

## Original Research Article

# Enhancing batting skills in young female cricketers via simulator

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## ABSTRACT

**Background:** This research explored the potential of an advanced cricket simulator- integrating cutting-edge technology- to transform traditional training methods for young female cricket players. The system features an LED-based display for realistic bowler animations, a programmable bowling machine, and a machine vision replay for detailed feedback. This setup creates an immersive, data-rich environment that sharpens batsmen's timing, anticipation, and decision-making through lifelike simulations of real bowlers. The primary aim was to evaluate the effectiveness of this individualized digital simulator, combined with performance and fitness analytics, in boosting batting skills among young female athletes. Specific objectives included enhancing key fitness metrics: reaction time, shot perfection, and footwork efficiency.

**Methods:** Thirty college-level female cricket players, aged 18-22 from the Coimbatore region, met the inclusion criteria and participated. The simulator quantitatively assessed reaction time, shot perfection, and footwork efficiency. Participants underwent pre-testing before a 4-week matrix training protocol, followed by post-testing to measure improvements.

**Results:** Post-intervention data showed significant gains across all parameters. The matrix training protocol delivered outstanding enhancements in reaction time, shot perfection, and footwork efficiency for all 30 players.

**Conclusions:** The individualized advanced digital cricket simulator, with its integrated performance and fitness analysis, markedly improved batting skills, reaction time, footwork efficiency, and shot perfection in young female cricket players. Additionally, it boosted players' speed and dynamic balance, offering a promising tool for optimized training.

**Keywords:** Advanced digital cricket simulator, Batting skills, Footwork efficiency, Reaction time, Shot perfection, Young female cricket players

## INTRODUCTION

There are significant turning points in the centuries-long history of women's cricket, including instances of tenacity and advancement. Initial steps, the first-ever women's cricket match was played between the ladies of Bramley and Hambledon on July 26, 1745, in Surrey, England. In social and recreational women's cricket was first played in local communities as a social pastime. The sport didn't

start to get more structured until the late 19<sup>th</sup> century. When it comes to developments in Organizations, the first official women's cricket clubs were founded in Yorkshire in 1887 and was called the White Heather Club.<sup>1</sup> The Women's Cricket Association (WCA), which was established in 1926, played a key role in setting up national tournaments in England. Its goals were to support the establishment of cricket clubs and give women the chance to participate.<sup>1,2</sup> The International Women's Cricket

Council (IWCC) was founded in 1958 and oversaw women's cricket worldwide until 2005, when it amalgamated with the International Cricket Council (ICC). In 1934, first international match held in England where England and Australia played against each other. During their tour, England won two of their three test matches. Jack Hayward sponsored the inaugural Women's World Cup, which took place in 1973 which was an important turning point that raised awareness of and interest in the sport.<sup>1-3</sup>

The International Cricket Council (ICC) oversees women's cricket, which is the sport's female equivalent of men's cricket. Test matches, one-day internationals (ODIs), and twenty-20 internationals (T20Is) are among the formats it encompasses. Shorter formats like ODIs and T20 is now dominate the international schedule because of their accessibility and popularity.<sup>3,4</sup>

In cricket, hitting the ball to score runs while avoiding dismissal is known as batting, and it is an essential ability. Depending on the game circumstances, bowling types, and match formats, batters must modify their tactics. To elaborate more on the technical aspects of batting skills.<sup>5,6</sup>

Traditional/existing regimens for improving batting, advanced digital cricket simulator with integrated performance and fitness analysis (MATRIX). Matrix, the sophisticated video replay, bowler animation synchronization, and ball release mechanism work in unison to improve realism and add a new degree of analytical depth to cricket training.<sup>7</sup> While coaches gain from extensive data and video archives that enable well-informed decision-making for skill development and injury prevention, players receive immediate, actionable feedback on their performance.<sup>8,9</sup>

A crucial component of cricket training to improve performance in actual match scenarios, a reaction time test in a cricket simulator usually entails reacting as fast as possible to a stimulus (visual or auditory) utilizing techniques like the ruler drop, ball drop, or digital testing.<sup>10</sup> This vision-based system transforms ordinary video footage into a rich source of biomechanical and fitness insights, without requiring intrusive wearables or complex lab setups.<sup>11,12</sup> Players receive instant, actionable insights on their performance, while coaches benefit from comprehensive data and video archives that allow informed decision-making for skill development and injury prevention.<sup>12,13</sup>

Young female cricket players can achieve shot precision with the help of simulator training. Through the integration of immersive practice, real-time analytics, and individualized feedback, simulators help players improve their technical skills, increase their self-assurance, and get ready for competitive cricket in a data-driven, encouraging setting.<sup>13,14</sup>

Cricket simulator matrix also does the following values of video capture trigger, real-time pose estimation, posture and bat swing analysis (front camera), footwork and balance analysis (top camera), fitness indicator extraction, fatigue detection, injury risk indicators, consistency metrics, biomechanical observations.

