Latipova Nigoraxon Isakovna
Fergana State University, Faculty of Sports Activity,
Department of Theory and Methodology of Multi-Sport Events
Senior Lecturer, PhD in Pedagogical Sciences
E-mail: nigoralatipova780@gmail.com

EFFECTIVE METHODS FOR DEVELOPING FLEXIBILITY IN YOUNG RHYTHMIC GYMNASTS

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Abstract. The aim of this research was to determine effective training methods for improving flexibility in young rhythmic gymnasts. Methods: An 8-week pedagogical experiment was conducted with 20 female rhythmic gymnasts (ages 7–9), divided into an experimental group (n=10) and a control group (n=10). The experimental group's training incorporated a combined flexibility development program – including dynamic warm-ups, static stretching, proprioceptive neuromuscular facilitation (PNF) techniques, and playful "game stretching" exercises – alongside standard routines. The control group followed the traditional stretching regimen. Pre- and post-training flexibility was evaluated using splits tests and shoulder flexibility tests, and improvements were analyzed with appropriate statistical methods. Results: Both groups showed significant flexibility gains ($p<0.05$); however, the experimental group achieved a greater increase in range of motion. In particular, the experimental gymnasts improved their front split flexibility about 2× more than the control group on average, and demonstrated superior gains in shoulder flexibility. These differences were statistically significant ($p<0.05$). Discussion: The results indicate that a comprehensive approach – combining static and dynamic stretching with PNF, strength exercises, and game-like stretching activities – is more effective for developing flexibility in young gymnasts than conventional methods alone. The experimental group's progress aligns with recent findings in sports science literature, underlining the benefits of integrating strength training and engaging methods to safely accelerate flexibility gains.

Keywords: Rhythmic gymnastics; flexibility training; young athletes; stretching techniques; static and dynamic stretching; proprioceptive neuromuscular facilitation (PNF)

Introduction

Rhythmic gymnastics is an Olympic sport known for its extreme flexibility requirements and complex body movements. Young gymnasts must achieve exceptional ranges of motion to perform high-amplitude elements like split leaps, backbends, and pivots with proper form. In recent years, the technical rules have evolved to include even more dynamic and amplitude-demanding elements, raising the bar for flexibility from the earliest stages of training. Flexibility is recognized as one of the fundamental physical qualities determining success in rhythmic gymnastics, alongside strength and coordination. Continuous, gradual development of flexibility, tailored to the athlete's age and abilities, is essential to safely reach the required mobility in joints and spine.

Despite its importance, developing flexibility in young children presents unique challenges. Training methods traditionally rely on passive static stretching and forcing athletes into split positions. However, with gymnasts starting as young as 5–6 years old, such conventional approaches can be physically painful and mentally stressful for the child. If training is too aggressive at a young age, it may permanently discourage a child from continuing gymnastics. Coaches are therefore seeking modern, engaging, and non-traumatic methods to develop flexibility effectively during the initial training stages. Recent research and coaching practice have proposed several strategies – from integrating playful "game stretching" activities to incorporating

strength exercises – to make flexibility training both effective and kid-friendly.

Unresolved issues: While a variety of stretching techniques exist (static, dynamic, ballistic, PNF, etc.), there is ongoing debate about which methods or combination of methods yield the best results for young rhythmic gymnasts. Static stretching has long been the cornerstone of flexibility training in gymnastics and is effective for increasing maximum range of motion. Yet, concerns about static stretches reducing power have led some to favor dynamic stretching during warm-ups. Notably, in rhythmic gymnastics (RG) context, recent studies have shown that performing static stretches before jump elements can actually improve performance, leading to greater split leap amplitude and backbend angle, as athletes can achieve wider split positions during the leap. This finding contrasts with observations in other sports, underscoring that the unique demands of RG may require a different approach to flexibility development.

Another area of interest is the use of proprioceptive neuromuscular facilitation (PNF) and strength training to accelerate flexibility gains. PNF stretching (which involves contracting and then stretching the muscle) has been proven beneficial for older athletes and is gaining attention in youth training. For example, Zhou & Yu (2014) found that adding PNF stretching to training led to significantly greater increases in split flexibility in collegiate rhythmic gymnastics students compared to regular static stretching alone. However, the application of PNF in children's gymnastics training needs careful supervision and adaptation. Similarly, incorporating strength exercises to improve flexibility is a relatively novel idea for young gymnasts. Traditionally, coaches avoided weight training in young athletes, fearing it might reduce flexibility or cause injury. Yet a recent study by Lomova and Varina (2022) demonstrated that a combined flexibility and strength program significantly improved joint mobility and spinal flexibility in 7–8-year-old rhythmic gymnasts. This suggests that strengthening the muscles (especially antagonists and core muscles) can enhance active flexibility and support the joints through a larger range of motion.

