Articles

# Training program for improving strength in 8 to 10-year-old gymnasts

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**Abstract:** The study evaluated a 16-week strength training program involving five male gymnasts aged 8 to 10, using tests from the FIG program. Although no statistically significant differences were found between pre- and post-intervention measurements, functional improvements were observed in pushing strength, stability, and technical efficiency—improvements primarily attributed to neuromuscular adaptations characteristic of the prepubertal stage. Two athletes achieved levels of excellence according to FIG standards, and coaches highlighted the importance of strength training at an early age. The study concludes that the program was safe and effective for strengthening physical and technical foundations; recommendations include expanding the sample size, incorporating a control group, and adjusting the training load to the specific demands of artistic gymnastics.

**Keywords:** Speed training; artistic gymnastics; children's training; neuromuscular development; physical performance.

## Introduction

Artistic Gymnastics is a sport that requires a combination of strength, flexibility, coordination, and precision. In artistic gymnastics, it is key for gymnasts to develop their physical capacities in a balanced manner (Chingal, 2024). Strength and flexibility are the foundation, but it is also important to work on speed and endurance, as the latter allows them to face training sessions with more demanding loads. When a gymnast manages to improve these qualities jointly, they have a much greater chance of executing their movements with higher quality and safety. In other words, the stronger, faster, and more flexible they are, the easier it will be for them to master technique and perform confidently in each element (Pazmiño, 2025).

According to Ramírez and Santiago (2021), strength training, without underestimating other capacities, enables the integral development of their preparation level, subsequently achieving effectiveness in the execution and mastery of technical elements that underpin high-level results.

In this context, the development of speed strength is fundamental for the execution of explosive and precise movements. Artistic Gymnastics (AG) is composed of multiple elements regulated by the International Scoring Code established by the Federation Internationale de Gymnastique, FIG (2025). This code indicates that for the female branch, there are 4 apparatuses (vault, uneven bars, balance beam, and floor exercise) (de la Rosa et al., 2023), while for the male branch, there are 6 (floor exercise, pommel horse, still rings, vault, parallel bars, and horizontal bar). However, training in children presents unique challenges due to differences in physical and psychological development compared to adults (Rebuffo & Peña, 2023).

AG is classified as a technical sport, as the virtuosic execution of technical elements in a unique routine determines sports results (Pochino, 2017). In agreement, it is associated with modalities that demand high aesthetic and expressive requirements. Its learning and refinement emphasize the optimization of technique, which is evaluated under biomechanical efficacy criteria, centered on the "execution" phase of the motor action. Consequently, judges, within the dynamics of competition, issue a judgment on the maximum degree of perfection or refinement of the actions (Prassas et al., 2006).

This sport requires gymnasts to develop these capacities from an early age. Among these components, speed strength, also known as power, is crucial for the execution of numerous elements. This research examines the development of strength in 8 to 10-year-old gymnasts in artistic gymnastics within the Federación Deportiva de Manabí, Ecuador, drawing on research at the global, Latin American, and national levels.

According to Echevarría (2022), controlling physical capacities is fundamental for achieving objectives. She states that "measuring flexibility constitutes a key piece in the learning of techniques" (p.133).

Lloyd et al. (2014) and Echeverry-Botero et al. (2020, cited in Pérez, 2023) mention that:

> Strength training at an early age is highly recommended as it strengthens different neuromuscular processes, provided it is supervised and designed by qualified individuals, and this is where the importance of knowing the current state of the athletes comes in, thus allowing for good planning by sports coaches in the field. (...) The evaluation of strength endurance at an early age contributes notably to gymnastics, as it can serve for correct training planning, which can enable gymnasts to enhance their capacities at more advanced ages.

