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ORIGINAL

LUMBAR HYPERLORDOSIS PREVENTION AND ITS ASSOCIATED PATHOLOGIES IN RHYTHMIC GYMNASTICS

PREVENCIÓN DE HIPERLORDOSIS LUMBAR Y PATOLOGÍAS ASOCIADAS EN GIMNASTAS DE GIMNASIA RÍTMICA

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ABSTRACT

The aim of this study was to analyze the effect of a 12 weeks program based on stretching and muscle strengthening in a group of 30 non-elite gymnasts, young Rhythmic Gymnastics (RG) (8.37 ± 1.81 years). Thus, to prevent Lumbar Hyperlordosis (LHL) and its associated pathologies: Low Back Pain (LBP). Control group continued with their regular RG training. Lordosis curve was assessed through the Sagittal Arrow's Test before and after intervention. In the same way, gymnasts were interviewed about their LBP incidence. Lordosis curve was reduced significantly after intervention ($p < 0.05$) and LBP incidence decreased a 33.3%. A relationship between lordosis curve level and LBP incidence was not found. As a result, program's effect size was small. We encourage to continue applying this kind of initiatives in RG training.

KEY WORDS: Gymnastics, posture, lordosis, Low Back Pain, exercise therapy

RESUMEN

Se analizó el efecto de un programa de flexibilización y fortalecimiento muscular de 12 semanas de duración para prevenir la Hiperlordosis Lumbar (LHL) y sus patologías asociadas: el dolor lumbar (LBP) en un grupo de 30 jóvenes gimnastas de Gimnasia Rítmica (GR) (8,37 ± 1,81 años) de nivel no élite. El grupo control continuó con su entrenamiento habitual de GR. La curva lumbar fue evaluada mediante el Test de Flechas Sagitales antes y después de la intervención. Asimismo, se entrevistó a las gimnastas sobre su incidencia de LBP. Tras la intervención, la curva lumbar se redujo significativamente ($p < 0,05$) y la incidencia de LBP disminuyó en un 33,3%. No se encontró relación entre el nivel de LHL y la incidencia de LBP. El Tamaño del Efecto (TE) del programa aplicado resultó ser de magnitud pequeña. Se anima a seguir aplicando este tipo de iniciativas en el entrenamiento de GR.

PALABRAS CLAVE: Gimnasia, postura, dolor lumbar, ejercicio físico, intervención

INTRODUCTION

Any sport gesture requires a certain Range of Motion (ROM) to be correctly performed (Moras, 2002). This ROM will be higher or lower depending on sports modalities. Gymnastic sports represent the principal sports discipline where the ROM requirement is quite high (Mahdavie, Rezasoltani & Simorgh, 2017; Piazza et al., 2009; Rodríguez & Gómez-Landero, 2017; Volpi da Silva et al., 2008). In this kind of sports, the spine is one of the osteo-articular complexes most involved in technical movements. And, regarding its movements, they are brought to their maximum joint limits, especially in Rhythmic Gymnastics (RG) (Conesa & Martínez-Gallego, 2015, 2017; Piazza et al., 2009; Rodríguez & Gómez-Landero, 2017; Rodríguez, Villacieros & Ferro, 2013; Volpi da Silva et al., 2008). However, Holt, Pelham & Holt (2008) indicate that exceeding the ROM of a particular joint can involve pathologies. These pathologies are translated into muscle tone imbalances which will cause changes in body posture (Cantó & Jiménez, 1998; Kendall, Kendall & Geise, 2007).

Several studies state that the spine sagittal shape curves can be modified by sport through an adaptation process caused by the sport's technical requirements themselves (Grabara, 2014; López-Miñarro, Alacid & Rodríguez-García, 2010; Mahdavie et al., 2017; Rocco & Campos, 2012). This fact is further accentuated in immature spines like those presented in children, because it is still in growing process (López-Miñarro et al., 2010; Rocco & Campos, 2012; Vidal-Conti, Borràs & Palou, 2014; Wojtys et al., 2000).

