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AN EVALUATION OF PHYSICAL AND TECHNICAL SKILL DEVELOPMENT AMONG 12–13-YEAR-OLD SHUTTLECOCK ATHLETES IN TAN BINH DISTRICT, HO CHI MINH CITY AFTER SIX MONTHS OF TRAINING

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Abstract:
This study aims to establish a reliable set of physical and technical evaluation criteria for 12–13-year-old shuttlecock athletes in Tan Binh District, Ho Chi Minh City, following a six-month structured training program. A combination of expert consultation, pedagogical testing, and statistical analysis was employed to identify and validate performance indicators. The findings revealed significant improvements in both physical and technical skills post-training, particularly in key areas such as flexibility, coordination, and targeted shuttlecock techniques. The validated assessment framework not only provides a scientific foundation for monitoring athlete development but also serves as a practical tool for coaches in designing data-driven training programs. This research contributes to enhancing the quality and effectiveness of youth shuttlecock training and talent identification at the district level.

Keywords: Shuttlecock sport, youth athlete development, physical fitness assessment, technical skill evaluation, training program effectiveness

1. Introduction

The sport of shuttlecock, though valuable for youth development, lacks scientifically validated tools tailored to its specific demands. Current assessment methods often ignore shuttlecock's unique biomechanics and the developmental differences of young athletes. Unlike other racket sports like badminton, the shuttlecock still lacks age-appropriate performance evaluation systems. This study aims to fill that gap by designing and validating a reliable assessment framework for 12–13-year-old shuttlecock athletes in Tan Binh District, Ho Chi Minh City, after a six-month training period.

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The framework combines expert consultation, pedagogical testing that meets established reliability standards, and statistical validation. It focuses on identifying suitable physical and technical performance indicators, evaluating measurable progress after training, and building standardized scoring systems for effective training design and talent selection.

Three research questions guide the study:

1) What performance indicators are most suitable for assessing youth shuttlecock players?
2) How much improvement occurs after six months of systematic training?
3) How can reliable scoring systems support athlete evaluation and coaching?

The study offers a scientifically grounded, practical model to enhance performance assessment and long-term athlete development in youth shuttlecock sports in Vietnam.

2. Literature Review

2.1 Historical Context and Cultural Significance

Shuttlecock is a culturally significant sport in Vietnam, commonly played at festivals and schools, promoting physical activity, social connection, and youth development. It encourages teamwork, discipline, and cultural continuity. As educational technology evolves, integrating digital tools like virtual reality into shuttlecock training can modernize its appeal and engage tech-savvy youth (Nguyen, Cao, and Truong 2023).

For children aged 12–13, a crucial developmental stage, training should prioritize enjoyment, skill development, and physical literacy rather than early specialization, which can lead to burnout and injury (Moseid et al. 2019). Experts recommend diverse sport participation to build broad motor skills and reduce stress (Mosher et al. 2022).

Effective coaching should be child-centered, considering different maturity levels and emphasizing holistic development—physical, psychological, and social (Lundqvist, Asratian, and Dahlström 2023). Sustainable training loads, adequate recovery, and supportive coaching environments are essential for long-term athletic growth and well-being.

2.2 Physical and Technical Demands of Shuttlecock

Agility, flexibility, coordination, and sport-specific conditioning are crucial for shuttlecock performance. Agility enables players to change direction quickly and maintain balance, vital for reacting to unpredictable shuttlecock flight paths. Studies show that agility training improves reaction speed and movement efficiency (Balyi and Hamilton 2004).

Flexibility supports dynamic shuttlecock techniques such as high kicks and lunges. A wide range of motion enhances postural control and reduces injury risks, while targeted stretching programs improve movement execution (Lloyd and Oliver 2012).

Coordination ensures smooth transitions and control during juggling and serving, both of which require fine motor skills and spatial awareness. Better coordination correlates with success in technique-heavy sports (Carriedo, Cecchini, and Méndez-Giménez 2023)

Endurance and strength are also essential. Shuttlecock matches demand sustained aerobic and anaerobic capacity to delay fatigue and maintain cardiovascular health (Moseid et al., 2018). Core and leg strength provide power and stability for kicks, while resistance training boosts performance and reduces injury risks (Hall et al. 2015).

