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ORIGINAL ARTICLE / ARTICULO ORIGINAL

Efficacy of a Dynamic and Static Flexibility Program on Joint Range of Motion in High-Performance Athletes

Eficacia de un Programa de Flexibilidad Dinámica y Estática sobre el Rango de Movimiento Articular en Atletas de Alto Rendimiento

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A B S T R A C T

Objectives: The amplitude of joint movement was evaluated by means of Goniometry and muscle tests such as Ober's test, Thomas' test, Ely's test, shoulder flexion-extension test and the trunk flexion-extension test. **Methods**: The research was of a quantitative approach, longitudinal, temporal, uninterrupted design in two repeated measures, that is, pre-test and post-test with a control group, it had the participation of 27 Lucha Libre athletes, they were assigned into 3 groups, group A performed dynamic stretching, group B, static stretching, and group C (control) who performed regular training. Participants in the intervention group exercised 5 times a week for 2 months, with a total of 24 sections. **Results**: The amplitude of the joint movement of group A, had greater significance with an increase in the amplitude of 16 movements, by 31.3%, followed by group B with the improvement in 7 joint movements by 13.7% and finally group C with only 3 increase in range of joint movement, by 5.8%. The results of the Levene, Kruskal-Wallis, Mann-Withney, and Wilcoxon statistical tests showed that there were significant differences in the variables. **Conclusion**: The implementation of the flexibility program achieved an increase in the amplitude of joint movement between the POST measurement with respect to the PRE. Dynamic stretching being more effective.

Keywords: Muscle Stretching Exercises, Elasticity, Physical Condition, Warm-Up Exercises, Olympic Wrestling.

R E S U M E N

Objetivos: Se evaluó la amplitud del movimiento articular mediante Goniometría y pruebas musculares como prueba de Ober, prueba de Thomas, prueba de Ely, prueba de flexión-extensión de hombro y prueba de flexión-extensión de tronco. **Métodos:** La investigación fue de enfoque cuantitativo, diseño longitudinal, temporal, ininterrumpido en dos medidas repetidas, es decir, pretest y postest con un grupo control, contó con la participación de 27 deportistas de Lucha Libre, fueron asignados a 3 grupos, el grupo A realizó estiramientos dinámicos, el grupo B, estiramientos estáticos y el grupo C (control) que realizó entrenamiento regular. Los participantes del grupo de intervención hicieron ejercicio 5 veces por semana durante 2 meses, con un total de 24 secciones. **Resultados:** La amplitud del movimiento articular del grupo A, tuvo mayor significancia con un aumento en la amplitud de 16 movimientos, en un 31,3%, seguido del grupo B con la mejora en 7 movimientos articulares en un 13,7% y finalmente el grupo C con solo 3 aumento del rango de movimiento articular, un 5,8%. Los resultados de las pruebas estadísticas de Levene, Kruskal-Wallis, Mann-Withney y Wilcoxon mostraron que existieron diferencias significativas en las variables. **Conclusión:** La implementación del programa de flexibilidad logró un aumento en la amplitud de movimiento articular entre la medición POST con respecto al PRE. Los estiramientos dinámicos son más efectivos.

Palabras clave: Ejercicios de estiramiento muscular, elasticidad, condición física, ejercicios de calentamiento, lucha olímpica.

INTRODUCTION

Flexibility is defined as the ability to move one or more joints. Joints through the entire range of motion required for a specific activity or action, is one of the main elements of fitness for elite athletes [1]. A limited range of motion is considered one of the main factors of intrinsic and modifiable risk of the most prevalent sports injuries. In addition, in certain sports, having high range of motion values in most movements is essential for the execution of sports gestures. Therefore, it is necessary to assess the range of movement, especially of the main joints of the lower extremity due to its high rate of injuries [2].

The sport of Fight classified as a combat sport based on a system of weight categories that tries to balance the physical potential between rivals and therefore increase the percentage of performance; The ability to establish optimal joint mobility indices will be one of the elements that together with other performance factors such as physical preparation, resistance, strength, speed, flexibility, technique, among others. They will determine the degree of efficiency in the execution of the demands that are demanded during sports practice [3].

For this reason, the knowledge of the optimal values of Range of Movement (ROM) in sports can be an advance in the world of physical and sports preparation, since it will allow achieving sports success. In addition, these reference values may be used to set specific quantifiable objectives in flexibility training as a basic physical quality to optimize sports physical-technical performance [4].

