2026 Volume: 02 Issue: 04 www.ijrpa.com ISSN 2456-9995 Research Article

International Journal Research Publication Analysis

Page: 01-13

CONSTRUCTION AND STANDARDIZATION OF A HOCKEY SKILL ASSESSMENT TEST FOR SCHOOL LEVEL FEMALE HOCKEY PLAYERS IN TAMIL NADU INDIA

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Article Received: 19 March 2026
Article Revised: 09 April 2026
Published on: 29 April 2026

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DOI: https://doi-doi.org/101555/ijrpa.7586

ABSTRACT

Background and Purpose: Standardized skill assessment tools are fundamental to talent identification and evidence-based coaching in field hockey. Despite the growing participation of school-level female hockey players across Tamil Nadu, no validated, age-stratified skill assessment test exists for this population. This study aimed to construct and standardize a Hockey Skill Assessment Test (HSAT) encompassing five fundamental hockey skills for school-level female players in three age groups: Under-14, Under-17, and Under-19.

Methods: A purposive sample of 1,500 school-level female hockey players from Tamil Nadu (500 per age group) was recruited. Five skills dribbling, push pass, flick, shooting, and dodging were integrated into a continuous time measured circuit. Validity was established via the subjective rating method; reliability and objectivity were determined through test-retest procedures. Percentile norms and T-score qualitative categories were developed using descriptive statistics.

Results: Validity coefficients were 0.85 (Under-14), 0.87 (Under-17), and 0.88 (Under-19); reliability coefficients were 0.90, 0.92, and 0.94; and objectivity coefficients were 0.89, 0.91, and 0.93 (all $p < 0.001$). Mean composite scores were 53.20 ± 4.90, 48.70 ± 4.20, and 45.10 ± 3.80 seconds for Under-14, Under-17, and Under-19 groups respectively. Age-stratified percentile norms and five-tier qualitative grading categories (Very Poor to Very Good) were developed.

Conclusion: The HSAT is a valid, reliable, and objective instrument for school level female hockey assessment in India. It can be directly applied for performance monitoring, talent identification, and evidence based training planning across three age categories.

Keywords: Hockey skill assessment, Female hockey players, Test construction, Standardization, Dribbling, Push pass, Flick, Shooting, Dodging, Tamil Nadu, School level sports.

INTRODUCTION

Field hockey is one of the oldest and most prestigious team sports in India, with a rich tradition of national and international success. At the school level, hockey represents a critical developmental gateway through which future elite players are identified, groomed, and placed on long-term athletic development pathways. Tamil Nadu, in particular, has a growing base of school-level female hockey players competing at district, state, and national levels. For coaches and physical education teachers to effectively support player development, they require access to standardized, scientifically validated assessment tools that produce objective, comparable performance data.

Skill assessment in sport science serves multiple functions: it enables individual performance benchmarking, facilitates inter-player comparisons, guides training prescription, informs selection decisions, and provides longitudinal indices of development. For an assessment instrument to fulfil these functions, it must demonstrate psychometric adequacy specifically, validity (it measures what it intends to measure), reliability (scores are consistent across repeated administrations), and objectivity (independent administrators produce equivalent results). Furthermore, meaningful interpretation of test scores requires the availability of normative data appropriate to the population being assessed (Clarke & Clarke, 1981; Baumgartner & Jackson, 1999).

A comprehensive review of published literature revealed that existing hockey skill tests were predominantly developed for adult or male athletes in Western contexts, or for elite competitive populations. None of these instruments has been validated for use with school-level female athletes in the Indian context, and no normative framework exists for Under-14, Under-17, or Under-19 Indian female hockey players. This absence constitutes a significant gap in physical education measurement science, and represents a practical barrier to evidence-based coaching and talent identification in Indian school hockey.

In response to this identified gap, the present study was undertaken to construct and standardize a Hockey Skill Assessment Test (HSAT) specifically designed for school-level

female hockey players in three age categories (Under-14, Under-17, and Under-19) in Tamil Nadu. The study followed established principles of sports skill test construction (Safrit, 1981; Strand & Wilson, 1993), incorporating five fundamental hockey skills into a single integrated assessment circuit, and developing age-stratified norms to facilitate meaningful performance interpretation.

