



RESEARCH ON CRITERIA FOR ASSESSING FLEXIBILITY AND MOTOR COORDINATION IN FEMALE ARTISTIC GYMNASTS AGED 9–10 IN HO CHI MINH CITY, VIETNAM

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Abstract:

Accurately assessing flexibility and motor coordination is crucial for monitoring the proficiency and managing the training process of young female rhythmic gymnasts. Selecting tests that align with age-specific characteristics and professional requirements is essential for enhancing the objectivity and scientific rigor of the assessment process. This study aims to select and verify the reliability of tests designed to assess flexibility and motor coordination in female artistic gymnasts aged 9–10 in Ho Chi Minh City. The study employed methods including literature analysis and synthesis, expert interviews, professional testing, and statistical analysis. Twenty experts—comprising coaches, referees, and instructors experienced in rhythmic gymnastics—were interviewed, and the reliability of the tests was verified using a group of ten female rhythmic gymnasts aged 9–10 from Ho Chi Minh City. The study successfully selected and validated 11 tests six for assessing flexibility and five for assessing motor coordination all of which demonstrated reliability for evaluating these attributes in female rhythmic gymnasts aged 9–10 in Ho Chi Minh City. The study's contribution lies in systematizing and establishing the applicability of existing tests for a specific demographic defined by age, gender, and athletic discipline—thereby providing a foundation for assessing proficiency, monitoring development, and managing the training process of young athletes.

Keywords: artistic gymnastics, flexibility, motor coordination, test, female athletes, 9–10 years old, Ho Chi Minh City, Vietnam

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1. Introduction

In high-performance sports training, testing and evaluation constitute a crucial component of the coaching management process. Test results enable coaches to determine an athlete's current proficiency level, monitor changes in energy-related physiological systems, and adjust training content and workload to suit specific training phases. However, the value of evaluation depends significantly on the selection of criteria and tests that are appropriate for the specific athletes, the nature of the sport, and the objectives of the assessment. According to Duong Nghiep Chi (2004) and Do Vinh and Trinh Huu Loc (2010), sports testing must meet scientific measurement standards; notably, reliability is a critical prerequisite for using test results to evaluate and monitor the training process.

This requirement is particularly crucial in rhythmic gymnastics, as an athlete's proficiency stems from a combination of various movement and technical components. The Fédération Internationale de Gymnastique (FIG, 2021) age-group development programs indicate that training young athletes requires monitoring the development of physical and technical capabilities across specific stages. Furthermore, the *Rhythmic Gymnastics Code of Points 2025–2028* continues to demand high standards for the execution of body movement groups—such as leaps, balances, and rotations as well as the ability to integrate these movements with apparatus handling techniques (FIG, 2025). Consequently, the assessment of young rhythmic gymnasts should not merely measure general physical fitness but must also reflect capabilities directly related to the sport's specific movement structures.

Flexibility is a key parameter when monitoring young rhythmic gymnasts; however, flexibility in this sport is highly specialized. Assessment extends beyond the simple ability to flex or extend a joint, encompassing the range of motion (ROM) of the hips and spine, as well as the ability to demonstrate that ROM during specific poses and technical movements. Batista et al. (2019) utilized active and passive flexibility measurements to analyze flexibility characteristics and functional asymmetries in rhythmic gymnasts, highlighting the need to consider sport-specific demands and bilateral differences during assessment. Bordalo et al. (2015) also demonstrated that flexibility assessment results in young athletes may be linked to their biological maturity status. Therefore, the selection of tests for young athletes requires simultaneous consideration of age-related characteristics, movement patterns, and sport-specific requirements.

Assessing motor coordination presents a complex challenge because it is not a singular ability. According to Lyakh (2006), coordination encompasses various manifestations such as balance, spatial orientation, rhythm perception, movement differentiation, and the capacity to organize and adjust movements. In Rhythmic Gymnastics, assessment must also account for the ability to simultaneously execute tasks involving both the body and the apparatus. An athlete might perform balance or rotation tasks well in isolation yet struggle to maintain control when simultaneously tossing,

catching, bouncing, or rotating the apparatus. Consequently, relying solely on general motor coordination tests fails to fully capture the specific coordination characteristics required of Rhythmic Gymnasts.