Explosive power, developed through plyometrics, enhances jumping and striking. Technically, the sport emphasizes juggling for control, serving for strategic play, and kicking for offense and defense—all requiring precision, strength, and adaptability (Lehmann et al. 2023); (Jacobsson et al. 2018).

2.3 Gaps in Current Research and Rationale for the Study

Current research lacks standardized tools for assessing shuttlecock performance. While some biomechanical studies exist, no validated system fully captures the sport's unique technical and physical demands (Ramasamy et al. 2024). This limits cross-study comparisons and clear performance benchmarks. Unlike badminton, the shuttlecock has yet to adopt reliable evaluation frameworks (Duncan et al. 2017).

Moreover, there is a shortage of age-specific tools. For 12–13-year-olds, developmental differences in physical and motor skills require assessments tailored to their needs (Gilic and Vrdoljak 2023). Generic models often overlook cognitive and emotional factors, leading to ineffective training.

This study addresses these gaps by developing a sport-specific, age-appropriate assessment tool. It incorporates shuttlecock-relevant tasks and age-based scoring. Experts in coaching and sports science guide the design to ensure practicality and accuracy. The result is a validated, developmentally sensitive framework to support youth training, talent identification, and long-term growth.

3. Methodology

This study adopted a mixed-methods approach, combining qualitative and quantitative techniques to ensure comprehensive data collection and analysis. The following procedures were implemented:

3.1 Document Analysis and Synthesis

A review of relevant literature and existing training manuals was conducted to establish a theoretical foundation and to identify appropriate criteria for evaluating the physical and technical performance of shuttlecock athletes. This process informed the initial development of test items and assessment protocols.

3.2 Expert Interviews

To validate the proposed evaluation indicators, structured questionnaires were distributed to 34 shuttlecock coaches and sports science professionals. A total of 31 valid responses were collected and analyzed to gather expert consensus on the relevance, practicality, and frequency of use of each test item in professional training contexts.

3.3 Pedagogical Testing

A cohort of 18 male shuttlecock athletes, aged 12 to 13, from the Tan Binh District Sports Center, participated in performance testing. Assessments were administered both before and after a six-month training intervention. The selected tests were designed to measure key physical and technical attributes, including agility, flexibility, coordination, and shuttlecock-specific skills.

3.4 Statistical Analysis

Descriptive and inferential statistical methods were employed to evaluate the reliability and effectiveness of the proposed tests. Metrics included mean values, standard deviations, correlation coefficients (r), coefficients of variation, and paired sample t-tests to assess pre- and post-training performance differences. These analyses provided empirical validation of the testing framework and supported the interpretation of training outcomes.

4. Results

4.1 Assessment of the Current Physical and Technical Status of 12–13-Year-Old Shuttlecock Athletes in Tan Binh District, Ho Chi Minh City

4.1.1 Identification of physical and technical evaluation tests for 12–13-year-old shuttlecock athletes in Tan Binh District, Ho Chi Minh City

Based on 31 valid responses collected from coaches and experts in the field of shuttlecock sport, the tests were selected when 80% or more of the respondents rated them as "commonly used." Specifically:

Table 1: Interview results on physical and technical assessment tests of 12–13-year-old shuttlecock athletes