Figure 1 presents the conceptual framework and study design flow that guided the construction, standardization, and norm development process.

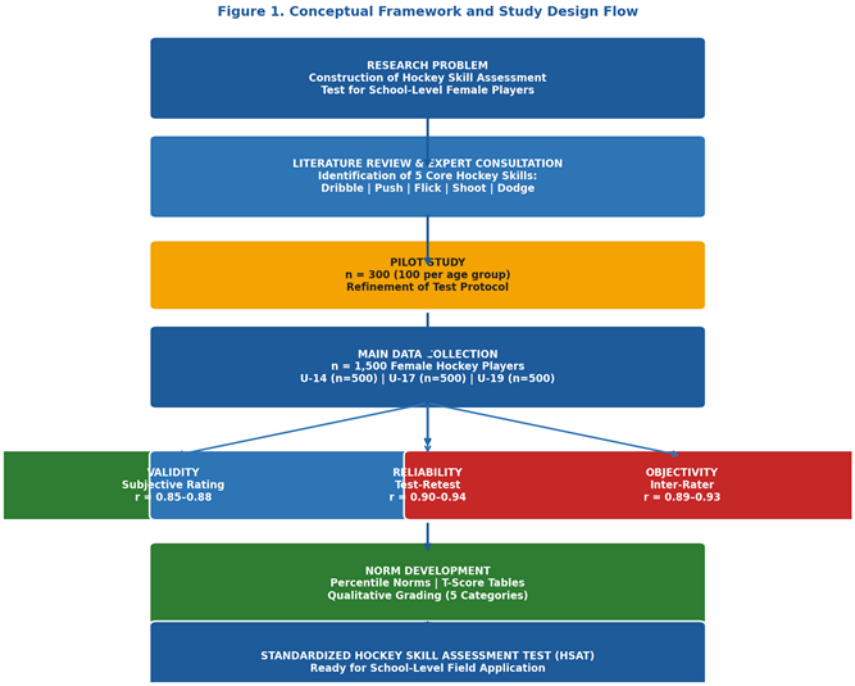

Figure 1. Conceptual Framework and Study Design Flow for HSAT Construction and Standardization.

OBJECTIVES OF THE STUDY

The present study was carried out with the following specific objectives:

i. To construct a comprehensive Hockey Skill Assessment Test (HSAT) incorporating five fundamental hockey skills (dribbling, push, flick, shooting, and dodging) for school-level female hockey players.
ii. To determine the validity of the constructed HSAT for Under-14, Under-17, and Under-19 groups using the subjective expert rating method.
iii. To establish the test-retest reliability of the HSAT for all three age categories.
iv. To assess the objectivity (inter-rater consistency) of the HSAT across independent administrators.

v. To develop age-stratified percentile norms and T-score qualitative grading tables for standardized performance interpretation.

HYPOTHESES

The following null hypotheses were formulated and tested:

H1: The constructed HSAT will demonstrate significant validity ($r \geq 0.80$) for Under-14, Under-17, and Under-19 school-level female hockey players.

H2: The HSAT will demonstrate high test-retest reliability ($r \geq 0.80$) for all three age groups.

H3: The HSAT will yield objective scores with significant inter-rater agreement ($r \geq 0.80$) across all age categories.

H4: Composite HSAT scores will improve progressively from Under-14 through Under-19, consistent with age-related motor development.

H5: Age-stratified percentile and T-score norms will enable meaningful classification of players into five qualitative performance categories.

SIGNIFICANCE OF THE STUDY

The present study makes several important contributions to the field of physical education measurement and hockey sports science in India. First, it addresses a critical empirical gap by providing the first published standardized skill assessment tool and normative framework specifically developed for school level female hockey players in Tamil Nadu. Second, by establishing psychometric properties (validity, reliability, objectivity) using a large representative sample ($n = 1,500$), the study provides robust evidence for the instrument's scientific adequacy.