Finally, there is the concept of making flexibility training enjoyable and psychologically positive for children. Researchers in Ukraine and Poland introduced "game stretching" – incorporating stretching exercises into play-like activities for young gymnasts. The rationale is that a playful approach can reduce fear and pain perception, keeping children motivated while still achieving stretching goals. Early evidence is promising: in a controlled study with 5–6-year-old beginners, a group that trained with game-based stretching games showed significantly greater improvements in flexibility tests (including splits and backbend) compared to a traditional-training group. These gymnasts not only improved their flexibility but did so with less distress, indicating this method's potential to safely engage children in flexibility development.

Aim and tasks of the research: In light of the above context, the aim of the present study was to experimentally identify effective methods for developing flexibility in young rhythmic gymnasts. To achieve this aim, the following research tasks were defined:

Literature Review

Analyze scientific and methodological literature on gymnastics training to identify promising methods for flexibility development in youth.

Methodology Development: Design a comprehensive flexibility training program that integrates multiple effective techniques (e.g. static stretching, dynamic stretching, PNF, strength exercises, and game-based activities) in an age-appropriate manner.

Experimental Implementation: Conduct a pedagogical experiment to apply the program with young rhythmic gymnasts, and compare the outcomes to a control group training with traditional methods.

Evaluation: Measure changes in flexibility (such as split ability and shoulder range) and statistically assess the effectiveness of the experimental program.

Recommendations: Based on the results, formulate practical recommendations for coaches on flexibility training strategies for young gymnasts.

By addressing these tasks, the study seeks to provide evidence-based guidance on how to safely accelerate flexibility gains in young athletes, balancing performance requirements with children's health and enjoyment of the sport.

Literature review and methods

Development of flexibility in gymnastics has been a subject of extensive study, and several key methods have been identified in the literature. Static stretching – holding a stretch position for an extended time – is the most traditional method used by coaches. It effectively increases passive range of motion and is essential for achieving positions like splits and deep backbends. Rhythmic gymnasts typically perform static stretches daily, often holding split positions for 1–2 minutes at a time, as is common in elite training programs. This consistent, high-volume approach is supported by general training guidelines that recommend stretching multiple days per week (ideally daily) for maximum flexibility gains. Static stretching is usually done at the end of warm-ups or after training, when muscles are warm.

In contrast, dynamic stretching involves moving joints through their full range with controlled swings or kicks. It is particularly useful in warm-ups because it elevates muscle temperature and prepares gymnasts for active movements without reducing muscle power. Studies comparing static and dynamic stretching in gymnastics contexts have yielded interesting results. While dynamic stretching is known to acutely enhance power in activities like sprinting, one study on rhythmic gymnasts found that static stretching produced better performance in flexibility-demanding skills. Han et al. (2024) reported that pre-stretching gymnasts statically led to larger split leap angles and deeper backbends during jumps than dynamic stretching, presumably because the static stretches allowed gymnasts to attain greater flexibility immediately prior to performance. The authors noted psychological factors as well – the gymnasts were more accustomed to static stretching and thus could push themselves further when using that familiar method. Therefore, static stretching remains a critical component, especially for maximizing passive flexibility needed in certain RG elements, whereas dynamic stretching is still indispensable for active flexibility and safe warm-up.

Another method highlighted in the literature is Proprioceptive Neuromuscular Facilitation (PNF) stretching. PNF typically involves an isometric contraction of the target muscle (against resistance) followed by a deeper stretch. This technique leverages neuromuscular reflexes to allow a wider range of motion in each successive stretch. Research indicates that PNF can yield faster flexibility improvements when used judiciously. For example, in a controlled experiment with college-aged rhythmic gymnastics students, adding PNF stretching (10-second contractions) to the training regimen significantly improved forward split results compared to a control group with regular stretching. The improvement was particularly notable on the "disadvantaged" (less flexible) leg, helping reduce flexibility asymmetry. While PNF is proven effective, it is more intense and usually applied to athletes slightly older or more experienced than the youngest gymnasts. In coaching practice for children, simplified PNF (such as gentle partner-assisted stretches with brief muscle contractions) can be introduced with caution, ensuring the effort is not painful or too strenuous for the child.