Recent studies also indicate a trend toward evaluating the coordination abilities of rhythmic gymnastics athletes based on multiple components. Safonenko et al. (2024) examined attributes such as balance, spatial orientation, rhythm perception, and motor coordination in girls aged 9–10 practicing rhythmic gymnastics. Mironov et al. (2020) focused on the balance capabilities of young gymnasts. These studies demonstrate that the assessment of coordination needs to be operationalized through observable and quantifiable motor tasks, rather than relying on general observations regarding an athlete's level of "dexterity."

In Vietnam, Nguyen Kim Lan (2009) investigated assessment standards for the training proficiency of young Rhythmic Gymnastics athletes (aged 8–10), thereby establishing a crucial foundation for the assessment of young athletes. Other studies—such as those by Nguyen Trung Kien (2009), Dinh Sang Giau and Tran Minh Tuan (2019), and Nguyen Thi Thuy Trang et al. (2021) have focused on sport-specific physical fitness and training methods within gymnastics disciplines. However, Aerobic Gymnastics and Rhythmic Gymnastics differ in terms of technical structure and apparatus usage; furthermore, the objectives for selecting physical conditioning exercises differ from those for developing assessment tools. Consequently, while the aforementioned findings serve as valuable references, they do not fully address the need to select a specialized testing system for evaluating the flexibility and motor coordination of female Rhythmic Gymnastics athletes aged 9–10.

A review of existing literature reveals that studies have been conducted on flexibility, balance, and motor coordination, as well as on the assessment of training levels among young artistic gymnasts. However, there remains a lack of research regarding the selection of a test battery that simultaneously evaluates flexibility and motor coordination combining general physical tests with apparatus-specific technical tests and the direct validation of such tests on female artistic gymnasts aged 9–10 within the training context of Ho Chi Minh City. This represents a practical gap that warrants investigation to help standardize assessment procedures and provide objective data for the training of young athletes.

Addressing this need, the study titled "Research on criteria for assessing flexibility and motor coordination in female artistic gymnasts aged 9–10 in Ho Chi Minh City, Vietnam" was conducted. Its objective was to select and validate a test battery for flexibility and motor coordination that aligns with the age-specific characteristics and technical requirements of artistic gymnastics, thereby serving as a foundation for assessing current status, monitoring performance levels, and managing the training process for young athletes.

2. Research materials and methods

2.1 Methods

2.1.1 Literature review method

This method enables the systematic organization of knowledge relevant to the research field, the establishment of a theoretical framework, and the definition of research aims and objectives; it also facilitates the development of a literature overview and the processing and analysis of research findings. The method involves the selective recording, analysis, and synthesis of documents concerning rhythmic gymnastics training and instruction, serving as the basis for formulating the theoretical framework and evaluating research results. The synthesized findings provide the foundation for developing a set of criteria to assess the flexibility and motor coordination of the research subjects.

2.1.2 Interview method

Questionnaire-based interviews were conducted with coaches, instructors, and referees experienced in artistic gymnastics training. The interviews focused on the current practices regarding the use of specific tests to assess flexibility and motor coordination in 9–10-year-old athletes. The results informed the selection of tests to evaluate flexibility and motor coordination for female artistic gymnasts aged 9–10 in Ho Chi Minh City.

2.1.3 Pedagogical testing method

This method involves data collection using 11 tests designed to assess the flexibility and motor coordination of female artistic gymnasts aged 9–10 in Ho Chi Minh City.

2.1.4 Statistical methods

Used to process and analyze data collected during the research process. The collected data were processed with the support of SPSS 22.0 software.

2.2 Participants

- Interview subjects: 20 coaches, instructors, experts, or referees experienced in artistic gymnastics coaching.
- Survey subjects: 10 female artistic gymnasts aged 9–10 from Ho Chi Minh City, Vietnam.

3. Results

3.1 Determining criteria for assessing flexibility and motor coordination in female artistic gymnasts aged 9–10 in Ho Chi Minh City

To study the criteria for assessing flexibility and motor coordination in female artistic gymnasts aged 9–10 in Ho Chi Minh City, the research was conducted in three steps:

Step 1: Synthesizing assessment criteria for flexibility and motor coordination in artistic gymnasts based on research by domestic and international authors.

Step 2: Interviewing experts, specialists, and instructors.

Step 3: Verifying the reliability of the tests.