According to the above, it is important to apply activities aimed at improving and maintaining flexibility, through a flexibility program that promotes the best physical performance and favors physical performance and reducing the risk of injury. That is why, in the current work, he intends to study the possible effects of a flexibility program on the amplitude of joint movement in the usual practice of Olympic Wrestling in the Bolivar League.

METHODOLOGY

Two records were taken, one pre-test and the other post-test, with a control group as similar as possible to the treated group, with observations recorded at the same time and under the same circumstances as the treatment group. The measurements were carried out in a controlled manner under the same period of time and laboratory conditions. An attempt was made to randomize without stratifying the population, with the final size of the groups being unbalanced; however, the data analyst was blinded to avoid bias in the analysis of the results.

The study was applied to 27 individuals divided into three groups: Group A, 9 athletes, who received the dynamic flexibility intervention, Group B, 9 athletes with the static flexibility intervention, and finally Group C, 9 athletes, who were of the control group, they performed the usual warm-up, led by one of the athletes under the supervision of the coach. And the first two groups led by two researchers. Three individuals were lost to follow-up for reasons unrelated to the study.

For the pretest and posttest, anthropometric measurements, goniometry with a Baseline brand goniometer, muscle retraction tests such as the Ober, Thomas, and Ely tests, shoulder flexion-extension and trunk flexion-extension tests were performed [5]. The evaluation was carried out by one of the researchers who received training on how to correctly measure the amplitude of joint mobility and the level of muscle retraction, by an expert person who has made more than 2,000 measurements in Goniometry as well as muscle retraction tests.

Two large and small goniometers were used with the objective of greater precision in the results of the measurement of joint mobility. It consists of the following steps: Explanation of the method, Position of the examinee according to the segment to be evaluated, Stabilization of the proximal segment, palpation and identification of the bone landmarks, alignment of the goniometer with the bone landmarks, measurement of the joint movement arc, reading of the result of the measurement, recording of the measurement, comparison with normal values and finally comparison with scales [6].

The Ober test: Evaluates the presence of retraction in hip abduction, the athlete was positioned in lateral decubitus, on the side that is not going to be explored [7]. The Thomas Test: It was performed to assess the existence of retraction or contracture of the hip in flexion, especially of the Psoas-iliac muscle. Evaluate the opposite hip to the one that is mobilized. It was evaluated by positioning the athlete in the supine position with the lower limbs aligned and supported on the stretcher [8]. The Ely Test: It was carried out with the objective of evaluating the flexibility of the quadriceps muscle, indicating the athlete to be placed in the prone position, with the arms aligned to the body [8]. And the shoulder flexion-extension test: one arm is brought above the shoulder trying to put the hand above the shoulder blade, while the other arm is flexed behind and below the back and trying to touch hands behind back [9].

The intervention consisted of a supervised stretching program, designed by different bibliographic references of exercise programs of studies already carried out. Composed of 24 sessions, carried out for 2 months, 5 times a week, lasting 20 minutes after finishing the fight training. The stretches were organized progressively according to the level of difficulty (easy, medium, and advanced) that changed levels every 2 weeks.

The usual warm-up to increase muscle temperature begins at 5:00 Pm, with a total duration between 20 and 30 minutes, led by the team coach, consisting of general exercises such as general joint mobility, cardiovascular and muscle strength exercises to In this way, activate the neuromuscular system and thus carry out good motor coordination and complex skills that are necessary when repeated, that is, the sporting and technical fighting gesture, for example: grip, knockdown, semi-turns, sweeps, etc.

Once the program was completed, a second data collection session (final evaluation) was carried out by the same evaluator and the goniometry and anthropometric measurements, and muscle retraction tests were carried out under the same conditions as the first evaluation. During the process, the loss to follow-up of the members of the different groups was systematized. Finally, the measure to know the efficacy was established in those athletes who remained in the study throughout.

The statistical treatment of the information includes a descriptive analysis and a review of the initial conditions of the athletes. Subsequently, hypotheses are evaluated in order to verify if there are statistically significant differences between the groups when applying the treatments. Non-informative variables for the analysis are considered gender and frequency of practice since they are the same for all athletes. The total number of variables considered is 57, 6 dealing with sociodemographic questions and 51 on measures of joint movements. The statistical analysis is carried out in the free software R-project. With the Levene tests, which measured the homogeneity of the variables, Kruskal-Wallis used to identify the groups, Mann-Withney was used to measure 2 to 2 variables between the different groups, and Wilcoxon for the analysis of the results in Pre and Post measurements.

