PODIUM
Journal of Science and Technology in Physical Culture

Volume 19
Issue 3
2024

University of Pinar del Río "Hermanos Saíz Montes de Oca"

ISSN: 1996–2452 RNPS: 2148
PODIUM Journal, September-December 2024; 19(3): e1684

PODIUM
REVISTA DE CIENCIA Y TECNOLOGÍA
EN LA CULTURA FÍSICA

Translated from the original in spanish ***Review article***

Jumping capacity in athletes of artistic and rhythmic gymnastics

La capacidad de salto en deportistas de gimnasia artística y rítmica

Capacidade de salto em atletas de ginástica artística e rítmica

Santiago Nahadme Sarango Domínguez[1*]

[1] Central University of Ecuador. Ecuador.

[*] Corresponding author: snsarango@uce.edu.ec

Received: *05/30/2024.*
Approved. *07/26/2024.*

ABSTRACT

The International Gymnastics Federation recognizes six sports disciplines, which have their own characteristics that allow them to be differentiated from each other. For this research, it has been determined to study two of them, artistic and rhythmic gymnastics, specifically in female athletes. This is because rhythmic gymnastics is an exclusive discipline for women, while artistic gymnastics is practiced by women and men; therefore, it is more than prudent to develop research into these considerations, based on anatomical and physiological arguments, which, added to the demands of both disciplines in gymnastics and acrobatics, allow for a greater understanding of the variables to be investigated. Thus, the objective of

this research is to carry out an analysis of the jumping capacity in rhythmic and artistic gymnastics athletes; through the systematic review of theses, digital journals and academic articles, following the guidelines of the PRISMA method, where the results indicate that jumping capacity differs significantly with respect to its development in these two disciplines, being in artistic gymnastics more relevant due to the nature of the apparatus and demands in their development than in rhythmic gymnastics, where despite sharing similar requirements artistically, they do not share it in acrobatics, so it does not require the same level of development.

Keywords: jumping capacity; jump; saltability; artistic gymnastics; rhythmic gymnastics.

RESUMO

A Federação Internacional de Ginástica reconhece 6 modalidades esportivas, que possuem características próprias que permitem diferenciá-las entre si. Para esta pesquisa, determinou-se estudar duas delas, a Ginástica Artística e a Ginástica Rítmica, especificamente em atletas do sexo feminino. Isso porque a ginástica rítmica é uma disciplina exclusiva das mulheres, enquanto a ginástica artística é praticada por mulheres e homens; Portanto, é mais que prudente desenvolver pesquisas sobre essas considerações, baseadas em argumentos anatômicos e fisiológicos, que, somadas às demandas de ambas as disciplinas da ginástica e da acrobacia, permitem uma maior compreensão das variáveis a serem investigadas. Assim, o objetivo desta pesquisa é realizar uma análise da capacidade de salto em atletas de Ginástica Rítmica e Artística; por meio da revisão sistemática de teses, periódicos digitais e artigos acadêmicos. Seguindo as diretrizes do método PRISMA. Onde os resultados indicam que a capacidade de salto difere significativamente no que diz respeito ao seu desenvolvimento nestas duas disciplinas. Sendo na ginástica artística mais relevante pela natureza dos aparelhos e exigências no seu desenvolvimento; que, na ginástica rítmica, onde apesar de compartilharem requisitos artísticos semelhantes, não os compartilham na acrobacia, portanto não exige o mesmo nível de desenvolvimento.

Palavras-chave: capacidade de salto; salto; saltabilidade; ginástica artística; ginástica ritmica.

INTRODUCTION

Limitations or insufficiencies in physical development present various challenges for athletes who plan to become more technical in gymnastics. If there are gaps or deficiencies in the base, such as physical preparation, there will be problems in the teaching stage of any technical element, with the risk of poor learning, possible microtraumas that can lead to injuries and even permanent retirement.

The nature of the sport and the demands on the devices or implements used in gymnastics are another factor that is not usually considered to determine what needs to be developed to a certain degree. Thus, when talking about explosive strength or power of the lower body, which is usually expressed in jumping capacity, in the case of rhythmic gymnastics it is demonstrated in gymnastic jumps such as strides, and in the case of artistic gymnastics It is very important in gymnastic and acrobatic elements (Leyton *et al.,* 2012). This is where the importance of research lies, since, if these requirements that sports disciplines demand and that are certainly exclusive are not differentiated, a correct preparatory stage cannot be developed that allows the athlete to be in conditions for learning of a technical element.