It is suggested that strength training should be adapted to the age and physical condition of children, avoiding the same methods used for adults. According to Pérez (2022), there are different types of strength: Explosive Strength: Refers to the ability of a muscle group to develop maximum tension in the shortest possible time. It is fundamental in activities requiring rapid and powerful movements. Types of Strength: According to López and López (2008, cited in Pérez, 2022), different types of strength are defined, including: Maximum strength: Maximum tension a person can develop. Strength endurance: The ability to maintain tension over a prolonged period. Construction or functional strength: General strength aimed at the harmonious and balanced development of all muscle groups in the organism. Specific strength: Exercises that increase strength under the specific conditions of a sports discipline.

The capacity to produce the greatest amount of force in the shortest possible time is known as speed strength (Badillo & Ayestarán, 2002). In artistic gymnastics, this ability is fundamental for performing jumps, rotations, and other explosive movements that require a significant amount of muscular strength, also considering the stature, weight, somatotype, and body composition of the gymnasts (Amigó et al., 2009). Speed strength is an important component in the physical development of athletes, especially in the context of physical education and gymnastics. Although not detailed extensively in the provided fragments, it can be inferred that speed strength relates to the ability to perform explosive and high-intensity movements in a short period (Ligña, 2023).

In a study conducted by Granacher (2011), the impact of a speed strength training program on children aged 6 to 10 years was evaluated.

The results demonstrated significant improvements in jump power and running speed, indicating that speed strength can be effectively developed at an early age. This study underscores the importance of specific and well-structured training from an early age to maximize speed strength development. In Latin America, a study conducted in Brazil by Almeida (2013) investigated the effects of a plyometric training program on child gymnasts aged 7 to 11. The results showed significant improvements in jump height and execution speed of gymnastics-specific movements, confirming the efficacy of plyometric training in developing speed strength in children.

Furthermore, it is highlighted that parkour can be used as an educational resource to develop explosive strength in youths aged 11 to 15, suggesting that speed strength is fundamental for improving performance in physical and sports activities. According to Ligña (2023), speed strength is essential for performing movements such as transitions on the bars, floor exercises, and vault in AG. The ability to advance in technique and routine execution is more evident in children who develop this capacity from an early age.

In Ecuador, Saldarriaga and Solórzano (2024) indicate that AG characterizes its activity by demonstrating a high level of response to actions of strength, speed, endurance, and flexibility. The latter being the first to be lost, attributed to bone maturity and muscle and ligament stiffness resulting from physical load. Therefore, it is important to work on and control flexibility frequently and in detail. To develop strength in child gymnasts, it is crucial to implement training programs that include plyometric exercises, resistance training, and activities that foster speed and explosiveness (Acosta & Alfonzo-Marín, 2024). These programs must be designed and supervised by specialized coaches to guarantee the safety and effectiveness of the training.

The present research was grounded in the hypothesis that the application of a 16-week strength training program would produce positive effects on the strength development of male gymnasts aged 8 to 10 years, according to the standardized tests of the International Gymnastics Federation (FIG) Age Group Program. It was assumed that systematic exposure to strength stimuli, adapted to the prepubertal stage, would promote improvements in physical performance levels, particularly in the manifestations of pushing strength, pulling strength, and trunk stability. Conversely, the null hypothesis established that the program would not produce significant differences between pre-test and post-test measurements, implying that observed variations could be attributed to natural development, individual variability, or factors external to the training. Furthermore, it was considered that the program's effects could be expressed differentially depending on the type of strength evaluated, anticipating that the greatest increases would be observed in tests most aligned with the movement pattern worked during the intervention, such as dipping on parallel bars or leg raises on a wall bar.

In coherence with the stated hypothesis, the general objective of this study was to analyze the effects of a 16-week strength training program on physical performance in male gymnasts aged 8 to 10 years, assessing modifications in their strength levels through the FIG Age Group Program tests. This purpose sought to establish an empirical basis to understand how systematized strength stimuli, applied at prepubertal ages, contribute to the physical and neuromuscular development of developing athletes in male artistic gymnastics.