RESULTS

Initially, the summary measures of the characterization variables of the observed individuals are presented. The closeness of the average values with the median value suggests a similarity of the individuals within the groups in these variables at the beginning of the study. Likewise, the similar values of the variables between groups suggest a similarity between groups. It is observed that the ages of the participants of Group C are in a higher range than the other groups (**Table 1**).

Table 1. Distribution of groups
Tabla 1. Distribución de grupos

GRUPO	Grupo A					Grupo B					Grupo C				
MEDIDA	Promedio	Desv_Est	Mediana	Min	Max	Promedio	Desv_Est	Mediana	Min	Max	Promedio	Desv_Est	Mediana	Min	Max
EDAD	17	1.73	17	14	19	16	1.46	15.5	15	19	23	4.9	23	17	31
ESTRATO			1	1	3			2	1	5			3	1	4
TALLA CM	169	10	167	156	185	167	10	166	152	180	166	12	163	153	186
PESO KG	61	8.35	60	48	76	62.8	11.3	60.5	52	88	67.3	14.9	59	56	96
IMC	21.7	1.5	21.7	19.6	24	22.5	2.6	22.1	19.7	27.8	24.0	2.6	24.5	19.3	27.8
VIDA DEPORTIVA	3.44	2.01	3	2	8	2.50	2.73	1.5	1	9	6.86	4.41	7	1	13

A variance homogeneity test is performed to determine if the values of the PRE-test variables were not influenced by the assigned group, that is, if the groups could be compared later. To evaluate the homogeneity of the variables, the Levene test is used, which tests the hypothesis about the equality of variances. The test hypothesis is rejected when the p-value of the test is less than p-value<0.05. The NO test rejects the homogeneity hypothesis for the vast majority of variables, which makes the groups comparable. Only in the Age variable is the hypothesis that the groups are homogeneous rejected, which was suspected in the analysis of the summary measures of this variable; that is, the athletes in Group C have ages that differ significantly from that of the other two groups. The Shapiro-Wilk normality test is performed for the different variables. The normality hypothesis is rejected for most of the POST variables, so the groups were compared using non-parametric tests, which do not require the assumption of normal distribution in the population. The non-parametric test chosen is the one-way Kruskal-Wallis test to compare more than two groups; The hypothesis tested in this test is that the groups are equal. **Table 2** below shows the p-values of the test for the different POST variables.

It is observed that for 12 variables the test rejects the hypothesis that the 3 groups are equal, so that the values observed in the POST treatment variables in at least two groups are different. In order to know between which groups these differences occur, a comparison must be made in the different pairs of groups.

Next, tests were carried out two by two, of the variables where statistical differences between the groups were determined. To find out which pair of groups differences have been found, the Mann-Whitney test is applied to each pair of groups. Below are the results for each of the variables that were statistically significantly different between the groups, in red the groups that are statistically different are highlighted, p-value less than <0.05 (**Table 3**).

Table 2. Test values for the different POST variables
Tabla 2. Valores de prueba para las diferentes variables POST