The jumping capacity is the ability of living beings to leave the ground, both vertically and horizontally, at the greatest possible distance, only with the help of their legs and depending on their development in terms of strength, flexibility and speed (Díaz, Robert & Asin, 2019). With this, there are a variety of ways to work, train and understand jumping capacity; and this is where training methods appear that, depending on the needs, one will have more relevance than the other. In this case, it is directed at the development of the lower body, which is why there are very numerous studies that have shown that a strength training program can increase the vertical jumping capacity in both adults and boys and girls (Pérez *et al. al.,* 2006).

Artistic gymnastics is divided into female and male branches, with a predominant tendency of its female participants to the number of male gymnasts. The female branch consists of four competition apparatuses, while the male branch consists of six (Allen, 2023). Women's Artistic Gymnastics is a sport of art and precision, where capacities such as strength, speed and flexibility are developed. This branch is developed in devices such as the jump, uneven bars, balance beam and floor (Muñoz, 2018). Three of them with predominance and demand of the lower body in their practice.

Rhythmic gymnastics is the union of sport and art, with a notable influence from ballet and modern dance, where the athletes perform routines with music, individually or in a group, who, when demonstrating their skills, execute maneuvers with hand instruments such as the hoop, ball, clubs, ribbon and rope (International Gymnastics Federation, 2022). A purely feminine sport.

Jumping capacity is essential in gymnastic and acrobatic sports. Modalities such as trampoline gymnastics (tumbling, trampoline and double minitramp) or the jumping and floor horse of Women's and Men's Artistic Gymnastics, among others, are sports specialties characterized by an important capacity for impulsion of the lower body (Gómez *et al.*, 2011). Similar situation happens in rhythmic gymnastics, where all forms of competition, depending on the instruments or apparatus, are developed purely on the floor and there is a notable display of jumps, rotations, balances, flexibility/cadence waves and rhythm; sport and art intertwined (Rodríguez *et al.*, 2018).

In this way, the objective of the research is to analyze, through a systematic review, the importance of the development of jumping capacity in artistic and rhythmic gymnastics athletes, under consideration of the requirements that are demanded by the very nature of the two sports disciplines. regarding gymnastic, acrobatic elements and apparatus/implements.

Therefore, this review research is of utmost importance for athletes and coaches of artistic and rhythmic gymnastics who may consider this research as a source of consultation; as well as students, teachers or physical activity professionals who may have a basis for future research.

The research focuses on the systematic review of academic documentation in order to achieve the stated objective. This type of reviews is characterized by describing in detail the transparent and understandable development process of collection, selection, critical evaluation and summary of all available evidence regarding a particular topic (Moreno *et al.,* 2018).

The bibliographic search was carried out in the data sources: Scielo, Dialnet, Science Direct and Redalyc. With keywords such as "jumping capacity", "jumping", "jumping capacity in gymnasts", "jumping capacity in artistic gymnastics", "jumping capacity in rhythmic gymnastics", "artistic gymnastics" and "rhythmic gymnastics"; which were combined in English and Spanish. In the same way, in order to specify the search, the Boolean operators AND and OR were used, and documents published between 2016 and 2023 were established as the search limit.

For the selection of the documents, the Preferred Reporting Items for Systematic Reviews and Meta-Analyzes (PRISMA) was taken into account, which allowed the studies to be organized and classified according to identification, eligibility and inclusion criteria. Finally, with respect to the selection of documents, priority was given to degree theses, digital journals and academic articles from research that has been carried out on artistic and rhythmic gymnastics athletes. Discarding those articles that were derived from bibliographic reviews, reflection articles by authors and reviews.

DEVELOPMENT

In the applied identification stage, according to the PRISMA method, the population of publications for this study was 160. Of which, 95 were eliminated for not contributing to the study, 65 that met the search filters applied as they were degree theses, scientific articles, language (English-Spanish) and year of publication (2016-2024). Of them, 22 were eliminated because they were duplicate publications. In the eligibility stage, of the 43 selected publications, four were excluded, since they did not have the full text and 22

because they did not fit the study topic. With this, the sample for this research is 17 academic-scientific publications (Figure 1) and (Table 1).