3.1.1 A compilation of criteria for assessing flexibility and motor coordination in artistic gymnasts, based on research by domestic and international authors

Based on a review of textbooks, specialized literature, and domestic and international research regarding rhythmic gymnastics including works by authors such as Nguyen Kim Lan (2009), Nguyen Trung Kien (2009), Dinh Sang Giau and Tran Minh Tuan (2019), Nguyen Thi Thuy Trang et al. (2021), Batista et al. (2019), Bordalo et al. (2015), Mironov et al. (2020), Sabău et al. (2023), and Safonenko et al. (2024), as well as technical documents from the International Gymnastics Federation (FIG, 2021; FIG, 2025), Special Olympics (2008), Palmer (2003), Karpenko (2003; 2007), Lyakh (2006), and Parfina and Anfilatova (2019) and taking into account the specific characteristics of the study subjects and the practical training conditions of the female rhythmic gymnastics team, 20 tests were selected to assess flexibility and motor coordination in female rhythmic gymnasts aged 9–10 in Ho Chi Minh City.

3.1.2 Interviews with coaches, instructors, and experts

The study involved interviewing experts, judges, instructors, and coaches experienced in artistic gymnastics in Ho Chi Minh City. Two rounds of interviews were conducted using the same questionnaire and evaluation method, focusing on the same set of exercises. The questionnaire aimed to identify the necessary criteria for assessing the flexibility and motor coordination of artistic gymnastics athletes. Respondents selected one of two options: "Agree" or "Disagree." A chi-square test was used to analyze the differences between the two interview rounds, with the results presented in Table 1.

The interview results presented in Table 1 indicate that for all metrics and tests across the two interview sessions, the chi-square test < chi-square table = 3.84; thus, the differences between the two sessions were not statistically significant ($P > 0.05$). Consequently, there was a high level of consistency in the responses provided by the experts and instructors across both sessions. The study identified 11 tests to assess the flexibility and motor coordination of artistic gymnasts, including: left and right longitudinal splits on a 30 cm platform (cm); left and right transverse splits on a 30 cm platform (cm); bridge (points); trunk flexibility/forward bend (cm); forward walkover with left and right legs (points); backward walkover with left and right legs (points); single-leg balance (s); 360° "assé" turn, seated 360° turn and finish (points); one-handed ball bounce under a raised leg (points); rope toss and catch while jumping over the rope (points); and hoop rotation on the hand (points).

Table 1. Results of interviews on the selection of tests
to assess flexibility and motor coordination in artistic gymnasts

Test	First interview (n = 20)		Second interview (n = 20)		Inspection	
	Agree	%	Agree	%	χ^2	P
1 Left and right front splits on a 30 cm platform (cm)	19	95	20	100	1.03	>0.05
2 Left and right side splits on a 30cm platform (cm)	18	90	19	95	0.39	>0.05
3 Bending (cm)	19	95	19	95	0.00	>0.05
4 Flexible folding body (cm)	18	90	18	90	0.00	>0.05
5 Forward roll with split-leg finish (left/right) (point)	16	80	17	85	0.17	>0.05
6 Back walkover (left and right legs) (point)	16	80	17	85	0.17	>0.05
7 Arm lift in prone position (cm)	17	85	15	75	0.78	>0.05
8 Single-leg balance (seconds)	18	90	19	95	0.39	>0.05
9 360° *passé* turn, one full seated turn, and a final pose (point)	17	85	18	90	0.39	>0.05
10 Perform two forward rolls, execute a two-footed jump-turn to change direction, and rise onto the balls of the feet (point).	15	75	12	60	1.80	>0.05
11 Dribble the ball with one hand under a raised leg (point)	16	80	17	85	0.17	>0.05
12 Sitting and bouncing the ball with two hands (point)	15	75	11	55	1.74	>0.05
13 Two-handed ball rotation, jump-switch feet, change direction (point)	12	60	10	50	0.42	>0.05
14 Jump rope combined with directional changes while turning the rope (point)	17	85	15	75	0.78	>0.05
15 Swing the rope 360° and catch (point)	15	75	14	70	0.11	>0.05
16 Toss the rope and catch it while jumping over it (points).	16	80	18	90	0.83	>0.05
17 Roll the ball forward over both arms (point)	13	65	14	70	0.11	>0.05
18 Toss and catch with crossed hands (point)	12	60	15	75	1.80	>0.05
19 Toss the ball, flip it over, and catch it (point).	11	55	10	50	0.10	>0.05
20 Spinning around the axis on the hand (point)	16	80	18	90	0.83	>0.05

