

Development and application of health-preserving training methods for ball exercises for young gymnasts aged 8-9

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Abstract

Background and Study Aim In the context of modern requirements for rhythmic gymnastics training, special attention is given to the development of methodologies for mastering ball exercise techniques with consideration for the health of young gymnasts. The goal of this research is to create specialized exercise complexes that contribute to safe and effective training in ball handling techniques among girls aged 8-9 years, with a focus on their physical health safety.

Material and Methods The study involved 20 young gymnasts aged 8-9 years, who were part of basic training groups. Over the course of five months (from January to May 2023), the gymnasts performed specially designed exercise complexes aimed at maintaining and improving their technique and physical condition. The girls executed the proposed exercise complexes twice a week (a total of 40 sessions). The effectiveness of the methodologies was assessed through pedagogical testing of the performance of key ball exercises. The following were selected as control exercises: a large roll-over across the hands and chest forward, a large roll-over across the hands and back, an 'eight' forward with a wheeling hand movement, a high throw and catch. All control exercises were performed with both the right and left hand and were evaluated on a 5-point scale.

Results The analysis of the results showed that the proposed methodologies significantly improve the performance of complex elements, such as rolls and ball throws. Progress in performing these elements with the left hand was especially notable. It was found that the greatest difficulties occur when performing sets of exercises with the ball, in particular, large rolls and high throws. The most significant improvement was observed in the scores for the "large roll-over forward with the left hand" test (at $p < 0.002$) and the "figure eight" test with the left hand (at $p < 0.01$). This confirms the effectiveness of specialized exercises in improving the technical preparation of gymnasts.

Conclusions The study confirmed the significance and effectiveness of the application of the developed exercise complexes in rhythmic gymnastics training. It is particularly noteworthy that the implementation of such methods contributes not only to the technical perfection of gymnasts but also to the strengthening of their health. This is an important aspect in the preparation of young gymnasts.

Keywords: subject training, technique, development, rhythmic gymnastics, ball exercises

Introduction

In the field of children's sports and rhythmic gymnastics training, the importance of developing safe and health-preserving training methods is evident. This is compounded by the growing popularity of rhythmic gymnastics among younger girls. In this context, the age category of 8-9 years is critical for forming the basis of physical development and technical skills, which requires a special approach to the training process.

However, alongside the growing popularity of rhythmic gymnastics, there is an increased demand for comprehensive training of young athletes. According to studies encompassing physical,

technical, psychological, and tactical preparation [1, 2, 3, 4, 5], modern rhythmic gymnastics requires young athletes to not only master a variety of equipment – such as ropes, hoops, balls, clubs, and ribbons – but also to achieve a high level of execution of complex technical elements. These include balances, turns, and jumps, skills that must be mastered at a young age [6, 7, 8, 9, 10]. Special attention is not only paid to achieving technical perfection but also to the health care of athletes [11]. It emphasizes the importance of focusing on harmonious development and safety, rather than solely on sports results, in the early stages of training and the educational process.

This approach is supported by the belief that the key to a successful sports career lies not only in the development of technical skills but also in forming

a foundation for the long-term preservation of health and physical well-being of young athletes. This, in turn, requires coaches and developers of training programs to pay special attention to teaching methods that consider the individual characteristics of each gymnast and contribute to their comprehensive and balanced development.

Another study focused on assessing the internal and external load on young gymnasts when using various apparatuses, as well as during apparatus-free training sessions [13]. The results indicated significant differences in loads depending on the equipment used and the category of gymnasts, highlighting the need for individualized approaches to the training process. An important direction also became the study of the effect of plyometric training on increasing reactive strength and calf muscle strength [14]. The results demonstrate that incorporating these exercises into the training plan significantly improves these parameters.

