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Original article

Effectiveness of active and passive flexibility in rhythmic gymnastics training

Efectividad de la flexibilidad activa y pasiva en el entrenamiento de gimnasia rítmica

Efetividade da flexibilidade ativa e passiva no treino da ginástica rítmica

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ABSTRACT

Flexibility is the joint capacity to perform movements at maximum amplitude, being a determining capacity in sports such as rhythmic gymnastics, for which the sports training planning models prioritize its content as part of the management process. This paper research is aimed at assessing the effect of passive and active flexibility training on the lower limbs of rhythmic gymnasts from the Liga Deportiva Cantonal of Rumiñahui. This is a Quasi-experimental research of a correlational order, studying 35 rhythmic gymnastics athletes from the Rumiñahui Cantonal Sports League (5-15 years). A

flexibility periodization model is implemented in three mesocycles, with 30 passive and active flexibility exercises, applying a lateral and frontal split test at two preparation moments. In the Lateral Split pretest, 1.74cm is achieved, and in the posttest 6.86cm (p=0.000), while in the Front Split pretest it is obtained 1.11cm, and the posttest 8.03cm (p=0.000). They are superior indicative when combining both methods of flexibility than those carried out separately when comparing results with another work. Significant improvements in the Lateral and Frontal Split are evidenced for the present research, indicating that the combination of various joint flexibility training methods can optimally improve capacity.

Keywords: Passive and Active Flexibility; Rhythmic Gymnastics.

RESUMEN

La flexibilidad es la capacidad de articular, de realizar movimientos a máxima amplitud, siendo una capacidad determinante en deportes como la Gimnasia Rítmica, por lo cual los modelos de planificación del entrenamiento deportivo priorizan su contenido como parte del proceso de dirección. Este trabajo tiene como objetivo: valorar el efecto de un entrenamiento pasivo y activo de flexibilidad en los miembros inferiores de gimnastas rítmicas de la Liga Deportiva Cantonal de Rumiñahui. El tipo de investigación utilizada es el cuasiexperimental de orden correlacional. En dicho estudio, se incluyen a 35 deportistas de gimnasia rítmica de la Liga Deportiva Cantonal de Rumiñahui (5-15 años). Se implementa un modelo de periodización de la flexibilidad en tres mesociclos, con 30 ejercicios de flexibilidad pasiva y activa, la cual se aplica en dos momentos de la preparación y un *test* de Split lateral y frontal. En el pretest del Split Lateral, se obtiene 1.74 cm. y en el postest 6.86 cm. (p=0.000), mientras que en el pretest del Split Frontal se obtiene 1.11 cm. y el postest 8.03 cm. (p=0.000). Los anteriores son indicativos superiores al combinar ambos métodos de flexibilidad, que los realizados aisladamente al comparar resultados con otra obra. En la investigación, se evidencian mejoras significativas en el Split Lateral y Frontal para el presente estudio. Esto confirma que la combinación de diversos métodos de entrenamiento de la flexibilidad articular puede mejorar la capacidad de forma óptima.

Palabras clave: Flexibilidad Pasiva y Activa; Gimnasia Rítmica.

RESUMO

A flexibilidade é a capacidade de articular, de realizar movimentos à máxima amplitude, sendo uma capacidade determinante em desportos como a ginástica rítmica, razão pela qual os modelos de planejamento do treino desportivo dão prioridade ao seu conteúdo como parte do processo de gestão. O objetivo deste trabalho é avaliar o efeito do treino de flexibilidade passivo e ativo nos membros inferiores dos ginastas rítmicos da Liga Desportiva Cantonal de Rumiñahui. O tipo de investigação utilizada é quase-experimental e correlacional. Neste estudo estão incluídos 35 ginastas rítmicos da Liga Desportiva Cantonal de Rumiñahui (5-15 anos de idade). Um modelo de periodização da flexibilidade é implementado em três mesociclos, com 30 exercícios de flexibilidade passivos e ativos, que são aplicados em dois momentos da preparação e um teste Split lateral e frontal. No pré-teste da Fenda Lateral, obtém-se 1,74 cm e no pós-teste 6,86 cm. (p=0,000), enquanto no pré-teste da fenda frontal 1,11 cm. e no pós-teste 8,03 cm. (p=0.000). Os acima referidos são indicadores superiores quando se combinam ambos os métodos de flexibilidade, do que aqueles realizados isoladamente quando se comparam resultados com outros trabalhos. Na investigação, melhorias significativas na

Divisão Lateral e Frontal são evidentes no presente estudo. Isto confirma que a combinação de vários métodos de treino de flexibilidade conjunta pode melhorar de forma óptima a capacidade.