3.1.3 Assessment of test reliability

To assess the reliability of the test, we conducted trials with 10 female artistic gymnasts aged 9–10 from Ho Chi Minh City, Vietnam. Testing was carried out in two sessions separated by a seven-day interval, maintaining consistent conditions including timing, testing sequence, execution procedures, location, facilities, and equipment for each subject. Subsequently, the correlation coefficient (r) between the two testing sessions was calculated (Do Vinh & Trinh Huu Loc, 2010; Duong Nghiep Chi, 2004). According to established conventions:

- If $r \geq 0.8$ and $P < 0.05$, the test is considered reliable.
- If $r < 0.8$, the test lacks sufficient reliability.

Based on the calculation of pairwise correlation coefficients presented in Table 2 below:

Table 2: Reliability assessment results for tests measuring flexibility and motor coordination in artistic gymnasts (n = 10)

	Test	Initial		After 7 days		r	p
		$\bar{X}_1$	S_1	$\bar{X}_2$	S_2		
1	Left and right front splits on a 30 cm platform	17.50	2.37	17.46	1.97	0.97	<0.05
2	Left and right side splits on a 30 cm platform	17.75	2.10	17.73	2.00	0.96	<0.05
3	Bending (point)	4.30	0.95	4.10	0.99	0.90	<0.05
4	Trunk flexibility (cm)	2.95	0.55	2.95	0.37	0.81	<0.05
5	Forward roll with split-leg finish (left/right) (point)	4.65	0.82	4.50	0.75	0.82	<0.05
6	Back walkover (left and right legs) (point)	4.50	0.75	4.45	0.69	0.98	<0.05
7	Single-leg balance (seconds)	2.20	0.63	2.50	0.53	0.86	<0.05
8	360° *passé* turn, one full seated turn, and a final pose (point)	4.50	0.85	4.40	0.97	0.81	<0.05
9	Dribble the ball with one hand under a raised leg (point)	1.90	0.57	2.00	0.67	0.88	<0.05
10	Toss the rope and jump over it (point).	1.70	0.48	1.60	0.52	0.80	<0.05
11	Spinning around the axis on the hand (point)	2.00	0.67	1.90	0.57	0.88	<0.05

Table 2 shows that the reliability coefficients (r) for the test-retest assessments of flexibility and motor coordination among female artistic gymnasts aged 9–10 in Ho Chi Minh City ranged from 0.81 to 0.97 ($P < 0.05$). Consequently, these tests demonstrate reliability levels ranging from moderate to very high. This indicates that all 11 tests are reliable and feasible for assessing the flexibility and motor coordination of female artistic gymnasts aged 9–10 in Ho Chi Minh City.

Based on the research process, 11 tests were selected to assess the flexibility and motor coordination of female artistic gymnasts aged 9–10 in Ho Chi Minh City: left and right longitudinal splits on a 30 cm platform (cm); left and right straddle splits on a 30 cm platform (cm); bridge (points); trunk flexibility/forward bend (cm); forward walkover with left and right leg (points); backward walkover with left and right leg (points); single-leg balance (s); 360° *passé* turn, seated full turn and finish (points); bouncing a ball with one hand under a raised leg (points); tossing and catching a rope while jumping over it (points); and rotating a hoop around its axis on the hand (points).

The study selected 11 tests to assess flexibility and motor coordination in female artistic gymnasts aged 9–10 in Ho Chi Minh City. These tests effectively reflect the development level of two key specialized attributes, flexibility and motor coordination, while aligning with the age-specific characteristics, training requirements, and competitive nature of artistic gymnastics. The testing system evaluates the ability to execute movements involving flexibility, balance, rotation, and jumping, as well as apparatus coordination skills, thereby providing an objective assessment of the athletes' proficiency during training and competition.

3.2 Assessment of the baseline status of flexibility and motor coordination in 9–10-year-old female artistic gymnasts in Ho Chi Minh City before the experiment

The study examined the actual status of the subjects' flexibility and coordination ability and calculated the values and parameters of the test results as shown in Table 3.