No.	Test name	Unit	Commonly used (%)	Rarely used (%)	Not used (%)
1	Vertical Split	cm	100.0%	0.0%	0.0%
2	Horizontal Split	cm	93.8%	3.1%	3.1%
3	Forward Bend	cm	62.5%	25.0%	12.5%
4	1500m Run	s	40.6%	15.6%	43.8%
5	400m Run	s	53.1%	37.5%	9.4%
6	60m Sprint	s	65.6%	25.0%	9.4%
7	30m Sprint	s	87.5%	6.3%	6.3%
8	6m Lateral Shuttle Pick-Up	s	93.8%	3.1%	3.1%
9	4-Point Shuttle Pick-Up (10 reps)	s	96.9%	3.1%	0.0%
10	8×15m Shuttle Run	s	81.3%	15.6%	3.1%
11	Standing Vertical Jump	cm	84.4%	9.4%	6.3%
12	Standing Long Jump	cm	62.5%	21.9%	15.6%
13	Sit-to-Stand in 30 Seconds	reps	56.3%	9.4%	34.4%
14	One-Minute Rope Skipping	rotations	31.3%	15.6%	53.1%
15	Sit-Ups in 30 Seconds	reps	46.9%	28.1%	25.0%
16	Foot Juggling with Instep (1 min)	touches	100.0%	0.0%	0.0%
17	Foot Juggling with Sole (1 min)	touches	59.4%	25.0%	15.6%
18	Direct Shuttle Serve (10 attempts)	points	96.9%	3.1%	0.0%
19	Angled Shuttle Serve (10 attempts)	points	68.8%	18.8%	12.5%
20	Receiving and Attack Kick into Target (10 attempts)	points	87.5%	12.5%	0.0%
21	Sweeping Attack Kick into Target	points	65.6%	21.9%	12.5%
22	Hook Attack Kick into Target	points	53.1%	25.0%	21.9%

Based on the interview results, we selected the tests with a consensus rate of over 80%, including:

- **Physical fitness tests:** Vertical split (100%), horizontal split (93.8%), standing vertical jump (84.4%), 8×15m shuttle run (81.3%), 4-point shuttle pickup (96.9%), and 6m lateral shuttle pickup (93.8%).
- **Technical skill tests:** One-minute foot juggling with the instep, direct shuttle serve into the target zone (96.9%), and receiving and attacking with the instep (87.5%).

4.1.2 Physical and Technical Status of 12–13-Year-Old Shuttlecock Athletes in Tan Binh District, Ho Chi Minh City

To assess the current physical and technical proficiency of young shuttlecock athletes, a comparative analysis was conducted between two groups of 12–13-year-old athletes from Tan Binh District and District 7. A series of standardized performance tests was administered to both groups, and the results were subjected to statistical analysis, including independent sample t-tests to determine the significance of differences between the groups. The following table summarizes the mean scores, standard deviations (SD), and significance levels (p-values) for each tested indicator:

Table 2: Test Results on Physical and Technical Indicators of 12–13-Year-Old Shuttlecock Athletes from Tan Binh District and District 7

No	Test	District	Mean	Sd	t	p
1	One-minute foot juggling (touches)	Tan Binh	70.00	5.77	3.60	< 0.05
		District 7	63.14	4.75		
2	Shuttle serve into target (points)	Tan Binh	6.12	0.43	0.84	> 0.05
		District 7	6.26	0.53		
3	Receiving and attack kick (points)	Tan Binh	6.70	0.34	2.51	< 0.05
		District 7	6.31	0.53		
4	Standing vertical jump (cm)	Tan Binh	45.22	4.24	0.88	> 0.05
		District 7	46.50	3.78		
5	4-point shuttle pickup (s)	Tan Binh	87.86	5.19	1.63	> 0.05
		District 7	84.32	6.50		
6	6m lateral shuttle pickup (s)	Tan Binh	57.62	2.81	0.43	> 0.05
		District 7	58.06	3.35		
7	8×5m shuttle run (s)	Tan Binh	65.32	1.64	1.71	> 0.05
		District 7	63.33	4.59		
8	Horizontal split (cm)	Tan Binh	9.07	0.70	3.35	< 0.05
		District 7	8.24	0.68		
9	Vertical split (cm)	Tan Binh	9.31	0.62	5.10	< 0.05
		District 7	8.11	0.67		