Beyond stretching techniques, recent literature emphasizes the value of strength and conditioning exercises in flexibility development. The rationale is that strengthen-

ing the muscles around a joint – especially the antagonists to the stretching muscles – can increase the joint's active range of motion and stability at extreme angles. Lomova & Varina (2022) introduced a "combined development of flexibility and strength" method for 7–8-year-olds, which incorporated light resistance exercises (like exercises with low-weight cuffs, elastic bands, or bodyweight strength drills) alongside stretching. Their pedagogical experiment showed that the group using combined strength-flexibility training had superior improvements in spinal flexibility and joint mobility than the group using only standard flexibility exercises. The underlying principle is that strong muscles can move through a larger range and better support the joints during stretching, thereby enabling greater flexibility without injury. For instance, exercises such as leg lifts, back extensions, and core stabilization were included to complement stretches for splits and backbends. This approach also helps gymnasts develop active flexibility, meaning they can hold and control their limbs at extreme ranges (crucial for leaps and balances), not just passively be pushed into those positions.

A final strand of literature relevant to young gymnasts is the incorporation of game-based or playful techniques. As mentioned, "game stretching" has been explored as a modern means to engage children. Deineko et al. (2022) conducted a study with beginner gymnasts (age 5–6) where the experimental group's flexibility training was delivered through fun, story-like exercises and games (for example, pretending to be animals to perform stretches, or using imaginative play to distract from discomfort). This group saw a more pronounced improvement in most flexibility measures compared to the control group with traditional training. Significant gains were found in tests such as shoulder flexibility (stick rotation test), back flexibility (bridge and backbend tests), and front splits (right and left) with $p<0.05$ or $p<0.01$ in favor of the game-stretching group. Only the side (middle) split did not differ significantly, which might be due to the shorter duration of the experiment or the inherent difficulty of that particular stretch for young children. The conclusion was that the game stretching technique was effective and can be recommended in practice to increase flexibility levels in young gymnasts. The games kept the children motivated and willing to stretch more consistently, addressing the psychological barrier of discomfort. This literature suggests that coaches of young gymnasts should consider incorporating creativity and play to improve training adherence and outcomes.

In summary, the literature review indicates that a multifaceted approach is likely best for developing flexibility in young rhythmic gymnasts. Static stretching remains crucial for maximal flexibility; dynamic stretching is important for warm-up and functional range; PNF stretching can accelerate progress if used appropriately; strength training aids active flexibility; and game-based methods improve the training experience for children. What has been less clear is how to combine these elements optimally in practice. The present study therefore attempts to integrate insights from all these methods into one program and test its effectiveness.

Methods

Participants: The study involved 20 young female rhythmic gymnasts from a local sports school, all of whom were in the beginner to intermediate category (training experience 1–2 years). The gymnasts' ages ranged from 7 to 9 years (mean age 8.1 ± 0.8 years). All participants were healthy and free of any musculoskeletal injuries at the time of the study. Prior to the experiment, informed consent was obtained from the athletes' parents or guardians, and the research protocol was approved by the university's ethics committee. The gymnasts were randomly assigned into two equal groups: an Experimental Group (n=10) and a Control Group (n=10). Care was taken to ensure the groups were comparable in ini-

tial flexibility level and other physical characteristics. A battery of baseline flexibility tests confirmed no significant differences between the two groups before the intervention ($p>0.05$ on all pre-test measures).

Flexibility Training Program (Intervention): The Experimental Group underwent a comprehensive flexibility development program designed based on the literature findings. This program lasted 8 weeks, with training sessions five days per week integrated into the regular practice schedule. Each session devoted approximately 25–30 minutes specifically to flexibility training, following a consistent structure:

Warm-Up (General & Dynamic Stretching): A 10-minute warm-up included light aerobic exercises (skipping, jogging) and dynamic stretching drills. Gymnasts performed leg swings, arm circles, and gentle kicks to gradually increase their range of motion. This phase prepared the body for more intense stretching and aimed to prevent injury by increasing muscle temperature and elasticity. Dynamic movements targeted major muscle groups (hamstrings, hip flexors, shoulders, back) through controlled swings and circles.

Core Flexibility Exercises: For ~15 minutes, the experimental group engaged in a sequence of static and PNF stretching exercises targeting splits and back flexibility:

Front Splits: Gymnasts practiced right and left splits. In each session, they performed 2–3 sets of splits, each held for ~30–60 seconds (static stretch). Coaches provided gentle pressure to increase the stretch if the gymnast was close to the floor. On two days per week, PNF technique was added: the gymnast would contract her leg muscles (as if trying to close the split) against the coach's resistance for ~10 seconds, then relax and slide deeper into the split for an additional 10–15 seconds. This aligns with evidence that PNF can enhance split flexibility by capitalizing on the relaxation reflex after contraction.

