability receive AO + MI intervention, they demonstrate enhanced precision and speed control in putting. The findings suggest that kinesthetic awareness becomes more important when AO is combined with MI, leading to improved performance. (McNeill et al., 2020) This study compared kinesthetic and visual modeling for learning tennis serves, focusing on how mental practice affects these methods. Results revealed that kinesthetic modeling, particularly when mentally rehearsed, led to better speed and form performance. (Féry & Morizot, 2000)

- It was hypothesized that there is a positive correlation between the kinesthetic perception abilities of female basketball players at the Sports Authority of India in Dharamshala and their basketball skills.
- It was hypothesized that those with higher kinesthetic perception abilities would exhibit better sports performance in basketball skills assessments.

II. Material and Methods

Participants

The study consisted of 20 female basketball players registered with the Sports Authority of India, National Centre for Excellence, Dharamshala Himachal Pradesh. Inclusion criteria included players aged 18-25 years and actively participating in competitive basketball programs.

Selection of Variables of the Study

For this research study, variables were selected after studying the literature, the details of which are given in the table below.

Table 1: ***The selected tests, variables, abbreviations, and units of the study***

S.No.	Tests	Selected Variables	Abbreviations	Units
1.	Johnson Basketball Skill Test	Field Goal Speed Test	FGST	Points
		Basketball Throw for Accuracy	BTA	Points
		Basketball Dribble Test	BDT	Points
2.	Kinesthetic Obstacles Test	Obstacle 1	OBT1	Points
		Obstacle 2	OBT2	Points
		Obstacle 3	OBT3	Points
		Obstacle 4	OBT4	Points
		Obstacle 5	OBT5	Points

		Obstacle 6 Obstacle 7 Obstacle 8 Obstacle 9 Obstacle 10	OBT6 OBT7 OBT8 OBT9 OBT10	Points Points Points Points Points

N=20

Data Collection

Kinesthetic perception ability was measured using the Kinesthetic Obstacle Test, while basketball skills were assessed with the Johnson Basketball Skill Test. The data collection spanned two days. On the first day, the Kinesthetic Obstacle Test (Johnson, Barry L. & Nelson, Jackson K, 1988) was administered, followed by a 12-hour rest period. The Johnson Basketball Skill Test was conducted on the second day, both assessments taking place in controlled indoor environments. Qualified individuals conducted the assessments, and participants provided informed consent before participation.

Procedure

Day 1: Kinesthetic Perception Assessment

Participants completed a standardized warm-up for physical readiness. The Kinesthetic Perception Test assessed their body movement awareness, position sense, and muscle force perception. This test occurred indoors to ensure controlled conditions.

12-Hour Rest Period

Following the Kinesthetic Perception Test, participants were granted a 12-hour rest period to mitigate potential fatigue effects.

Day 2: Basketball Skill Assessment

On the second day of data collection, participants underwent the Johnson Basketball Skill Test, which comprehensively evaluated their skills in shooting, dribbling, passing, and game awareness. Similar to the kinesthetic assessment, the basketball skill assessment was conducted indoors, ensuring controlled and consistent conditions for the evaluation. This approach aimed to provide a reliable and unbiased assessment of the participants' basketball proficiency across various aspects of the sport.

Procedure Administration

For all assessments, qualified and experienced individuals, trained in the administration of both the Kinesthetic Perception Test and the Johnson Basketball Skill Test, were responsible for conducting the evaluations. Prior to participation, participants received a comprehensive briefing regarding the research's objectives. Informed consent was diligently obtained from each participant, ensuring they were fully informed about the study's purpose and willingly agreed to take part in the assessments.

Data Analysis

Data collected from both assessment tests were statistically analyzed using Pearson product-moment correlation (r), and linear regression (r^2).

The significance level was set at (0.05) to determine the strength and significance of any relationship between kinesthetic perception ability and basketball skills.