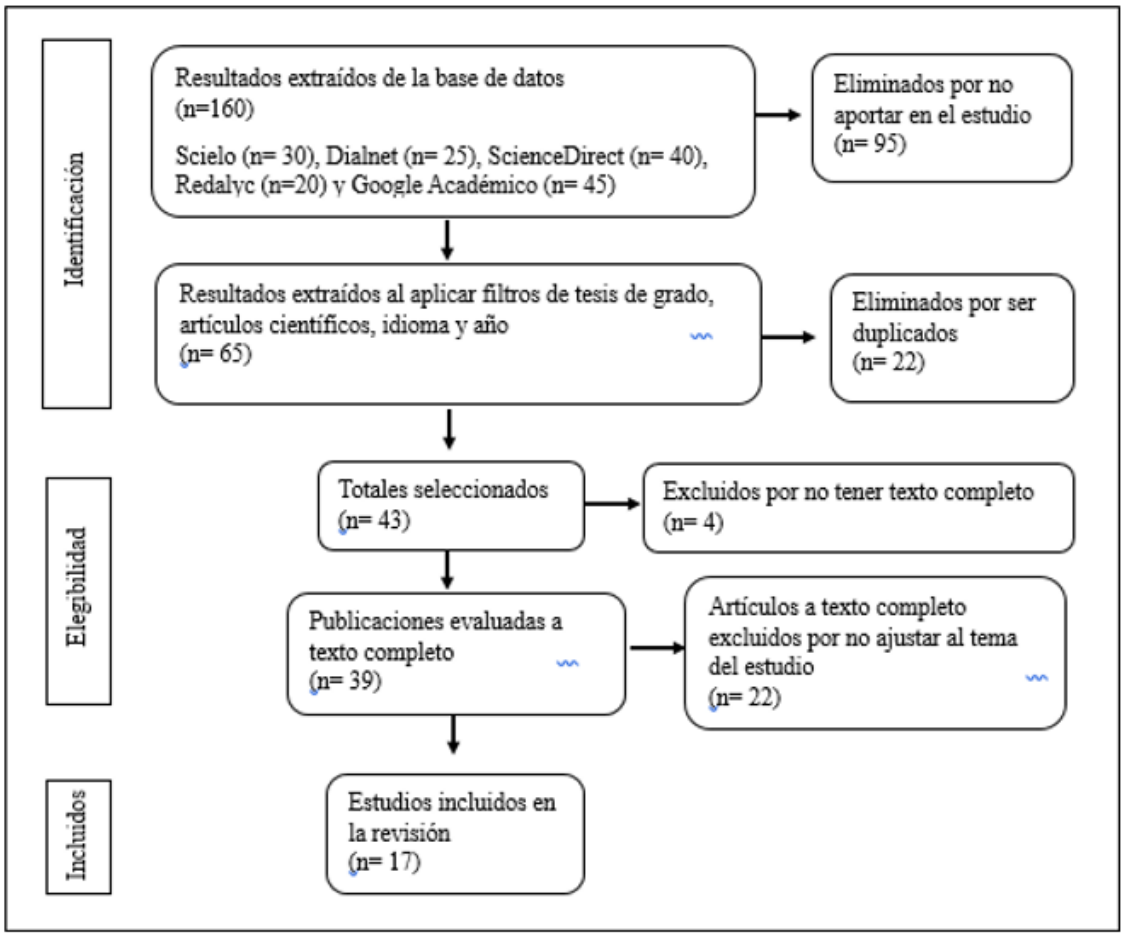

Fig. 1. - *Flow chart of the bibliographic selection process*

Table 1. - *Analytical matrix of bibliographic review*

Author/Title	Aim	Design	Instrument	Conclusions
Soenyoto, T., Aji, Ranu., Darmawan, A., & Irsyada, R. (2021). Contribution of Leg Flexibility, Limb Length, Leg Power for the Split Leap Skills of Rhythmic Gymnastics Athletes	To examine the association between leg flexibility, leg length, jump height, and split jump movement scores in various levels of rhythmic gymnasts.	Experimental.	Observation. Survey with an ex post facto research design. Anthropometric measurements, test for jumping power.	The athlete's flexibility, body composition, and explosive leg power effectively contribute to the split jump movement at the youth level.
Skopal, L., Netto, K., Aisbett, B., Takla, Amir., & Castricum, T. (2020). The effect of a rhythmic gymnastics-based power-flexibility program on the lower limb flexibility and power of contemporary dancers.	To test the effectiveness of a complementary training program based on rhythmic gymnastics on the flexibility and power of the lower extremities of contemporary dancers.	Experimental using a between-groups design.	Measured Range of Motion and power test.	contemporary dancers' lower extremity flexibility and power. This was evidenced by improvements in the execution of dance jumps such as the grand jeté, as well as isokinetic torque during a dance kick.
Ruano, C., & Cejuela Anta, R. (2020). Evaluation of the main performance factors in	Compare the performance factors of rhythmic gymnastics studied in the literature between two groups of Spanish individual gymnasts of different	Experimental.	Anthropometric, physical (flexibility and jumping ability) and physiological (heart rate and lactate) tests.	Anthropometric values, jumping ability, flexibility and lactate recycling capacity would be the main performance factors

