ORIGINAL ARTICLE
PAIN

CORRELATION BETWEEN LOW BACK PAIN DUE TO FATTY DEGENERATION AND SEX AND AGE: STUDY BY MRI

CORRELAÇÃO ENTRE LOMBALGIA POR DEGENERAÇÃO GORDUROSA E SEXO E IDADE: ESTUDO POR IRM

CORRELACIÓN ENTRE EL DOLOR LUMBAR POR DEGENERACIÓN GRASA Y EL SEXO Y LA EDAD: ESTUDIO POR IRM

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ABSTRACT

Objective: To correlate low back pain caused by fatty degeneration, visualized by magnetic resonance imaging (MRI), with sex and age. Methods: With a timeframe of 2015 to 2020, data on sex and age of fifty symptomatic patients with low back pain were collected from medical records and correlated with MRI analyses showing the occurrence of fatty infiltration in the paraspinal and erector muscles. Three trained observers, using the classification of Goutallier et al. (1994), analyzed five lumbar levels and the degree of injury. The Kolmogorov-Smirnov, Shapiro Wilk, Student's t, Mann-Whitney and Spearman correlation tests were used, all with a 5% significance level. Results: Among the cases, the L5-S1 level was found in all the images, with a prevalence of 46% of grades 1 and 2 and 24% in the five lumbar levels. Severity was present in a small portion (8%) of the injuries. There was a predominance of 78% women, with significantly more severe injuries in relation to the number of levels ($p < 0.001$) and injuries of a higher degree ($p < 0.001$). The age range was 14 to 38 years (mean = 26.70 ± 5.70 years), showing a significant and moderate correlation between the number of levels reached and a greater degree of degeneration ($p < 0.001$). Conclusion: Fatty degeneration as a cause of low back pain was significantly more severe in women in terms to the number of levels and the higher degree of injury. The number of levels and the severity of fatty degeneration were not correlated with the patient's age. ***Level of evidence II; Retrospective Study***.

Keywords: Orthopedics; Spine; Low Back Pain; Magnetic Resonance; Diagnostic Imaging.

RESUMO

Objetivo: Correlacionar a lombalgia por degeneração gordurosa visualizada em imagens de ressonância magnética (IRM) com sexo e idade. Métodos: Com um recorte temporal de 2015 a 2020, sexo e idade de cinquenta pacientes sintomáticos com lombalgia foram coletados em prontuários e correlacionados com análises de IRM com ocorrência de infiltração gordurosa nos músculos paraespinhais e eretores. Três observadores treinados que usaram a classificação de Goutallier et al. (1994) analisaram cinco níveis lombares e o grau das lesões. Empregaram-se os testes estatísticos de Kolmogorov-Smirnov, Shapiro-Wilk, t de Student, Mann-Whitney e correlação de Spearman, todos com nível de significância de 5%. Resultados: Dentre os casos, o nível L5-S1 foi encontrado em todas as imagens, com prevalência de 46% dos graus 1 e 2 e de 24% nos cinco níveis lombares. A gravidade esteve presente em pequena parcela (8%) de lesões. Houve predomínio de 78% em mulheres com lesões significativamente mais graves com relação ao número de níveis ($p < 0,001$) e ao maior grau ($p < 0,001$). A faixa etária foi de 14 a 38 anos (média = 26,70 ± 5,70 anos), demonstrando correlações significativa e moderada entre número de níveis atingidos e maior grau de degeneração ($p < 0,001$), respectivamente. Conclusões: A degeneração gordurosa como causa de lombalgia foi significativamente mais grave em mulheres com relação ao número de níveis e ao maior grau da lesão. O número de níveis e a gravidade da degeneração gordurosa não se correlacionaram com idade dos pacientes. ***Nível de evidência II; Estudo Retrospectivo.***

Descritores: *Ortopedia; Coluna Vertebral; Dor Lombar; Ressonância Magnética; Diagnóstico por Imagem.*