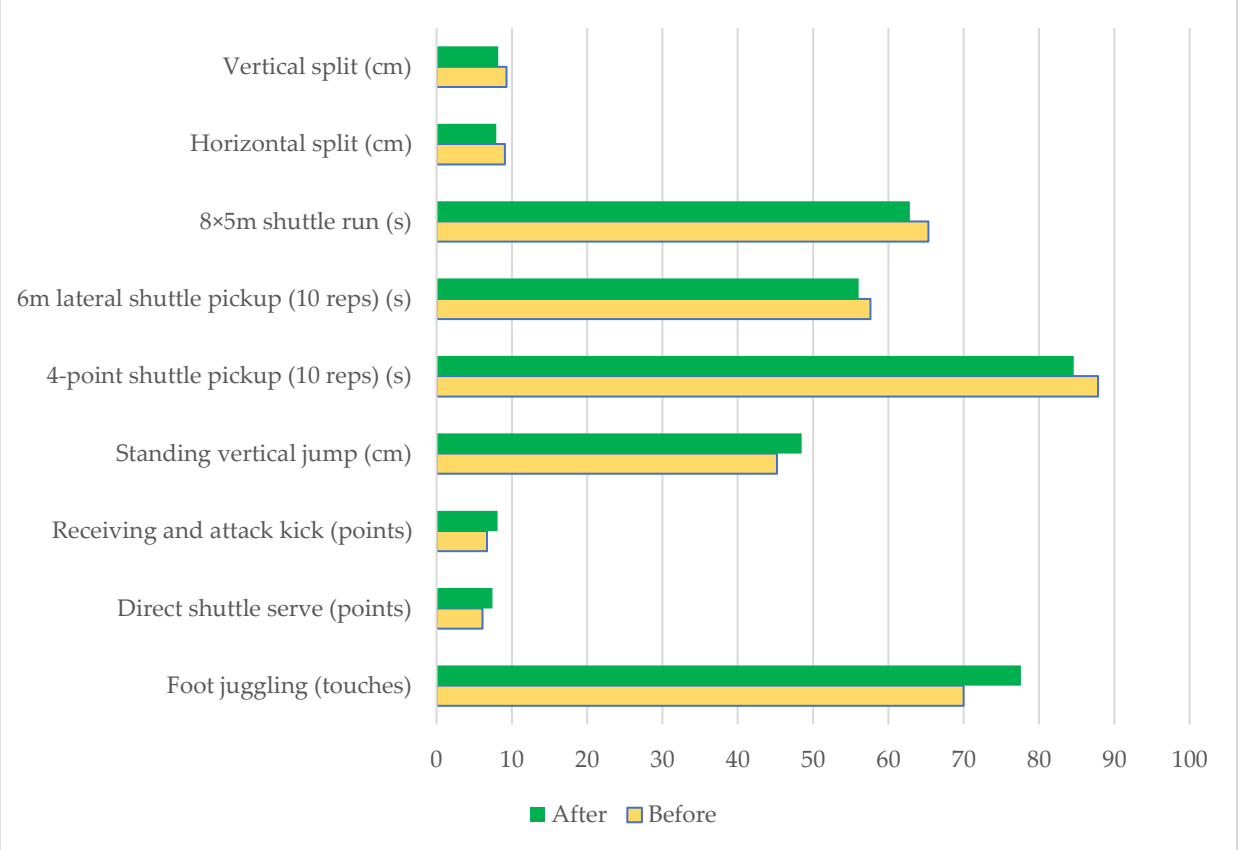
The results show that Tan Binh athletes outperformed District 7 in technical skills, notably in foot juggling and kicking, with statistically significant differences ($p < 0.05$). This reflects strong technical training in Tan Binh. However, no significant differences were found in most physical fitness measures ($p > 0.05$), and District 7 slightly excelled in some areas. This suggests a training imbalance in Tan Binh, where technical skill is prioritized over physical conditioning. To support long-term development, it is recommended that Tan Binh enhance training in flexibility, agility, and endurance.

4.2 Evaluation of Physical and Technical Skill Development in 12–13-Year-Old Shuttlecock Athletes from Tan Binh District, Ho Chi Minh City After Six Months of Training

Table 3: Results of Initial and Post-Training Physical and Technical Assessments for 12–13-Year-Old Shuttlecock Athletes in Tan Binh District After Six Months of Training

