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Association between the increased thoracic curvature and the prevalence of pain in the shoulder complex on roping practitioners

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ABSTRACT

Background: The roping practice is a sporting the practitioner aims to throw a type of rope with a loop over the head or around the horns of the steer during the horse riding. The movement of looping is performed by repeated rotations of the shoulder above the shoulder girdle line, and this action, associated with changes in the thoracic spine, can overwhelm the structures of the shoulder complex and the muscles. **Objective**: Analyze the association between changes in increased thoracic curvature and the prevalence of pain in the shoulder complex in roping practitioners. **Methods:** The sample was intentionally with 20 male roping practitioners who were submitted to assessment of shoulder pain using the shoulder pain and disability index (spadi), three shouder's orthopedic test, the jobe's test, the yergason's test, the neer's test, and also the measurement of the thoracic curvature angle through the flexicurve method. The statistical data were processed using the SPSS version 20.0, and the Chi-Squared test was applied to evaluate the association between the variables. The level of significance adopted was 5%. **Results:** 70% of the sample presented pain in the shoulder joint complex and 45% of the practitioners presented hyperkyphosis. There is a moderate association between the variables (p = 0.008 / contingency coefficient = 0.510). **Conclusion**: The results showed a moderate association between the prevalence of pain in the shoulder complex and the increase of the thoracic curvature angle.

Keywords: Thoracic Curvature; Pain; Shoulder Complex; Posture; Roping Practitioners

INTRODUCTION

The "Gaúcha" tradition was consolidated culturally through the knowledge and experience of the different peoples who colonized Rio Grande do Sul (Brazil), building a common identity that continues to the present day. An example of this is the dances and rodeos that were once held in the ranches. Currently, these celebrations are held in traditionalist entities, especially in the Gaucho Traditions Centers (CTGs)[1]. In these CTGs, one of the most visible and frequent practices of the "gauchismo", are the championships of Lasso Throwing, that take place practically every weekend[2].

Lasso Throwing is a practice that has already become the most imposing of the gaucho competitions. It is an activity carried out by women and men, whose objective is to lasso the cattle by the horns during the mount in a horse[1, 2]. In this activity, the practitioner needs to perform the movement of flexion, abduction and repeated rotations of the shoulder joint above the shoulder girdle, this being a possible factor of lesions and pain in the joint complex of the shoulder[3].

As in any competitive sport, excellence is achieved through a constant training routine, which is no different in the practice of Lasso Throwing. In this sense, due to the performance of the characteristic gesture of the activity, a large number of repetitions are imposed on the shoulder region, which can often injure the rotator cuff muscles due to repetitive use and with load on the upper limb at an angle above the 90° of abduction and flexion of the glenohumeral joint[4-6]. Movement of the upper limb above the shoulder girdle is a result of the harmony between the sternoclavicular, acromioclavicular, scapulothoracic and glenohumeral joints, and a misplaced position of any of the bones composing these joints may impair the efficiency of upper limb movement[7].

The term clinically used to describe the lack of movement control, reduction of scapular kinematics, and alteration of the position of the scapula in relation to the costal gradil is scapular dyskinesis[7-9]. The scapular dyskinesis can be generated by several factors, one of them related to changes in the curvature of the thoracic spine. The excessive increase of thoracic kyphosis, called hyperkyphosis, alters the movement and proper positioning of the shoulder girdle affecting its relation with the costal gradil and the humerus[10, 11].

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This postural change is considered when the thoracic kyphosis angle is above the normal range from 20º to 40º[12]. Hyperkinesis is related to the increase in the number of orthopedic injuries in the shoulder joint[13], because it triggers a poor alignment of the glenohumeral joint, impairing the humeral scapular rhythm and the joint kinematics of the shoulder joint complex, thus generating overloads[14]. The pain and limited range of motion characteristic of shoulder joint complex dysfunctions result in altered movement patterns and functional limitations, resulting in inadequate biomechanical performance, leading to lesions and chronic pain in the shoulder joint complex[15].

