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The Relationship Between Dorsal Subcutaneous Fat Tissue Thickness and Lumbar Disc Herniation: A Magnetic Resonance Imaging-Based Study

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Abstract

Objective: The aim of this study was to find out the relationship between dorsal subcutaneous fat tissue thickness and lumbar disc herniation.

Methods: The lumbar magnetic resonance images of 209 were re-interpreted. Of these patients, 107 had disc herniation (herniated group), while 102 of them had no disc herniation (non-herniated group) in lumbar magnetic resonance images. The dorsal subcutaneous fat tissue thickness was measured for each patient on lumbar magnetic resonance imaging and the results were compared between these groups. The dorsal subcutaneous fat tissue thickness was measured on magnetic resonance images at the L4-5 and L5-S1 levels for all the patients included in the study and the measurement results were compared with an independent *t*-test for all groups.

Results: There was no statistically significant difference between herniated and non-herniated groups according to the measurement results of the dorsal subcutaneous fat tissue thickness ($P = .446$). No significant differences were observed within different age groups or within females and males either.

Conclusion: No relationship was found between dorsal subcutaneous fat tissue thickness and lumbar disc herniations according to the results of this study.

Keywords: Disc herniation, adipose tissue, magnetic resonance imaging, lumbosacral region

INTRODUCTION

Balanced body composition is crucial for health and physical activities. Inactivity and body composition-related chronic diseases are accepted as one of the most important public health problems of the 21st century.[1] Some authors in the literature claimed that increased body weight might have biomechanical effects on lumbar spine alignment.[2] These biomechanical stresses are well known to play a role in vertebral pathologies.[3,4] The alterations of the spinal biomechanics led the authors to investigate the possible relationship between low back pain and body weight.[5] Optimal anatomical alignment of the bones and joints renders an effective function of the musculoskeletal system, and disc herniations are one of the most common problems of the spine, which causes low back pain and decreases the quality of life of the individual. Magnetic resonance (MR) imaging enables the detection of disc pathologies and explains the underlying cause of the radiculopathies with its excellent soft tissue contrast. There are some parameters that were claimed to be related to disc pathologies in the literature. Dorsal subcutaneous fat tissue thickness (DSFTT) is one of the parameters which were studied before using MR images and the investigators tried to find out the relationship between DSFTT, obesity, and disc degeneration.[6,7] This current study aimed to focus on revealing the relationship between lumbar disc herniations and DSFTT which can easily be measured on MR images.

METHODS

Patients

This research was designed as a retrospective cross-sectional study. After the approval of this study by the institutional ethics committee (Ethics Commitee of Erzincan Binali, Yıldırım University, Date: 02.11.2022, Session: 04, Number: E-26447783-050.06.04-212526), the lumbar MR images of 345 patients who had undergone MR examination between January 1, 2022, and January 20, 2022, have been re-interpreted. The patients who had any disc herniation (disc protrusion or extrusion) in L4-5 or L5-S1 or both these intervertebral disc levels were chosen as the "herniated" group. The patients who had no disc herniations in any intervertebral disc levels were chosen as the "non-herniated" group and disc bulging was also included in this category since this pathology is not accepted as a real disc herniation. Patients with any previous lumbar spinal surgery, congenital anomalies, scoliosis, vertebral deformities, or malignant lesions on MR images were excluded. Since this study aimed to investigate the relationship between DSFTT and lumbar disc herniations in skeletally mature individuals, patients under 18 years old were excluded. As a result, 209 MR images, each belonging to a different patient were considered to calculate the statistical results.

Lumbar Magnetic Resonance Imaging and Interpretation

Magnetic resonance imaging for the lumbar region was handled by a standard protocol used for disc pathologies. All MR images were obtained by a 1.5 T MR machine (Magnetom Aera, Siemens, Erlangen, Germany) and with 32-channel lumber coils. The patients were in the supine position in the MR machine while the images were acquired. Sagittal plane T2-weighted images (TR [Time of Repetation]: 4120 ms, TE [Time of Echo]: 104 ms, average: 2, field of view: 280 mm, slice thickness: 4 mm, voxel size: 0.9 × 0.9 × 4 mm), sagittal plane T1-weighted images (TR: 646 ms, TE: 9 ms, average: 2, field of view: 280 mm, slice thickness: 4 mm, voxel size: 0.9 × 0.9 × 4 mm), and axial plane T2-weighted images (TR: 5070 ms, TE: 88 ms, average: 1, field of view: 190 mm, slice thickness: 4 mm, voxel size: 0.7 × 0.7 × 4 mm) were obtained from each patient as a part of a routine lumbar spinal study with regard to intervertebral disc protocols. All MR images were re-evaluated by a radiologist with 17 years of experience. A picture archiving and communication system (Akgün PACS Viewer v7.5, Akgün Software, Ankara, Turkey) was used to analyze the MR images and make measurements in standard digital imaging and medicine formats.