RESUMEN

Objetivo: Correlacionar el dolor lumbar por degeneración grasa, visualizada en imágenes de resonancia magnética (IRM) con el sexo y la edad. Métodos: En un período de tiempo de 2015 a 2020, se recopilaron en historias clínicas, datos de sexo y edad de cincuenta pacientes sintomáticos con dolor lumbar y se correlacionaron con análisis de IRM para determinar la aparición de infiltración grasa en los músculos paraespinales y erectores. Tres observadores entrenados, utilizando la clasificación de Goutallier et al. (1994), analizaron cinco niveles lumbares y el grado de las lesiones. Se utilizaron las pruebas estadísticas de Kolmogorov-Smirnov, Shapiro-Wilk, t de Student, Mann-Whitney y correlación de Spearman, todas con un nivel de significancia del 5%. Resultados: Entre los casos, el nivel L5-S1 estuvo presente en todas las imágenes, siendo prevalente con 46% para los grados 1 y 2 y con 24% en los cinco niveles lumbares. La severidad estuvo presente en una pequeña parte (8%) de las lesiones. Hubo predominio del 78% en mujeres con lesiones significativamente más

Study conducted at the Hospital Santa Teresa – Spine Group of the Orthopedics and Traumatology Service of the Prof. Dr. Donato D'Ângelo, Petrópolis, RJ, Brazil.
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graves en relación al número de niveles (p < 0,001) y al grado más alto (p < 0,001). El rango de edad fue de 14 a 38 años (media = 26,7 ± 5,7 años), demostrando una correlación significativa y moderada con el número de niveles alcanzados y un mayor grado de degeneración (p < 0,001). Conclusión: La degeneración grasa como causa de dolor lumbar fue significativamente más grave en las mujeres con respecto al número de niveles y al mayor grado de lesión. El número de niveles y la gravedad de la degeneración grasa no se correlacionaron con la edad de los pacientes. ***Nivel de evidencia II; Estudio Retrospectivo****.*

Descriptores: *Ortopedia; Columna Vertebral; Dolor de la Región Lumbar; Resonancia Magnética; Diagnóstico por Imagen.*

INTRODUCTION

An evaluation of the morphology of the paravertebral muscle, especially of the multifidus muscle, is the focal point when assessing the etiology, prognosis and treatment of chronic low back pain.[1,2] Examination of the total cross-sectional area of the multifidus muscle using Magnetic Resonance Imaging (MRI) has been used to assess the effectiveness of selective spinal stabilization exercises in patients with chronic low back pain (LBP).[3]

The role of the paraspinal muscles in the origin of LBP remains unclear.[1-5] There are indications that the multifidus muscles are susceptible to the different pathologies in LBP.[6-8] However, it is not known whether atrophy of the paravertebral muscles is a cause or a result of the different pathological processes of LBP.[8] Hides et al.,[9] demonstrated a reduction in the cross-sectional area of the multifidus muscles on the ipsilateral side in patients with unilateral LBP. The multifidus is important as it provides segmental stability and functions as a dynamic stabilizer of the lumbar spine.[3]

Previous studies[4,5] showed a significant increase in the cross-sectional area of the multifidus muscle after eight weeks of spinal stabilization exercise compared to the pre-exercise status. It is generally believed that muscular insufficiency and LBP are related, although the primary direction of this relationship is unclear.[6-9] Does insufficient muscle control or strength cause LBP, or does lower back pain affect the muscles and their function?[8]

The musculature reinforces lumbar lordosis during rotation and opposes lumbar flexion.[3,10-12] It is hypothesized that lumbar muscle dysfunction results in pain, and can lead to fatty infiltration of the multifidus.[2,8,13-21]

An MRI test can provide a view of the paravertebral muscle condition in relation to LBP.[8,17] Fatty infiltration can be observed on an MRI scan, demonstrating validation for the identification of muscle volume and the amount of fat in the human skeletal muscle.[8,22-28]

Thus, the following hypothesis is raised: The characteristics of low back pain due to fatty degeneration are not significantly associated with the patient's sex or age.

In light of the above, this retrospective cross-sectional observational study focuses on correlating fatty degeneration, visualized on MRI, with the sex and age of patients with symptomatic low back pain.