Given that sport cans produce postural adaptations, some studies analyze how is posture in RG gymnasts and which are the main alterations of the rachis that they present (Ambegaongkar et al., 2014; Kums et al., 2007; Radas & Trost, 2011; Rocco & Campos, 2012; Volpi da Silva et al., 2008). From these authors, a conclusion is revealed: Lumbar Hyperlordosis (LHL) is the most characteristic postural alteration in the sagittal plane of this kind of gymnasts. LHL in RG arises as a result of the own technical requirements of this sport modality (Conesa & Martínez-Gallego, 2015, 2017; Sabeti et al., 2015; Volpi da Silva et al., 2008). According to several authors, RG technical requirements are characterized by intense and repeated training programs (Volpi da Silva et al., 2008). They usually start from an early age (5-6 years) (Rocco & Campos, 2012; Sabeti et al., 2015), by using asymmetric loads (Radas & Trost, 2011) and where there is a lack of multilateralism in the body work (Conesa & Martínez-Gallego, 2015, 2017). Furthermore, the repeated use of extreme joint movements is added, both in training and competition conditions: hyperflexions and hyperextensions of lumbar spine, walking on tiptoe (or in *releve* position) and the execution of jumps of great articular hips amplitude (Rodríguez et al., 2013; Sabeti et al., 2015).

Lumbar deviations are associated with an increase of pathologies and injuries in this region (Ambegaongkar et al., 2014). RG can be included in the list of sports modalities that promote a high risk of lumbar injuries. In consequence, given the LHL characteristic in these athletes, the apparition of a series of pathologies can be associated, such as Low Back Pain (LBP) (Cupisti et al., 2004; Hutchinson, 1999; Piazza et al., 2009; Sabeti et al., 2015; Volpi da Silva et al., 2008).

In the light of the preceding considerations, the importance and the need to establish programs focused on improving the health of athletes become clear, given the presence of LHL and LBP in RG gymnasts (Fett, Trompeter & Platen, 2017), specially in young athletes (López-Miñarro et al., 2010). Regarding the RG, there is a great lack of researchs where preventive programs are proposed to reduce lumbar pathologies in this kind of gymnasts. There are only a few studies in which, any intervention made, some recommendations are proposed to avoid injuries during trainings (Conesa & Martínez-Gallego, 2015, 2017; Hutchinson, 1999; Sabeti et al., 2015; Volpi da Silva et al., 2008; Zetaruk et al., 2006). It should be emphasised the age group to which these interventions are focused, since there are rare those aimed at children (Radas & Trost, 2011; Volpi da Silva et al., 2008; Wojtys et al., 2000). As Rocco & Campos (2012) point out, an early detection of postural alterations in athletes is necessary. This is in line with achieving an imminent prevention of pathologies that they may involve. For this reason, it is necessary to carry out prevention programs in children in order to avoid any postural problem in future (and pathologies resulting from). This might also ensure their sports health (Conesa & Martínez-Gallego, 2017; Grabara, 2014; López-Miñarro et al., 2010; Radas & Trost, 2011; Wojtys et al., 2000).

Once literature have been reviewed, it is confirmed that the postural assessment issue towards the prevention of any spine pathologies or alterations, it is a point of great importance. Although there are not many studies conducted with RG gymnasts. Much less with gymnasts from the childhood stage (6-12 years). Moreover, in real life, these practices of preventive or compensatory physical exercises are not either frequent in clubs and/or schools of sports initiation (Wojtys et al., 2000). These proofs lead us to outline the working hypotheses of this research. On the one hand, the fact that prepubertal gymnasts (between 6-12 years) have a higher risk of suffering LHL because of an immature spine (López-Miñarro et al., 2010). This fact goes, generally, hand in hand with the RG clubs/schools responsibles for sports initiation who do not provide compensatory exercise programs in training (Wojtys et al., 2000). Consequently, a first working hypothesis is proposed: "*Young RG gymnasts (6-12 years) who do not perform preventive-compensatory LHL exercises present a higher degree of it, and report a higher LBP incidence"*. On the other hand, we must take into account that to ensure the athletes's health is responsibility of sports professionals, especially if they are young. A need to implement preventive-compensatory programs in the training sessions of atheletes is arised (Fett, Trompeter & Platen, 2017). In the case of lumbar pathologies, quite commons in RG gymnasts (Ambegaongkar et al., 2014; Volpi da Silva et al., 2008), it is necessary to perform specific programs including flexibilization exercises for lumbar muscles and hip flexor muscles, followed by strengthening exercises for the abdominal, gluteal and hamstring muscles (Cantó & Jiménez, 1998; Conesa & Martínez-Gallego, 2017; Hutchinson, 1999; Zetaruk et al., 2006). Therefore, we have considered the second hypothesis as the following: "*The positive effects in the prevention of LBP as a result of developing a flexibilization and muscular strengthening program (FMSP), because LHL is reduced*".