Table 2: ***The Kirkendall et, al. (1987) criteria for correlation***

Correlation (r)	Rating
r = 0.80 to 1.00	Very Strong
r = 0.60 to 0.79	Strong
r = 0.40 to 0.59	Moderate
r = 0.20 to 0.39	Week
r = 0.00 to 0.19	Very Week

According to the information provided in Table 2, correlations are interpreted based on the values of the correlation coefficient (r). When the correlation coefficient falls within the range of (r = 0.80 to 1.00), it is categorized as a "very high correlation." Similarly, if the correlation coefficient falls within the range of (r = 0.60 to 0.79), it is deemed a "strong correlation." For values in the range of (r = 0.40 to 0.59), the correlation is labeled as a "moderate correlation." When the correlation coefficient ranges from (r = 0.20 to 0.39), it is considered a "weak correlation." Lastly, if the correlation coefficient is within the range of (r = 0.00 to 0.19), it is described as a "very weak correlation." This categorization allows for a quick assessment of the strength of the relationship between the variables under consideration.

Table 3: ***The descriptive statistics of selected variables of the study.***

Statistics	Score
Mean	28.08789
Median	27.53
Standard Deviation	3.229832

Table 4: ***The Pearson product-moment correlation of selected variables of the study***

	FGST	BBTA	BBDT	OBT 1	OBT 2	OBT 3	OBT 4	OBT 5	OBT 6	OBT 7	OBT 8	OBT 9	OBT 10
FGST	1												
BBTA	0.26	1											
BBDT	0.09	0.7	1										
OBT1	0.16	0.46	0.29	1									
OBT2	0.17	0.02	-0.01	0.3	1								
OBT3	0.16	0.66	0.34	0.14	0.32	1							
OBT4	0.03	0.10	-0.27	0.11	0.3	0.4	1						
OBT5	0.16	0.38	0.18	0.14	0.09	0.46	0.59	1					
OBT6	0.21	0.43	0.06	0.22	0.21	0.56	0.69	0.85	1				
OBT7	0.01	0.45	0.10	0.28	0.43	0.58	0.65	0.64	0.87	1			
OBT8	0.08	0.54	0.20	0.15	0.12	0.49	0.46	0.53	0.78	0.89	1		
OBT9	-0.01	0.21	-0.02	-0.1	0.23	0.5	0.60	0.47	0.69	0.71	0.63	1	
OBT10	-0.18	0.05	-0.09	0.03	0.21	0.53	0.55	0.21	0.38	0.46	0.27	0.63	1

*A Correlation was found significant at ($r = 0.40$-0.59, $p < .05$).

Correlations between the selected variables Obstacle 4 and the Field Goal Speed Test ($r = 0.393$, $p > .05$), between the Basketball Test for Accuracy ($r =.103$, $p >.05$), and between the Basketball Dribble Test ($r = -0.273$, $p > .05$) was obtained which was not statistically significant. Correlations between the selected variables Obstacle 5 and the Field Goal Speed Test ($r = 0.162$, $p > .05$), the Basketball Test for Accuracy ($r = 0.389$, $p > .05$), and the Basketball Dribble Test ($r = 0.182$, $p > .05$). .05) were obtained which was not a statistically significant correlation. Correlations between the selected variables Obstacle 6 and the Field Goal Speed Test ($r = 0.215$, $p > .05$), the Basketball Test for Accuracy ($r = 0.431$, $p < .05$), and the Basketball Dribble Test ($r = 0.06$, $p >.05$), there was only one variable namely basketball test for accuracy was found statistically significant, but remaining two variables which were not a statistically significant correlation. Correlations between the selected variables Obstacle 7 and the Field Goal Speed Test ($r = 0.016$, $p > .05$), the Basketball Test for Accuracy ($r = 0.457$, $p < .05$), and the Basketball Dribble Test ($r = 0.106$, $p >.05$), there was only one variable namely basketball test for accuracy, was found statistically significant, but remaining two variables which were not a statistically significant correlation. In the correlations between the selected variables Obstacle 8 and the Field Goal Speed Test ($r = 0.008$, $p > .05$), the Basketball Test for Accuracy ($r = 0.548$, $p < .05$), and the Basketball Dribble Test ($r = 0.206$, $p >.05$), there was only one variable namely basketball test for accuracy, was found statistically significant, but remaining two variables which were not a statistically significant correlation. The correlations between the selected variables Obstacle 9 and the Field Goal Speed Test ($r = -0.006$, $p >.05$), between the Basketball Test for Accuracy ($r =0.211$, $p >.05$), and between the Basketball Dribble Test ($r = -0.023$, $p > .05$), were found not to be statistically significant. The correlations between the selected variables Obstacle 10 and the Field Goal Speed Test ($r = -0.177$, $p >.05$), between the Basketball Test for Accuracy ($r =0.051$, $p >.05$), and between the Basketball Dribble Test ($r = -0.086$, $p > .05$), were found not to be statistically significant.