Variable	p-Valor	Rechaza	Variable	p-Valor	Rechaza
POST_FLEX_CABEZA	0.01361	SI	POST_ABD_DER_CADERA	0.32076	NO
POST_FLEX_CUELLO	0.32093	NO	POST_ABD_IZQ_CADERA	0.07685	NO
POST_FLEX_CONJUNTA_ CABEZA_CUELLO	0.84584	NO	POST_ROT_MED_DER_CAD ERA	0.23271	NO
POST_EXT_CABEZA	0.09021	NO	POST_ROT_MED_IZQ_CADE RA	0.04688	SI
POST_EXT_CUELLO	0.03123	SI	POST_ROT_LAT_DER_CADE RA	0.51326	NO
POST_EXT_CONJUNTA_ CABEZA_CUELLO	0.00581	SI	POST_ROT_LAT_IZQ_CADE RA	0.34967	NO
POST_INC_LAT_DER_CABEZ A	0.06209	NO	POST_FLEX_DER_RODILLA	0.02448	SI
POST_INC_LAT_IZQ_CABEZA	0.06657	NO	POST_FLEX_IZQ_RODILLA	0.37241	NO
POST_ROT_DER_CABEZA	0.1823	NO	POST_DORSI_DER_TOBILLO	0.99935	NO
POST_ROT_IZQ_CABEZA	0.01048	SI	POST_DORSI_IZQ_TOBILLO	0.68536	NO
POST_FLEX_DER_HOMBRO	0.26173	NO	POST_PLANTI_DER_TOBILL O	0.81652	NO
POST_FLEX_IZQ_HOMBRO	0.40661	NO	POST_PLANTI_IZQ_TOBILLO	0.25777	NO
POST_EXT_DER_HOMBRO	0.08674	NO	POST_INV_DER_TOBILLO	0.55545	NO
POST_EXT_IZQ_HOMBRO	0.59734	NO	POST_INV_IZQ_TOBILLO	0.53157	NO
POST_ABD_DER_HOMBRO	0.11973	NO	POST_EVER_DER_TOBILLO	0.10126	NO
POST_ABD_IZQ_HOMBRO	0.05597	NO	POST_EVER_IZQ_TOBILLO	0.74029	NO
POST_ROT_MED_DER_HOM BRO	0.00267	SI	POST_TEST_OBER_DER	0.01625	SI
POST_ROT_MED_IZQ_HOMB RO	0.01475	SI	POST_TEST_OBER_IZQ	0.01106	SI
POST_ROT_LAT_DER_HOMB RO	0.13964	NO	POST_TEST_THOMAS_DER	0.16387	NO
POST_ROT_LAT_IZQ_HOMB RO	0.05461	NO	POST_TEST_THOMAS_IZQ	0.65508	NO
POST_FLEX_DER_CADERA	0.31107	NO	POST_TEST_ELY_DER	0.0563	NO
POST_FLEX_IZQ_CADERA	0.53512	NO	POST_TEST_ELY_IZQ	0.03092	SI
POST_EXT_DER_CADERA	0.54686	NO	POST_FLEX_EXT_DER_ HOMBRO	0.20148	NO
POST_EXT_IZQ_CADERA	0.68845	NO	POST_FLEX_EXT_IZQ_ HOMBRO	0.40064	NO
POST_ADD_DER_CADERA	0.02226	SI	POST_FLEX_EXT_TRONCO	0.21624	NO
POST_ADD_IZQ_CADERA	0.053	NO			

Table 3. Results of the application of the Mann-Whitney Test
Tabla 3. Resultados de la aplicación de la Prueba de Mann-Whitney

	p-Valor		
VARIABLE	Grupo A vs B	Grupo A vs C	Grupo B vs C
POST_FLEX_CABEZA	0.11177	0.04211	0.53434
POST_EXT_CUELLO	1	0.21395	0.03804
POST_EXT_CONJUNTA_CABEZA_ CUELLO	0.16199	0.23479	0.0133
POST_ROT_IZQ_CABEZA	1	0.01999	0.05211
POST_ROT_MED_DER_HOMBRO	1	0.024	0.00434
POST_ROT_MED_IZQ_HOMBRO	1	0.024	0.07058
POST_ADD_DER_CADERA	1	0.04232	0.10567
POST_ROT_MED_IZQ_CADERA	0.06943	0.45175	0.88506
POST_FLEX_DER_RODILLA	1	0.03722	0.10869
POST_TEST_OBER_DER	1	0.08786	0.03018
POST_TEST_OBER_IZQ	1	0.04341	0.02709
POST_TEST_ELY_IZQ	1	0.05277	0.27047

Evidence is found that the differences are mainly found in Group C with respect to Groups A and B. That is, it is established that the differences between groups A and B are not significant, while group C is statistically different from A. and the B in these variables. It is presented in analysis of the results observed in the PRE and POST test measurements; For this, the Wilcoxon test is used to compare means for paired data. The null hypothesis of this test is that the median of the difference between the PRE and POST values is zero. The significance value to reject the test result is when the p-value <0.05. In the first instance, the BoxPlot graphs are presented to directly compare the PRE and POST values for each observed variable, see **Figure 1**.

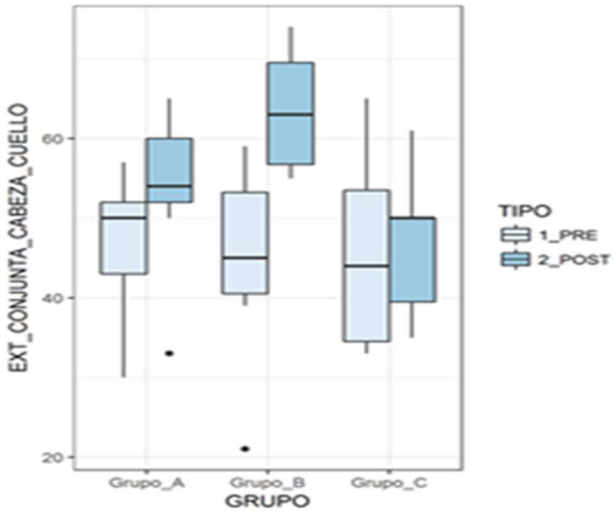

Figure 1. BoxPlot - Comparisons of the variables
Figura 1. BoxPlot - Comparaciones de las variables