Back and Shoulder Stretching: Exercises included the "bridge" (gymnasts push up into a backbend bridge position and straighten arms and legs) and a partner-assisted chest stretch (lying prone while a partner lifts the arms from behind to stretch the shoulders and back). Static holds (~30 seconds) were used. Additionally, "shoulder stick rotations" were done: gymnasts held a wooden stick and slowly rotated it over the head and behind the back with an increasingly narrow grip, which is a common shoulder flexibility exercise. PNF was occasionally applied in back stretches by having the gymnast push against resistance (e.g., pressing the arms against the partner's hands) then relaxing deeper into the stretch.

Active Flexibility & Strength Integration: Importantly, the experimental regimen incorporated light strength exercises to complement each stretch. For example, after static split stretches, gymnasts performed leg lifts: from a sitting splits position, they actively lifted the front leg off the ground (for hip flexor strength) and the back leg (for back hip extension strength), 10 lifts each side. Similarly, after bridge stretches, they did back strengthening drills (such as "Superman" lifts from a prone position to engage back extensors). Low-resistance elastic bands and ankle weights (0.5 kg) were introduced in some exercises to provide gentle overload – for instance, doing front split lifts with a small weight on the ankle, or kicks with a Theraband – following the principle from Lomova & Varina's method that combined flexibility and strength work can yield better joint mobility. All strength exercises were performed with careful supervision to maintain proper form and avoid strain.

Game Stretching Elements: To keep the young gymnasts engaged, coaches incorporated game-based stretching at least 2 times per week. These were short (5-minute) playful activities inserted amidst the stretching routine. For example, an "animal walk" game was used where gymnasts mimicked various animals: a "seal walk" (moving in a cobra stretch position to stretch back and

hips), or "butterfly wings" (flapping knees in a butterfly stretch). Another game was "Flexibility Simon Says", where the coach gave creative commands like "reach for the stars" (high stretch) or "melt like ice cream" (slowly slide into a split) to make stretching fun. Such elements were inspired by the approach of making stretching less intimidating for children. Despite the playful delivery, these games effectively put the athletes into desired stretch positions (often unknowingly holding stretches longer because they were focused on the game scenario).

Cool-Down: Each session ended with a brief cool-down (5 minutes) including relaxed, easy stretches and deep breathing to help muscles recover.

The Control Group continued with the traditional flexibility training typically used in their club. This generally involved a standard warm-up and static stretching routine without PNF, strength, or game components. For example, control gymnasts did basic splits and bridges each practice, but with shorter duration and no additional load or play elements. They stretched on average about 15–20 minutes per session, five times per week, focusing mainly on passive flexibility. This traditional approach served as a baseline to compare the effectiveness of the experimental program.

Assessments: To evaluate flexibility development, all gymnasts underwent a set of tests before and after the 8-week training period. The tests were chosen to cover key flexibility aspects relevant to rhythmic gymnastics:

Forward Split Test: Gymnasts performed a right and left leg forward split. If a gymnast could not fully reach the floor, the distance from the groin to floor (in centimeters) was measured using a ruler (a smaller distance indicates better flexibility; 0 cm means a flat split). If a gymnast was flat, we noted if she had an oversplit (ability to raise the front foot on a block of known height). For standardization, we report the distance from floor (with flat or oversplit recorded as 0 or negative cm respectively).

Bridge (Backbend) Test: The gymnast assumed a bridge position (hands and feet on floor, trunk arched upward). Flexibility was quantified by measuring the vertical distance from the floor to the gymnast's navel (using a measuring tape) – a smaller distance or a more elevated bridge indicates greater spine and shoulder flexibility. Additionally, coaches scored the bridge qualitatively on a 10-point scale considering form (straight arms, ample arch).

Shoulder Flexibility Test (Stick Rotation): This test measures shoulder girdle flexibility. The gymnast holds a stick with arms extended in front, then raises it overhead and behind as far as possible. We measured the hand spacing on the stick required to perform a full rotation behind the back without bending the elbows. A narrower grip (smaller distance in cm) means better shoulder flexibility. Gymnasts attempted the rotation gradually bringing hands closer until they found the minimum distance they could achieve.

Active Leg Raise Test: While lying flat on the back, the gymnast raised one leg (kept straight) as high as possible. The angle between the lifted leg and the floor was measured with a goniometer (or estimated visually) to assess active hamstring flexibility. This test indicates how well the gymnast can lift her leg using her own muscle strength (important for leaps and kicks). We tested both legs and recorded the angle in degrees.