Dorsal Subcutaneous Fat Tissue Thickness Measurement and Statistical Analysis

The DSFTT measurements were done on MR images at the L4-5 and L5-S1 levels for all the patients included in the study. The thickness of the dorsal subcutaneous fat was measured perpendicularly to the skin surface in mid-sagittal T1-weighted images (Figure 1). The average value of these 2 levels was considered in the statistical calculations. All statistical calculations were achieved using the Statistical Package for the Social Sciences version 22.0. (IBM SPSS Corp.; Armonk, NY, USA). The Kolmogorov–Smirnov test was carried out to find out the distribution characteristics of the data and the association between the DSFTT measurements was compared with an independent *t*-test for all groups. To analyze the test results, *P* values less than .05 were accepted to indicate statistical significance.

RESULTS

The age and sex distribution of the patients included in this study were shown in Table 1. There was no significant difference between herniated and non-herniated groups with regard to age ($P = .844$). There was no statistically significant difference between herniated and non-herniated groups' DSFTT measurements ($P = .446$).

The data set was also studied to calculate a possible significant difference between age groups (<40 years and ≥40 years) and any difference between females and males with regard to DSFTT measurement results. The age groups revealed no significant difference, and the mean DSFTT value of the males was significantly lower than females ($P < .001$) (Table 2).

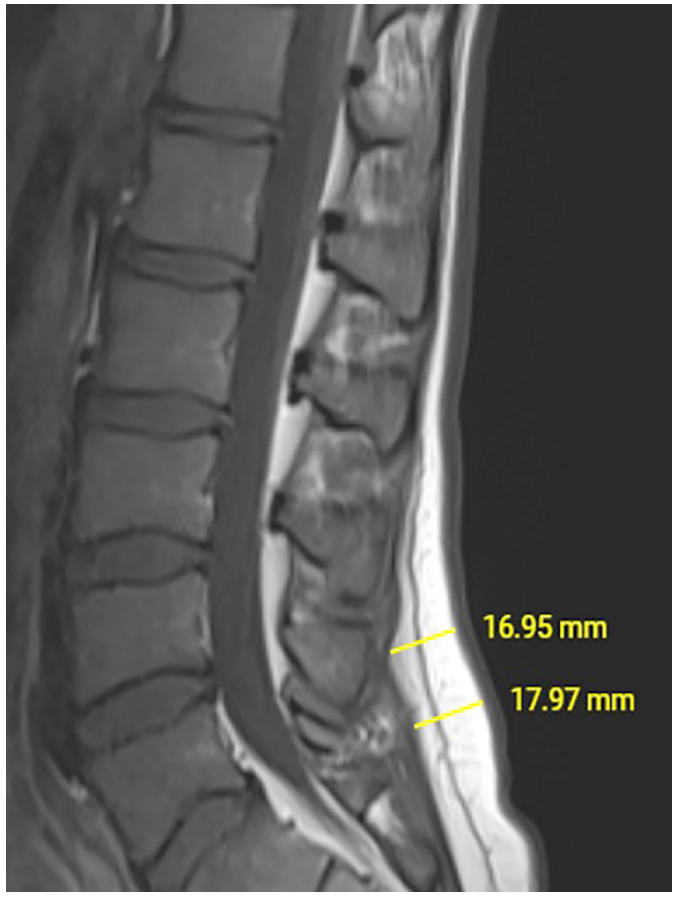

Figure 1. The dorsal subcutaneous fat thickness was measured on sagittal T1-weighted images as shown in the figure.

Table 1. Age and Sex Distribution of Patients

	Herniated	Non-herniated	*P*
n	107	102	
Sex (F/M)	65F/42M	60F/42M	
Mean age	43 ± 14	43 ± 13	.844
Mean DSFTT (mm)	26.62 ± 12.96	25.94 ± 14.23	.446

DSFTT, dorsal subcutaneous fat thickness; F, female; M, male.

Table 2. Dorsal Subcutaneous Fat Tissue Thickness Measurements Regarding Age and Sex

Age	<40 Years (n=84)	≥40 Years (n=125)	*P*
Mean DSFTT (mm)	38.43 ± 27.41	38.60 ± 24.72	.948
Sex	Female (n=125)	Male (n=84)	
Mean DSFTT (mm)	42.67 ± 25.31	32.12 ± 25.18	**<.001**

The results in bold represents the statistically significant values

Table 3. Dorsal Subcutaneous Fat Tissue Thickness Measurements of the Female Group

	n	Mean	Standard Deviation	*P*
Herniated	65	43.02	25.79	.769
Non-herniated	60	42.08	24.86	

MAIN POINTS

- Low back pain may cause decreased physical function, compromised life quality, and psychological stress.
- Obesity is recognized as another factor playing a role in low back pain.
- In the literature, there are researchers indicating the association between low back pain and disc degeneration both for adolescents and adults.
- A high correlation between body fat percentage and dorsal subcutaneous fat tissue thickness was shown by some investigators.
- The results of this current study indicated no relationship between dorsal subcutaneous fat tissue thickness and intervertebral disc herniations