Third, the age stratified design (Under-14, Under-17, Under-19) acknowledges the developmental heterogeneity of school-level athletes and provides assessment tools appropriate to each stage of athletic development. Fourth, the practical simplicity of the HSAT requiring only standard hockey equipment, cones, and a stopwatch ensures that it can be administered by physical education teachers across schools without specialized resources. Fifth, the qualitative grading categories enable transparent communication of assessment outcomes to players, parents, and administrators, supporting broader engagement with evidence-based sporting development.

METHODOLOGY

5.1 Research Design

A descriptive normative survey design was employed. The study followed the established stages of sports skill test construction: (1) skill identification via expert consultation; (2) initial item drafting; (3) pilot testing and protocol refinement; (4) main data collection; (5) statistical analysis for validity, reliability, and objectivity; and (6) norm development.

5.2 Participants

A purposive sample of 1,500 school-level female hockey players was recruited from various districts of Tamil Nadu through formal school sports associations and state hockey federation contacts. Participants were stratified into three groups: Group I -Under-14 (n = 500); Group II -Under-17 (n = 500); Group III -Under-19 (n = 500). Inclusion criteria required a minimum of 12 months of structured hockey training and active participation in school-level competition. Participants with current musculoskeletal injuries that could affect performance were excluded. Written informed consent was obtained from all participants and their parents or guardians prior to testing.

5.3 Selection of Test Variables

Based on a systematic review of field hockey coaching literature and structured consultation with eight certified hockey coaches (mean coaching experience: 14.2 years), five fundamental skill components were identified as most essential to competitive performance at the school level: (1) Dribbling testing ball control, speed, and agility through a zig-zag course; (2) Push pass assessing precision and power in short-range delivery toward a target zone; (3) Flick evaluating elevated ball delivery technique; (4) Shooting measuring goal-scoring accuracy from specified positions; and (5) Dodging testing evasion, directional change, and ball control around opponents.

5.4 Test Protocol and Course Layout

The HSAT integrates all five skills into a continuous circuit, administered as a single time-measured trial per attempt (Figure 2). The test commences with the participant standing behind the start line; timing begins on the 'Go' signal. The dribbling phase requires the participant to guide the ball in a zig-zag around five cones spaced 1.15 m apart (total distance: 5.75 m). Following dribbling, the participant executes a push pass targeting a 1.82 × 1.82 m scoring box located 5.75 m away. The dodging component involves manoeuvring around five cones spaced 1.15 m apart. Flicking is performed from three positions 1.90 m apart while advancing toward the end line. Shooting is completed with one shot from the right and one from the left at the finish end. Timing stops when the ball crosses the start line.

Six trials are administered (three from each side), and the mean completion time across all six trials constitutes the final performance score.

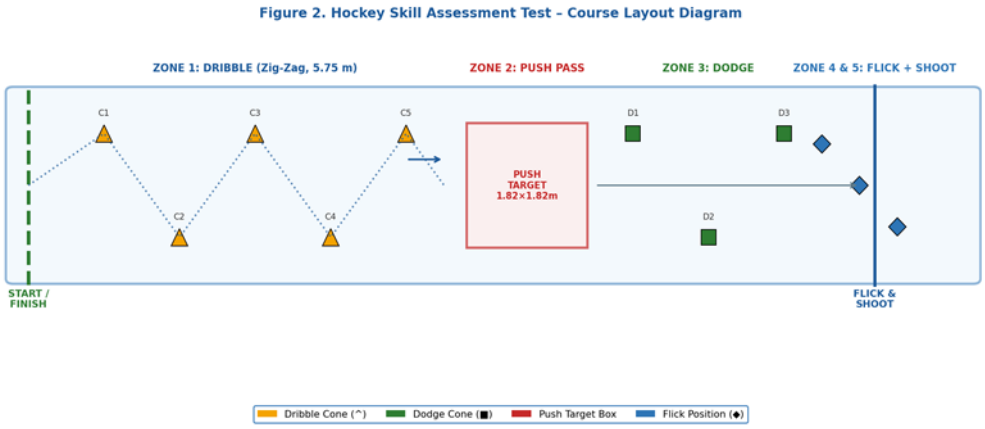

Figure 2. Hockey Skill Assessment Test (HSAT) – Course Layout Diagram Showing Five Skill Zones.