- There is a positive correlation between the kinesthetic perception abilities of female basketball players at the Sports Authority of India in Dharamshala and their basketball skills.
- It is hypothesized that those with higher kinesthetic perception abilities will exhibit better performance in basketball skills assessments.

III. Results of the Study

In Table 3, the data revealed the performance statistics for two distinct tests: the basketball skill test and the obstacle test. For the basketball skill test, the mean score (M) stood at 28.08, indicating the average performance level of the participants. The median score (Me) of 27.53 signified the middle point of the dataset, and the standard deviation (SD) of 3.229 demonstrated the degree of variability in scores around the mean. On the other hand, the obstacle test showed a mean score of 58.46, reflecting the average outcome for those who took the test. The median score for this test was 57.08, indicating the middle value in the dataset, while the standard deviation of 6.927 provided insight into the extent of score dispersion around the mean. These statistics offered valuable insights into the performance of participants in these two tests, providing a comprehensive view of their central tendency and score variability.

According to the data from Table 4, it was observed that correlations existed between selected variables. A correlation ($r = .267, p > .05$) was identified between the field goal speed test and basketball throw accuracy, which was not statistically significant according to the established criteria. Likewise, a correlation ($r = .099, p > .05$) was found among the selected variables of the basketball skill test, field goal speed test, and basketball dribble test, and this too was not considered statistically significant based on the criteria. In contrast, a substantial correlation ($r = .700, p < .05$) was discovered between the selected variables of the basketball skill test, basketball throw accuracy, and basketball dribble test, indicating a strong and statistically significant relationship between these variables. These findings provided valuable insights into the strength and significance of the associations among these selected variables.

Similarly, there was a correlation between selected variables of the obstacle test namely Obstacle 1 and Field Goal Speed Test ($r = -.167, p > .05$), and Basketball Test for Accuracy ($r = 0.464, p <.05$), and the basketball dribble test ($r = .298, p > .05$), there was one variable namely basketball test for accuracy was found statistically significant, but there was no significant correlation between the remaining two variables of the basketball skills test. Additionally, there were correlations between the selected variables Obstacle 2 and the Field Goal Speed Test ($r = -.175, p > .05$), the Basketball Test for Accuracy ($r = -.294, p > .05$), and the Basketball dribble test ($r = .005, p > .05$), which was not significant.

IV. Discussion and Findings

This section presents a comprehensive analysis of the study's findings, with a focus on performance statistics for two distinct tests: the basketball skill test and the obstacle test, and the correlations between selected variables. These findings provide valuable insights into the participants' performance in these tests and the relationships between various test scores. Let's delve into these findings in greater detail.

Performance Statistics:
Basketball Skill Test:

The basketball skill test assessed participants' proficiency in various aspects of basketball skills, including shooting accuracy, dribbling, and other fundamental skills. The mean score (M) of 28.08 in this test indicates the average performance level of the participants. This metric is crucial as it provides a central reference point for evaluating individual performance. It allows us to understand how the participants, as a group, performed on average.

The median score (Me) of 27.53 provides additional insight into the distribution of scores. The median is particularly useful when dealing with datasets that might have outliers, as it represents the middle value. In this case, it suggests that half of the participants scored above 27.53 and half scored below it, which gives us a sense of the overall distribution of performance in the basketball skill test.

The standard deviation (SD) of 3.229 measures the degree of variability in scores around the mean. A smaller SD indicates that scores tend to cluster closely around the mean, while a larger SD suggests more dispersion. In this case, the relatively small SD suggests that scores in the basketball skill test are tightly clustered around the mean. This could imply that participants' performance in this test is relatively consistent, with less variation from the mean score.

Obstacle Test:

The obstacle test, on the other hand, aimed to assess participants' agility and adaptability, which are crucial skills in the context of basketball. The mean score of 58.46 for the obstacle test indicates the average outcome for those who took the test. Like the mean in the basketball skill test, this value serves as a reference point for understanding the central tendency of performance in the obstacle test.