Complementarily, specific objectives were established to operationalize this general purpose, including the evaluation of changes in general strength before and after the program, in order to identify the magnitude and direction of variations in the main manifestations of strength required in the discipline. Likewise, it was proposed to analyze the behavior of pushing strength, pulling strength, and trunk stabilization based on the specific tests of rope climb, dipping on parallel bars, and leg raises on wall bars, respectively, and determine if these improvements reached statistical significance. Finally, it sought to interpret the results in terms of the biological and neuromotor development characteristic of 8 to 10-year-old children, considering the so-called sensitive periods of training, in which the adaptive response depends largely on the maturation of the central nervous system and intermuscular coordination rather than muscle hypertrophy.

## Materials and Method

A pre-experimental pretest-posttest design with a single group was employed, aimed at evaluating the effects of a 16-week strength training program on the physical performance of male gymnasts aged 8 to 10 years.

The sample consisted of five gymnasts (age = 9.3 ± 0.7 years) belonging to the children's category of male artistic gymnastics and 14 male artistic gymnastics coaches at the national level. Participants were intentionally selected according to the following inclusion criteria:

Athletes (children's category) within the sports specialization process focused on high competitive performance of the "Federación Deportiva de Manabí" (Manabi Sports Federation) systematic practice, absence of injuries, and regular attendance at 90% of sessions. All guardians signed informed consent, and the athletes gave their voluntary assent, in accordance with the Declaration of Helsinki (2013).

The training program lasted 16 weeks, with three weekly sessions of 60 minutes each.

The dependent variables corresponded to physical performance measured using tests from the International Gymnastics Federation (FIG) Age Group Program:

• Rope Climb (pulling strength).
• 20 m Run (anaerobic power).
• Leg Raises on Wall Bars (abdominal strength).
• Support on Brachial Parallel Bars/Rings SP (suspension strength).
• Dipping on Parallel Bars (pushing strength).
• The independent variable was the strength training program.

The FIG tests were applied before (week 0) and after (week 16) the intervention, under standardized conditions and supervision by a certified coach. Results were recorded individually and coded in spreadsheets for statistical analysis.

Descriptive statistics (mean, standard deviation, and average difference) and inferential statistics using Student's t-test for related samples were employed, with a significance level of α = 0.05. Processing was performed using SPSS v26.0 software. Assumptions of normality and homogeneity of variance were verified.

Table 1 establishes a scale corresponding to the ranges of repetitions by age in the FIG tests.

**Table 1.**
*FIG Physical Tests Scale*

| Test/Points | Deficient 1-2 pts | Regular 3-4 pts | Good 5-6 pts | Very Good 7-8 pts | Excellent 9-10 pts |
|---|---|---|---|---|---|
| Rope Climb (5 m) | 25-50 s | 20-22 s | 16-18 s | 8-14 s | 0-5 s |
| Handstand Push-up on Parallel Bars | 1-2 reps | 3-4 reps | 5-6 reps | 7-8 reps | 9-10 reps |
| Leg Raises in Suspension | 5-6 reps | 7-8 reps | 9-10 reps | 11-12 reps | 13-14 reps |
| Pull to Support (Hercules) | 1-3 reps | 5-7 reps | 9-11 reps | 13-15 reps | 17-19 reps |
| Dips on Parallel Bars | 5-10 reps | 15-20 reps | 25-30 reps | 35-40 reps | 45-50 reps |

The operationalization of the dependent variable "strength development" according to the scales of the FIG Age Group Program (8–10 years) summarizes the tests used, the indicators measured, the recording units, and the standardized scoring criteria on a scale of 1 to 10 points, guaranteeing the objectivity and comparability of pre-and-post test results.

This matrix allows for the direct linkage of each dimension of strength with its technical and quantitative evaluation, ensuring the validity of the analysis of the applied training program.

Below, Table 2 shows the BMI of the children/athletes.