METHODS

As it is a research project involving human subjects, this study was submitted to the Institutional Review Board (IRB), as determined by Resolution no. 466/2012 and Operating Standard no. 001/2013 of the Brazilian National Board of Health (CNS), CAAE no. 46177621.0.0000.5245.

The sample group of this study was made up cases of unreferred symptomatic low back pain patients treated between 2015 and 2020 in the Serviço de Ortopedia e Traumatologia Prof. Donato D'Angelo (Orthopedics and Traumatology Division) of Hospital Santa Teresa (HST) de Petrópolis-RJ, Brazil.

Retrospective data were collected, in that we initially sought to identify eligible cases from an analysis of 341 medical records of patients treated in the period. However, only fifty cases presented fatty degeneration on the MRI. At the same time, we also collected data on the patients' age and sex for correlation with injury, degree of degeneration at each spinal level, number of levels affected, and highest degree of degeneration. Additionally, in the medical records with an MRI scan without fatty degeneration, we also collected data on the patients' sex and age for correlation extraction.

Using the information obtained from the medical records, with the authorization of the Radiology Division of the Institution, the MRIs with fatty degeneration were released for use in this study. The outcome observed in the MRIs was the occurrence of fatty infiltration in the paraspinal and erector muscles that would justify the complaint of LBP. This analysis was carried out by three blind observers (2 Orthopedics and Traumatology Division residents and 1 Radiology Division employee) who received prior training with the Classification of Goutallier et al.,[29], using five MRIs (provided by the Radiology Division of the same institution) with a diagnosis of fatty degeneration as pilot.

In the corresponding MRIs, we observed the musculature at the five lumbar levels (L1-L2, L2-L3, L3-L4, L4-L5, L5-S1) and the degree of fatty degeneration at each level, defined according to the Classification of Goutallier et al.:[29] Grade 0 – no fatty infiltration; Grade I – some fatty streaking; Grade 2 – less fat than muscle; Grade 3 – equal amounts of fat and muscle; Grade 4 – more fat than muscle (Figure 1). Each analyzed image was filed with the respective study registration number (MRIdg-01, MRIdg-02...., MRIdg-341) without any information that could identify the patient (first name, last name, initials, medical record number), and saved with the file extension*.jpeg to support the study database.

The variables of interest (Table 1) from the research instrument (Figure 1) were allocated in a Microsoft Excel electronic spreadsheet, thereby constructing a research database. (Figure 2) The statistical analysis was performed using the IBM Statistical Package for the Social Sciences (SPSS), version 22.0.

The purpose of the analysis was to describe the characteristic patient profiles and the distributions of the variables of interest. The analysis was based on the construction of box plots, frequency distributions and calculation of descriptive statistics (mean, standard deviation) and coefficient of variation (CV) for the quantitative variable (age). Age distribution variability was considered low if CV <0.20, moderate if CV ≤0.20 and <0.40, and high if CV ≥0.40.

MRI/Sex/Age data collection instrument

Patient ID No. _____
Age:_____
Sex:_____

MRI Data
Injury found on the MRI that justifies low back pain:_____

Lumbar level	Degree of fatty degeneration
L1-L2	
L2-L3	
L3-L4	
L4-L5	
L5-S1	

Classification of Goutallier et al. (1994)
Grade 1: Some fatty streaking
Grade 2: Less fat than muscle
Grade 3: Equal amounts of fat and muscle
Grade 4: More fat than muscle

Number of levels affected by fatty degeneration_____
Highest degree of degeneration obtained_____

Figure 1. MRI/Sex/Age data collection instrument.

Table 1. Study variables: classification and definition.

Variable	Classification	Definition
Age	Quantitative discrete	Patient's age at the time of the test
Sex	Qualitative nominal	Patient's sex
Lumbar level injury	Qualitative nominal	Injury declared in the MRI scan, which justified the low back pain
Degree of degeneration at each level	Qualitative ordinal	Degree of degeneration found at the lumbar level according to the Classification of Goutallier et al. (1994).
Number of levels affected	Quantitative discrete	Number of levels affected by degeneration
Highest degree of degeneration	Qualitative ordinal	Highest degree found at the lumbar levels

Database for statistical analysis							
N	Patient			MRI – Fatty degeneration			
	ID Number	Sex	Age	Lumbar Level	Degree	N. of levels	Highest Degree
01							
02							
03							
04							
05							
06							
...							
341							

Figure 2. Database for statistical analysis.