## **METHODS**

### ***Study design***

It was a single group pre and posttest experimental study

### ***Study setting***

The study was carried out at HexGen Sports Tech Pvt Ltd, Coimbatore.

### ***Study participants***

Young female cricketers were the study participants.

### ***Study duration***

The study took place for a period of 2 months. Training duration was 4 weeks of matrix training session.

### ***Outcome measures***

#### ***Reaction time***

A young female cricket simulator's reaction time test gauges a player's ability to react fast to visual or aural signals that mimic the fast-paced scenarios they face in the game, such as catching, batting, or wicket-keeping. Because milliseconds can determine whether a cricket play is successful or a missed opportunity, these tests are essential. Professional cricket players, particularly batting, may reply to rapid deliveries with reaction speeds of over 100 milliseconds, but the average human reaction time is between 200 and 250 milliseconds for visual inputs states Müller et al.<sup>15</sup>

#### ***Shot perfection***

The ability of a batter to regularly produce technically sound, potent, and precisely timed cricket shots is known as shot perfection. This involves hitting the ball with the best technique, timing, and placement possible during simulator training, as determined by sophisticated tracking technologies. A controlled, immersive environment for skill development is created by modern cricket simulators (matrix), which combine hardware (smart bats, high-speed cameras, sensors) and software (real-time analytic, visual feedback).<sup>15,16</sup> A variety of bowling styles and deliveries can be replicated using simulators, allowing for focused practice against certain obstacles. Progress is evident and inspiring because each shot is measured and evaluated according to distance, placement, power, and accuracy.

**Footwork efficiency**

In cricket, footwork efficiency describes a batter’s capacity to move their feet swiftly, precisely, and equitably in order to position themselves for each ball. For young female cricket players building their technical foundation in particular, efficient footwork is essential for shot selection, timing, balance, and injury prevention.<sup>17</sup> Young players’ footwork effectiveness ranged from 70% to 88%, with greater shot execution closely correlated with higher efficiency. Superior shot accuracy and head stability were displayed by players with the ideal stride length and balanced foot placement. Overstepping, restricted stance, and delayed foot movement against outswingers were common problems that resulted in missed shots or a higher risk of injury. It was discovered that fatigue decreased the effectiveness and form of footwork, emphasizing the necessity of endurance training.<sup>18,19</sup>

**Intervention and procedure**

All participants (n=30) were young female cricketers, aged 18-22 years, who fulfilled the selection criteria were taken for this study. Players having recent musculoskeletal injuries and less than one year of training in cricket were excluded. The study was conducted in HexGen Sports Tech Pvt Ltd, Coimbatore between July and August 2025. All participants gave their consent before enrolment. Each participant's age, demographic information, and physical attributes, including body mass index (BMI), were documented before to the intervention. No dropouts. The study’s tool is the advanced digital cricket simulator, a digital cricket simulator that incorporates performance and fitness assessments and matrix training protocol as an intervention. Prior to training, pre-test values of reaction time, footwork efficiency and shot perfection were gathered. 50 balls are delivered at random each session, (training with matrix protocol) three days a week. Training lasted for four weeks. Among the traditional eight distinct bowling techniques off-spin, leg-spin, in-swing, and out-swing were employed in the matrix protocol training. Test results are gathered and analyzed four weeks after the training completion.

**Table 1: Advanced digital cricket simulator with integrated performance and fitness analysis (matrix) protocol.**

No of sessions/week	Delivery type	No. of balls
3	Off-spin,	50/session/ player
	Leg-spin,	
	Inswing,	
	Outswing.	