rhythmic gymnastics. Comparison between different levels.	levels (first and third national division).			to evaluate to differentiate gymnasts based on their level.
Schärer, C., Reinhart, L., & Hübner, K. (2023). Age-Related Differences between Maximum Flight Height of Basic Skills on Floor, Beam and Vault and Physical Condition of Youth Female Artistic Gymnasts	Describe the differences between age groups in the physical requirements of the lower extremities, flight height and running speed in the performance of basic skills on floor, beam and vault by young gymnasts between 7 and 15 years of age.	Experimental.	Observation, Jump Test and Swiss Diagnostic Manual of Olympic performance for elements evaluated on the floor, beam and jump apparatus.	In women's artistic gymnastics, jumping ability is of crucial importance, as three of the four apparatus require a high level of lower body power. To perform difficult elements, land cleanly and thus obtain a high final score in a competition, a long flight time (i.e. a high flight altitude) is necessary.
Papia, A., Apostolidis, N., Bogdanis, G., & Donti, O. (2018). Jumping performance is not a strong predictor of change of direction and sprinting ability in preadolescent female gymnasts	To examine the association between vault performance, change of direction, and sprint ability in preadolescent gymnasts.	Experimental	Observation- Jump test: countermovement jump with one and two legs (CMJ), drop jump (DJ), squat jump. (SJ) and standing long jump (SLJ). Sprint and change of direction ability tests.	All performance scores in this study were statistically correlated, demonstrating that vault performance is associated with locomotion skill performance in young gymnasts.

Russo, L., Palermi, S., Dhahbi, W., Delas, S., Bragazzi, N., & Padulo, J. (2020). Selected components of physical fitness in rhythmic and artistic youth gymnast	Clarify how gymnastics training experience over years could lead to motor skill development and learning	Intervention	Tests of joint mobility, balance, explosive strength, speed and endurance	Rhythmic gymnastics develops more joint mobility and artistic gymnastics develops more strength, balance and endurance.
Ferreira, L., Leite, I., Batista, A., & Tristão, M. (2023). Jump ability and force-velocity profile in rhythmic gymnastics.	To analyze the Strength-Velocity profile during the countermovement jump of Rhythmic Gymnastics athletes, the magnitude and direction of the imbalance between the two variables (strength and speed) and compare the jumping capacity and mechanical variables of different age groups.	Experimental	Questionnaires, anthropometric measurements and countermovement jump (CMJ) test.	From the analysis of the VF profile of all the gymnasts, we verified that 73.2% presented a strength deficit, while 11% presented a speed deficit. Therefore, this research highlights the lack of specific physical preparation to improve jumping performance in Rhythmic Gymnastics, which may be the result of repeated training adaptations where physical preparation is one of the most frequently

				neglected components.
Leite, I., Goethel, M. Cenceicao, F., & Ávila, L. (2023). How Does the Jumping Performance Differs between Acrobatic and Rhythmic Gymnasts?	To investigate how vault performance differs between acrobatic and rhythmic gymnasts, focusing on the mechanical variables of the force-velocity (FV) profile.	Intervention.	Background survey, anthropometric evaluations and Myjump.	The acrobatic gymnastics bases presented the highest height in CMJ and developed higher F0 than the rhythmic gymnasts. While both roles present low strength deficits, rhythmic gymnastics roles present high strength deficits. It is imperative that gymnastics coaches introduce strength/power conditioning training in addition to skills training.
García, K., & Brenes, N. (2023). Evaluation of Bio-Banding in rhythmic gymnastics: analysis **Comparison of anthropometric and performance variables. pilot study**	To analyze and compare the body composition and physical condition variables of rhythmic gymnastics athletes from Madrid (Spain) taking into account their year of birth in order to know if there are significant differences in first-year and second-year	Intervention.	Anthropometric test and physical condition	There is a tendency towards significant differences in body composition and physical condition in first- and second-year gymnasts, which could indicate that it is possible to make a division of categories that take into account the