It is notorious that between groups A and B with respect to group C, there were significant differences P<0.014 in the joint extension of the head and neck, group C after having performed the stretching intervention the mean remained the same, there were participants who decreased the AMA and presented greater variability between them. However, **Figure 2** shows a significant improvement with p<0.02, in the medial rotation of the right shoulder. Where group C is below the values obtained at the beginning of the exercise program, having with it greater variability in the post intervention and the average remained within the same range, with respect to group A and B the average, group B increased considerably unlike group A, there was no considerable difference between group A and B.

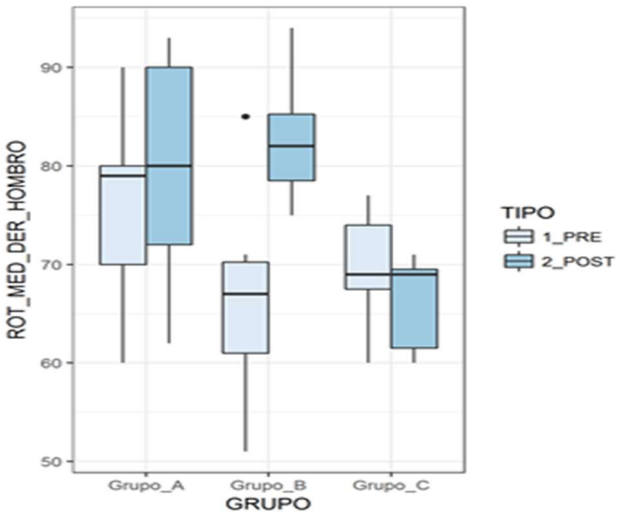

Figure 2. Comparisons of the variables
Figura 2. Comparaciones de las variables

In **Figure 3**, in comparison with groups A, B and C, from the beginning of the pre-intervention evaluation, low values in the AMA and after the intervention of the program increased considerably, but with more significance in group A and B With p< (0.022).

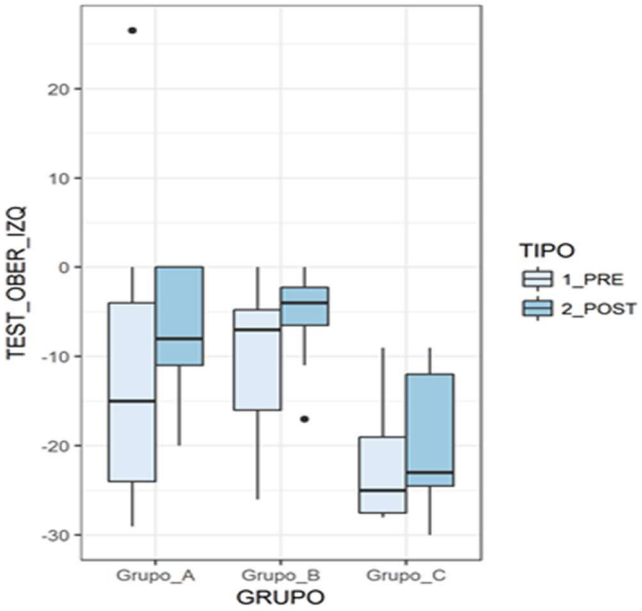

Figure 3. BoxPlot - Comparisons of the variables
Figura 3. BoxPlot - Comparaciones de las variables

In **Table 4**, the values of the test that reject the null hypothesis that the median of the values observed in the groups were significantly different in the POST measurement with respect to the Premeasurement are presented in red. It is observed that in groups A and B are found most variables whose measurements were statistically different, in Group A 16 variables, in Group B 7 variables and in Group C only 3 variables.

The statistical tests applied allow us to conclude that Group A was the one that presented the greatest differences in the PRE test / POST test observations, followed by Group B. Groups A and B differ significantly from Group C.

D I S C U S S I O N

The primary purpose of performing a muscle stretching routine is to maintain or improve the range of motion of a joint or series of joints. You can find various stretching techniques, this will depend on the goal to be achieved and the location of the stretching in each session. Since each of them can get advantages or disadvantages. The objective of this study was to determine the effectiveness of a dynamic and static flexibility program on AMA in Fighting athletes.