**Data collection and statistical analysis**

The demographic data, body mass index (BMI), and physical characteristics of young females were all calculated and reaction time, shot accuracy, and footwork efficiency were measured, and the gathered information

was digitally saved for later analysis. Baseline characteristics were summarized using descriptive statistics.<sup>20</sup> Independent t-tests were used to compare group differences after all data were checked for normality. Statistical significance was defined as a p value of less than 0.05. All statistical analyses were conducted using IBM Co.’s SPSS program (version 22.0).

**RESULTS**

The data represents mostly young adults (ages 18-22), a population with stable height and weight. Weight varies moderately within the group, and height ranges from 152 to 160 cm. The BMI values mostly fall within the healthy weight category of 18.5 to 24.9, which aligns with the recorded values between 18 and 22 of age. The BMI values in the data set closely match the calculated values using the standard BMI formula, indicating accurate demographic and anthropometric reporting. Weight and height are moderately positively correlated. BMI correlates positively with weight and negatively with height. Age shows very low correlation with the other parameters, consistent with the narrow age range.<sup>20,21</sup>

**Reaction time (in milliseconds)**

Pre-test scores ranged from 492 ms to 620 ms. Post-test scores ranged from 490 ms to 608 ms. The overall tendency shows slightly lower values in the post-test, indicating improved (faster) reaction times.<sup>21</sup> Mean pre-test accuracy was 0.727 (SD 0.060), rising to 0.749 (SD 0.064) post-test. This improvement was statistically significant (paired t=-6.81, p<0.0001).<sup>21</sup>

**Shot accuracy**

Post-test values ranged from 0.63 to 0.87. Most participants recorded slight improvements post-intervention. Shot accuracy improved from a mean of 72.15% (SD=5.92) at pre-test to 73.95% (SD=6.29) at post-test. The paired t-test indicated the improvement was statistically significant (t=-4.49, p<0.05), demonstrating that the intervention positively impacted accuracy.<sup>21,22</sup>

**Table 2: Shot perfection.**

Metric	Description
<b>Bat speed</b>	Measures the velocity of the bat at impact
<b>Bat angle</b>	Tracks the angle of the bat during the shot
<b>Shot power</b>	Quantifies the force applied to the ball
<b>Shot efficiency</b>	Evaluates timing and energy transfer
<b>Shot placement</b>	Assesses where the ball would land on the field
<b>Consistency score</b>	Tracks repeatability of correct shots

**Foot efficiency**

Pre-test scores ranged from 0.7 to 0.88. Post-test scores ranged from 0.72 to 0.89. There is a consistent trend of improvement. Foot efficiency showed incremental improvement, rising from 78.10% (SD=5.63) in the pre-test to 79.40% (SD=5.13) post-test. The paired t-test

confirmed this change was significant ( $t=5.94, p<0.05$ ), suggesting improved motor efficiency post-intervention.<sup>21,22</sup> Pre-test mean was 0.783 (SD=0.056), increasing to 0.795 (SD=0.052) post-test. Paired t-test confirms significance ( $t=-7.53, p<0.0001$ ).<sup>21</sup>

**Table 3: Footwork efficiency.**

Metric	Description
<b>Stride length</b>	Measures how far the player steps forward or back to reach the ball
<b>Foot placement</b>	Assesses accuracy and consistency of where the feet land
<b>Pivot mechanics</b>	Evaluates the ability to turn and adjust stance quickly
<b>Weight distribution</b>	Tracks balance and stability during movement and shot execution
<b>Movement speed</b>	Measures how quickly the player gets into position for each delivery
<b>Consistency score</b>	Tracks repeatability of efficient footwork across multiple deliveries

**Table 4: Demographic statistical summaries.**

Statistics	Age (years)	Weight (kg)	Height (cm)	BMI
<b>Mean</b>	19.8	52.47	154.9	19.8
<b>Median</b>	20	52.5	154	20
<b>SD</b>	1.27	4.08	3	1.27

**Table 5: Pre- and post-test descriptives for all outcomes (n=30 each).**

Statistic	Reaction time pre (ms)	Reaction time post (ms)	Shot accuracy pre	Shot accuracy post	Foot efficiency pre	Foot efficiency post
<b>Mean</b>	559.067	555.333	0.727	0.749	0.783	0.795
<b>Median</b>	570	568	0.72	0.74	0.8	0.81
<b>SD</b>	41.631	40.851	0.06	0.064	0.056	0.052

Lower reaction time indicates improvement; higher values indicate better accuracy/efficiency.