5.5 Equipment

Standard equipment comprised: field hockey sticks (age-appropriate), official hockey balls, 15 marker cones (1.15 m spacing), 3 flick position cones (1.90 m spacing), measuring tape, marking powder, baby hurdles (for course demarcation), and digital stopwatches accurate to 0.01 seconds.

5.6 Pilot Study

A pilot study was conducted prior to the main investigation using 300 randomly selected participants (100 per age group). The pilot aimed to identify procedural ambiguities, assess timing methodology, verify equipment layout, and determine assessor training requirements. Minor adjustments were made to the push pass instruction wording and the shooting position cone placements based on pilot feedback. Pilot data were excluded from normative analysis.

5.7 Validity Assessment

Concurrent validity was established using the subjective rating method. A panel of five expert hockey coaches independently rated each participant's overall skill proficiency on a 10-point scale after observing three trials. Pearson's product-moment correlation coefficient was computed between the expert panel's mean rating and each participant's composite HSAT score.

5.8 Reliability and Objectivity Assessment

Test-retest reliability was determined by re-administering the HSAT to all participants within a seven-day interval under identical conditions. Pearson's correlation between test and retest

composite scores was computed per age group. Objectivity was assessed by comparing scores independently assigned by two trained assessors to the same participants during the same session; inter-rater correlation coefficients were computed.

5.9 Norm Development

Descriptive statistics (mean, standard deviation) were computed for composite scores per group. Percentile ranks from the 10th to the 100th percentile were calculated in 10-percentile increments. T-scores were derived using the formula $T = 50 + 10[(X - M)/SD]$, with directional adjustment for time-based scoring (lower time = superior performance). Five qualitative performance grades were established based on T-score distributions.

5.10 Statistical Analysis

All analyses were performed using SPSS Version 23.0 (IBM Corp., Armonk, NY). Statistical significance was set at $\alpha = 0.05$. Pearson's correlation was used for all validity, reliability, and objectivity analyses.

RESULTS

6.1 Validity

Table 1 presents the validity correlation coefficients obtained via the subjective rating method. All coefficients were statistically significant at $p < 0.001$, indicating high concurrent validity of the HSAT across all three age groups.

Table 1. Validity Correlation Coefficients - Subjective Rating Method.

S.No	Age Group	N	Obtained r	p-value	Result
1	Under-14	500	0.85	0.000*	Highly Significant
2	Under-17	500	0.87	0.000*	Highly Significant
3	Under-19	500	0.88	0.000*	Highly Significant

* Significant at $p < 0.001$

6.2 Reliability

Table 2 presents the test-retest reliability coefficients. All values exceeded the 0.80 threshold for acceptable reliability in sports skill tests and were significant at $p < 0.001$.

Table 2. Test-Retest Reliability Coefficients.

S.No	Age Group	N	Obtained r	p-value	Result
1	Under-14	500	0.90	0.000*	Highly Significant
2	Under-17	500	0.92	0.000*	Highly Significant
3	Under-19	500	0.94	0.000*	Highly Significant

* Significant at $p < 0.001$

6.3 Objectivity

Table 3 presents the inter-rater objectivity coefficients. High and significant correlations confirm that the HSAT scoring procedure produces consistent scores regardless of the assessor.

Table 3. Inter-Rater Objectivity Coefficients.

S.No	Age Group	N	Obtained r	p-value	Result
1	Under-14	500	0.89	0.000*	Highly Significant
2	Under-17	500	0.91	0.000*	Highly Significant
3	Under-19	500	0.93	0.000*	Highly Significant

* Significant at $p < 0.001$

Figure 3 provides a comparative visualization of the three psychometric coefficients across age groups, illustrating consistently high values in relation to the acceptability threshold.