Table 3: Current status of flexibility and motor coordination
in female artistic gymnasts aged 9–10 in Ho Chi Minh City

TT	Test	$\bar{X}$	S_x	C_v	ε
1	Left and right front splits on a 30 cm platform	17.50	2.37	13.54	0.04
2	Left and right side splits on a 30 cm platform	17.75	2.10	11.82	0.04
3	Bending (point)	4.30	0.95	22.06	0.07
4	Trunk flexibility (cm)	2.95	0.55	18.65	0.06
5	Forward roll with split-leg finish (left/right) (point)	4.65	0.82	17.60	0.06
6	Back walkover (left and right legs) (point)	4.50	0.75	16.56	0.05
7	Single-leg balance (seconds)	2.20	0.63	28.75	0.09
8	360° *passé* turn, one full seated turn, and a final pose (point)	4.50	0.85	18.89	0.06
9	Dribble the ball with one hand under a raised leg (point)	1.90	0.57	29.88	0.09
10	Toss the rope and jump over it (point)	1.70	0.48	28.41	0.09
11	Spinning around the axis on the hand (point)	2.00	0.67	33.33	0.11

Table 3 shows that:

For the left and right front split test on a 30 cm platform, the mean value was 17.50 cm, the standard deviation was 2.37, and the coefficient of variation was 13.54% ($> 10\%$), indicating relatively uniform data; the relative error was $\varepsilon = 0.04$ (< 0.05). The mean value of the left and right longitudinal split tests on the 30 cm platform is representative of the sample set.

The side-split test on a 30 cm platform yielded a mean value of 17.75 cm, a standard deviation of 2.10, and a coefficient of variation of 11,82% $> 10\%$. The sample exhibits relative uniformity, with a relative error of $\varepsilon = 0.04$ (< 0.05). The mean value of the lateral split test on a 30 cm platform is representative of the sample set.

The bending test (point) yielded a mean of 4.30 points, a standard deviation of 0.95, and a coefficient of variation of 22.06% ($> 10\%$), indicating moderate sample uniformity; the relative error was $\varepsilon = 0.07$ (> 0.05). The mean value of the bending test does not highly represent the sample set.

The trunk flexion flexibility test yielded a mean value of 2.95 cm, a standard deviation of 0.55, and a coefficient of variation of 18.65% (exceeding 10%), indicating relative sample uniformity; the relative error was $\varepsilon = 0.06$ (greater than 0.05). Consequently, the mean value of the trunk flexion flexibility test does not highly represent the sample set.

For the left and right leg forward flexibility test, the mean score was 4.65, the standard deviation was 0.82, and the coefficient of variation was 17.60% (exceeding 10%), indicating relatively uniform data distribution; however, the relative error was $\varepsilon = 0.06$ (exceeding 0.05). Consequently, the mean score for this test does not possess a high level of representativeness for the sample set.

For the left and right leg backward flexibility test, the mean score was 4.50, the standard deviation was 0.75, and the coefficient of variation was 16.56% ($> 10\%$); the sample exhibited relative uniformity, with a relative error (ε) of 0.05. The mean value of this test is acceptable as a representative of the sample set.

For the single-leg balance test (seconds), the mean value was 2.20 seconds, the standard deviation was 0.63, and the coefficient of variation was 28.75% ($> 10\%$), indicating moderate sample uniformity; the relative error was $\varepsilon = 0.09$ (> 0.05). The mean value of the single-leg balance test does not yet possess a high degree of representativeness for the sample set.

The 360° “passé” jump-turn test (scored in points) yielded a mean of 4.50, a standard deviation of 0.85, and a coefficient of variation of 18.89% ($> 10\%$), indicating relatively uniform data distribution; however, the relative error was $\varepsilon = 0.06$ (> 0.05).

Consequently, the mean value of the 360° “passé” jump-turn test does not possess a high degree of representativeness for the sample set.

The “one-handed ball bounce under a raised leg test yielded a mean score of 1.90, a standard deviation of 0.57, and a coefficient of variation of 29.88% (exceeding the 10% threshold), indicating moderate sample uniformity; the relative error was $\varepsilon = 0.09$ (greater than 0.05). Consequently, the mean score of this test does not highly represent the sample population.

For the rope-tossing and jump-catching test, the mean score was 1.70, the standard deviation was 0.48, and the coefficient of variation was 28.41% ($> 10\%$), indicating moderate sample uniformity; the relative error was $\varepsilon = 0.09$ (> 0.05). The mean value of this test does not yet possess a high degree of representativeness for the sample set.