	gymnasts of their category.			physical development or state of maturity of the gymnasts. gymnasts.
Chiriac, T., Teodorescu, S. Bota, A. & Mezei, M. (2021). The duration of technical elements in rhythmic gymnastics jumps – a longitudinal and correlational study	Identify the level of development of some abilities/components that condition the execution of elements of difficulty in the jumping group in accordance with the requirements of the FIG Scoring Code and increase the value of technical elements in competition routines.	Experimental.	Observation and tests (evaluation, muscle power, contact times, jump height, flight times and jump rhythm, using Microgate OptoJump Next devices)	There are strong correlations between contact time, flight time, jump height, muscle power and rhythm for the left and right lower limbs, which is explained by the concern of coaches to approach physical training in a manner balanced for all body segments regardless of their contribution to the execution of the specific technique.
Bogdanis, G., Donti, O., Papia, A., Donti, A., Apostolidis, N., & Sands, W. (2019). Effect of Plyometric Training on Jumping, Sprinting and Change of Direction Speed	To examine the effects of eight weeks of plyometric training on the performance in jumping, sprinting and changes of direction (COD)	Repeated measures design Experimental.	Test: 10 and 20 m sprints, 5+5 m and 10+10 m COD tests, counter movement jump with one and two legs (CMJ), drop jump (DJ), squat jump. (SJ) and standing long jump (SLJ).	Supplemental plyometric training increased sprint and change-of-direction performance more than regular gymnastics training, while jumping performance

in Child Female Athletes				improved equally in both groups.
Cabrejas, C., Solana, M., Morales, J., Nieto, A., Bofill, A., Carballeira, E., & Pierantozzi, Em. (2023). The Effects of an Eight-Week Integrated Functional Core and Plyometric Training Program on Young Rhythmic Gymnasts' Explosive Strength	To evaluate the effects of an integrated functional Central Plyometric Training program on the explosive strength and jumping performance of young rhythmic gymnastics athletes.	Experimental.	Countermovement jump test with one and two legs (CMJ), performed using a force platform, and performance evaluation in specific Rhythmic Gymnastics jumps.	An integrated functional Core Plyometric Training program improved explosive strength and greatly impacted aspects of Rhythmic Gymnastics-specific performance.
Agostini, B., Godoy, E., Almeida, R., Macedo, F., and Alves, N. (2017). Analysis of the influence of plyometric training in improving the performance of athletes in rhythmic gymnastics.	To evaluate the efficiency of Plyometric Training (PT) in improving the performance of rhythmic gymnastics athletes in the youth and adult categories for 12 months, incorporating PT in two training macrocycles.	Intervention.	Test: vertical jump, horizontal jump and agility,	Athletes trained with the addition of plyometric exercises presented better performance than the group trained with normal exercises, with greater strength in the lower limbs in vertical jump, horizontal jump, and improved agility.

Deliceoglu, G., Atalay, G., & Kabak, B. (2024). The effect of leg stiffness on reactive agility, jumping and speed in gymnastics athletes.	To investigate the effects of gymnasts' leg stiffness on performance parameters such as reactive agility, jumping and speed.	Experimental.	Drop jump test (Optojump measuring device), Leg Stiffness: vertical jump test (Optojump), Speed: 20 m sprint test (with Witty measuring device)	Increasing the stiffness of gymnasts' legs positively contributes to jumping power, speed and reactive agility. In this case, it is recommended to include plyometric exercises in training programs to improve leg stiffness in trampoline gymnasts, rhythmic gymnasts, and artistic gymnasts who focus on jumping.
Sánchez, P. & Hernández, J. (2021). Effect of different types of physical training on gymnasts' jump height: meta-analysis	Determine the effect of different types of physical training on the jump height of gymnasts under the meta-analysis methodology.	Meta-analysis.	PRISM	The type of training that showed the largest overall Effect Size was plyometrics, followed by vibration platform training. Among others, depending on the Effect Size: trampoline training, resistance training; weight belt training; post-activation potentiation;