In the light of the above, we believe in this study that it is essential to ensure the health of our gymnasts. For that reason, we believe as imperative to establish and to develop preventive-compensatory LHL physical exercise programs, since gymnasts are young. Thereby, verifying the effect of a FMSP to reduce the degree of LHL in young RG gymnasts was the objective of this research, and, in this sense, to prevent the possible LBP incidence in future. To provide quantitative information on the need for incorporating compensatory exercises in training sessions, as well as methodological information to RG technicians and coaches regarding the care and health promotion of gymnasts: that will be important, specially in a study of these characteristics..

MATERIAL AND METHODS

Participants

30 women RG gymnasts were selected through the following inclusion criteria: to have between 6 and 12 years old, to have a minimum of 2 years of sports experience in RG (Grabara, 2014; López-Miñarro et al., 2010), and to have a non-elite competitive level categorized according to "Level 1" (Rodríguez & Gómez-Landero, 2017). This technical level corresponds to *sports initiation*, that

is to say, participation in official federatives competitions at a provincial level (Rodríguez & Gómez-Landero, 2017; Volpi da Silva et al., 2008). Participants were divided into two groups. On the one hand, the Experimental Group (EG) (n = 15) which carried out the FMSP to reduce the LHL degree and to prevent its associated pathologies (LBP). And, on the other hand, the Control Group (CG) (n = 15) which did not perform the physical exercise program. All gymnasts participated in the study voluntarily. An informed consent was signed by their legal guardians. This consent complied with the ethical guidelines of the Pablo de Olavide University and the International University of Andalusia, and with the Ethical Principles on Human Research of the Declaration of Helsinki (World Medical Association, 2008).

Procedures

Three phases were conducted to developthis study:

1.1 Pre-test

In the first phase, a *Pre-test* was performed in both EG and CG. This process was carried out by a single observer (with previous experience in data collection and recording). It entailed: on the one hand, the measurement of the Independent Variable (IV) and, on the other hand, the measurement of the Dependent Variable (DV). Regarding the quantification of IV, a postural evaluation of the spine in its lateral vision (sagittal plane) was carried out to measure the physiological curve of lumbar lordosis. For it, the *Sagittal Arrows Test* described by Santonja & Martínez (1992) (cited in Yuing et al., 2010) was applied. To perform this test, the gymnast had to adopt her natural standing position, maintaining feet together, legs stretched, back straight, head straight and gaze straight ahead. Before measuring the lumbar curve, the gymnast was asked to maintain the posture for 3 min. According to several authors (Mahdavie et al., 2017), this time is considered to be enough for the subject to adopt their natural posture. Moreover, to facilitate the measurement of the researcher, to keep gymnast arms crossed over her chest was asked. Once the gymnast had adopted her natural standing position, lumbar curve was measured following the protocol of Santonja & Martínez (1992) (cited in Yuing et al., 2010). In this protocol only a goniometer (Gima SpA, Gessate, Italy) and a plumb line (Silverline Tools, Yeovil, UK) were used, and the curvature value was expressed in centimeters (cm) (Figure 1). This measurement was taken in triplicate maintaining an interval of 30 seconds between each measurement. Finally, following the procedures of Anthropometry (Stewart et al., 2011), it was decided to take the median (or, otherwise, the mode) of the three measures as the final real value of the gymnast's lumbar curve. In this way, a direct measurement of the variable to be quantified is obtained, instead of indirect (as it would take place with the mean).