Palavras-chave: Flexibilidade Passiva e Ativa; Ginástica rítmica.

INTRODUCTION

Gymnastics is a discipline that focuses on the physical conditioning of the people who practice and train it, Lasma & Rachman, (2019). Currently, gymnastics is subdivided into six modalities or categories, of which three are competition within the Olympic Games (artistic, rhythmic and trampoline). Rhythmic gymnastics is a sport characterized by the high level of technical difficulty and physical demand of the gymnasts, Santos, Arce, Lebre, & ÁvilaCarvalho, (2015); Skopal, Netto, Aisbett, Takla, & Castricum, 2020; Coppola, Albano, Sivoccia, & Vastola, (2020) in which different elements of ballet, gymnastics, dance and musical rhythm are combined, complemented with different body and acrobatic movements that require various degrees of body flexibility, with different degrees of difficulty.

On the other hand, in gymnastics, the use of instruments or apparatus such as the rope, hoop, ball, clubs and ribbon are usually indispensable in individual and group choreographies, as well as choreographies without instruments, both with high degrees of motor difficulty.

A basic characteristic of gymnastics is the level of flexibility required to execute different body movements, Granja & Frómeta, (2018); Santos, Arce, Lebre, & Ávila-Carvalho, (2015). It is flexibility a determinant capacity in sport and, therefore, a significant indicator for sport search and selection, (Cabeza, Llumiquinga, & Guayasamín, (2020); Frómeta, Cuayal, & Jácome, (2019); Calero-Morales, 2019). This modality is determinant for the conformation of performance scales that serve as a guide in the processes of sports training management, for which reason, training models in gymnastics include the systematic enhancement of flexibility capacity, Lima, Brown, Li, Herat, & Behm, (2019). This feature is caused by the existing correlation between gymnast success and flexibility as a capacity, as established by Bastürk & Marangoz, (2018).

The theory consulted defines flexibility as the quality that, based on joint mobility and muscle elasticity, allows the maximum travel of the joints in different positions, allowing the subject to perform actions that require great agility and dexterity. Morales & González, 2015; Morales & González, 2014). On the other hand, various authors argue that flexibility can be understood as the maximum passive physiological amplitude in a given joint movement. According to this approach, flexibility would be specific for each joint and for each movement, Bragança, Bastos, Salguero, & González, (2008); Palacios, Chiriboga, Arroyo, & Ayala, (2020) understanding that flexibility is the maximum physical capacity that joints have to be able to move in different angles of amplitude, as well as muscle fibers, ligaments and tendons, being able to perform different actions of agility and dexterity. Flexibility is a physical capacity that comprises morpho-functional properties of the locomotor apparatus that determine the amplitudes of the different body movements of the athlete or individuals, Plantonov & Bulatova, (2007), which is one of the most studied and prioritized physical capacities in the theory of sports training, including in Physical Education and in various sports disciplines (Eras, *et al.,* 2020; Morales & González, 2014).

For the achievement of this research work, the authors focused on active and passive flexibility and assumed the conception of active flexibility as the maximum amplitude of a joint or movement that a person can reach without external help. This phenomenon occurs only through the voluntary contraction and distension of the muscles of the body and passive flexibility, known as the maximum amplitude of a joint or movement through the action of external forces, i.e., through the help of a partner, a device, one's own body weight, etc. Bragança, Bastos, Salguero, & González, (2008); Merino & Fernández, (2009). Each type of flexibility has, as well as its characteristics, different implications in the development of this capacity, Tacan, Werz, & Cevallos, (2021), although the authors of this research understand that the combination of both can further enhance the physical quality studied.

This can be studied in sports competitions where it can be observed that flexibility in rhythmic gymnastics is very important and relevant to be able to apply different gymnastic body movements, as well as *ballet*. This is the reason why it has been decided to carry out a study on the flexibility capacity and its active and passive work methods. For this work, the purpose of the research is defined as: to evaluate the effect of passive and active flexibility training in the lower limbs of rhythmic gymnasts of the Liga Deportiva Cantonal of Rumiñahui (Cantonal Sports League of Rumiñahui).