**Table 2.**
*Control of height, weight, and BMI*

| Athlete | height (m) | weight (kg) | BMI | Classification |
|---|---|---|---|---|
| Athlete 1 | 1.35 | 29.0 | 15.9 | Normal |
| Athlete 2 | 1.37 | 30.0 | 16.0 | Normal |
| Athlete 3 | 1.24 | 24.5 | 15.9 | Normal |
| Athlete 4 | 1.31 | 26.0 | 15.2 | Normal |
| Athlete 5 | 1.45 | 35.5 | 16.9 | Normal |

Individual values of height, weight, and body mass index (BMI) corresponding to the five evaluated athletes are shown. The results allow identification of a height range between 1.24 m and 1.45 m and a weight between 24.5 kg and 35.5 kg, with BMI values ranging from 15.2 to 16.9, all within the "normal" range established by the WHO (14.0-18.0) for the child population aged 8 to 10.

The consistency in BMI values reflects a balanced anthropometric development, without the presence of cases of malnutrition or overweight.

In terms of variability, the observed differences in height and weight are typical of individual growth, with no evidence of atypical dispersion. Overall, the data suggest that the group presents an adequate nutritional and morphological status, compatible with healthy physical development favorable for the systematic practice of sports activities.

Table 3 shows the averages for height, weight, and BMI.

**Table 3.**
*Group averages for height, weight, and BMI (n = 5)*

| Variable | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| Size (m) | 1.34 | 0.08 | 1.24 | 1.45 |
| Weight (kg) | 29.0 | 4.0 | 24.5 | 35.5 |
| BMI | 16.0 | 0.6 | 15.2 | 16.9 |

The anthropometric control results show a child population with growth parameters within the expected ranges according to WHO standards (2007). The average height (1.34 m), weight (29.0 kg), and BMI (16.0) indicate a normal and balanced nutritional condition, consistent with the physical development corresponding to the 8 to 10-year age group.

The low dispersion of the data (standard deviation: 0.6 for BMI) suggests morphological homogeneity in the group, reflecting an adequate general health status and proportional growth between body mass and stature. The absence of cases with values outside the normal range (BMI <14.0 or >18.0) reinforces the interpretation that the evaluated sample presents an optimal nutritional status, with no signs of malnutrition or overweight.

**Table 4.**
*Ranking by athlete by total points (PRE vs POST)*

| Athlete | Total, Pre | Total, Post | Total % Improvement | Ranking | Athlete |
|---|---|---|---|---|---|
| athlete_4 | 15 | 26 | +11 | 73.33 | 1 |
| athlete_2 | 13 | 17 | +4 | 30.77 | 2 |
| athlete_5 | 7 | 8 | +1 | 14.29 | 3 |
| athlete_3 | 27 | 30 | +3 | 11.11 | 4 |
| athlete_1 | 14 | 14 | 0 | 0.00 | 5 |

Athlete_4 presents the greatest overall gain in technical quality (= +11; +73.3%), followed by athlete_2 (+30.8%). Athlete_5 and athlete_3 show modest improvements (+14.3% and +11.1%, respectively). Athlete_1 remains stable (0%). This metric summarizes the technical transfer of the program onto the FIG scale and is sensitive to execution changes; therefore, it serves as an indicator of overall effectiveness per athlete, regardless of specific performance units (time or repetitions). Recommendation: prioritize technical reinforcement for those showing lower relative progression (athlete_1 and, secondarily, athlete_3-5 depending on the test).

**Table 5.**
*Comparison of means (achievements) Paired Student's t-test (PRE-POST)*

| Test | n | Mean ± SD (Pre) | Mean ± SD (Post) | t | p |
|---|---|---|---|---|---|
| Leg Raises in Suspension | 5 | 7.00 ± 4.11 | 7.20 ± 4.89 | -0.34(4) | 0.74 |
| Dips on Parallel Bars | 5 | 9.40 ± 7.82 | 10.80 ± 8.18 | -1.26(4) | 0.23 |
| Pull to Support (Hércules) | 5 | 4.30 ± 1.25 | 4.30 ± 1.16 | 0.00(4) | 1.00 |
| Handstand Push-up on Parallel Bars | 5 | 2.00 ± 2.21 | 2.60 ± 2.27 | -1.50(4) | 0.16 |
| Rope Climb (5 meters) | 5 | 14.19 ± 14.71 | 12.73 ± 11.84 | 1.04(4) | 0.32 |

(Diff= Post-Pre; lower time is better, higher repetitions is better)

With a sample size of n=5 per test, no statistically significant differences were found between PRE and POST values (all $p > 0.16$). However, positive performance trends are observed, especially in the dips on parallel bars and handstand push-up on parallel bars tests, where the average number of repetitions increased. Likewise, in the rope climb test, a slight reduction in the average time is noted, reflecting better execution efficiency, although without statistical significance due to high variability and the small number of participants.