In other studies [15, 16], an attempt was made to develop and test a specialized test for assessing coordination abilities, aimed at improving approaches to evaluating and training gymnasts' technical skills. The study also included testing for test-retest reliability and establishing normative values to ensure objectivity and comparability of results. These studies collectively aim to enrich our understanding of optimal training methods in rhythmic gymnastics, taking into account the health and safety of young athletes.

Ball exercises in rhythmic gymnastics stand out for their visual appeal and technical complexity, making them one of the most spectacular elements in the all-around competition. The specifics of working with the ball require gymnasts to have a high level of coordination, strength, and precision. This is because even minor errors in ball handling can significantly affect the final performance score. For example, an inaccurate throw trajectory or incorrect ball reception can lead to losses during the execution of elements. This emphasizes the importance of thorough preparation in this area.

Studies conducted in the analysis of actions with the ball have demonstrated how different techniques affect the kinetic and kinematic parameters of exercises. For example, the study of the sliding step revealed its significant impact on the efficiency of executing jumps with the ball, improving strength, speed, and flexibility [17]. Similarly, an analysis of three running techniques showed that certain approaches could enhance the rate of force development and vertical movement, which is important for performing technically complex elements [18, 19]. It was also found that the effectiveness and safety of executing jumps with the ball depend not only on the gymnasts' physical preparedness but also on the training methodology [20]. The authors emphasize that the methodology

should consider both kinetic and kinematic aspects of movements [20]. This underscores the need for a comprehensive approach in the training process, starting from an early age, to develop the necessary skills in gymnasts and prevent errors.

Despite the existence of studies dedicated to the technical preparation of gymnasts for ball exercises, the current body of knowledge still does not fully unveil the potential for improving training methodologies. There is significant scope for further research aimed at optimizing training processes and enhancing the efficiency of young athletes' preparation.

Thus, the main task of the study is to create a methodology that will allow young gymnasts to achieve high results without excessive physical loads, while maintaining the joy of practicing sports and supporting their overall physical and psychological well-being. The aim of this study is to develop and test a complex of exercises with the ball, which not only contributes to the development of technical skills of young gymnasts but also focuses on maintaining their health and preventing possible injuries.

Materials and Methods

Participants

The study involved 20 young female gymnasts aged 8-9 years, who were part of basic training groups. For the purpose of the research, two groups were formed: a control group (CG, n=10) and an experimental group (EG, n=10). Parents consented to their children's participation in the experiment. This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the University.

Study Design The study was conducted at the Andromeda Sports Club, Roseto degli Abruzzi, Italy. Over five months (from January to May 2023), the gymnasts performed specially designed exercise complexes aimed at maintaining and improving their technique and physical condition. The girls performed the proposed exercise complexes twice a week (a total of 40 sessions). The effectiveness of the methods was assessed through pedagogical testing of the performance of key exercises with the ball:

- Test 1: Large roll-through hands and chest forward (right hand), scores;
- Test 2: Large roll-through hands and chest forward (left hand), scores;
- Test 3: Large roll-through hands and back behind (right hand), scores;
- Test 4: Large roll-through hands and back behind (left hand), scores;
- Test 5: Figure eight (right hand), scores; Test 6: Figure eight (left hand), scores;
- Test 7: High throw and catch (right hand),

scores;

- Test 8: High throw and catch (left hand), scores.
- All control exercises were performed with both the right and left hand and were evaluated on a 5-point scale.

Statistical Analysis

For the analysis and visualization of the data, the integrated development environment PyCharm Community Edition was used. The software code was written in Python, with a primary focus on using the Matplotlib library for creating charts and diagrams. For processing statistical data, including calculating mean values, standard deviations, and determining the statistical significance of results, the NumPy library was applied. Differences were considered significant at a significance level of $p < 0.05$.

Results

The greatest improvement was observed in the scores for the large roll-through hands and chest forward with the left hand (at $p < 0.002$) and the figure eight with the left hand (at $p < 0.01$) (fig. 1).