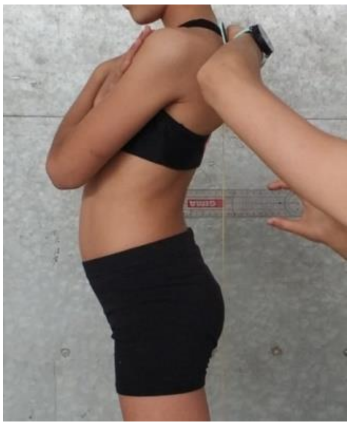

Figure 1. Lumbar curve measurement by using the Sagittal Arrows Test.

On the other hand, regarding to the DV quantification, an interview with the gymnasts of both groups was conducted on LBP frequency of appearance in their experience as RG gymnasts. This interview consisted of a single question: "*Have you ever had LBP since practicing RG?*". Gymnasts only had to answer "Yes" or "No" (Marini et al., 2008).

1.2 Intervention

One week after *Pre-test*, the second phase of this investigation began. An FMSP was performed with the EG gymnasts whose objective was decrease the LHL level in the young gymnasts to prevent, thereby, LBP problems. CG gymnasts continued with their usual RG workouts. Intervention program was constituted by 24 work sessions. A 12-week period was covered for the realisation of all of them (Marini et al., 2008). This period coincided with the RG competitive season (Durall et al., 2009; Marini et al., 2008). The frequency of carrying out the program was 2 days per week (Durall et al., 2009). Its development took place in the indoor sports facilities where each club or school to which the gymnasts belonged trained. Following Cantó & Jiménez (1998) indications for LHL treatment and prevention, the program was based on the execution of a series of exercises for flexibilization of the lumbar muscles and hip flexor muscles, followed by a series of exercises for strengthening the abdominal, hamstring and gluteal muscles. On the other hand, the Pilates method principles (breathing, elongation, center, concentration, control and fluidity) were also followed, since some authors affirm the positive effect of the use of this type of training in the treatment of LHL and LBP (Eliks et al., 2019). Coming up next, the exercise protocol of this program is described:

1st Part: Flexibilization. Following Cantó & Jiménez (1998), in the first place, a lumbar muscle stretching exercise was performed and, then, a hip flexor muscle stretching exercise (Figure 2). In each exercise the stretching is maintained for 20 seconds; 2 series are performed in total; both exercises are executed in pairs (previously, gymnasts were instructed to execute them correctly in the companions); resting time between each series is the time the companion gymnast takes for execute it. In the first exercise (Figure 2-A), the gymnast rests her forearm on the partner's pelvis to make a downward pressure, while with the other arm she exerts a pressure to the opposite side so that the lumbar spine musculature is lengthened. In the second exercise (Figure 2-B), the gymnast rests her hand on the upper part of the partner's knee to press down, while with the other hand she pushes her other knee to the opposite side.

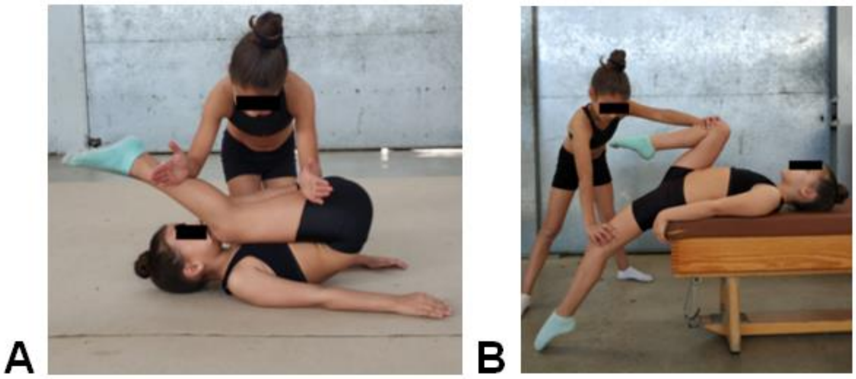

Figure 2. Flexibilization exercises: A) lumbar musculature and B) hip flexor musculature.