In the Inferential Analysis, two complementary proportions were compared using the Binomial test, and normality distribution of age was investigated using the *Kolmogorov-Smirnov* and *Shapiro Wilk* tests. To discover whether the degree of fatty degeneration was associated with the patient's sex, the distributions of this variable in the two independent subgroups (male and female) were compared using Student's t-test if the subgroup sample was ≥30 and the distributions normal in the two subgroups, or the *Mann-Whitney* test if at least one of the groups had a sample size <30 or non-normal distribution. The same methodology was used to investigate whether fatty degeneration was associated with age.

The correlation between two quantitative or ordinal variables, e.g., the correlation between the degree of degeneration and the patient's age, was evaluated using the Spearman Rank-Order Correlation Coefficient. A correlation was considered strong only if its absolute value was >0.70, and moderate if its value was >0.50 and ≤0.70. The significance of the correlation coefficient was investigated using the t-test of significance of the correlation coefficient. All discussions were carried out at the maximum significance level of 5%.

RESULTS

This study was based on the analysis of MRI scans of unreferred patients treated in the HST (Petrópolis-RJ) due to complaints of low back pain. The distribution of frequencies of injury found in the MRI test that can justify low back pain is shown in Table 2. No finding that would justify low back pain due to fatty degeneration was recorded in the majority of cases (80.90%), and among the causes, fatty degeneration was found in 14.70% (n = 50) of cases.

Table 3 shows the main statistics of the patients' age distribution with the distribution in each group (Figure 3). Overall, patients' ages ranged from 14 to 40 years (mean = 28.90 ± 5.40 years), which resulted in a coefficient of variation (CV = 0.19), attesting to low variability around the mean. Patients with fatty degeneration only are younger than those without any MRI abnormalities, with a difference of 2.40 years on average (Figure 3). When comparing the age distributions of patients without abnormalities and with fatty degeneration, the *Mann Whitney* test revealed a significant difference between distributions (p = 0.005).

The frequency distribution of the characterization of cases of low back pain due to fatty degeneration (n = 50) is allocated in Table 4. The results show that a Grade 1 L5-S1 injury was the most frequent case in 24% (n = 12) of patients with this injury. Table 5 contains the identification of each lumbar level with the degree of degeneration, number of cases, and relative frequency of cases at the above levels. It was confirmed that in all cases of injury, the degree of fatty degeneration of a higher level was never greater than the degree of fatty degeneration of a lower level.

Table 6 contains the severity analysis of cases of fatty degeneration, according to the number of injured levels and the highest degree of degeneration. Regarding the number of injured levels, the results that stand out are the frequencies of 30% (n = 15) of cases with two levels, 26% (n = 13) of cases with only one level, and an important portion: 24% (n = 12), of cases with fatty degeneration at five spinal levels. However, when severity was evaluated according to the degree of degeneration, a small portion (8%) had an injury with a high degree of degeneration.

The coefficient of correlation between age and number of levels affected was (r = 0.22; p = 0.128); therefore, the number of levels affected was not correlated with the patient's age. The coefficient of correlation between age and highest degree of degeneration

Table 2. Distribution of frequencies of injury found in the MRI that justifies low back pain.

Injury detected on MRI	Frequency	%
No findings	276	80.90
Fatty degeneration	50	14.70
Degenerative Disc Disease	8	2.30
Post-operative	2	0.60
Degenerative Disc Disease and Synovitis	2	0.60
Fracture	1	0.30
Synovitis	1	0.30
Fracture and Synovitis	1	0.30
Total	341	100.00

% (percentage).

Table 3. Main statistics of the age distribution of patients with complaint of low back pain.

Age	Overall (n = 341)	No alteration (n = 276)	Fatty degeneration (n = 50)
Mean	28.90	29.10	26.70
sd	5.40	5.20	5.70
CV	0.19	0.18	0.22

sd (standard deviation); CV (coefficient of variation).