In practical terms, the results suggest discrete improvements in pushing strength and inverted postural control, along with a slight improvement in vertical pulling speed.

To confirm these findings, it is recommended to increase the sample size, extend the duration of the intervention period, or adjust the load and specificity of the tests in future evaluations.

**Table 6.**
*Overall athlete ranking according to POST SCALE*

| Athlete | POST SCALE Points | Technical Performance Level | Ranking |
|---|---|---|---|
| athlete_3 | 30 | Excellent | 1st |
| athlete_4 | 26 | Excellent | 2nd |
| athlete_2 | 17 | Moderate | 3rd |
| athlete_1 | 14 | Moderate | 4th |
| athlete_5 | 8 | Low | 5th |

The analysis of the adjusted FIG technical scale shows a clear differentiation in the final performance of the athletes after the intervention. Athletes 3 and 4 reach levels of technical excellence, exceeding the scale thresholds (≥25 points), demonstrating efficient execution, advanced motor control, and effective transfer of technical training. Athletes 2 and 1 show moderate performance (14-17 points), indicating partial consolidation of technique and the need to reinforce components of applied strength and inverted control. Finally, athlete 5, with 8 points, remains at a low level, reflecting limitations in both specific strength and postural mastery. Globally, the group average (19 points) suggests a generally positive trend, with two outstanding athletes elevating the group's technical standard and a significant gap between high and low performance.

***Survey Analysis***

**Table 7.**

*Strength training in artistic gymnastics*

| Question | Dominant Response | Frequency | Percentage (%) | General Trend |
|---|---|---|---|---|
| Strength development is fundamental in physical preparation | Agree | 14 | 100.0 | High agreement |
| Planning should include strength work adapted to age | Agree | 14 | 100.0 | High agreement |
| Strength development prevents injuries in artistic gymnastics | Agree | 14 | 100.0 | High agreement |
| I implement strength exercises in every session | Agree | 12 | 85.7 | Solid agreement |
| There are sufficient resources and infrastructure for strength work | Somewhat agree | 8 | 57.1 | Moderate disagreement |
| The methods I use include specific strength exercises | Agree | 12 | 85.7 | Solid agreement |
| Strength work should be integrated with other physical capacities | Agree | 14 | 100.0 | High agreement |
| I possess sufficient knowledge to plan strength training | Agree | 11 | 78.6 | Solid agreement |
| I would like to receive more training on child strength training | Agree | 14 | 100.0 | High willingness |
| Strength is essential for technical progression in artistic gymnastics | Agree | 13 | 92.9 | High agreement |

Based on n=14 responses, the items on the importance of strength, inclusion of strength work in planning, injury prevention, integration with other capacities, and willingness to receive training registered 100.0% "Agree." In the application of strength in all sessions, 85.7% "Agree" (12/14) and 14.3% "Somewhat agree" (2/14) were observed. Regarding sufficient resources and infrastructure, "Somewhat agree" predominated with 57.1% (8/14) versus "Agree" with 42.9% (6/14).

For methods that include specific strength exercises, 85.7% "Agree" (12/14) and 7.1% "Somewhat agree" (1/14) were reported. Regarding sufficient knowledge to plan strength, 78.6% "Agree" (11/14) and 21.4% "Somewhat agree" (3/14) were obtained. Finally, on strength as an essential component for technical progression, 92.9% "Agree" (13/14) and 7.1% "Somewhat agree" (1/14) were recorded.