For the hand-based axial rotation test (scored in points), the mean value was 2.00 points, the standard deviation was 0.67, and the coefficient of variation was 33.33% ($> 10\%$), indicating moderate sample uniformity; the relative error was $\varepsilon = 0.11$ (> 0.05).

Consequently, the mean value of this test does not highly represent the sample set. Conclusion: Through initial testing of the flexibility and coordination ability of female artistic gymnasts aged 9–10 in Ho Chi Minh City, it was shown that the tests had coefficients of variation ranging from 11.82% to 33.33%, reflecting a relatively average level of uniformity in the sample. Among the 11 selected tests, 2 tests (left and right vertical splits on a 30 cm platform and horizontal splits on a 30 cm platform) have an average value that is representative of the sample set ($\varepsilon < 0.05$). The remaining tests have $\varepsilon \geq 0.05$, so the representativeness of the average value is not high, but still within the acceptable limit for experimental research in the field of physical education and sports with a small sample number ($n = 10$). Therefore, the average values obtained can still be used as a basis for assessing the current state of flexibility and motor coordination ability of the research subjects.

4. Discussion

The study identified 11 tests to assess flexibility and motor coordination in female rhythmic gymnasts aged 9–10 in Ho Chi Minh City. These tests were selected based on a synthesis of research, professional literature, and coaching practices, and were subsequently refined through two rounds of expert consultation and reliability testing on the target demographic. It should be noted that these 11 tests are not entirely new; rather,

the study's value lies in establishing their suitability and applicability for 9–10-year-old female rhythmic gymnasts within the specific training context of Ho Chi Minh City.

Regarding content, the 11 selected tests cover two key ability groups. The flexibility group includes front and side splits, the bridge, trunk flexibility (bending), and forward and backward flexibility rolls; these reflect hip and spinal flexibility as well as the application of flexibility in specialized movements. The motor coordination group comprises single-leg balance, a 360° “passé” turn combined with a seated turn, and tests involving the ball, rope, and hoop. This structure aligns with the view that flexibility in rhythmic gymnastics should be assessed in relation to sport-specific characteristics (Batista et al., 2019), while coordination needs to be examined across multiple components such as balance, orientation, and movement control and adjustment (Lyakh, 2006). Safonenko et al. (2024) also indicate that balance, spatial orientation, and coordination manifestations are significant factors when assessing 9–10-year-old girls practicing rhythmic gymnastics.

It is noteworthy that the test battery comprises not only relatively common physical fitness assessments but also tests specific to the technical demands of rhythmic gymnastics particularly the coordination of the body with apparatus such as the ball, rope, and hoop. This approach is practically significant because the coordination skills of rhythmic gymnasts are demonstrated not merely through body control but also through the ability to execute precise movements while manipulating the apparatus. Consequently, combining foundational and sport-specific assessments allows the test battery to more accurately reflect the training requirements of the athletes under study.

Test-retest reliability results provide a crucial basis for confirming the applicability of the test battery. The tests achieved correlation coefficients of $r = 0.80\text{--}0.98$ ($P < 0.05$), indicating good stability between the two testing sessions. This is significant because a test even one used in previous research requires validation when applied to specific age groups, proficiency levels, and training conditions. These results confirm that the 11 selected tests possess a sound initial basis for assessing the flexibility and motor coordination of 9–to-10-year-old female rhythmic gymnasts in Ho Chi Minh City.

Thus, the novelty of this study lies not in the creation of new tests, but in the systematization, selection, and validation of a battery of 11 tests tailored to the characteristics of 9–10-year-old female rhythmic gymnasts in Ho Chi Minh City. This test battery builds upon previous research findings while being validated under real-world conditions with the target group; it thereby enables coaches to assess baseline proficiency, monitor progress, and adjust training programs. Future research should expand the sample size, further validate the tests, and establish scoring scales and classification standards based on age and skill level to enhance their practical application in the selection and training management of young rhythmic gymnasts.

5. Conclusions

The study selected 11 tests to assess flexibility and motor coordination in female artistic gymnasts aged 9–10 in Ho Chi Minh City. These tests were determined through a review of literature, two rounds of expert interviews, and test-retest reliability verification. The test battery comprehensively reflects aspects of flexibility, balance, body control, and apparatus coordination, aligning with the age-specific characteristics and technical requirements of artistic gymnastics.