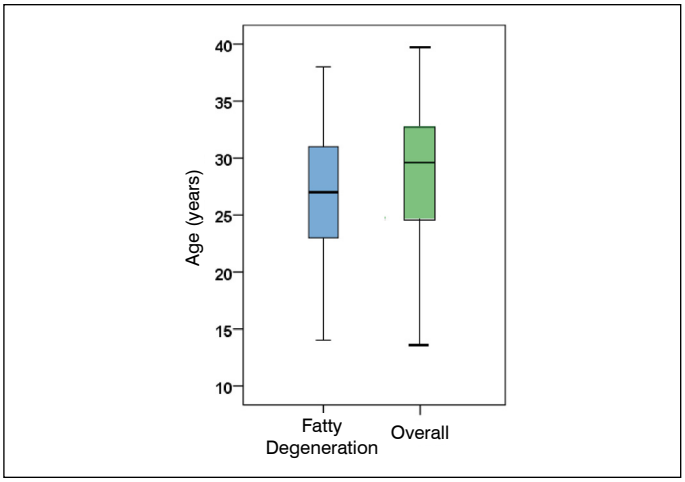

Figure 3. Box plot of patient age distribution according to the abnormality detected in the MRI.

(r = 0.13; p = 0.352) also demonstrated that the severity of the degeneration was not correlated with the patient's age, yet the coefficient of correlation between number of affected levels and the highest degree of degeneration (r = 0.67; p <0.001) showed that there was a significant and moderate correlation between the number of levels affected and the highest degree of fatty degeneration found. The positive correlation indicated that as the number of affected levels increases, the highest degree of degeneration also tends to increase.

Among the cases of fatty degeneration (n = 50), 78% (n = 39) were women and 22% (n = 11) men, and the binomial test showed a significant predominance (p <0.001) of women among patients with low back pain due to fatty degeneration. The distributions shown in Table 7 and in Figures 4 and 5 show that the injuries were significantly more severe, in terms of both the number of levels affected (p <0.001) and the highest degree of injury (p <0.001).

DISCUSSION

The study partly rejected the hypothesis by noting that injuries in low back pain due to fatty degeneration were significantly more severe in women, in terms of both the number of levels and the greater degree of injury. However, it was noted that the number of levels affected, and the severity of the degeneration, were not correlated with the patient's age. Kjaer et al.,[8] showed that fatty infiltration in the lumbar multifidus muscles was strongly associated with LBP, and that this association appears to be more pronounced in women.

According to previous studies,[30,31] fatty infiltration in the lumbar multifidus muscles is reversible, and if this is indeed the case, this reversibility needs to be studied to verify whether it coincides with the improvement of symptoms.[8]

This study enabled us to characterize the causes of low back pain cases and to describe cases due to fatty degeneration based on information about patients' age and sex, lumbar level with degeneration, degree of degeneration and number of spinal levels affected by fatty degeneration. We were able to ascertain that for 80.90% of patients with complaints, there were no MRI findings that would justify low back pain due to fatty degeneration, and this occurred in 14.70% of cases. In one study,[8] fatty infiltration was identified in 81% of the sample group, but in only 14% of younger patients. High prevalence rates were also reported in previous studies,[32,33] and

Table 4. Characterization of cases of low back pain due to fatty degeneration.

Description of fatty degeneration	Frequency	%
Grade 1 at L5-S1	12	24.00
Grade 1 at L4-L5 and L5-S1	8	16.00
Grade 1 from L1-L2 to L4-L5 and Grade 2 at L5-S1	7	14.00
Grade 1 at L4-L5 and Grade 2 at L5-S1	7	14.00
Grade 1 from L3-L4 to L4-L5 and 2 at L5-S1	5	10.00
Grade 1 from L1-L2 to L3-L4; Grade 2 at L4-L5 and Grade 3 at L5-S1	3	6.00
Grade 1 at L3-L4 to L5-S1	2	4.00
Grade 1 from L1-L2 to L5-S1	1	2.00
Grade 1 from L1-L2 to L3-L4 and Grade 2 from L4-L5 to L5-S1	1	2.00
Grade 1 from L2-L4 to L4-L5 and Grade 2 at L5-S1	1	2.00
Grade 1 at L3-L4 de L4-L5 and Grade 3 at L5-S1	1	2.00
Grade 1 at L3-L4 and L4-L5 and Grade 2 at L5-S1	1	2.00
Grade 2 at L5-S1	1	2.00
Total	50	100.00

% (percentage).