The median score for the obstacle test, 57.08, reveals that the middle value in the dataset lies at this point. It is important to help us gauge how the scores are distributed for this test. If the median is close to the mean, it suggests that the data is relatively symmetrical. This provides a nuanced understanding of the performance distribution in the obstacle test.

The standard deviation of 6.927 for the obstacle test is notably higher than that of the basketball skill test. This suggests a greater degree of variability in scores. In other words, participants' performance in the obstacle test is more spread out, indicating a wider range of abilities or other factors influencing their scores. This could be due to the complex and multifaceted nature of the obstacle test, which may require diverse skills and adaptations.

Correlations Between Selected Variables:

The study also explored correlations between selected variables, including different test scores. These correlations provide insights into the relationships between various aspects of basketball skill and obstacle test performance. The analysis was conducted using correlation coefficients (r) and p-values to assess the strength and statistical significance of these relationships.

Basketball Skill Test Correlations:

A particularly significant finding was the strong and statistically significant correlation ($r = 0.700$, $p < .05$) between the selected variables of the basketball skill test, basketball throw accuracy, and basketball dribble test. This indicates a robust and meaningful relationship between these three aspects of basketball skills. Participants who performed well in one of these areas tended to excel in the others, suggesting a holistic proficiency in basketball skills.

This significant correlation is valuable for coaches and trainers, as it implies that focusing on one of these aspects of skill development could potentially lead to improvements in others. It underscores the interconnectedness of various fundamental basketball skills and the potential for comprehensive skill enhancement.

Obstacle Test Correlations:

The study examined correlations between the selected variables within the obstacle test and their relationships with other test scores. Notably, these correlations revealed varying strengths and statistical significance.

For example, a statistically significant correlation ($r = 0.464$, $p < .05$) was found between Obstacle 1 and the Basketball Test for Accuracy. This suggests that agility and adaptability, as assessed in Obstacle 1, have a moderate positive relationship with basketball throw accuracy. Participants who performed well in this particular obstacle were more likely to demonstrate accuracy in their basketball throws.

However, not all correlations were statistically significant, indicating that some obstacle variables might not significantly influence basketball skill performance. The presence or absence of statistically significant correlations was observed across the different obstacle variables, providing nuanced insights into the relationships between agility and adaptability as assessed in the obstacle test and basketball skills.

Implications and Further Analysis:

The findings of this study have several implications:

- Skill Development: The strong correlation between different aspects of basketball skills highlights the importance of holistic skill development. Coaches and trainers should consider a well-rounded approach to improving players' proficiency in basketball.
- Obstacle Test Complexity: The higher variability in scores in the obstacle test could suggest that this test is more complex, with a broader range of challenges that participants face. Further analysis could delve into which specific elements of the obstacle test are most influential in overall performance.
- Training Strategies:

Understanding the relationships between different aspects of basketball skills and agility can inform training strategies. Coaches may consider designing training regimens that integrate both skill-specific drills and agility-focused exercises to maximize player development.

V. Conclusion of the Study

In conclusion, the study's findings offer valuable insights into the performance statistics of the basketball skill test and obstacle test, shedding light on the central tendency and variability of participants' scores. Additionally, the correlations between various test scores reveal the interconnectedness of basketball skills and agility, with varying strengths and statistical significance. These insights can be a valuable resource for basketball coaches, trainers, and researchers seeking to optimize skill development programs and enhance player performance. Further in-depth analysis and future research can provide a more comprehensive understanding of the intricate relationships between these variables in the context of basketball skill development.

VI. Recommendations of the Study

1. Emphasize holistic skill development by integrating various aspects of basketball skills in training programs.
2. Design individualized training regimens that target specific skill areas based on players' strengths and weaknesses.
3. Further investigate the specific elements of the obstacle test that may have the greatest impact on basketball performance to refine and enhance its relevance.

4. Incorporate both skill-specific drills and agility-focused exercises in player assessments to provide a more comprehensive evaluation of performance.
5. Encourage further research to deepen our understanding of the complex relationships between agility, basketball skills, and performance.
6. Coaches and trainers should adapt their coaching methods and training strategies to align with the study's findings, optimizing player development.

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