Considering the great use of the upper limb in large amplitudes by practitioners of Lasso Throwing, investigations about the relationship between increases in thoracic curvature and the pain are relevant aspects to be evaluated. These aspects can help to highlight the factors that can generate lesions and to establish a relation between them in this population. Therefore, the present study aimed to analyze the association between increased thoracic curvature and the prevalence of pain in the shoulder joint complex in practitioners of Lasso Throwing.

MATERIALS AND METHODS

The study provides a quantitative approach, descriptive exploratory cross-sectional model. The sample was intentional and non-probabilistic, consisting of 20 male practitioners with a mean age of 31.5 ± 7.4 years, who practice Lasso Throwing in a group of CTG from Rio Grande do Sul (Brazil). The inclusion criteria were the practice of Lasso Throwing at least twice a week and practicing the modality more than one year. Practitioners with a history of fracture of the shoulder joint complex were excluded from the study. All participants in the research signed the Informed Consent Form and were informed about the objectives, the procedures of the research and about their direct of leave the research whenever they want to. This study was approved by the Research Ethics Committee of the Universidade do Vale do Rio dos Sinos (CEP-UNISINOS), with protocol number 1.871.753/2016. All collects were carried out by a single researcher in a room provided by the CTG.

Initially, an anamnesis was performed, with questions related to the age, profession, time and frequency of Lasso Throwing practice, upper limb used in the Lasso Throwing gesture, history of diagnosed lesions and treatments in the region of the shoulder girdle and shoulder. Then, Lasso Throwing practitioners responded to the Shoulder Pain and Disability Index (SPADI) in Brazilian Portuguese[16]. The SPADI is an instrument used to evaluate pain and disability of the shoulder joint consisting of thirteen items distributed in eight items in the disability domain and five items in the pain domain. Each item allows a response on a numerical evaluation scale ranging from zero to ten, with the disability scale score 0 indicating "without difficulty" and 10 indicating "failed to do", and the pain scale score 0 indicates "no pain" and 10 indicates "worse pain". The final result of the SPADI can be obtained either generally or individually for each domain, and it is converted into a percentage for values ranging from 0 to 100, with the highest score indicating the worst condition of the shoulder dysfunction. In the present study, the result of the item "pain" was used to establish the relationship with the angles of the thoracic curvature. The questionnaire was answered individually and had an average duration of approximately 10 minutes.

Subsequent to the application of the SPADI, the body mass, height and the body mass index (BMI) calculation of each participant were evaluated by means of a scale (MONDIAL - M.K. Eletrodomésticos Ltda, Conceição do Jacuípe, Brazil) and a tape measure attached to the wall. Then the Lasso Throwing practitioner was positioned sitting in a chair, with his torso erect and naked, for Neer's, Jobe's and the Yergason's Test. According to the tests, subjects were scored on positive and negative.

In the last collect performed, the participants were instructed to acquire an orthostatic posture with their shoulders and elbows at 90 degrees slightly supported on the wall and the measurement of the angle of the thoracic curvature was performed by the Flexicurve method[17]. This method consists in the utilization of a flexible ruler called Flexicurva (Tridente, Itapuí, Brazil), which allows the molding of the surface of the curvatures of the vertebral column in the dorsal region and its subsequent design in a graph paper. Initially, for the collection of the angles of the thoracic curvature, the thrombus processes of 6 anatomical points (C7, T1, T12, L1, L5 and S1) were located through the palpatory method. These anatomical points were marked with round paper stickers on the participant's back. After marking the anatomical points of interest, the flexible ruler was molded on the back of the participant from the C7 to the S1. After performing the mold on the back and identifying the spinous processes of the vertebrae of interest in the flexible ruler, Flexicurve was removed from the back and its internal contour (side of the Flexicurve in contact with the skin) was drawn on a graph paper. This design represented the sagittal and thoracic curvatures of the thoracic and lumbar spines, and also identified the spinous processes of interest (C7, T1, T12, L1, L5 and S1).