The analysis of Figure 1 confirms that the experimental group showed significant progress in the technique of performing control exercises with the ball compared to the control group. This progress was especially pronounced in exercises requiring a high level of coordination and technical preparedness. While improvements were also observed in the control group, they did not reach statistical significance in most cases, except for the high throw and catch with the left hand. This highlights the importance of specialized training and targeted exercises for developing specific skills.

Discussion

In our study, the main focus is on analyzing and evaluating the developed complex of exercises with the ball for young gymnasts aged 8-9 years. Based on the set goal, we aimed not only to form and improve technical skills with the ball but also to create conditions for protecting and maintaining the health of young athletes, minimizing the risk of injury. This study was aimed at integrating two key aspects of the training process: the effectiveness of

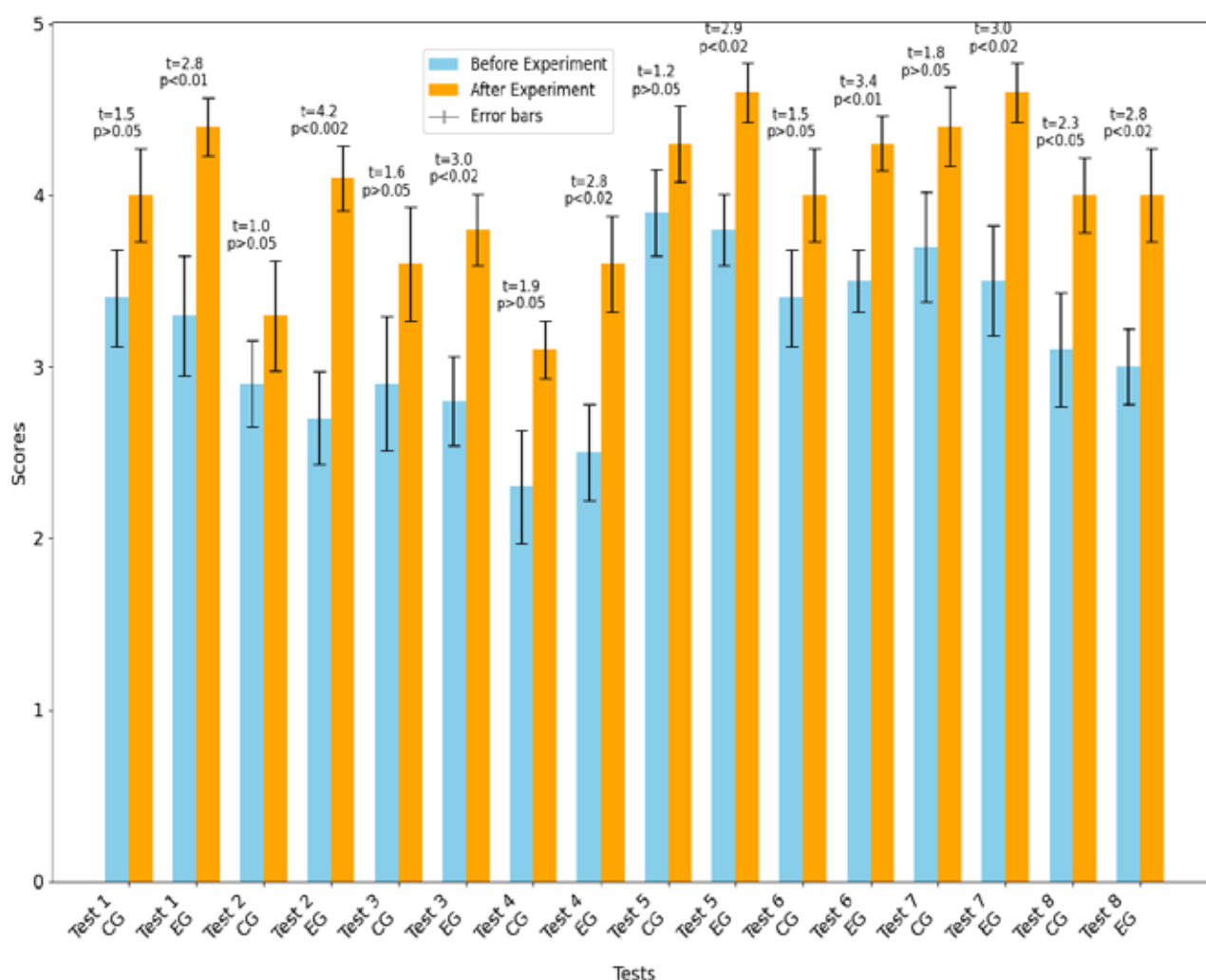


Figure 1. Scores for the technique of performing control exercises with the ball by the participants of the control group (CG, $n=10$) and the experimental group (EG, $n=10$) at the beginning and the end of the study.

learning and a health-preserving approach, taking into account the peculiarities of physiological development and the needs of this age category.

In our study, we observed a noticeable improvement in the technique of performing exercises with the ball in the experimental group. This was especially true for the large roll-through and figure eight exercises with the left hand, where a significant increase in scores was observed ($p < 0.01$ and $p < 0.002$, respectively). These results confirm the effectiveness of the developed exercise complex aimed at improving technical skills in conjunction with maintaining health. While the control group also demonstrated improvements, they were not statistically significant in most cases, highlighting the advantage of the experimental methodology.

Comparing our approaches and results with data from other studies [5, 8, 9, 10] highlights the uniqueness and effectiveness of our methodology in training young gymnasts in ball exercises. Previous works [11, 13, 14] emphasized the importance of developing technical skills and physical health in rhythmic gymnastics but often overlooked the comprehensive approach we proposed.

Our results showed that an integrated approach combining technical excellence and health-preserving practices leads to a significant improvement in ball exercise performance. This is particularly evident against the backdrop of previous studies [17, 18, 19, 20], where the focus was predominantly on one aspect of preparation. For example, studies [24, 26, 27] emphasized the kinematic and dynamic aspects of jumps or the influence of using various equipment on the training process, but they may not fully cover the issue of health preservation and injury prevention.