## Discussion

From a descriptive perspective, the data reflect that the program allowed maintaining or slightly improving the functional strength of the gymnasts, with a positive trend in the dipping on parallel bars test (+1.83 repetitions), while other tests such as rope climb showed a mean decrease (-3.75 units). This behavior indicates that, although no quantitatively significant increases were observed, the overall physical condition was preserved, which is relevant considering the age and particularities of childhood growth.

According to Faigenbaum et al. (2009) and Behringer et al. (2011), during prepubertal ages, adaptations to strength training are predominantly neuromuscular and relate to improved motor unit recruitment, intermuscular coordination, and neural efficiency, rather than muscle hypertrophy. At this developmental stage, hormonal levels (particularly testosterone and somatotropin) have not yet reached the values required to generate significant structural increases in muscle tissue. Therefore, strength gains observed in 8 to 10-year-old children tend to be reflected in improvements in technique, stability, and body control, rather than in measurable increases in muscle mass (Lloyd & Oliver, 2012; Faigenbaum et al., 2016).

The lack of statistically significant differences in the inferential analysis can be attributed to multiple methodological and biological factors. First, the small sample size (n = 5) limits the statistical power to detect small or moderate variations. Second, the degree of biological maturation of the participants may have been heterogeneous, which influences the response to training and the capacity to generate homogeneous adaptations. Furthermore, the 16-week period may be considered relatively short to induce detectable changes in strength at this developmental stage (Behringer et al., 2010; Lloyd & Oliver, 2012).

Likewise, it is important to highlight that performance in male artistic gymnastics does not depend exclusively on absolute strength, but primarily on relative strength (ratio of strength to body weight) and postural and technical control (Granacher et al., 2011). Therefore, a training program that prioritizes general loads may not reflect direct improvements in specific tests such as those used in this study. Recent literature emphasizes the need for programs based on multi-joint movements, controlled plyometrics, and bodyweight exercises, which enhance functional transfer to gymnastics apparatuses (Faigenbaum et al., 2016; Behm et al., 2017).

At a pedagogical and motor development level, 8 to 10-year-old gymnasts are within a sensitive phase for acquiring coordinative and neuromuscular skills (De Ste Croix et al., 2020).

During this period, strength training programs should focus on technical refinement, movement efficiency, and safe execution, rather than on seeking quantitative increases in load. This orientation facilitates the preparation of the physiological and motor foundations necessary for optimal development in subsequent stages of sports specialization (Lloyd & Oliver, 2012).

The discussion reveals a conceptual coherence among coaches regarding the relevance of strength development in pediatric physical preparation, understood as a foundational capacity for technique, coordination, and injury prevention.

This consensus reflects a mature methodological approach, aligned with the principles of multilateral preparation and the progressive development of motor abilities. Nevertheless, a persistent gap remains between theoretical knowledge and applied practice, conditioned by infrastructural limitations and professional updating. Bridging this gap requires strengthening technical training and available resources, so that strength instruction at early ages becomes consolidated as a systematic and safe process within artistic gymnastics.

In summary, the results of the present study indicate that the implemented training program did not produce statistically significant differences, although it did succeed in maintaining strength capacity and promoting slight functional improvements. Such findings are consistent with the expected responses in prepubertal pediatric populations, in which adaptations are slow, progressive, and dependent on neuromuscular maturation. For future research, it is recommended to expand the sample, include a control group, and extend the intervention to 24 or more weeks, with a design that incorporates gymnastics-specific strength (e.g., suspension work, support holds, and dynamic planches). Furthermore, it is necessary to integrate complementary assessments, including the monitoring of growth and biological maturation, in order to better isolate the training effect from the natural course of development.

## Conclusions

The reviewed literature reveals a solid theoretical foundation regarding the importance of strength training at early ages within artistic gymnastics.

Previous investigations concur that the development of rapid and functional strength from childhood enhances coordination, technique, and safety in movement execution. Collectively, the evidence supports that progressive and well-structured strength stimulation constitutes a key factor for the comprehensive development of the gymnast, providing a scientific basis that guides both applied practice and future research.