After the drawing was done on the graph paper, the evaluator removed the adhesives from the skin of the participant. With the design of each participant and according to the method proposed by the Flexicurve instrument, it were started the procedures for calculating the angle of the thoracic curvature. Initially, six random points were marked between C7 and T12 and between L1 and L5, on the graph paper, totaling 18 points on the contour of the evaluated curvature. After marking the points, the digital image of the drawing of the spine contour

was obtained on the graph paper by means of the photographic record. Photographic record was performed using a camera NIKON model V (Nikon do Brasil, São Paulo, Brazil) positioned perpendicular to the graph paper. To calculate the angle of the thoracic curvature of each participant, the digital image obtained through photographic recording was processed in the Biomecflex v. 3.0[17] Biomec-FLEX free software (www.ufrgs.br/biomec). To obtain the angle of the thoracic curvature in degrees (º) in the software Biomecflex v. 3.0, it was initially performed the scanning with the help of the mouse of all 18 points marked on the curvature in the millimeter paper. After scanning the points, the Biomecflex v. 3.0, through mathematical procedures, generates a graph with the curvature design and provides the angle of the thoracic and lumbar curvature.

The results obtained in the pain domain by the SPADI-Brazil Questionnaire were used as a division criterion. Participants who presented a score above 0 points were considered individuals with pain, and individuals with a score of 0, without pain. In the disability domain evaluated by the SPADI-Brazil Questionnaire, individuals who presented a score above 0 points were considered individuals with disability in the shoulder joint complex. For the classification of the thoracic curvature, was used the angular range proposed in the literature[13], which classifies with hyperkyphosis the individuals who presented angles of thoracic curvature above the normal range from 20º to 40º. Regarding orthopedic tests, individuals who tested positive for at least one of the three orthopedic tests performed were considered positive in the tests.

With the results of SPADI regarding pain and disability, results of orthopedic tests and angles of thoracic curvature, the statistical treatment was performed in the SPSS 20.0 software. Initially, a descriptive statistic was performed to evaluate the means of data collected, frequency of occurrence of postural deviations, results of orthopedic tests and pain in the joint complex of the shoulder. Subsequently, an inferential statistic was performed using the Qui-square test of independence to evaluate the association between the presence of shoulder pain and the postural pattern evaluated and between the presence of pain and the results of the orthopedic tests. A literature proposal was used to classify the association[18]. In addition, the student t test was used to compare the parametric data and the Wilcoxon test for the non-parametric data. The level of significance was 5%.

RESULTS

Table 1 shows the frequencies obtained in the variables evaluated by the SPADI-Brazil and obtained from the classification of the thoracic curvature. The results show that 70% (n = 14) of the participants presented pain and disability in the shoulder joint complex, whereas 30% (n=6) are asymptomatic (*p=0.001*). Participants with pain practiced Lasso Throwing for 17.4 ± 6.9 years while participants who did not present pain practiced for 16.0 ± 6.4 (p = 0.679). The assessment of pain in Lasso Throwing practitioners was based on the results of the pain domain of the SPADI-Brazil Questionnaire and the mean pain score was 52.1 ± 9.9 on a scale from 0 to 100, where zero is no pain. In the present study, Lasso Throwing practitioners who presented zero score in the pain domain of the SPADI-Brazil Questionnaire were classified as painless individuals. On the other hand, the results in the disability domain of the SPADI-Brazil Questionnaire for Lasso Throwing practitioners with pain in the shoulder joint complex presented a mean score of 41.5 ± 9.9 on a scale of 0 to 100, in which zero is normal and one hundred worse condition of the shoulder joint complex. These values generate a final SPADI-Brazil questionnaire score of 44.9 ± 8.1 for individuals with pain. Another point evaluated in the anamnesis was the presence of a diagnosis of joint shoulder injury, which 100% (n = 20) of the patients reported not having a diagnosis of shoulder injury (p = 0.000). Regarding the demand for physiotherapeutic care, 100% (n = 20) of the practitioners reported never having performed physiotherapy in the shoulder joint complex, either by prevention or rehabilitation (p = 0.000).