2nd Part: Strengthening (Cantó & Jiménez, 1998; Eliks et al., 2019). Firstly, three exercises were performed to strengthen the gluteal and hamstring musculature: knee flexion from prone position over a bench (Figure 3-A); glute kickback with bent knee and forearm support (Figure 3-B); and glute bridge to one leg (Figure 3-C). Secondly, two exercises were performed to strengthen the abdominal muscles: superseries of upper and lower abdominal muscles (Figure 3-D). These muscle strengthening exercises were performed by each gymnast individually. Gymnasts were informed (prior to the program start) of the correct execution of these exercises following the Pilates method principles (Eliks et al., 2019). In each exercise, 2 sets of 20 repetitions were performed, with 30-second rest between each series. The execution of all the exercises described above was carried out at the end of the training session of the participating gymnasts, and was about 15-20 min long (Durall et al., 2009). On the other hand, taking into account the sports training principles (specifically, the principles of "progressive increase in load" and "variety of load") (García-Manso, Navarro-Valdivieso & Ruiz-Caballero, 1996), exercises intensity was increased starting from session number twelve (that is, in the middle of the program). For it, the following modifications were added: a third series was added in all muscle strengthening exercises; the "glute bridge to one leg" exercise (Figure 3-C) was modified by incorporating a *step* to raise the gymnast's support foot and thus increase the difficulty of the exercise; and one more exercise was added for strengthening the abdominal muscles: horizontal planks (2 series maintaining the position for 30 seconds) (Figure 3-E).

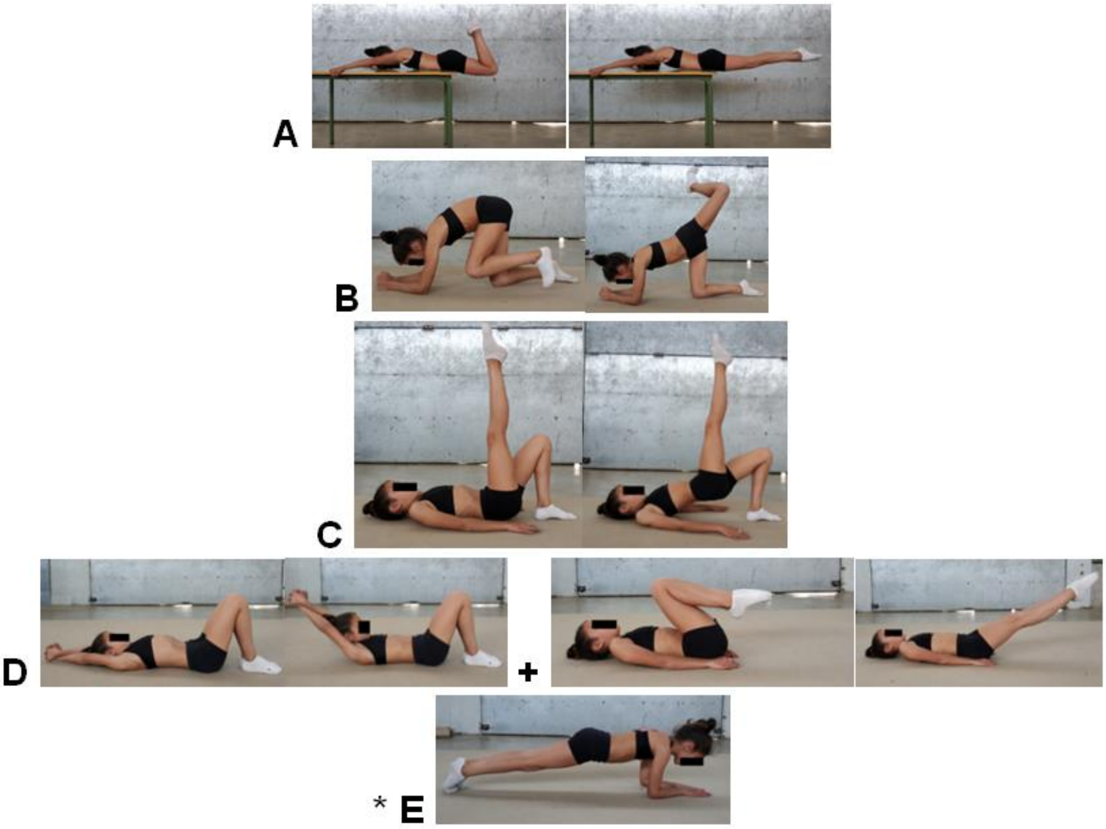

Figure 3. Muscle strengthening exercises: A) Knee flexion from prone position over a bench, B) Glute kickback with bent knee and forearm support, C) Glute bridge to one leg, D) Superserie of upper and lower abdominal muscles, and E) Horizontal planks.