**DISCUSSION**

**Batting as a primary performance indicator**

In cricket batting contributes directly to team success through runs scored. Research shows that batting averages, strike rates, and boundary-hitting ability are strongly associated with match outcomes in both men’s and women’s cricket. Women’s cricket has evolved with higher scoring rates in T20 and ODI formats, making batting efficiency a decisive factor.<sup>21</sup>

**Gender-specific skill development needs**

the studies indicate women cricketers often face differences in strength, ball release velocity, and boundary distances compared to men. Focused batting training helps women adapt shot selection, timing, and placement to optimize performance in match conditions.<sup>21</sup>

**Cognitive and motor skill integration**

batting is not only biomechanical but also perceptual-cognitive (anticipation of bowler’s action, decision-making under pressure). Structured batting drills enhance

visuomotor coordination, pitch awareness, and shot execution.

**Match demands in modern women’s cricket**

The shift toward aggressive batting in T20 cricket requires improved power-hitting, strike rotation, and adaptability. Training batting skills bridges the gap between traditional play and modern performance demands.<sup>22</sup>

**Controlled and repetitive practice**

The Matrix simulator provides consistent ball delivery at varying speeds, lengths, and trajectories. This allows players to face hundreds of deliveries in a short span, something not always possible with manual bowlers. Evidence shows high-repetition, variable practice improves batting skill acquisition and retention.

**Enhanced decision-making and reaction training**

Simulators expose players to realistic game-like scenarios (swing, spin, pace variations). Research supports that simulation-based training improves anticipation and response time, crucial for batting against fast bowlers.<sup>2</sup>

### ***Safe and customizable learning environment***

Women cricketers can gradually train against higher speeds without injury risk. Ball speed, bounce, and spin can be adjusted to match developmental stages and player skill levels.<sup>22</sup>

### ***Performance analysis and feedback***

The modern simulators often include video replay and analytics (bat swing, timing, contact point). Immediate feedback accelerates correction of technical errors and builds confidence.

### ***Bridging the gap between practice and match play***

Simulated match conditions (crowd noise, pressure scenarios) improve psychological readiness. Studies in other sports (e.g., baseball, tennis) show simulator-based training enhances transfer of skills to competition.<sup>23</sup>

Benefits of advanced digital cricket simulator with integrated performance and fitness analysis (matrix) as follows:

#### ***Strengthening muscles and joint protective measures***

By include neuromuscular exercises in the regimen, it can lower the risk of common ailments like sprains and strains by strengthening the muscles and prevent the joint structures.

#### ***Improving stability and balance***

By enhancing stability and balance, neuromuscular training lowers the risk of accidents or falls during physical activity.

#### ***Promoting recovery and rehabilitation***

By encouraging appropriate movement patterns and control, physical therapy and rehabilitation can help people with pre-existing injuries or disorders recover and regain their mobility.<sup>23,24</sup>

#### ***Enhancing batting performances***

##### ***Enhancing response time, agility, and speed***

Neuromuscular training regimens concentrate on improving coordination and response time, which are essential for athletes who want to succeed in their particular sports.

##### ***Improving motor control and coordination***

By included workouts, athletes can improve their performance by honing their movement patterns and achieving accurate motions. Increasing power and

efficiency, neuromuscular training enhances performance by optimizing the body's capacity to produce power and increase efficiency during sports-specific tasks.<sup>23-25</sup>

## **CONCLUSION**

Batting skill training is essential in women's cricket because it directly determines performance outcomes, demands adaptation to modern high-scoring formats, and integrates cognitive, biomechanical, and tactical skills. Matrix cricket simulator training is necessary because it provides controlled, repetitive, game-like practice with immediate feedback, improving technical consistency, decision-making, and match readiness in a safe, structured environment.