Table 1- Variables evaluated by the SPADI-Brazil and obtained from the classification of the thoracic curvature

Acquired variables	Frequency (n/%)		p value
	Left	Right	
Upper limb used in the movement	13 (65%)	7 (35%)	0.002*
	Disability	**Normal**	
Total disability domain value - SPADI	14 (70%)	6 (30%)	0.001*
	With pain	**No pain**	
Total pain domain value - SPADI	14 (70%)	6 (30%)	0.001*
	Hyperzythosis	**Normal**	
Chyphosis	9 (45%)	11(55%)	0.011*

Note: *significant difference (*p<0.05*)

In relation to the angle of the thoracic curvature, 9 participants had mean angular values of 44.5 ± 3.7º, being classified with hyperkyphosis. And 11 participants had mean angular values of 32.5 ± 2.7. When comparing the BMI values of the participants with pain in the joint complex of the shoulder and of the participants without the presence of pain, respectively, were obtained the values of 25.9 ± 1.9 kg/m² and 23.6 ± 1.2 kg/m² (*p=0.013*), demonstrating that individuals with pain have a higher BMI. Table 2 presents the results of the evaluation of the association between the classification of the thoracic curvature and the presence of pain in the shoulder joint complex.

The results presented in table 2 demonstrate an association between pain and the angle of the thoracic curvature (X^2*=7.01/p=0.008*). Observing the contingency coefficient obtained in Table 2 (*CC=0.510*), it is possible to verify that the association between presence of pain in the shoulder joint complex and the angle of the thoracic curvature can be classified as moderate. Regarding the orthopedic tests performed, 40% (n= 8) of the participants presented a positive result and 60% (n= 12) showed a negative result (p = 0.005). For the Jobe's test, 45% (n= 9) of the participants presented a positive result and 55% (n= 11) presented a negative result (p= 0.011). In the Yergason's test, a higher frequency of negative results was observed with 75% (n= 15) and only 25% (n= 5) with a positive result (p= 0.000). The associations between positive orthopedic tests and pain can be visualized in table 3. The results demonstrate an association between pain and positive orthopedic tests performed (X^2*=12,8/p=0.000*). Observing the contingency coefficient (CC = 0.626), it is possible to verify that the association between presence of pain in the shoulder joint complex and the result in the orthopedic tests can be considered moderate.

DISCUSSION

The present study aimed to verify the association between increased thoracic curvature and the prevalence of pain in the shoulder joint complex of Lasso Throwing practitioners. After evaluations in the shoulder joint complex through the application of the SPADI-Brazil Questionnaire, it was possible to observe a higher prevalence of individuals with pain and disability among Lasso Throwing practitioners. Considering the results concerning pain and disability, it must take into account that for the accomplishment of the gesture of noose, repetitive movements with high articular mobility are necessary of both the shoulder complex and the vertebral column. In this movement the shoulder joint complex remains above 90º practically during the whole lacing gesture. Also, in addition to elevation, movement is associated with rotations that need to occur at both joints for a precise gesture that aims to noose the cattle. In this sense, due to the high amount of repetitive movements with the upper limb in an elevated position, pain is frequently reported in the literature in individuals under these conditions[19-22]. Similar to the results of the present study changes and symptoms in the shoulder

Table **2: Cross-reference and Chi-square test (X^2)**

Variables		Result of pain domain - SPADI				
		With pain	%	No pain	%	Total %
Thoracic curvature	Normal	5	25.0	6	30.0	55.0%
	Hyperzythosis	9	45.0	0.0	0.0	45.0%
Total		14	70.0	6	30.0	100%
X^2 = 7.01				p= 0.008*		
Contingency coefficient = 0.510						

Note: * significant difference (*p<0.05*)

Table **3- Cross-reference and Chi-square test (X^2)**

Variables		Relationship of pain with positive orthopedic test			
With pain	%	No pain	%	Total	
Positive test	12	60.0%	0	0.0%	60.0%
Negative test	2	10%	6	30.0%	55.0%
Total	14	70.0%	6	30.0%	100%
X^2 = 12.8				p= 0.00*	
Contingency coefficient				p= 0.626*	

Note: * significant difference (*p<0.05*)

complex are also evidenced in baseball[23], swimming[24-26], volleyball[19] players and in other sports, which also use the upper limb above the shoulder joint and shoulder girdle[27]. Thus, the practice of Lasso Throwing, due to its characteristics, may generate overload in the shoulder complex, which may favor the onset of pain and injuries, as well as the decrease of the practitioner's performance.