Table 5. Distribution of lumbar levels with degree and number of cases of fatty generation.

Lumbar level	Frequency	%	Grade	# of cases	%
LI-L2	12	24.00	1	12	100.00
L2-L3	13	26.00	1	13	100.00
L3-L4	22	44.00	1	22	10.000
L4-L5	37	74.00	1 2	33 4	89.20 10.80
L5-LS	20	100.00	1 2 3	23 23 4	46.00 46.00 8.00

% (percentage).

Table 6. Distribution of severity of cases of fatty degeneration found in the MRI.

Variable		Frequency	%
Number of levels affected	1	13	26.00
	2	15	30.00
	3	9	18.00
	4	1	2.00
	5	12	24.00
Highest degree found	Grade 1	23	46.00
	Grade 2	23	46.00
	Grade 3	4	8.00

% (percentage).

Table 7. Distribution of severity of cases of fatty degeneration according to sex.

Variable		Women		Men	
		Frequency	%	Frequency	%
Number of levels affected	1	5	12.80	8	72.70
	2	13	33.30	2	18.20
	3	8	20.50	1	9.10
	4	1	2.60	0	0.00
	5	12	30.80	0	0.00
Highest degree found	Grade 1	13	33.30	10	90.90
	Grade 2	22	56.40	1	9.10
	Grade 3	4	10.30	0	0.00

% (percentage).

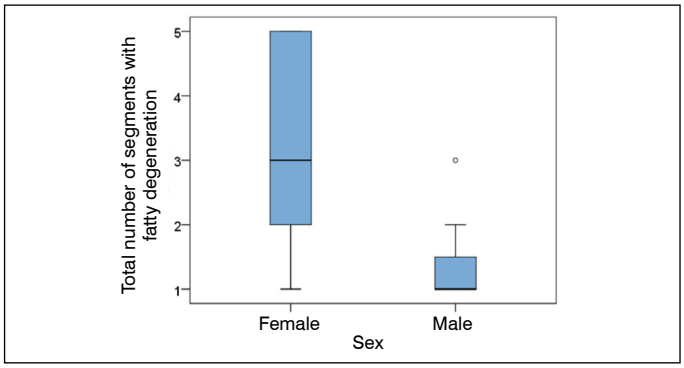

Figure 4. Box plot of the distribution of the total levels affected by fatty degeneration in the female and male groups (p < 0.001, *Mann-Whitney*).

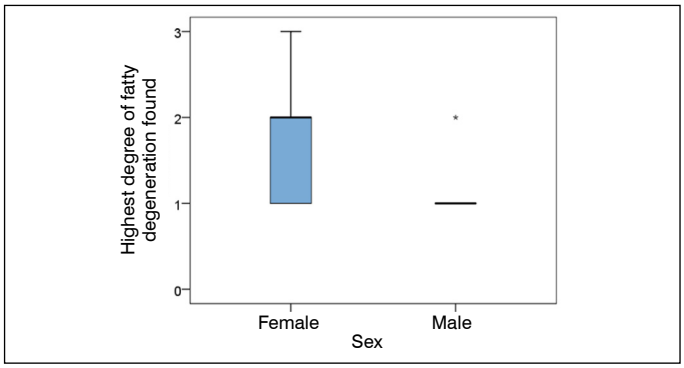

Figure 5. Box plot of the distribution of the highest degree of fatty degeneration in the female and male groups (p < 0.001, *Mann-Whitney*).

fatty infiltration was previously found to be more common in elderly subjects.[34] The fact that fatty infiltration is more common in adults suggested that it is LBP that causes muscle degeneration, and that in younger patients, LBP has not been present for sufficient time to produce such changes.[8]