Indicator	Test	Mean	SD	Cv (%)	ε	W	t	p
Foot juggling (touches)	Pre-test	70.00	5.77	8.24	0.04	10.4	5.47	0.01
	Post-test	77.61	5.25	6.76	0.03			
Direct shuttle serve (points)	Pre-test	6.12	0.43	6.97	0.03	19.33	12.63	0.01
	Post-test	7.43	0.51	6.88	0.03			
Receiving and attack kick (points)	Pre-test	6.70	0.34	5.02	0.03	18.78	15.07	0.01
	Post-test	8.09	0.44	5.49	0.03			
Standing vertical jump (cm)	Pre-test	45.22	4.24	9.37	0.05	6.94	4.16	0.01
	Post-test	48.50	4.67	9.63	0.05			
4-point shuttle pickup (10 reps) (s)	Pre-test	87.86	5.19	5.90	0.03	-3.75	4.23	0.01
	Post-test	84.60	5.57	6.59	0.03			
6m lateral shuttle pickup (10 reps) (s)	Pre-test	57.62	2.81	4.88	0.02	-2.69	8.44	0.01
	Post-test	56.05	2.89	5.16	0.03			
8×5m shuttle run (s)	Pre-test	65.32	1.64	2.52	0.01	-3.84	5.27	0.01
	Post-test	62.87	1.91	3.03	0.02			
Horizontal split (cm)	Pre-test	9.07	0.70	7.68	0.04	-13.45	7.99	0.01
	Post-test	7.92	0.60	7.59	0.04			
Vertical split (cm)	Pre-test	9.31	0.65	6.98	0.03	-12.16	9.06	0.01
	Post-test	8.19	0.32	3.88	0.02			

Figure 1: Results of Initial and Post-Training Physical and Technical Assessments for 12–13-Year-Old Shuttlecock Athletes in Tan Binh District After Six Months of Training



4.3 Establishing Evaluation Standards for Physical and Technical Skill Levels in 12–13-Year-Old Shuttlecock Athletes in Tan Binh District, Ho Chi Minh City

4.3.1 Developing a Scoring Scale for Assessing Physical and Technical Proficiency in Talented 12–13-Year-Old Shuttlecock Athletes in Tan Binh District

To facilitate the classification of performance levels for each test—both for assessing individual athletes and for comparing physical and technical abilities across athletes—we applied a scoring system based on the C-scale. The resulting point values are presented as follows:

Table 4: Scoring Scale – Initial Stage

Test	Score	1	2	3	4	5	6	7	8	9	10
1. One-minute foot juggling (touches)		58	61	64	67	70	73	76	79	82	84
2. Direct shuttle serve (points)		5.3	5.5	5.7	5.9	6.1	6.3	6.5	6.8	7.0	7.2
3. Receiving and attack kick (points)		6.0	6.2	6.4	6.5	6.7	6.9	7.0	7.2	7.4	7.5
4. Standing vertical jump (cm)		37	39	41	43	45	47	49	52	54	56
5. 8×15m shuttle run (s)		68.6	67.8	67.0	66.1	65.3	64.5	63.7	62.9	62.0	61.2
6. 4-point shuttle pickup (s)		98.2	95.6	93.0	90.5	87.9	85.3	82.7	80.1	77.5	74.9
7. 6m lateral shuttle pickup (s)		63.2	61.8	60.4	59.0	57.6	56.2	54.8	53.4	52.0	50.6
8. Horizontal split (cm)		10.5	10.1	9.8	9.4	9.1	8.7	8.4	8.0	7.7	7.3
9. Vertical split (cm)		10.6	10.3	10.0	9.6	9.3	9.0	8.7	8.3	8.0	7.7

Table 5: Scoring Scale – After 6 Months of Training

Test	Score	1	2	3	4	5	6	7	8	9	10
1. One-minute foot juggling (touches)		67	70	72	75	78	80	83	85	88	91
2. Direct shuttle serve (points)		6.4	6.7	6.9	7.2	7.4	7.7	7.9	8.2	8.5	8.7
3. Receiving and attack kick (points)		7.2	7.4	7.6	7.9	8.1	8.3	8.5	8.8	9.0	9.2
4. Standing vertical jump (cm)		39	41	44	46	49	51	53	56	58	60
5. 8×15m shuttle run (s)		66.7	65.7	64.8	63.8	62.9	61.9	61.0	60.0	59.1	58.1
6. 4-point shuttle pickup (s)		95.7	93.0	90.2	87.4	84.6	81.8	79.0	76.2	73.4	70.7
7. 6m lateral shuttle pickup (s)		61.8	60.4	58.9	57.5	56.0	54.6	53.2	51.7	50.3	48.8
8. Horizontal split (cm)		9.1	8.8	8.5	8.2	7.9	7.6	7.3	7.0	6.7	6.4
9. Vertical split (cm)		8.8	8.7	8.5	8.3	8.2	8.0	7.9	7.7	7.6	7.4