1.3 Post-test

After the program, the third and final phase of this investigation began, where a final evaluation (*Post-test*) was carried out in both EG and CG. In it, the measurement of the IV and the DV was performed again, as was done in the *Pre-test*.

Statistical Analysis

Statistical analyses were carried out using SPSS software version 25.0.0.0 (IBM Corp., Armonk, NY, USA). Data distribution analysis was performed using the Shapiro-Wilk normality test. A reliability analysis was performed in the lumbar curve repeated measurements throught the intraclass correlation coefficient (ICC), for the relative reliability analysis, and the coefficient of variation (CV) for absolute reliability. ICC was calculated taking into account the difference in measures and with a confidence interval of 95%, through a one factor analysis of variance (ANOVA) for repeated measures. The descriptive statistics: mean (X), standard deviation (SD) and percentages (%) have been used for the descriptive analysis of the study variables. The Wilcoxon-test was used to compare Pre and Post-test means in both groups of gymnasts. Finally, Cohen's *d* value was calculated to verify the magnitude of the Effect Size (ES) of the performed program. The level of significance was set at 0.05 for all statistical analysis.

RESULTS

Table 1 shows the reliability analysis results of gymnasts' lumbar curvature measurements, performed both before and after the intervention. The observed ICC values are greater than 0.9; therefore, these data suggest that the performed measurements are reliable and have great internal validity (Vincent, 1999). Regarding the absolute reliability of these measures, the CV presented by the lumbar curve measurements are less than the maximum 5% recommended by the GREC (Cabañas & Esparza, 2009).

Table 1. ICC (CI 95%) and CV (%) of the IV measurements (n=30).

Lumbar curve (cm)	CV (%)	ICC	CI (95%)	
			Lower limit	Upper limit
PRE-TEST	0.62	0.993	0.987	0.996
POST-TEST	3.34	0.920	0.860	0.958

ICC, intraclass correlation coefficient; CV, coefficient of variation; CI, confidence interval.

Table 2 shows the lumbar curve evolution of the gymnasts before and after the FMSP. A significant difference in EG can be observed ($p < 0.05$).

Table 2. Lumbar curvature evolution (X±SD).

	Lumbar Curve PRE-TEST (cm)	Lumbar Curve POST-TEST (cm)	Difference Lumbar curve PRE-POST (cm)	Sig.	*d*
EG (n = 15)	5.54 ± 0.94	4.85 ± 0.43	-0.69	0.010*	0.73
CG (n = 15)	4.75 ± 1.09	4.62 ± 1.19	-0.13	0.752	

* EG: experimental group; CG: control group; $p < 0,05$

To quantify the magnitude of the changes achieved in the EG gymnasts thanks to the FMSP performed, we can estimate the ES of said program through the Cohen's *d* value using the following formula (Rhea, 2004):

$$d = (X_2 – X_1) / SD_1$$

The resulting *d*-value of this formula, representative of the FMSP applied to the EG gymnasts, is shown in Table 2. To interpret this value, Rhea (2004) proposed a scale to determine the ES magnitude in the field of strength training research which distinguishes subjects according to their level of training (Table 3). Following this scale, the EG gymnasts are located within the recreationally trained subjects, so it is concluded that the ES of the intervention performed in this study has been of small magnitude.

Table 3. ES determination scale in strength training (adapted from Rhea, 2004).

Magnitude	Untrained	Recreacionally trained	Highly trained
Trivial	<0.50	<0.35	<0.25
Small	0.50-1.25	0.35-0.80	0.25-0.50
Moderate	1.25-1.9	0.80-1.50	0.50-1.0
Large	>2.0	>1.5	>1.0

Untrained: individuals who have not been consistently trained for 1 year; *Recreationally trained*: individuals training consistently from 1-5 years; *Highly trained*: individuals training for at least 5 years.