In our study, we relied on a broad spectrum of coordination development aspects. We were able to demonstrate that a comprehensive approach significantly enhances technical mastery and ensures better adaptation to physical loads, reducing

the risk of injury. This is particularly important given that our target group is young female athletes, for whom achieving high sports results is important, but so is maintaining health in the long term.

Thus, comparing our results with others confirms the assumption that training young gymnasts requires a balance between developing technical skills and focusing on physical well-being. Our approach demonstrates the advantages of such a balance, offering a model that can be adapted in other aspects of sports training.

Conclusions

An important conclusion from our study is the understanding that achieving high results in rhythmic gymnastics requires ensuring balanced development of technical skills and the physical condition of athletes. A health-oriented approach, combined with carefully selected technical exercises, allows for minimizing health risks and fosters a sustainable interest in sports activities.

Thus, the results of our study confirm the effectiveness of the developed exercise complexes for young gymnasts in the basic training stage. These complexes can be recommended to coaches for integration into training programs with the aim of improving the technical mastery of gymnasts and maintaining their health. Such an approach contributes to achieving better sports results and provides a favorable environment for the development of young athletes.

In the future, it is important to focus on developing individualized training programs that take into account the specific needs and capabilities of each gymnast. It is also recommended to expand the research to include an analysis of the impact of psychological preparation on the learning process and sports achievements. Such an approach will not only improve the technical preparedness of athletes but also contribute to their overall physical and psychological well-being.

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Cite this article as:

Kravchuk T, Potop V, Niżnikowski T. Development and application of health-preserving training methods for ball exercises for young gymnasts aged 8-9. *Pedagogy of Health*, 2024;3(1):18–23.
<https://doi.org/10.15561/health.2024.0103>

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Received: 02.02.2024

Accepted: 09.03.2024; Published: 30.06.2024