Table 4. Dorsal Subcutaneous Fat Tissue Thickness Measurements of the Male Group

	n	Mean	Standard deviation	*P*
Herniated	42	33.31	26.04	.420
Non-herniated	42	30.20	23.56	

Table 5. Dorsal Subcutaneous Fat Tissue Thickness Measurements of the Group Younger Than 40 Years

	n	Mean	Standard Deviation	*P*
Herniated	45	41.74	28.32	.074
Non-herniated	39	34.10	25.81	

Table 6. Dorsal Subcutaneous Fat Tissue Thickness Measurements of the 40 Years and Older Group

	n	Mean	Standard Deviation	*P*
Herniated	62	37.45	24.64	.553
Non-herniated	63	39.30	24.47	

The difference between herniated and non-herniated groups was also calculated within each gender group and both indicated no significant difference (Tables 3 and 4). There was no difference between the patients younger than 40 years (Table 5) and 40 years or older (Table 6) either.

DISCUSSION

Low back pain may cause decreased physical function, compromised life quality, and psychological stress.[8] Obesity is recognized as another factor playing a role in low back pain.[9,10] In the literature, there are researchers indicating the association between low back pain and disc degeneration both for adolescents[11] and adults.[12] A high correlation between body fat percentage and DSFTT was shown by some investigators.[7] Koda et al[13] used sonography and MR imaging together to measure the correlation between sonographic fat tissue thickness and visceral fat volume. They have found an association between sonographic subcutaneous fat index (fat thickness at the umbilicus level/height) and subcutaneous fat thickness were significantly correlated with subcutaneous fat volume measured on MR imaging. Another study in the literature indicated that subcutaneous fat tissue thickness at upper lumbar levels has been found to predict severe intervertebral disc degeneration and Modic changes better than body mass index.[14] Endorsed from all these data and associations underlined by the researchers in the literature, this current study tried to find out the possible relationship between lumbar disc hernias and DSFTT; however, the results showed no relationship between DSFTT and lumbar disc herniation.

Due to the mobility of the lumbosacral part of the spine, this segment is known to be prone to disc herniations. Previous literature has indicated that the 75% of lumbar flexion occurs at the lumbosacral joint and 15-20% of flexion occurs at the L4–L5 level.[15] In this study, L4–L5 and L5-S1 intervertebral disc levels were used to analyze since a majority (90-95%) of clinically significant compressive radiculopathies are known to be encountered at these levels.[16]

The study by Okan and Beyhan[17] indicated higher DSFTT values in females than in males. In another study, in which the association between the body mass index of 149 individuals and lumbar adipose tissue thickness was evaluated, women's adipose tissue thickness was higher than that of men.[18] The results in this current study were similar to these investigations in the literature. In women, estrogen receptors are more common and there are fewer androgen receptors in subcutaneous adipose tissue. On the other hand, androgen receptors are more predominant in visceral adipose tissue in men.[19] Some authors explained higher DSFTT values in women and claimed that higher subcutaneous adipose tissue thickness in women may be a result of a higher prevalence of estrogen receptors in subcutaneous adipose tissue compared to men.[17]

There are some limitations of this study to discuss. First, to better understand the effect of the amount of axial force on the spine, body mass index should be verified for each patient and the relationship between DSFTT and body mass index should also be studied to analyze the risk factors of the patients for lumbar disc herniation; however, this study focused on a direct relationship between disc herniations and DSFTT. Second, all measurements were done by 1 radiologist. It would be a lot better to measure the DSFTT with more than 1 reviewer and calculate the intra- and interobserver differences. In addition, disc herniations were decided by MR images and the herniated group was planned on the radiological evidence. Re-evaluating the preoperative MR images of the patients that are known to have undergone lumbar disc surgery would be better to compare the measurements with the non-herniated group to support the accuracy of the results of the study. Despite the limitations, there were also opportunities to increase the accuracy of the results of this study. In general, lumbar disc herniations tend to increase through aging. Despite this fact, the insignificance of the age difference between the herniated and non-herniated groups in this investigation rendered a better comparison of the statistical results between these groups.

CONCLUSION

Dorsal subcutaneous fat tissue thickness is easy to measure on MR images. This parameter is mentioned to be related to obesity and disc degeneration in the literature. However, the results of this study indicated no relationship between DSFTT and intervertebral disc herniations. More studies with larger patient groups are needed to show or rule out this relationship in the literature.

Ethics Committee Approval: This study has been approved by the institutional Ethics Committee of Erzincan Binali Yıldırım University, Faculty of Medicine (Date October 13, 2022, Decision No: EBYUKAEK- E-352 78931 0-040 .00.0 2-187 432).

Informed Consent: The ethics commitee has waived the informed consent from each patient due to the methodology of the study.

Peer-review: Externally peer-reviewed.

Declaration of Interests: The authors have no conflicts of interest to declare.

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