In the bibliographic search, authors such as Al Attar *et al*, who carried out a stretching program, although they did not carry out the same measurement tools and the same routine as in the present study, the results were similar [10]. Kilit *et al* [11], carried out a study to assess the acute effect of stretching on performance in maximum trunk flexion and 10 and 30 meter sprint in honor division soccer players, the participants were divided into 3 groups: static-passive stretching n=9, static-active stretching n=11 and dynamic stretching n=8, resulted in a statistically significant decrease in the static-passive group (p= 0.052). Regarding the dynamic stretching group, no differences were found. Statistically significant between the pre-test and the post-test for each of the variables, but compared to the static one, it was able to be maintained since the static stretching had a decrease.

Table 4. Pre and Post Variables
Table 4. Pre and Post Variables

VARIABLE		p-Valor		
PRE	POST	Grupo A	Grupo B	Grupo C
PRE_FLEX_CABEZA	POST_FLEX_CABEZA	0.018	0.736	0.106
PRE_FLEX_CUELLO	POST_FLEX_CUELLO	0.213	0.15	0.105
PRE_FLEX_CONJUNTA_CABEZA_CUELLO	POST_FLEX_CONJUNTA_CABEZA_CUELLO	0.674	0.445	0.073
PRE_EXT_CABEZA	POST_EXT_CABEZA	0.213	0.551	0.298
PRE_EXT_CUELLO	POST_EXT_CUELLO	0.233	0.014	0.595
PRE_EXT_CONJUNTA_CABEZA_CUELLO	POST_EXT_CONJUNTA_CABEZA_CUELLO	0.251	0.014	0.932
PRE_INC_LAT_DER_CABEZA	POST_INC_LAT_DER_CABEZA	0.529	0.262	0.02
PRE_INC_LAT_IZQ_CABEZA	POST_INC_LAT_IZQ_CABEZA	1	0.726	0.138
PRE_ROT_DER_CABEZA	POST_ROT_DER_CABEZA	0.058	0.183	1
PRE_ROT_IZQ_CABEZA	POST_ROT_IZQ_CABEZA	0.02	0.023	0.786
PRE_FLEX_DER_HOMBRO	POST_FLEX_DER_HOMBRO	0.859	0.932	0.346
PRE_FLEX_IZQ_HOMBRO	POST_FLEX_IZQ_HOMBRO	0.553	1	0.586
PRE_EXT_DER_HOMBRO	POST_EXT_DER_HOMBRO	0.822	0.362	0.59
PRE_EXT_IZQ_HOMBRO	POST_EXT_IZQ_HOMBRO	0.262	0.575	0.445
PRE_ABD_DER_HOMBRO	POST_ABD_DER_HOMBRO	0.234	0.204	0.49
PRE_ABD_IZQ_HOMBRO	POST_ABD_IZQ_HOMBRO	0.735	0.183	0.168
PRE_ROT_MED_DER_HOMBRO	POST_ROT_MED_DER_HOMBRO	0.447	0.02	0.075
PRE_ROT_MED_IZQ_HOMBRO	POST_ROT_MED_IZQ_HOMBRO	0.496	0.025	0.073
PRE_ROT_LAT_DER_HOMBRO	POST_ROT_LAT_DER_HOMBRO	0.021	0.313	0.203
PRE_ROT_LAT_IZQ_HOMBRO	POST_ROT_LAT_IZQ_HOMBRO	0.058	0.59	0.242
PRE_FLEX_DER_CADERA	POST_FLEX_DER_CADERA	0.009	0.742	0.751
PRE_FLEX_IZQ_CADERA	POST_FLEX_IZQ_CADERA	0.033	0.526	1
PRE_EXT_DER_CADERA	POST_EXT_DER_CADERA	0.138	0.496	0.548
PRE_EXT_IZQ_CADERA	POST_EXT_IZQ_CADERA	0.123	0.313	0.394
PRE_ADD_DER_CADERA	POST_ADD_DER_CADERA	0.098	0.573	0.279
PRE_ADD_IZQ_CADERA	POST_ADD_IZQ_CADERA	0.024	0.183	0.916
PRE_ABD_DER_CADERA	POST_ABD_DER_CADERA	0.314	0.181	0.198
PRE_ABD_IZQ_CADERA	POST_ABD_IZQ_CADERA	0.021	0.15	0.834
PRE_ROT_MED_DER_CADERA	POST_ROT_MED_DER_CADERA	0.16	0.042	0.734
PRE_ROT_MED_IZQ_CADERA	POST_ROT_MED_IZQ_CADERA	0.075	0.068	0.344
PRE_ROT_LAT_DER_CADERA	POST_ROT_LAT_DER_CADERA	0.014	0.149	0.462
PRE_ROT_LAT_IZQ_CADERA	POST_ROT_LAT_IZQ_CADERA	0.044	0.672	0.14
PRE_FLEX_DER_RODILLA	POST_FLEX_DER_RODILLA	0.012	0.014	0.021
PRE_FLEX_IZQ_RODILLA	POST_FLEX_IZQ_RODILLA	0.097	0.052	0.864
PRE_DORSI_DER_TOBILLO	POST_DORSI_DER_TOBILLO	0.286	0.574	0.021
PRE_DORSI_IZQ_TOBILLO	POST_DORSI_IZQ_TOBILLO	0.044	0.944	0.149