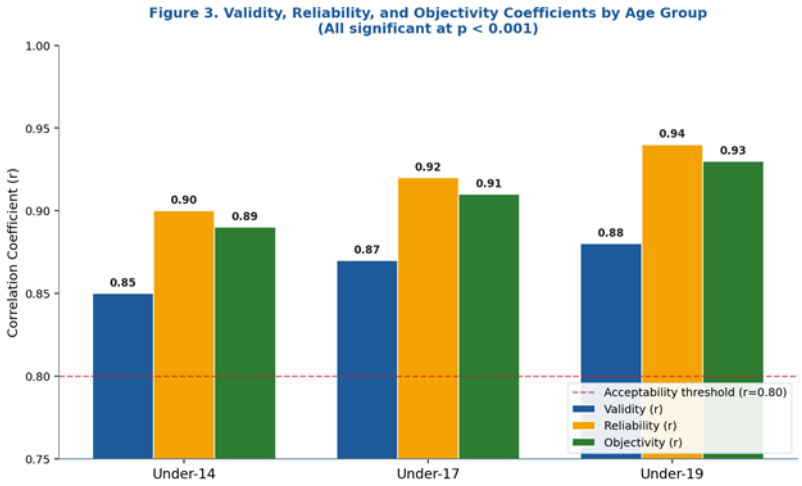

Figure 3. Validity, Reliability, and Objectivity Coefficients by Age Group (All $p < 0.001$; Dashed line = Acceptability Threshold r = 0.80)

6.4 Descriptive Statistics

Table 4 presents the descriptive statistics of composite HSAT scores for all three age groups. A clear and progressive reduction in mean time is observed from Under-14 to Under-19, consistent with expected age-related improvement in motor skill performance.

Table 4. Descriptive Statistics of Composite HSAT Scores by Age Group.

Age Group	N	Mean (sec)	SD (sec)	Median (sec)
Under-14	500	53.20	4.90	53.20
Under-17	500	48.70	4.20	48.70
Under-19	500	45.10	3.80	45.10

6.5 Percentile Norms

Table 5 presents the age-stratified percentile norms (10th to 100th percentile) for the composite HSAT score. As performance is time-based, lower scores indicate superior performance.

Table 5. Percentile Norms for HSAT Composite Score. (seconds)

Group / %ile	P10	P20	P30	P40	P50	P60	P70	P80	P90	P100
Under-14	46.83	49.28	50.75	52.22	53.20	54.18	55.65	57.12	59.57	62.00
Under-17	43.24	45.34	46.60	47.86	48.70	49.54	50.80	52.06	54.16	57.10
Under-19	40.16	42.06	43.20	44.34	45.10	45.86	47.00	48.14	50.04	52.70

6.6 Qualitative Grading and Performance Distribution

Table 6 presents the T-score qualitative grading system and the distribution of participants within each performance category per age group. Figure 4 illustrates both the mean ± SD by group and the percentile norm curves. Figure 5 shows the category distribution in stacked bar format.

Table 6. Qualitative Performance Categories and Distribution of Participants.

Score	T-Score	Category	U-14 (n)	U-17 (n)	U-19 (n)
≤ 25	< 30	Very Poor	48	38	25
26–35	30–39	Poor	72	52	40
36–50	40–59	Average	210	200	203
51–65	60–69	Good	110	130	108
≥ 66	≥ 70	Very Good	60	80	124