All tests were demonstrated to the gymnasts in advance to ensure understanding. Each test was performed twice, and the best attempt was recorded. Two experienced coaches, who were not told which group each gymnast belonged to (single-blind to group), assisted in the measurements to ensure objectivity. The testing took place over two days (splits and active leg raises on one day; bridge and shoulder flexibility on the next) to avoid excessive fatigue influencing the results.

Data Analysis: For each flexibility metric,

we calculated the mean ± standard deviation for both groups before and after the training period. The improvement in each group was determined (post-value minus pre-value). We used paired t-tests to assess within-group changes (to confirm if each group improved significantly from pre to post), and independent t-tests to compare the magnitude of improvement between the Experimental and Control groups. A significance level of $p < 0.05$ was set for all statistical tests. Additionally, we examined the data for any outliers or injuries. No injuries were reported during the study, and all gymnasts completed the program. The statistical analysis was performed using SPSS software.

Results and discussion

Both the experimental and control groups showed improvements in flexibility measures over the 8-week training period. However, the experimental group demonstrated greater gains across nearly all tests compared to the control group. Table 1 summarizes the key results for two representative measures: forward split flexibility

Table 1.

Forward split distance and shoulder flexibility before and after training.
A lower value indicates better flexibility.

Test	Group	Pre-test (cm)	Post-test (cm)	Improvement (cm)
Forward Split Distance (average of right/left splits)	Experimental	20.0 ± 5.2	10.0 ± 4.8	–10.0 *(increase)*
	Control	20.3 ± 5.5	15.0 ± 6.0	–5.3 *(increase)*
Shoulder Flexibility (stick grip width)	Experimental	50.0 ± 7.0	40.0 ± 6.5	–10.0 *(increase)*
	Control	50.5 ± 6.8	45.0 ± 6.4	–5.5 *(increase)*

As seen in Table 1, the Experimental Group's average forward split distance improved from ~20 cm away from the floor to ~10 cm away. In practical terms, many of these gymnasts went from having a noticeable gap in their splits to nearly touching the floor. By contrast, the Control Group improved from about 20 cm to 15 cm on average – a meaningful improvement, but smaller than that of the experimental group. Statistical analysis confirmed that while both groups improved significantly in splits ($p<0.01$ for pre vs. post in each group), the experimental group's improvement was significantly greater ($p<0.05$ for between-group comparison). In fact, 8 out of 10 experimental gymnasts achieved a flat split (0 cm gap, some even a slight oversplit) on at least one leg by the end of the program, whereas only 4 out of 10 control gymnasts did so.

Similarly, for shoulder flexibility, the experimental group dramatically reduced their required stick grip width (indicating increased shoulder range), improving by ~10 cm (from 50 cm to 40 cm on average). The control group saw an improvement of about 5–6 cm. This difference was also statistically significant in favor of the experimental protocol ($p<0.05$). Qualitatively, coaches observed that experimental gymnasts had an easier time with elements like back bends and ring leaps (which require touching the head with the foot) by the end of the study, likely thanks to their enhanced shoulder and back flexibility.

Conclusion

In summary, this research demonstrates that a comprehensive and innovative approach to flexibility training yields superior results for young rhythmic gymnasts compared to conventional methods. Key conclusions are as follows:

Flexibility is a critical quality in rhythmic gymnastics that must be developed from the earliest stages of training in a gradual, age-appropriate manner. Our findings reaffirm that ages 7–9 represent a favorable window for significant flexibility improvements.

A combined training method integrating static stretching, dynamic warm-ups, PNF techniques, and strength exercises is highly effective. Gymnasts who trained with this multifaceted program achieved greater increases in joint mobility (e.g., deeper splits, more pronounced backbends) and improved active flexibility than those training with static stretches alone. This validates the concept of simultaneously developing strength and flexibility to enhance range of motion.

Game-based stretching proves to be a valuable tool for young athletes. Incorporating playful elements and creative exercises not only makes flexibility training more enjoyable but also leads to measurable gains. The reduced psychological stress and increased enthusiasm enable children to stretch more consistently and effectively.

The experimental group's significant progress – roughly twice the improvement in key flexibility measures – highlights that traditional training can be safely augmented and improved. Important outcomes included most experimental gymnasts achieving flat splits and markedly better shoulder/back flexibility within 2 months, without any injuries or dropouts.

Coaches and trainers are encouraged to adopt a holistic approach for developing flexibility in young gymnasts: ensure proper warm-up, use static stretching for long-term gains, apply PNF carefully to advance limits, integrate light resistance exercises to build strength at end-range, and make use of games or fun drills to maintain motivation. Regular monitoring and individualized adjustments should accompany this program to cater to each child's needs and ensure correct technique.

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