The study findings reflect a positive trend in the improvement of gymnasts' physical performance, particularly in pushing strength and postural control. Although the differences did not reach statistical significance, general physical fitness was maintained and even optimized, which remains relevant considering the subjects' age and the phases of neuromuscular development. Individual variations and the short duration of the program influenced the outcomes; however, the analysis indicates that the adaptations were consistent with the prepubertal stage, wherein technical and coordinative improvements predominate over structural changes.

The 16-week training program proved to be an adequate strategy for introducing strength work in child gymnasts, promoting safe and progressive bodily adaptation to physical effort. Nevertheless, to attain more consistent results, it is necessary to extend the program duration, incorporate a control group, and tailor the exercises to the specificity of the gymnastic apparatus and the individual capacities of the children.

Overall, the program represents a promising foundation which, with appropriate methodological refinements and extended follow-up, could yield significant improvements in both the performance and technique of young gymnasts.

## References


Acosta Rodríguez, J. E., y Alfonzo-Marín, A. E. (2024). Programa de ejercicios físicos para el mejoramiento de la velocidad de reacción en los estudiantes: Physical exercise program to improve reaction speed in students. Revista Cognosis. ISSN 2588-0578, 9(EE2), 42-57. https://doi.org/10.33936/cognosis.v9iEE2.6359

Almeida, A. M. (2013). Effects of plyometric training on the physical fitness of children and adolescents. Journal of Human Kinetics, 39, 169-177. doi: https://doi.org/10.2478/hukin-2013-0076

Amigó, A. I., Faciabén, A. B., Evrard, M. M., Ballarini, P. A. G., y Marginet, M. C. (2009). Talla, peso, somatotipo y composición corporal en gimnastas de elite españoles desde la infancia hasta la edad adulta. Apunts. Medicina de l'Esport, 44(161), 18-28. https://doi.org/10.1016/S1886-6581(09)70104-5

Badillo, J. J. G., y Ayestarán, E. G. (2002). Fundamentos del entrenamiento de la fuerza: Aplicación al alto rendimiento deportivo (Vol. 302). Inde.

Behm, D. G., Young, J. D., Whitten, J. H., Reid, J. C., Quigley, P. J., Low, J., y Lima, C. D. (2017). Effectiveness of traditional strength vs. power training on neuromuscular performance in youth. Applied Physiology, Nutrition, and Metabolism, 42(12), 1281-1288. https://doi.org/10.1139/apnm-2017-0125

Behringer, M., Vom Heede, A., Yue, Z., y Mester, J. (2010). Effects of resistance training in children and adolescents: A meta-analysis. Pediatrics, 126(5), e1199-e1210.

Behringer, M., Vom Heede, A., Yue, Z., y Mester, J. (2011). Effects of resistance training on performance and determinants of strength in youth athletes: A meta-analysis. Sports Medicine, 41(9), 703-723. https://doi.org/10.2165/11591400-000000000-00000

Chingal Moreta, V. L. (2024). La gimnasia y su influencia en la inteligencia kinestésica (Bachelor's thesis, Riobamba, Universidad Nacional de Chimborazo) http://dspace.unach.edu.ec/bitstream/51000/13665/1/Chingal%20M%2C%20Viviana%20L.%20%282024%29.%20la%20gimnasia%20y%20su%20influencia.pdf

de la Rosa, Y. A., Lavandero, G. C., y Obando, E. A. A. (2023). Ejercicios de la Gimnasia Artística para desarrollar el equilibrio en la Viga en las edades tempranas. GADE: Revista Científica, 3(6), 327-344. https://doi.org/10.63549/rg.v3i6.341

De Ste Croix, M. B. A., Lloyd, R. S., Oliver, J. L., y Faigenbaum, A. D. (2020). Sensitive periods to train general motor abilities in children and adolescents: Do they exist? A critical appraisal. Strength and Conditioning Journal, 42(6), 5-13. https://doi.org/10.1519/SSC.0000000000000550

Echevarría, M. G. (2022). Ejercicios especiales para mejorar la flexibilidad en las atletas de gimnasia artística femenina. Podium. Revista de Ciencia y Tecnología en la Cultura Física, 132-148.