Finally, the results of the interview with the gymnasts of both groups regarding their LBP incidence level are shown in Figure 4. It is observed that after the intervention it was reduced by 33.3%.

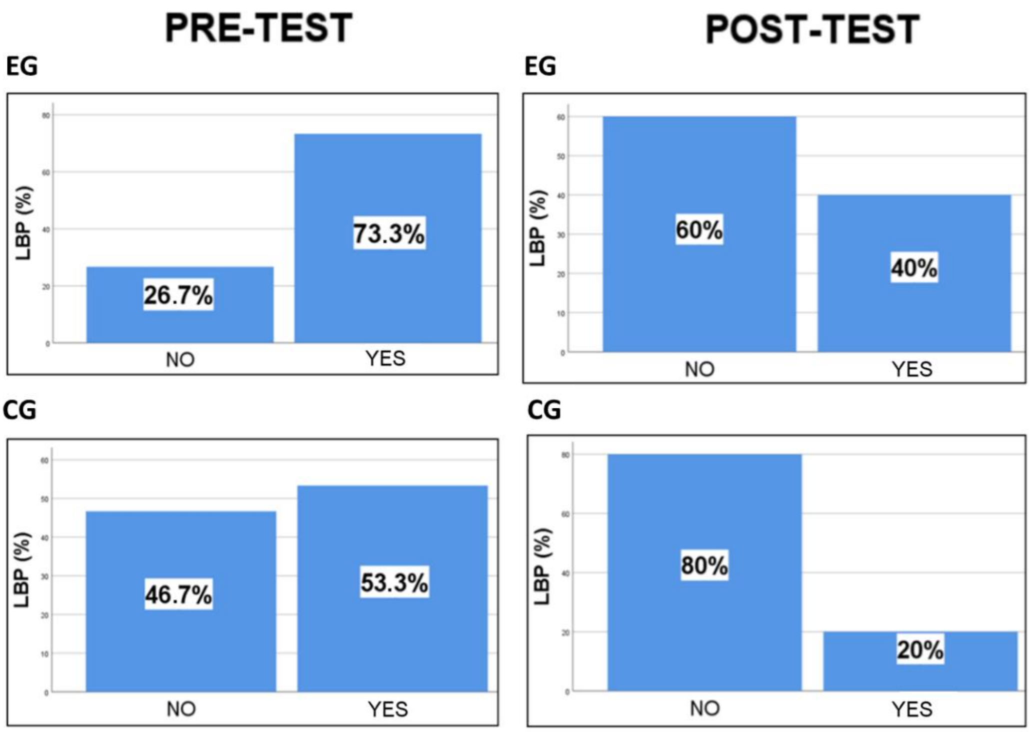

Figure 4.- LBP incidence before and after FMSP. Data from EG and CG (n=15).

DISCUSSION

The aim of this study was to check the effect of a FMSP to reduce the lumbar curvature level in a group of young RG gymnasts, and thereby prevent LHL and its associated pathologies: LBP. Similarly to this study, many works also provide quantitative information regarding lumbar curvature values that gymnasts present (Kums et al., 2007; Mahdavie et al., 2017; Radas & Trost, 2011; Rocco & Campos, 2012; Wojtys et al., 2000). In general, these works express the lumbar curve in degrees (º) instead of centimeters (cm), as it has been done in this study. Despite this difference, according to Yuing et al. (2010) the expression of lumbar curvature in cm is also valid and reliable, being values greater than 35 mm considered as LHL. Following this statement, the lumbar curve presented by the gymnasts of this study in the *Pre-test* showed a clear presence of LHL (Table 2).