MATERIALS AND METHODS

The research developed in this work was quasi-experimental, of correlational order, which includes 35 rhythmic gymnastics athletes of the Liga Deportiva Cantonal of Rumiñahui (515 years old). The study complied with the necessary inclusion measures to carry out the research (healthy subjects, without pathologies or previous or existing sports injuries at the time of implementing the intervention proposal; in the indicated age range and the mentioned league).

A flexibility periodization model was implemented, as it was the most appropriate for the category of study and the League under study. Basically, 30 passive and active exercises were implemented as essential content of the sport preparation. The intervention process lasted three mesocycles of 5 micros each.

To verify the results, the lower limb flexibility index was monitored through the following sports performance assessment tests:

1. Lateral Split *Test*: A reference point (zero point) was used, placing the right foot and proceeding to perform the lateral split at the maximum possible capacity. A numerical scale is applied in centimeters (from the zero point), measuring up to the maximum opening point.

2. Frontal Split *Test*: A reference point (zero point) was used as in the previous test, the instep was placed together with the left knee to the floor, the toes were placed as the reference point. The frontal split was performed up to the maximum of the possibilities. A numerical scale was applied in centimeters (from the zero point) and measured up to the maximum opening point.

For the assessment of range of motion, various measuring instruments were used (tape measure and dot-marking tape, HP I7th Generation computer, Office 2019 package, SPSS v25). On the other hand, since there was no normal distribution of the data, the

Wilcoxon Signed Ranks Test was applied for two related samples ($p \leq 0.05$) and the results were compared before and after the intervention proposal was implemented.

RESULTS AND DISCUSSION

Table 1 shows the results achieved when applying the Split Lateral and Split Frontal *tests* in two moments of the sport preparation, following the precepts of the research of Tacan, Werz, & Cevallos (2021) and for the specific case, in the application of the tests in lower limbs studied in Eras, *et al.,* (2020), in order to compare the results achieved in the present research with those of the aforementioned authors (Table 1).

Table 1. - Flexibility *test* results

No	*Pretest: Lateral Split*	*Posttest: Lateral Split*	*Pretest: Frontal Split*	*Posttest: Front Split*
1	*7*	*8*	*-1*	*10*
2	*8*	*10*	4	10
3	*4*	*6*	5	10
4	*4*	*8*	-1	6
5	*-2*	*4*	-1	7
6	*6*	*11*	-2	7
7	*3*	*11*	4	10
8	*5*	*10*	2	8
9	*-2*	*6*	1	6
10	*1*	*8*	-2	5
11	*2*	*10*	-2	5
12	*3*	*6*	-2	8
13	*-2*	*5*	0	5
14	*-1*	*3*	0	6
15	*-1*	*5*	-3	8
16	*2*	*8*	-2	7
17	*-1*	*6*	0	6
18	*1*	*6*	1	7
19	*3*	*6*	3	8
20	*2*	*6*	1	7
21	*3*	*6*	1	8

22	*4*	*8*	3	11
23	*2*	*5*	2	6
24	*-1*	*9*	-2	5
25	*2*	*5*	3	7
26	*2*	*5*	3	7
27	*-2*	*5*	0	7
28	*-3*	*5*	-1	6
29	*0*	*5*	1	10
30	*2*	*9*	4	12
31	*3*	*9*	5	13
32	*4*	*7*	5	12
33	*5*	*9*	6	12
34	*-1*	*5*	2	9
35	*-1*	*5*	2	10
Average	1,74	6,86	1,11	8,03
Median	2	7	-0,5	7

As shown in table 1, the average achieved in the pretest of the Lateral Split test was 1.74 cm, while it increased to 6.86 cm as part of the posttest, with significant differences (Table 2: p=0.000). The post-test showed an increase to 6.86 cm, with significant differences (Table 2: p=0.000). This increase behaved in favor of the second test performed, as established by the means reached and the ranges obtained (Posttest: 35 positive ranges). The result indicated an improvement of joint flexibility in lower limbs for a lateral movement, once the intervention proposal was applied with passive and active flexibility exercises during three mesocycles.

Given the results achieved in the Lateral Split test and when compared with the results of Tacan, Werz, & Cevallos (2021), the present research evidenced improvements, given that the mean achieved was 6.86 cm. Parallel to this, in the proposal of the aforementioned authors, a mean of 6.61 cm was reached. (Difference: +0.25 cm.), which is indicative for the present study that the combination of different work methods allows to enhance results, than in the isolated work in a physical capacity such as joint flexibility.