In addition, the study suggests that the presence of thoracic hyperkinesis is moderately related to the presence of pain and this is due to the positivity of orthopedic tests in Lasso Throwing practitioners. In the literature, studies have shown that advancing age, past pain and postural changes are factors related to rotator cuff injuries[28]. It is also speculated that there is an indirect relationship in the development of shoulder syndrome[29] induced by changes in scapular kinematics. Another point of discussion in the literature is the relation of the protruding shoulders, associated to the alteration in the scapular kinematics presenting a correlation with the increase of the thoracic kyphosis, however it is not known to report the existence of cause and effect relationships in this relation[30]. According to Kebaetse, Mcclure and Pratt[31] evaluated the effect of the thoracic posture on the scapular kinematics and the active range of motion of the shoulder. The results indicate that the thoracic posture affects the abduction range of motion in the scapular plane and the scapular kinematics. The authors report that the decrease in the range of motion of the shoulder in hyperkyphosis can be attributed to the lower posterior inclination and the lower superior rotation of the scapula. In this way, the acromion can create a bone barrier that can cause or contribute to repetitive lesions. The results and factors listed agree with the present study on a possible influence of thoracic hyperkinesis in the presence of pain in Lasso Throwing practitioners. Therefore, postural deviations can change the ability to perform precise movements, causing pain over time as a response to repetitive tasks in the wrong positions of the segments[32]. In disagreement with the findings, Punnett *et al*.[33] assessed the posture, relating it to shoulder pain in 79 male subjects and concluded that in only 10% the altered posture caused some type of shoulder pain. These facts summarized in the literature[34] currently demonstrated that there is no relationship between increased thoracic kyphosis and the presence of shoulder pain. However, when the relationship between hyperkyphosis and altered range of motion in the shoulder complex is analyzed, strong evidence is found for this relationship, in which it is the main aspect related to alteration of the scapular kinematics[34].

The results of the present study give us indications of an association between hyperkyphosis and the presence of pain, but it should be emphasized that only the changes coming from the thoracic spine on the pain in the shoulder joint complex were considered, and scapular kinematics were not assessed. This is a limitation of the study and a kinematic analysis would be associated in future studies to obtain more precise information of the different variables that influence the shoulder complex. The literature gives us indications of presence of changes in the scapular kinematics, due to the posture and presence of pain in other sports that maintains the upper limb in high amplitudes.

Mansoldo and Nobre[26], evaluated the posture of swimmers and showed that the majority of athletes presented scoliosis, misalignment of the inferior angle of the scapula and tendency to anterioration of the dorsum (thoracic hyperkinesis). This anteriority of the back was also observed in 45% of Lasso Throwing practitioners. Oliveira and Deprá[27] confirmed the presence of thoracic hyperkinesis as the most marked deviation among sports in juvenile athletes. According to Baraúna *et al*.[35] and Siqueira *et al*.[36], the early diagnosis of postural changes and the adoption of effective measures can prevent the occurrence of injuries, as well as contribute to the increase of the performance of athletes or practitioners of a modality.

Considering the implementation of effective measures in the prevention of injuries, the role of movement professionals in the Lasso Throwing is important because of the high prevalence of pain and the presence of hyperkyphosis. Still, a well-executed gesture by a practitioner of the sport can be a deterministic factor for success. In this sense, we emphasize that the study is of great relevance and notoriety, due to the scarce in the literature studies that carried out evaluations in practitioners of Lasso Throwing, as well as the insertion of physiotherapy in this environment.

CONCLUSION

The results demonstrated a high prevalence of pain in the shoulder joint complex and a moderate presence of hyperkyphosis in Lasso Throwing practitioners. The study showed a moderate association between the prevalence of pain in the shoulder joint complex and increased thoracic curvature.

AUTHOR'S CONTRIBUTION

ABS: development of the study, data collection, data analysis, discussion and article writing; **WD:** data analysis, statistical analysis and article discussion; **MT:** data analysis, data interpretation and article discussion.

CONFLICTS OF INTERESTS

The authors declare that there was no conflict of interests.

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