				proprioceptive training, battle rope. Also highlighting that stretching is not significantly related to the jump height of gymnasts.
Sáez, E., Alarcón, M., Valdés, P., & Guzmán, E. (2023). Effects of six weeks of isoinertial training on jumping capacity, running speed and dynamic postural balance	To analyze the effects of six weeks of isoinertial training on jumping capacity, running speed and dynamic postural balance in untrained adults.	Pre-experimental	Evaluation of explosive strength through the countermovement jump (CMJ), the 20-meter running test and the modified Star Excursion Balance Test (SEBTm) dynamic postural balance test.	Isoinertial training produces significant improvements in jumping capacity, running speed and dynamic postural balance in healthy untrained adults, becoming an efficient method, since it requires a reduced number of sessions and time.
Marinšek, M., & Samardžija, M. (2020). Association between muscles' contractile properties and jumping performance in gymnasts	To examine the association between muscle contractile properties and jumping skill performance in gymnasts.	Experimental.	Tensiomyography (TMG) Test: squat jump (SJ), countermovement jump (CMJ), jump with fall (DJ)	The results indicate that healthy back muscles are very important for the explosive function of the leg muscle and therefore for the performance of jumping skills.

Source: *Own elaboration.*

From the nature of the two sports studied. In rhythmic gymnastics, authors such as Soenyoto *et al.* (2021) and Skopal *et al.* (2020) demonstrate the importance of jumping capacity in gymnastic elements such as the grand jeté and the Split jump, which highlight the power and explosive strength of the lower extremities, as well as the determining role of flexibility in the development of rhythmic gymnasts. Therefore, authors such as Ruano & Cejuela (2020), in experimental research, determine that the performance factors to be evaluated to differentiate gymnasts into levels, added to jumping ability, would be anthropometric values, flexibility and ability of lactate recycling. Therefore, in research dealing with rhythmic gymnastics, flexibility will always be present, which gives us to understand that this ability plays a more leading role in this type of gymnastics.

With respect to artistic gymnastics, the fact that its execution in competition takes place in four totally different environments (apparatus), it can be stated that jumping capacity has greater prominence in three of them, for the simple reason that the Horse vault, balance beam and hands free (floor) require a high level of lower body power. This allows for more difficult gymnastic and acrobatic elements that require a long flight time and therefore greater height (Schärer *et al.*, 2023). Additionally, in the research by Papia *et al.* (2018), change of direction and sprint capacity are also considered; which are very notable in the practice of the three aforementioned devices, and that in the results together with the jumping capacity they are statistically correlated, which demonstrates that jumping performance is associated with the locomotion skills that must be developed.

In this way, the statement that rhythmic gymnastics develops more joint mobility while artistic gymnastics does so with strength, balance and resistance (Russo et al. 2020), is correct, but it does not mean that training of physical preparation with the development of other abilities such as jumping should be neglected. Thus, in rhythmic gymnastics, in research by the authors Ferreira *et al.* (2023) and Leite *et al.* (2023), high strength deficits are determined, where the strength-speed profile is considered and it is evident in both cases that there is a lack of specific physical preparation to improve jumping performance; therefore, they recommend the introduction of strength/power training, in addition to abilities training. Thus, in a research where the variables of body composition and physical condition were measured, García & Brenes (2023), after studies carried out on groups of

different levels, determined that there is a tendency to significant differences in body composition and in the physical condition of gymnasts, related to physical development and state of maturity, which is contrasted by the intervention type research carried out by Chiriac *et al.* (2021), where measurements were made before and after training that, due to the pandemic period, were aimed at physical development in a balanced way, reaching the conclusion that there are strong correlations between contact time, flight time, height. of jumping, muscular power and rhythm for the left and right lower limbs.

Finally, research was found where different training methods were applied that influenced the development of jumping capacity, where authors such as Bogdanis *et al.* (2019), Cabrejas *et al.* (2023), Agostini *et al.* (2017) & Deliceoglu *et al.* (2024), agree that plyometric training is the best option to develop jumping capacity and other aspects that affect it, such as sprint performance, changes of direction, explosive strength, knee stability, single-leg power and bipodal, and increased leg rigidity that contribute to the power of the jump. On the other hand, Sánchez & Hernández (2021), which coincides with plyometric training, also do so with training such as vibrating platform and trampoline; training against resistance, with weight belts or isoinertial training Sáez *et al.* (2023); and post-activation potentiation. All of them have a direct impact on jumping ability, as well as running speed and dynamic postural balance.

Research was also found that mentions other aspects such as that of the authors Marinšek & Samardžija (2020), who, when examining the association between the contractile properties of the muscles and jumping performance in gymnasts, affirm that healthy back muscles have important impact for the explosive function of the leg muscle and, therefore, for the performance of jumping abilities.