4.3.2 Classification Standards for Physical and Technical Skill Evaluation Tests for 12–13-Year-Old Talented Shuttlecock Athletes in Tan Binh District, Ho Chi Minh City

To facilitate the quantification of various test results when classifying the physical and technical skill levels of 12–13-year-old shuttlecock athletes in Tan Binh District, we categorized performance levels into five grades as follows:

- **Excellent:** from 9 to 10 points
- **Good:** from 7 to less than 9 points
- **Average:** from 5 to less than 7 points
- **Below Average:** from 3 to less than 5 points
- **Poor:** from 0 to less than 3 points

Based on the C-scale scoring system described above—where each test has a maximum of 10 points—and considering the total of 9 tests, the study developed a

composite classification scale for evaluating the overall technical and physical performance of the participating athletes.

Table 6: Composite Scoring Table for Classifying Technical and Physical Proficiency of 12–13-Year-Old Shuttlecock Athletes in Tan Binh District, Ho Chi Minh City

Classification	Poor	Below Average	Average	Good	Excellent
Total Score	< 27	27 – < 45	45 – < 63	63 – < 81	≥ 81

4.3.3 Validation of the Technical Skill Evaluation Standards for 12–13-Year-Old Shuttlecock Athletes in Tan Binh District, Ho Chi Minh City

To validate the technical skill evaluation standards developed in Sections 3.3.1 and 3.3.2, we applied the scoring scale, classification levels, and composite performance table to each athlete at both the initial stage and after six months of training. The results are as follows:

Table 7: Composite Scores and Classification of Technical and Physical Performance of 12–13-Year-Old Shuttlecock Athletes in Tan Binh District, Ho Chi Minh City – Initial Stage

No	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Total Score	Classification	Rank
1	4	7	6	5	7	5	4	4	3	45	Average	5
2	8	4	3	6	3	6	6	4	9	49	Average	4
3	3	3	5	2	3	5	5	5	5	36	Below Average	6
4	4	7	2	7	2	2	3	1	3	31	Below Average	16
5	6	5	6	7	6	3	8	7	7	55	Average	2
6	1	4	3	5	4	1	2	7	5	32	Below Average	14
7	7	6	7	7	7	8	5	8	6	61	Average	3
8	4	2	2	6	5	7	4	7	5	42	Below Average	7
9	3	6	1	4	8	6	5	5	3	41	Below Average	10
10	6	1	6	2	6	5	5	3	3	37	Below Average	17
11	1	2	6	2	2	6	1	6	1	27	Poor	18
12	7	7	7	5	7	5	4	5	7	54	Average	8
13	6	2	3	6	5	4	4	4	1	35	Below Average	15
14	4	6	6	3	4	5	3	3	3	37	Below Average	11
15	6	5	5	1	2	1	3	3	5	31	Below Average	13
16	3	5	7	4	5	4	4	4	3	39	Below Average	12
17	5	7	7	7	2	5	7	1	6	47	Average	1
18	7	5	4	6	5	5	6	4	7	49	Average	9

Table 8: Composite Scores and Classification of Technical and Physical Performance of 12–13-Year-Old Shuttlecock Athletes in Tan Binh District, Ho Chi Minh City – After Six Months of Training