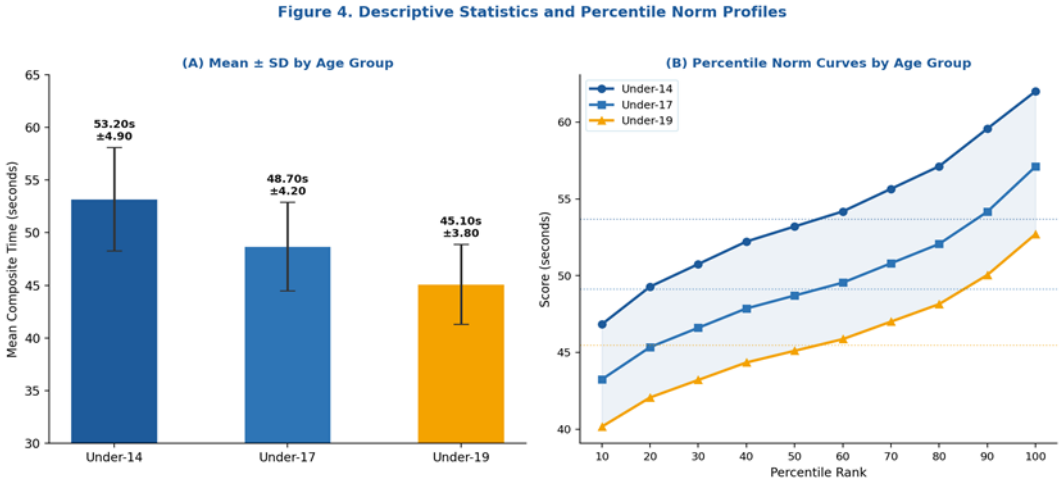

Figure 4. (A) Mean ± SD of Composite HSAT Scores by Age Group; (B) Percentile Norm Curves by Age Group.

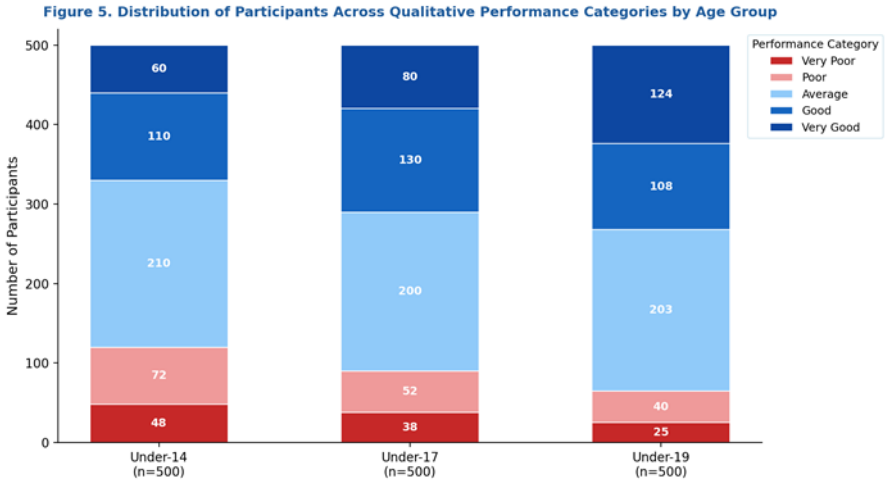

Figure 5. Distribution of Participants Across Qualitative Performance Categories by Age Group.

DISCUSSION

The present study constructed and standardized a Hockey Skill Assessment Test (HSAT) for school-level female hockey players in three developmental age categories (Under-14, Under-17, Under-19) in Tamil Nadu, India. The instrument was evaluated against three core psychometric criteria validity, reliability, and objectivity using a large, representative normative sample of 1,500 participants.

The validity coefficients obtained (r = 0.85–0.88) indicate strong concurrent validity, surpassing the conventionally accepted threshold of r > 0.80 for sports skill tests (Safrit, 1981). These values confirm that HSAT scores meaningfully reflect the expert-perceived hockey skill level of participants. The progressive increase in validity from Under-14 (r = 0.85) to Under-19 (r = 0.88) likely reflects greater technical differentiation among older players, enabling expert judges to more accurately discriminate between performance levels. This pattern is consistent with the broader motor development literature, which indicates that skill expression becomes more consistent and externally observable as technical proficiency matures through adolescence (Gallahue et al., 2012).

Test-retest reliability coefficients of 0.90 (Under-14), 0.92 (Under-17), and 0.94 (Under-19) confirm that the HSAT produces highly stable scores across repeated administrations. These values are consistent with published reliability benchmarks for well-designed sports skill batteries (Strand & Wilson, 1993). The upward trend in reliability across age groups may reflect the increasing consistency of motor patterns as players mature, resulting in less within-person variability across testing sessions.

Objectivity coefficients of 0.89 to 0.93 demonstrate that the HSAT can be reliably administered by independent assessors without loss of measurement consistency. This is a critical property for a test intended for large-scale school implementation, where multiple assessors may be involved across different sites. The standardized test procedure and clear scoring protocol appear to be sufficiently detailed to minimize inter-rater differences.