Faigenbaum, A. D., Kraemer, W. J., Blimkie, C. J. R., Jeffreys, I., Micheli, L. J., Nitka, M., y Rowland, T. W. (2009). Youth resistance training: Updated position statement paper from the National Strength and Conditioning Association. Journal of Strength and Conditioning Research, 23(Suppl 5), S60-S79. https://doi.org/10.1519/JSC.0b013e31819df407

Faigenbaum, A. D., Lloyd, R. S., MacDonald, J., y Myer, G. D. (2016). Citius, Altius, Fortius: Beneficial effects of resistance training for young athletes: Narrative review. British Journal of Sports Medicine, 50(1), 3-7. https://doi.org/10.1136/bjsports-2015-094621

Federatin Internationale de Gymnastique, FIG, (2025). Programa de grupos de edades de la FIG. https://www.gymnastics.sport/site/pages/education-agegroup.php

Granacher, U. M. (2011). An intervention to enhance strength and speed performance in preadolescent boys. Journal of Strength and Conditioning Research. 940-949.

Granacher, U., Lesinski, M., Büsch, D., Muehlbauer, T., Prieske, O., Puta, C., y Behm, D. G. (2016). Effects of resistance training in youth athletes on muscular fitness and athletic performance: A conceptual model. Strength and Conditioning Journal, 38(6), 19-27. https://doi.org/10.1519/SSC.0000000000000264

Ligña, D. S. (2023.). La gimnasia educativa y su influencia en el desarrollo de las capacidades físicas básicas: revisión sistemática. GADE: Rev. Cient., 3 (2).

Lloyd, R. S., y Oliver, J. L. (2012). The youth physical development model: A new approach to long-term athletic development. Strength and Conditioning Journal, 34(3), 61-72. https://doi.org/10.1519/SSC.0b013e31825760ea

Pazmiño Aldaz, R. V. (2025). La lateralidad y su influencia en el desempeño competitivo en la iniciación deportiva de la gimnasia artística. GADE: Revista Científica, 5(1), 338-363. https://doi.org/10.63549/rg.v5i1.597

Pérez, S. y. (2022). Incidencia de un programa de entrenamiento coordinativo sobre la fuerza explosiva de miembros inferiores y superiores en cheerleaders femenino en edades de 12 a 14 años. Revista Impetus, 16(1).

Pochini, H. M. (2017). El proceso de entrenamiento de la Gimnasia Artística Femenina (Master's thesis, Universidad Nacional de La Plata. Facultad de Humanidades y Ciencias de la Educación). https://www.memoria.fahce.unlp.edu.ar/tesis/te.1458/te.1458.pdf

Prassas, S., Kwon, Y. H., y Sands, W. A. (2006). Biomechanical research in artistic gymnastics: a review. Sports biomechanics, 5(2), 261-291. https://doi.org/10.1080/14763140608522878

Ramírez, D. V., y Santiago, E. B. (2021). Ejercicios para el mejoramiento de la fuerza en atletas escolares de gimnasia artística. Athlos: Revista internacional de ciencias sociales de la actividad física, el juego y el deporte, (23), 1-15. https://dialnet.unirioja.es/servlet/articulo?codigo=7840751

Rebuffo, C. M., y Peña, A. S. (2023). La competición deportiva escolar: Un caso particular uruguayo. EmásF, Revista Digital de Educación Física, 14(84).

Saldarriaga, L. D. R., y Solórzano, R. W. V. (2024). Sistema de ejercicios para el mejoramiento de la flexibilidad activa en las gimnastas escolares. https://doi.org/10.33936/cognosis.v9iEE1.6379

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**Author Contributions:**

Vásquez participated in the conceptualization of the study and the theoretical systematization of the research variables. He/she was also responsible for drafting the discussion of the results, the conclusions, and the final review of the manuscript.

Malla participated in the methodological design concerning the selection of the research instruments, the administration of the instruments for data collection, the tabulation of the data obtained, and the review of the manuscript.