CONCLUSIONS

According to the findings in this systematic review, it was evident that the development of jumping capacity differs significantly in these two types of gymnastics. In artistic gymnastics it is more relevant due to the nature of the competition apparatus, in terms of

gymnastics and acrobatics, where in three of them a high level of lower body power is required than in rhythmic gymnastics, where its development occurs purely on the floor and that, despite sharing similar requirements in gymnastics, it does not do so in acrobatics, so it does not require the same level of development.

All this could be observed in several studies that showed a certain degree of neglect in terms of physical preparation training in rhythmic gymnastics, so even though the nature of this sport does not require a high level of development of the jumping capacity, it does not mean that it is not important, which is why it is recommended to introduce specific strength/power training to specific physical preparation to improve jumping performance.

Finally, plyometrics becomes the type of training that has the best results in terms of the development of jumping ability, since the majority of the studies reviewed in the research express this statement.

REFERENCES

Agostini, B., Godoy, E., Almeida, R., Macedo, F., y Alves, N. (2017). Analysis of the influence of plyometric training in improving the performance of athletes in rhythmic gymnastics. *Motricidade, 13(2),* 71-80. http://dx.doi.org/10.6063/motricidade.9770

Allen, H. (2023). *Las diferencias entre gimnasia artística masculina y femenina.* Sankris Gymnastics Art Studio. https://www.sankrisgymnastics.com/blog/las-diferencias-entre-gimnasia-artistica-masculina -y-femenina/

Bogdanis, G., Donti, O., Papia, A., Donti, A., Apostolidis, N., & Sands, W. (2019). Effect of Plyometric Training on Jumping, Sprinting and Change of Direction Speed in Child Female Athletes. *Sports, 7(5),* 116-126. https://doi.org/10.3390%2Fsports7050116

Cabrejas, C., Solana, M., Morales, J., Nieto, A., Bofill, A., Carballeira, E., & Pierantozzi, Em. (2023). The Effects of an Eight-Week Integrated Functional Core and Plyometric Training Program on Young Rhythmic Gymnasts' Explosive Strength. *International*

Journal of Environmental Research and Public Health, 20(2), 1041-1061. https://doi.org/10.3390/ijerph20021041

Chiriac, T., Teodorescu, S. Bota, A. & Mezei, M. (2021). The duration of technical elements in rhythmic gymnastics jumps - a longitudinal and correlational study. *Physical Education, Sport and Kinetotherapy Journal, 60(3),* 265-279. https://doi.org/10.35189/dpeskj.2021.60.3.6

Deliceoglu, G., Atalay, G., & Kabak, B. (2024). The effect of leg stiffness on reactive agility, jumping and speed in gymnastics athletes. *Science of Gymnastics Journal, 16(1),* 55-65. http://dx.doi.org/10.52165/sgj.16.1.55-65

Díaz, D., Robert, R. & Asin, M. (2019). Referentes teóricos del desarrollo de la saltabilidad en la categoría 8 años de Gimnasia Artística. *ROCA. Revista científico-educacional de la provincia Granma 15(3),* 191-202. https://dialnet.unirioja.es/servlet/articulo?codigo=7121643

Federación Internacional de Gimnasia FIG. (2022). *Gimnasia Rítmica*. FIG: https://www.gymnastics.sport/site/discipline.php?disc=4

Ferreira, L., Leite, I., Batista, A., & Tristão, M. (2023). Jump ability and force-velocity profile in rhythmic gymnastics. *Science of Gymnastics Journal, 15(2),* 225-237. https://doi.org/10.52165/sgj.15.2.225-237

Gómez, L., Vernetta, M., & López, J. (2011). Análisis comparativo de la capacidad de salto en gimnastas de trampolín españoles. *Revista Internacional de Ciencias del Deporte*, 7(24), 191-202. https://www.redalyc.org/articulo.oa?id=71018866004

Leite, I., Goethel, M. Cenceicao, F., & Ávila, L. (2023). How Does the Jumping Performance Differs between Acrobatic and Rhythmic Gymnasts? *Biomechanics, 3(4),* 457-468. https://doi.org/10.3390/biomechanics3040037

Leyton, M., del Campo, V., Solana, R., & Morenas, J. (2012). Perfil y diferencias antropométricas y físicas de gimnastas de tecnificación de las modalidades de artística y rítmica. *RETOS. Nuevas Tendencias en Educación 21*, 5862. https://doi.org/10.47197/retos.v0i21.34606

Marinšek, M., & Samardžija, M. (2020). Association between muscles' contractile properties and jumping performance in gymnasts. *Science of Gymnastics Journal*, *12(1),* 75-86. http://dx.doi.org/10.52165/sgj.12.1.75-86