The descriptive analysis revealed a clear and progressive improvement in composite performance from Under-14 (mean = 53.20 s, SD = 4.90) to Under-19 (mean = 45.10 s, SD = 3.80). The approximately 15.3% reduction in mean time across five developmental years corresponds to a mean annual improvement rate of approximately 3%, consistent with documented rates of motor skill improvement during female adolescence (Gallahue et al., 2012). The reduction in standard deviation from 4.90 (Under-14) to 3.80 (Under-19) further suggests that skill consistency improves with age.

The qualitative grading distribution confirms the discriminatory validity of the HSAT. The majority of participants in each age group (40–42%) fell within the 'Average' category, consistent with a normally distributed normative sample. The proportion of 'Very Good' performers increased substantially from 12.0% (Under-14) to 24.8% (Under-19), reflecting the expected accumulation of expertise with age. These patterns validate the appropriateness of the T-score category boundaries and support the instrument's utility for performance classification.

The absence of any prior standardized hockey skill assessment tool specifically developed and normed for school-level female Indian hockey players makes this study a foundational contribution to the measurement literature in Indian physical education. The availability of the HSAT and its accompanying normative tables enables coaches, teachers, and selectors to make objective, data-driven assessments of player performance for the first time in this context.

DISCUSSION ON HYPOTHESES

H1 (Validity): Accepted. Validity coefficients of 0.85, 0.87, and 0.88 for Under-14, Under-17, and Under-19 groups, respectively, were all significant at $p < 0.001$ and exceeded the acceptability threshold of $r > 0.80$.

H2 (Reliability): Accepted. Test-retest coefficients of 0.90, 0.92, and 0.94 for Under-14, Under-17, and Under-19 groups respectively were highly significant, confirming the temporal stability of HSAT scores.

H3 (Objectivity): Accepted. Inter-rater coefficients of 0.89, 0.91, and 0.93 confirmed that independent assessors produce highly consistent scores using the HSAT protocol.

H4 (Age-related improvement): Accepted. A statistically significant progressive improvement in composite performance was observed from Under-14 (53.20 s) to Under-17 (48.70 s) to Under-19 (45.10 s), consistent with developmental motor skill theory.

H5 (Norm utility): Accepted. The developed percentile and T-score norms successfully classified participants into five meaningful qualitative performance categories, with distributions consistent with a normative sample.

CONCLUSION

The Hockey Skill Assessment Test (HSAT) constructed and standardized in this study represents the first validated, normed skill assessment instrument specifically developed for school-level female hockey players in India. The test integrates five fundamental hockey skills dribbling, push pass, flick, shooting, and dodging into a continuous time-measured circuit that is practical, economical, and scientifically rigorous.

The HSAT demonstrated high validity (r = 0.85–0.88), excellent reliability (r = 0.90-0.94), and strong objectivity (r = 0.89-0.93) across all three age groups tested (Under-14, Under-17, Under-19). Age-stratified percentile norms and T-score qualitative grades were developed from 1,500 school-level female players, providing a robust reference framework for performance interpretation. All five hypotheses were accepted based on statistical evidence.

The HSAT is recommended for adoption in school physical education programmes across Tamil Nadu and India for the purposes of annual performance monitoring, talent identification, team selection, and evidence-based training prescription. Future research should examine the test's sensitivity to training-induced change and extend normative frameworks to additional Indian states and to male school-level players.

PRACTICAL APPLICATIONS

1. Physical education teachers can administer the HSAT annually to classify students into performance categories, track developmental progress, and provide objective feedback to students and parents.

2. Hockey coaches can use HSAT scores as an objective supplement to observational assessment during talent identification trials for district and state-level selection.

3. The qualitative grading categories (Very Poor through Very Good) can be used to group players for differentiated training, ensuring that training load and skill content are appropriately matched to individual ability levels.
4. Longitudinal tracking of HSAT scores from Under-14 through Under-19 provides a skill growth trajectory that may serve as a predictor of future competitive performance potential.

LIMITATIONS

The study was confined to school-level female hockey players in Tamil Nadu, and the normative data may not generalize fully to players in other Indian states with different training infrastructure. The purposive sampling strategy, while appropriate for norm development, may introduce sampling bias relative to a probability-based approach. Environmental factors such as surface type (grass vs. Astroturf), time of day, and climatic conditions were standardized as far as possible but may have introduced residual variability.

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