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## **REFERENCES**

1. Mishra S, Agarwal P, Verma A. Design and control of a programmable bowling machine for cricket practice. *Int J Mech Engin Robot Res.* 2017.
2. Müller S, Abernethy B. Batting with occluded vision: An in situ examination of the information pick-up and interceptive skills of high-and low-skilled cricket batsmen. *J Sci Med Sport.* 2006;9(6):446-58.
3. Stenros M, Salin K, Smed J. Immersive training with virtual reality in sports: a review. *Sports Tech J.* 2020.
4. Pandey R, Dutta S, Srivastava S. Machine vision-based biomechanical analysis in cricket batting. *Proced Computer Sci.* 2019;152:643-50.
5. Müller S, Abernethy B, Farrow D. How do world-class cricket batsmen anticipate a bowler's intention? *Quart J Exp Psychol.* 2006;59(12):2162-86.
6. Carson HJ, Collins D, MacNamara Á. Real-time feedback and skill acquisition: applications in sports coaching. *Int J Sports Sci Coach.* 2018;13(2):256-66.
7. Yoon J, Kim Y, Lee H. Development of an immersive baseball batting simulator using virtual pitcher animation and ball projection. *IEEE Access.* 2021;9:30291-300.
8. Rathore A, Singh J. Technological advancements in cricket training: a review of existing tools and emerging trends. *J Sports Tech Analyt.* 2020;2(1):1-12.
9. Tissera K, Orth D, Huynh M, Benson AC. The impact of augmented feedback (and technology) on learning and teaching cricket skill: a systematic review with meta-analysis. *PLoS One.* 2022;17(12):e0279121.

10. Gururaj BN, Sooda K. Design of a comprehensive virtual reality cricket simulator for immersive skill training. In: Proceedings of the 8th International Conference on Computational System and Information Technology for Sustainable Solutions (CSITSS); 2024:1-6.
11. Kelly N, Stafford J, Craig C, Herring MP, Campbell M. Using a virtual reality cricket simulator to explore the effects of pressure, competition anxiety on batting performance in cricket. *Psychol Sport Exercise.* 2022;63:102244.
12. Jayaraj L, Wood J, Gibson M. Results of measuring immersion in a cricket simulation game for improved vr with real-time time-of-flight performance capture. In: IEEE International Conference on Metrology for eXtended Reality, Artificial Intelligence and Neural Engineering (MetroXRINE); 2024
13. Fogt JS, Fogt N. Studies of vision in cricket- a narrative review. *Vision.* 2023;7(3):57.
14. Wickramasinghe I. Applications of machine learning in cricket: a systematic review. *Mach Learn Appl.* 2022;10:100435.
15. Jayaraj L, Wood J, Gibson M. Improving the immersion in virtual reality with real-time avatar and haptic feedback in a cricket simulation. In: IEEE International Symposium on Mixed and Augmented Reality (ISMAR-adjunct); 2017:310-4.
16. Silva KP. Effect of a Cricket Batting Simulation on the Quality of Shot Selection. The University of North Carolina at Greensboro. 2025.
17. Portus MR, Farrow D. Enhancing cricket batting skill: implications for biomechanics and skill acquisition research and practice. *Sports Biomech.* 2011;10(4):294-305.
18. Davis J, Perera H, Swartz TB. A simulator for Twenty20 cricket. *Aust N Z J Stat.* 2015;57(1):55-71.
19. Kelly N, Stafford J, Craig C, Herring MP, Campbell M. Using a virtual reality cricket simulator to explore the effects of pressure, competition anxiety on batting performance in cricket. *Psychol Sport Exercise.* 2022;63:102244.
20. Dhawan A, Cummins A, Spratford W, Dessing JC, Craig C. Development of a novel immersive interactive virtual reality cricket simulator for cricket batting. In: Proceedings of the 10th International Symposium on Computer Science in Sport (ISCSS). Springer International Publishing; 2015:203-210.
21. Jayaraj L, Wood J, Gibson M. Improving the immersion in virtual reality with real-time avatar and haptic feedback in a cricket simulation. In: IEEE International Symposium on Mixed and Augmented Reality (ISMAR-adjunct); 2017:310-4
22. Gururaj BN, Sooda K. Design of a comprehensive virtual reality cricket simulator for immersive skill training. In: Proceedings of the 8th International Conference on Computational System and Information Technology for Sustainable Solutions (CSITSS); 2024:1-6
23. Runswick OR, Phillips M, Morrone J, North JS, Wilkins L. Construct Validity and Reliability of a Virtual Reality Cricket Batting Simulator. *SportsRxiv.* 2025.
24. Runswick OR. Player perceptions of face validity and fidelity in 360-video and virtual reality cricket. *J Sport Exercise Psychol.* 2023;45(6):347-54.
25. Justham LM, West AA, Harrison R, Jones R, Harland AR, Caine MP, et al. The use of virtual reality and automatic training devices in sport: a review of technology within cricket and related disciplines. *Engin Syst Design Analysis.* 2004;4174:333-40.

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