Similar results were found by Widerstrom *et al* [12]. Where he divided the participants into a control group and 4 experimental groups. 1st group performed 15 seconds of passive stretching, 2nd 30 seconds of passive stretching, 3rd 15 seconds of active stretching and 30 seconds of active stretching. With a total stretching time of 180 seconds, a frequency of 3 days a week, over 12 weeks, the results obtained show how all the stretching protocols achieved improvements in the levels of hamstring extensibility with gains of 20%.

These data coincide with the intervention and research results by Nara *et al* [13] Where the training period consisted of dynamic flexibility exercises, seven weeks of physical preparation and technical training, with varying intensities in alternate periods, resulted in an increase in the gain in

flexibility of the lumbar region muscles by 25, 2%, p <0.0001.

Likewise, Walsh [14], i carried out a study that, although it was not similar in terms of the duration of the implementation of the ecstatic flexibility program, and the muscles to work were specifically the hamstrings, the subjects had a significant improvement p < 0.001 of hamstring extensibility.

A study carried out by Shamsi *et al* [15] in the lower limb, where he executed a flexibility exercise program on an experimental group that received static flexibility training, while the control regular training showed a positive effect on the general index of flexibility by 22.9% with respect to the control group of 1.03% increase, which is not significant.

The results obtained in the present investigation are supported by the theory stated by Murphy DR. that defends the performance of dynamic activities to increase the amplitude of joint movement since when performing such activities, the antagonist muscle group contracts, thus allowing the relaxation of the agonist muscles and therefore achieving a greater lengthening of the muscle in a natural way [16].

Finally, after analyzing the results of this study, and as occurs in most of the scientific literature, the practice of stretching routines has proven to be an easy and effective way to increase the range of motion of a joint. One of the main limitations of the current study was that no sampling design was carried out due to the small initial population, added to this during the development of the program there was a loss of (3) three participants for reasons external to the research; therefore, the present study has internal validity. Although the longitudinal design contemplates the intervention, the limitation was that the researchers directed the intervention (dynamic and static flexibility) because in the Bolivar League Wrestling team they only performed the usual warm-up.

C O N C L U S I O N

The investigation carried out had the participation of 27 Lucha Libre athletes, who were divided into 3 groups, during 5 times a week for 2 months they carried out a habitual training; Group A performed dynamic stretching, Group B static stretching, and Group C control. Initially, the range of joint movements was evaluated, muscle tests were applied with different tests such as the Ober test, Thomas test, Ely test, shoulder flexion-extension test and the trunk flexion-extension test. The results obtained were the following: in group A, it was evidenced that it had a better performance in terms of joint amplitude in 16 movements, in 31.3%, followed by group B with the improvement in 7 joint movements in 13.7% and Finally, group C with only 3 increases in the range of joint movement, by 5.8%. The results of the statistical tests Levene, Kruskal-Wallis, Mann-Whitney, and Wilcoxon showed that there were significant differences in the variables: the implementation of the flexibility program achieved an increase in the amplitude of joint movement between the POST measurement with respect to the PRE. Being more effective dynamic stretching.

Conflict of interests

The authors declare that there is no conflict of interest.