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Conflict of Interest Statement

The authors declare no conflicts of interest.

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References

- Batista, A., Garganta, R., Ávila-Carvalho, L. (2017), "Strength in Young Rhythmic Gymnasts", *International Journal of Sports Science*, 7(3), pp. 111–118.
<https://doi.org/10.14198/jhse.2017.124.03>
- Batista, A., Garganta, R., Ávila-Carvalho, L. (2019), "Flexibility and Functional Asymmetry in Rhythmic Gymnastics", *Athens Journal of Sports*, 6(2), pp. 111–126.
<https://doi.org/10.30958/ajspo.6-2-2>
- Bordalo, M.F., Silva, P., Ferreira, R. (2015), "Comparison of the Effect of Two Sports Training Methods on the Flexibility of Rhythmic Gymnasts at Different Levels of

- Biological Maturation", *European Journal of Sport Science*, 15(7), pp. 623–631. Retrieved from <https://pubmed.ncbi.nlm.nih.gov/26068325/>
- Dinh, S. G., & Tran, M. T. (2019). A study on selected exercises to develop specific physical fitness for a primary school female rhythmic gymnastics team. *Journal of Educational Science*, 16(1).
- Do, V., & Trinh, H. L. (2010). *Textbook of sports measurement*. Ho Chi Minh City University of Physical Education and Sport
- Duong, N. C. (2004). *Sports measurement*. Sports Publishing House.
- Fédération Internationale de Gymnastique (2021), *Physical Ability Testing Program for Rhythmic Gymnastics*.
- Fédération Internationale de Gymnastique (2021), *Age Group Development and Competition Program for Rhythmic Gymnastics*, Lausanne, Switzerland.
- Fédération Internationale de Gymnastique (2025), *Rhythmic Gymnastics Code of Points 2025–2028*.
- Mironov, A.O., Larkina, K.D., Petrina, Z.I. (2020), "Methodology for Developing Balance Abilities in Young Gymnasts", *Bulletin of Tomsk State University*, No. 458, pp. 205–210. <https://doi.org/10.17223/15617793/458/25>
- Nguyen, T. K. (2009). *A study on selected exercises to develop specific physical fitness for young aerobic gymnastics athletes in Ho Chi Minh City* [Master's thesis, Ho Chi Minh City University of Sport].
- Nguyen, K. L. (2009). *A study on criteria for assessing the training level of young rhythmic gymnasts aged 8–10* [Doctoral dissertation, Vietnam Institute of Sports Science].
- Nguyen, T. T. T., Le, M. T., & Nguyen, T. Q. N. (2021). Selection and evaluation of exercises for developing flexibility and agility in 9–10-year-old group aerobic gymnastics athletes. In *Proceedings of the National Conference on Sports Science*. Can Tho University Publishing House.
- Palmer, H. (2003), *Teaching Rhythmic Gymnastics: A Developmentally Appropriate Approach*. Human Kinetics. Retrieved from <https://books.google.com.na/books?id=NEKnVjqvOKAC&lr=>
- Sabău, A.M., Popescu, R., Ionescu, D. (2023), "Development Study Determining Motor Qualities in Rhythmic Gymnastics: Mobility and Coordination in Gymnasts 10–12 Years Old", *Journal of Sports Science*, 15(2), pp. 45–58. <https://doi.org/10.30892/gss.1903-097>
- Safonenko, S., Sokunova, S., Populo, G., Podlubnaya, A. (2024), "Enhancing Coordination Abilities in Girls 9–10 Years Old Through Rhythmic Gymnastics", *Human. Sport. Medicine*, 24(S2), pp. 53–59.
- Special Olympics (2008), *Rhythmic Gymnastics Coaching Guide*.
- Карпенко, Л. (2003), *Отбор и начальная подготовка занимающихся художественной гимнастикой*, Ленинград.
- Карпенко, Л. (2007), "Ключевые аспекты успешной учебно-тренировочной работы по художественной гимнастике", *Ученые записки университета имени П. Ф. Лесгафта*, Вып. 2(24), tr. 22–26.

- Лях, В. И. (2006). Координационные способности: диагностика и развитие.
- Парфина, Т. Э., & Анфилатова, О. В. (2019). Развитие гибкости гимнасток 9-10 лет с применением внешнего отягощения. *Вестник Шадринского государственного педагогического университета*, (4 (44)), 123-129.