On the other hand, the results in Table 1 show an initial index of frontal flexibility in the lower limbs of 1.11 cm. The post-test showed a notable increase in the number of centimeters achieved. Thus, a mean or average of 8.03 cm was recorded, which makes it significantly different (Table 2: p=0.000). This mean was in favor of the second test or posttest, as specified in Table 2, from the analysis of the ranges (Post-test: 35 positive ranges); therefore, as in the previous test, the articular flexibility for a frontal movement

in lower limbs was enhanced from the implementation of a group of passive and active flexibility exercises.

As well as the comparison of the results of the Lateral Split of the present research, with those performed by Tacan, Werz, & Cevallos (2021), for the case of the Frontal Split test, the results achieved in the present research also evidenced additional improvements. These results were achieved because the mean in the research was established at 8.03 cm. The mean in the work of the aforementioned authors was 7.72 cm, while in the work of the aforementioned authors it was 7.72 cm. (Difference: +0.31 cm). It is specified that the experimental group was the one with the best results when applying the Maximal Contraction Method (MCM) (Table 2), (Table 3) and (Table 4).

Table 2. - Descriptive statistics, ranks and test statistics of the Wilcoxon Signed Ranks Test

Descriptive statistics

	N	Median	Deviation Deviation	Mínimum	Máximum
Pretest. Lateral Split	35	1,7429	2,77958	-3,00	8,00
Pretest. Front Split	35	1,1143	2,48254	-3,00	6,00
Postest. Lateral Split	35	6,8571	2,11636	3,00	11,00
Postest. Front Split	35	8,0286	2,26853	5,00	13,00

a. Postest.SplitLateral< Pretest.Split Lateral.
b. Postest.SplitLateral> Pretest.Split Lateral
c. Postest.SplitLateral = Pretest.Split Lateral.
d. Postest.SplitFrontal< Pretest.Split Frontal.
e. Postest.SplitFrontal> Pretest.Split Frontal.

Table 3.- Ranks

		N	Average range	Sum of ranks
Posttest. Lateral Split - Pretest. Lateral Split	Negative ranges	0[a]	,00	,00
	Positive ranges	35[b]	18,00	630,00
	Ties	0[c]		
	Total	35		
Postest.Split Front - Pretest.Split Front	Negative ranges	0[d]	,00	,00
	Positive ranges	35[e]	18,00	630,00
	Ties	0[f]		
	Total	35		
f. Postest.SplitFrontal = Pretest. Split Frontal				

Table 4. - Test statistics

	Posttest. Split Lateral - Pretest. Lateral Split	Posttest. Split Frontal - Pretest. Split Frontal
Z	-5,173b	-5,181b
Asymptotic sign(bilateral)	,000	,000

a. Wilcoxon signed-rank test.
b. It is based on negative ranges.

Prospective studies are useful to enhance a physical capacity, where the physical capacity of flexibility is not exempt from it, as evidenced by Eras (2021). In the structural analysis on the training of flexibility, in men's artistic gymnastics, are usually treated through empirical tests in numerous works such as the one presented in Palacios, Chiriboga, Arroyo, & Ayala, (2020) and in others where they are used to improve the process of sports training management in general, (Eras, *et al.,* 2020; Bastürk & Marangoz, 2018) or specific aspects of sport preparation as is the process of sport search and selection as in Cabeza, Llumiquinga, & Guayasamín, (2020); Frómeta, Cuayal, & Jácome, (2019); Granja & Frómeta, (2018).

On the other hand, in order to complete the results achieved in the present research, it is recommended, in the short term, to establish a more complete research, which includes other sport performance assessment tests. Specifically, a flexibility test is suggested, where joint flexibility is measured in trunk flexion to the front, arch, and leg maintenance to the front, side and back, as evidenced in the tests conducted by Eras, *et al.,* (2020).

CONCLUSIONS

As a conclusion, it is stated that once the intervention proposal with passive and active flexibility exercises was implemented in the gymnasts studied during three mesocycles of periodized training, significant improvements were evidenced in the Lateral and Frontal Split for the present study, indicating that the combination of various training methods of joint flexibility can improve the capacity in a more optimal way.

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The authors declare not to have any interest conflicts.

Authors' contribution:
The authors have participated in the writing of the work and analysis of the documents.