REFERENCIAS

1. Francisco Javier Robles-Palazón, José M. Puerta-Callejón, José A. Gámez, Mark De Ste Croix, Antonio Cejudo, Fernando Santonja, Pilar Sainz de Baranda, Francisco Ayala, Predicting injury risk using machine learning in male youth soccer players, Chaos, Solitons & Fractals, Volume 167, 2023, 113079
2. Travis G. Maak, Christina D. Mack, Brian J. Cole, Mackenzie M. Herzog, John Difiori, Peter Meisel, Sports Performance and Injury Research: Methodologic Limitations and Recommendations for Future Improvements, Arthroscopy: The Journal of Arthroscopic & Related Surgery, Volume 36, Issue 11, 2020, Pages 2938-2941
3. Julian (Jules) R. Woolf, Hyunseo (Violet) Yoon, Kaushik Perkari, Fighting and doping: Professional mixed martial artists experience

and exposure to performance-enhancing substances and supplements, Performance Enhancement & Health, Volume 9, Issue 1, 2021, 100190
4. Simone Caso, John van der Kamp, Variability and creativity in small-sided conditioned games among elite soccer players, Psychology of Sport and Exercise, Volume 48, 2020, 101645
5. Matthew D. DeLang, J. Craig Garrison, Joseph P. Hannon, Lasse Ishøi, Kristian Thorborg, Weekly screening of youth male football players: a 14-week longitudinal investigation of interactions between groin pain and long lever adductor squeeze strength, Journal of Science and Medicine in Sport, 2023
6. Nathan Short, Thomas G. Almonroeder, Caroline A. Fenker, Olivia A. Fisher, Kailey E. Francetic, Amy E. Hodel, Clayton A. Lange, Manu M. Mathew, Intra-rater reliability of goniometry to measure scapular protraction and retraction, Journal of Hand Therapy, Volume 35, Issue 2, 2022, Pages 275-281
7. Magdalena Stania, Grzegorz Juras, Wojciech Marszałek, Piotr Król, Analysis of pain intensity and postural control for assessing the efficacy of shock wave therapy and sonotherapy in Achilles tendinopathy – A randomized controlled trial, Clinical Biomechanics, Volume 101, 2023, 105830
8. Pascal Edouard, Vincent Gremeaux, Emmanuel Coudeyre, Sports rehabilitation special issue: Increase our efforts to allow athletes to return to sport with minimal health risks, Annals of Physical and Rehabilitation Medicine, Volume 65, Issue 4, 2022, 101668
9. Inge E.P.M. van Haren, Robert E.H. van Cingel, André L.M. Verbeek, Nicky van Melick, Janine H. Stubbe, Hans Bloo, J.Hans M.M. Groenewoud, Philip J. van der Wees, J.Bart Staal, Predicting readiness for return to sport and performance after anterior cruciate ligament reconstruction rehabilitation, Annals of Physical and Rehabilitation Medicine, Volume 66, Issue 3, 2023, 101689
10. Wesam Saleh A Al Attar, Ehdaa H Khaledi, Jumana M Bakhsh, Oliver Faude, Hussain Ghulam, Ross H Sanders, Injury prevention programs that include balance training exercises reduce ankle injury rates among soccer players: a systematic review, Journal of Physiotherapy, Volume 68, Issue 3, 2022, Pages 165-173,
11. B. Kilit, E. Arslan, Y. Soylu, Effects of different stretching methods on speed and agility performance in young tennis players, Science & Sports, Volume 34, Issue 5, 2019, Pages 313-320
12. Birgitta Widerström, Maria Elvén, Eva Rasmussen-Barr, Carina Boström, "How does physical examination findings influence physiotherapists' decision-making when matching treatment to patients with low back pain?", Musculoskeletal Science and Practice, Volume 53, 2021, 102374
13. Ginji Nara, Mina Samukawa, Kensuke Oba, Yuta Koshino, Tomoya Ishida, Satoshi Kasahara, Harukazu Tohyama, The deficits of isometric knee flexor strength in lengthened hamstring position after hamstring strain injury, Physical Therapy in Sport, Volume 53, 2022, Pages 91-96
14. Gregory S. Walsh, Effect of static and dynamic muscle stretching as part of warm up procedures on knee joint proprioception and strength, Human Movement Science, Volume 55, 2017, Pages 189-195
15. Mohammad Bagher Shamsi, Amir Ahmadi, Maryam Mirzaei, Shapour Jaberzadeh, Effects of static stretching and strengthening exercises on flexion relaxation ratio in patients with LBP: A randomized clinical trial, Journal of Bodywork and Movement Therapies, Volume 30, 2022, Pages 196-202
16. Rebecca Ban, Feng Yang, Preliminary study on acute effects of an intervention to increase dorsiflexion range of motion in reducing medial knee displacement, Clinical Biomechanics, Volume 95, 2022, 105637