Regarding the interview conducted on LBP incidence level, it was observed that both groups of gymnasts reported a high incidence of this pathology before beginning the intervention (Figure 4). This information can be related to that of other studies that also show data regarding the percentage of RG gymnasts who claim to have suffered LBP at some point in their sports career. According to Hutchinson (1999) and Winslow et al. (2018), an 86% of RG gymnasts interviewed reported suffering LBP. In the study by Kums et al. (2007), 50% of RG gymnasts suffered from LBP. These are a very high figures that resemble the values obtained in this work. In relation to the age group, in the study by Vidal-Conti et al. (2014) 38.3% of the children athletes surveyed showed LBP, being those who practiced GR those who showed the highest incidence of this pathology. These data resemble those obtained in this study (Figure 4).

After the application of the FMSP, EG gymnasts improved both their lumbar curvature (Table 2) and their LBP incidence level (Figure 4). These results are comparable with those of other studies that also carry out physical exercise interventions for LBP prevention in athletes, showing satisfactory results (Durall et al., 2009; Marini et al., 2008).

Concerning the efficacy of the FMSP applied in this study, Cohen's *d* has shown the small ES that has had the same (Table 2). No studies are found in the literature showing the ES of interventions performed in RG gymnasts for the prevention of LHL and/or LBP. There are only works carried out with general population (Bade et al., 2017) or review articles that deal with the effectiveness of different types of exercises against LBP (Behm et al., 2009). Behm et al. (2009) state that core muscle strengthening exercises have great efficacy in reducing LBP incidence, although they do not show quantitative values of ES. This information supports the positive effect achieved in this intervention thanks to the type of muscle strengthening exercises used. On the other hand, regarding ES quantification, the results of Bade et al. (2017) about LBP treatment in adults, resemble those obtained in this work, since ES achieved by the intervention performed by these authors was also characterized by presenting a small magnitude ($d = 0.58$). Despite the small ES achieved in this study, and given the scientific evidence presented above, we can affirm that the second hypothesis raised in this study has been fulfilled.

Interestingly, CG gymnasts also reduced their lumbar curve level as well as their LBP incidence level after the intervention (Figure 4). This fact can be explained by the usual RG training that this group of gymnasts have done. In scientific literature there are some studies that uphold that RG is not harmful to the spine and, therefore, that it is not a sport that poses a risk to it. According to the studies by Cupisti et al. (2004) and Sabeti et al. (2015), RG training seems to protect the lumbar spine, since subjects who practice RG have less LBP compared to equal subjects who do not practice this sport. Due to these reasons, it can be affirmed that our first working hypothesis is not fulfilled.

In view of the LHL data of the gymnasts of this study and their LBP incidence level in both Pre-test and Post-test, can we establish a relationship between lumbar curvature level and LBP incidence level? Given the results of this study, we cannot establish a direct relationship between both variables because not all gymnasts who had large lumbar curvature reported having suffered LBP, or vice versa. This fact may be explained perhaps by what several authors state: Kums et al. (2007) observed that the flatter the lumbar curve, the greater the LBP incidence in RG gymnasts; Kums et al. (2008) (cited in Radas &Trost, 2011) stated that the continuous response to the specific demands of the sport can (after a period of time) lead to muscle imbalances between agonist and antagonistic muscles as well as a local deficiency of flexibility, which will produce a postural deviation (such as LHL). Nevertheless, they do not specify how much is that period of time necessary for the mismatches to occur. For this reason, perhaps the years of sports experience in the gymnasts of our sample was the determining factor for some to present LBP problems and others not. However, there are no studies that have found a relationship between the training time and the evolution of sagittal curves in gymnasts (Sainz-de-Baranda et al., 2010).

CONCLUSIONS

We can conclude that there are few research studies that perform physical exercise interventions to prevent postural deviations and lumbar pathologies in RG gymnasts who are young (<12 years), as we confirmed in this study. Indeed from this research, valuable information has been obtained in order to promote the lower back health and an early prevention of associated pathologies with this area of the spine. Lumbar curvature from EG gymnasts was improved and their LBP incidence level was reduced by 33.3%, after FMSP application. Therefore, the effect proved was positive, although small. A longer duration of thereoft perhaps would have increased their ES. For that reason, we must continue to insiste on this type of initiatives in RG training. Finally, the results obtained from this study, to provide methodological information to RG technicians and coaches on caring and promotioning of lumbar health in gymnasts has been intended, as well as offering them a design of this exercise program as a possible useful work tool.

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