In this study, Grade 1 degeneration of level L5-S1 was the most frequent case of fatty degeneration among patients with this injury (24%) and high grade cases were not very frequent, occurring in 8% of cases. Fatty degeneration starts at more caudal levels, hence level L5-S1 was affected in 100% of cases, and as the level increases, the frequency and degree of fatty degeneration gradually decrease, to the extent that fatty degeneration only affected level L1-L2 in 24% of cases. The degree of degeneration of a higher level will never be greater than the degree of degeneration of a lower level. Accordingly, we noted a significant and moderate correlation between the number of levels affected and the highest degree of degeneration, indicating that as the number of affected levels increases, the highest degree of degeneration also tends to increase.

The patients selected for this study were aged between fourteen and forty years. The objective was to study the impact of isolated fatty degeneration as the cause of low back pain, and the isolated onset of this condition occurred at very young ages. In fatty degeneration, the patients' ages varied moderately within the range of 14 to 38 years (mean 26.70 ± 5.70 years), with no significant difference between males and females. Patients with fatty degeneration were significantly younger than patients without a diagnosis in the MRI. Future longitudinal studies are needed to clarify the extent to which age and LBP contribute to the development of fatty degeneration.

The number of levels affected ($r = 0.22$; $p = 0.128$) and highest degree of degeneration ($r = 0.13$; $p = 0.352$) were not correlated with the patient's age; however, separately, between the number of levels affected and the highest degree of degeneration ($r = 0.67$; $p < 0.001$), there was a significant and moderate correlation between the number of levels affected and the highest degree of fatty degeneration found. A positive correlation indicated that as the number of affected levels increases, the highest degree of degeneration also tends to increase.

Low back pain due to fatty degeneration occurred predominantly in females. While 32.60% of women had more than two levels affected, only 9.10% of men had more than two levels; and while only 12.80% of women had just one level affected, 72.70% of men had only one level. In terms of severity, while 90.91% of men had Grade 1 as the highest degree of degeneration, only 33.30% of women had Grade 1 (Table 7).

The association of variables of this study with the patient's sex was investigated using the *Mann-Whitney* test, which did not show a significant difference between the age of female and male patients ($p = 0.474$), but did show a significant difference between the severity of injuries in female and male patients. The marked differences in fat in the lumbar multifidus muscles in men and women may be a result of the well-documented differences in body composition. It would appear that the higher proportion of body fat in women is also reflected in the proportion of fat in the lumbar multifidus muscles. This raises the question as to whether the classification should be different for men and women. In addition, the high prevalence rate of slight fatty infiltration indicates the need to change the cutoff point used.[8]

A shortcoming of this study is the absence of a body mass index (BMI) and physical activity analysis among patients with an MRI with fatty degeneration. This absence is due to the fact that these data are missing from the medical records of most patients, which would result in considerable bias.

It is generally assumed that back muscle dysfunction results in pain inhibition, which can ultimately lead to fatty infiltration in the lumbar multifidus muscles.[2,20] The mean fat content in the lumbar multifidus muscle in healthy individuals is reduced to levels as low as 14.50%, while in individuals with chronic LBP, the fat content in this muscles can reach mean levels as high as 23.60%.[8,35] These data corroborate the results of this study, as it was the most common case of fatty degeneration among patients with this injury (24%). About 80% of people who suffer from LBP have increased fatty infiltration in this muscle.[28] Interestingly, there is no correlation between obesity and the presence of fat in the lumbar multifidus muscle.[8]

Finally, the study provides relevant knowledge about low back pain due to fatty degeneration, by characterizing the way in which this degeneration occurs and finding associations that enrich the learning and practice of professionals who study this pathology or treat patients with this type of injury.

CONCLUSION

Low back pain due to fatty degeneration occurs predominantly in women and patients' ages vary moderately within the range of 14 to 38 years (mean 26.70 years).

Regarding the number of levels and the highest degree of injury, fatty degeneration as a cause of low back pain was significantly more severe in women.

The number of levels and the severity of fatty degeneration were not correlated with the patient's age.

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