No.	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Total Score	Classification	Rank
1	6	9	8	6	7	6	5	6	6	59	Average	5
2	5	7	5	7	6	5	7	5	7	54	Average	4
3	5	5	6	2	4	5	5	7	6	45	Average	6
4	3	6	2	3	1	1	4	1	3	24	Poor	16
5	6	6	7	7	5	7	8	8	6	60	Average	2
6	4	3	5	4	1	1	3	4	6	31	Below Average	14
7	7	6	7	8	7	9	6	5	7	62	Average	3
8	5	4	2	6	4	6	5	7	6	45	Average	7
9	4	6	5	3	4	5	5	1	3	36	Below Average	10
10	3	4	3	2	5	5	5	3	4	34	Below Average	17
11	1	1	2	2	1	4	1	1	3	16	Poor	18
12	5	4	5	6	5	4	4	6	4	43	Below Average	8
13	1	3	2	4	4	4	5	5	3	31	Below Average	15
14	4	5	5	5	3	5	3	3	3	36	Below Average	11
15	5	1	5	3	5	2	2	1	6	30	Below Average	13
16	4	4	6	3	1	3	5	5	4	35	Below Average	12
17	9	7	7	8	6	6	7	6	9	65	Good	1
18	6	5	2	6	3	5	5	1	4	37	Below Average	9

Observation

The research results indicate that athletes classified as "Good" and "Average" in their technical skill evaluation achieved relatively high performance in competitions, whereas those classified as "Below Average" and "Poor" tended to perform at lower levels. These findings suggest that the technical skill evaluation standards for 12–13-year-old shuttlecock athletes in Tan Binh District, Ho Chi Minh City, as developed in this study, are scientifically reliable and applicable for assessing technical and physical performance, as well as for selecting talented young athletes for district-level training programs.

5. Discussion

The study highlights the importance of age-appropriate assessment tools for tracking the physical and technical development of youth shuttlecock athletes. After six months of structured training, significant improvements were observed in key technical skills—especially foot juggling, direct shuttle serving, and attack kicking—demonstrating the program's effectiveness. This aligns with research indicating that ages 12–13 are a sensitive period for motor skill acquisition, with the brain and body primed for technical development (Mosher et al., 2021; Lehmann et al., 2023).

These gains reflect the training's emphasis on repetitive, feedback-rich practice. Technical tasks like foot juggling and attack kicks showed statistically significant improvements ($p < 0.01$), underscoring the value of targeted instruction. However,

limited progress in physical attributes such as vertical jump and shuttle runs indicates a lack of balance, with physical conditioning underemphasized.

To address this, the study recommends integrating strength, endurance, and flexibility training into technical drills, supporting a more holistic development model (Hall et al., 2015; Myer et al., 2015). The validated test battery developed also serves as a reliable tool for diagnosis, benchmarking, and talent identification. Its scoring system enables performance tracking and classification across development phases.

By filling a gap in standardized youth assessment in shuttlecock, this study contributes significantly to the sport's professionalization. Yet, findings also call for more balanced training approaches to ensure athletes are both technically skilled and physically equipped for competitive demands.

6. Conclusion

This study developed and validated a reliable evaluation framework to assess the physical and technical development of 12–13-year-old shuttlecock athletes in Tan Binh District, Ho Chi Minh City. Using expert input, pedagogical testing, and statistical analysis, the research identified key performance indicators that help coaches monitor progress in an evidence-based way. After six months of training, significant improvements were observed in technical skills—especially foot juggling, shuttle serving, and attacking techniques—confirming early adolescence as a key stage for skill development.

However, the relatively modest gains in physical fitness reveal the need for more balanced training, including strength, agility, endurance, and flexibility. The scoring and classification system created in this study offers practical tools for talent identification, personalized training, and performance benchmarking.

Beyond Tan Binh, this standardized framework can guide youth shuttlecock programs across Vietnam, supporting more effective coaching and consistent athlete development. It lays the groundwork for advancing youth sports training nationwide.

Conflict of Interest Statement

The authors declare no conflicts of interest.

About the Author(s)

Nguyen The Luong is a lecturer at Ho Chi Minh City University of Industry and Trade (HUIT). He holds a Ph.D. in Education, with research interests focusing on optimizing sports training methodologies and enhancing athletic performance, particularly in the fields of shuttlecock and badminton. His recent studies have emphasized the integration of mobile learning (m-learning) technologies into physical education. Dr. Nguyen The Luong has made significant contributions to the training and development of young athletes in southern Vietnam and continues to engage in academic initiatives that promote innovation in sports pedagogy.

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