Moreno, Begoña, Muñoz, Maximiliano, Cuellar, Javier, Domancic, Stefan, & Villanueva, Julio. (2018). Revisiones Sistemáticas: definición y nociones básicas. *Revista clínica de periodoncia, implantología y rehabilitación oral,* *11*(3), 184-186. http://dx.doi.org/10.4067/S0719-01072018000300184

Muñoz, D. (2018). Fundamentos teóricos, pedagógicos y didácticos de los deportes acrobáticos. Bogotá: Ediciones USTA, Universidad Santo Tomás. https://repository.usta.edu.co/bitstream/handle/11634/10593/Mo%CC%81dulo%20Deportes%20acroba%CC%81ticos.pdf

Papia, A., Apostolidis, N., Bogdanis, G., & Donti, O. (2018). Jumping performance is not a strong predictor of change of direction and sprinting ability in preadolescent female gymnasts. *Science of Gymnastics, 10(2),* 273-283. https://www.proquest.com/openview/8a0e374d5cf1fd69493698e0058f073d/1?pq-origsite=gscholar&cbl=666318

Pérez, J., Rodríguez, G., Royo, I., Arteaga, R., Calbet, J., & Dorado, C. (2006). Capacidad de salto en niñas prepúberes que practican gimnasia rítmica. *Motricidad. European Journal of Human Movement. 15(4),* 186-192. https://dialnet.unirioja.es/descarga/articulo/2279575.pdf

Rodríguez, L., Guerra, M., y Lores, L. (2018). Influencia de los ejercicios básicos en las habilidades técnicas de las niñas de la gimnasia rítmica. *Olimpia: Revista de la Facultad de Cultura Física de la Universidad de Granma, 15(48),* 79-90. https://dialnet.unirioja.es/servlet/articulo?codigo=6399857

Ruano, C., & Cejuela-Anta, R. (2020). Evaluación de los principales factores de rendimiento en gimnasia rítmica. Comparación entre diferentes niveles. *Cultura, Ciencia y Deporte, 15(44),* 65-175. https://doi.org/10.12800/ccd.v15i44.1459

Russo, L., Palermi, S., Dhahbi, W., Delas, S., Bragazzi, N., & Padulo, J. (2020). Selected components of physical ftness in rhythmic and artistic youth gymnast. *Sport Sciences for Health, 17,* 415-421. https://doi.org/10.1007/s11332-020-00713-8

Sanchez, P. & Hernandez, J. (2021). Efecto de diferentes tipos de entrenamiento físico en la altura de salto de gimnastas: meta-análisis. *Pensar en Movimiento, revista de ciencias del ejercicio y la salud, 19(1),* 1-35. https://doi.org/10.15517/pensarmov.v19i1.43155

Schärer, C., Reinhart, L., & Hübner, K. (2023). Age-Related Differences between Maximum Flight Height of Basic Skills on Floor, Beam and Vault and Physical Condition of Youth Female Artistic Gymnasts. *Sports 2023, 11*, 100. https://doi.org/10.3390/sports11050100

Sáez, E., Alarcón, M., Valdés, P., & Guzmán, E. (2023). Efectos de seis semanas de entrenamiento isoinercial sobre la capacidad de salto, velocidad de carrera y equilibrio postural dinámico. *Retos, 48,* 291297. https://doi.org/10.47197/retos.v48.95284

Skopal, L., Netto, K., Aisbett, B., Takla, Amir., & Castricum, T. (2020). The effect of a rhythmic gymnastics-based power-flexibility program on the lower limb flexibility and power of contemporary dancers. *The International Journal of Sports Physical Therapy, 15(3),* 343-364. http://dx.doi.org/10.26603/ijspt20200343

Soenyoto, T., Aji, Ranu., Darmawan, A., & Irsyada, R. (2021). Contribution of Leg Flexibility, Limb Length, Leg Power for the Split Leap Skills of Rhythmic Gymnastics Athletes. *International Journal of Human Movement and Sports Sciences 9(4),* 648-653. http://dx.doi.org/10.13189/saj.2021.090407

PODIUM
REVISTA DE CIENCIA Y TECNOLOGÍA
EN LA CULTURA FÍSICA

Conflicts of interest:

The authors declare not to have any interest conflicts.

***Contribution of the authors*:**

The authors have participated in the writing of the work and analysis of the documents.