

Morphology of the Myofascial Structures of the Lumbosacral Complex in Healthy People: Preliminary Report from Single-Center and Cross-Sectional Study

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Abstract

Background: The proper functioning of the lumbosacral complex requires the integrated activity of all its components. Proper segmental control of the lumbosacral region of the spine and its stabilization are required.

Aims: This study aimed to determine the morphometry of the musculofascial structures of the lumbosacral region of the spine in young subjects with no history of lower back pain, and the gender differences in the thickness of these anatomical structures.

Material and methods: The study included 20 subjects who underwent ultrasound examinations to estimate the thickness of the musculofascial structures of the lower spine. For the purpose of this study, two zones were distinguished: muscular zone (MZ) and perimuscular zone (PMZ). In the MZ, the thickness of the multifidus muscle (MFM) was measured. In the PMZ, the thickness of the following structures was measured: epimysium of the multifidus muscle (EMFM), loose connective tissue (LCT), and thoracolumbar fascia (TLF). The collected thickness measurements were analyzed as the average values from both sides of the body.

Results: Differences in MFM thickness were observed between men and women, while no differences were noted in the other measurements in the PMZ.

Conclusions: Resting MFM thickness is greater in men, whereas the resting thicknesses of the TLF, LCT, and EMFM are similar for both genders in the lumbosacral complex.

Key words

muscle morphology, ultrasound, multifidus muscle, musculofascial structures, lumbar spine

Introduction

Modern ultrasound imaging examinations allow for the assessment of structures in the lumbosacral complex. Despite significant advances in musculofascial imaging methods for clinical physiotherapy, there is still a lack of well-designed, representative, and adequately conducted cross-sectional studies in the available literature. These studies could lead to a better understanding of the mechanisms of the lumbosacral complex and contribute to the selection of an effective therapeutic management algorithm [1, 2]. There is an urgent need to explore these subjects to transfer newly acquired theoretical knowledge to the clinical setting.

Aims

This study aimed to determine the morphometry of musculofascial structures of the lumbosacral region of the spine in young subjects without lo-

wer back pain episodes, and to estimate gender differences in the thickness of these anatomical structures.

Material and methods

The study included 20 subjects, including 10 men and 10 women (**Table 1**). Inclusion criteria were: (1) age between 20–50 years, (2) no pelvic or lower back pain in the past six months, and (3) no history of acute pelvic and lower back pain. Exclusion criteria were: (1) history of previous severe injury, (2) history of previous surgeries in the abdomen, pelvis, or lumbar spine, (3) pregnancy, (4) systemic disease, (5) skin diseases in the examined region, (6) active participation in training affecting the lower back region and abdominal muscles in the last three months, and (7) BMI values greater than 25 kg/m².

Table 1. Characteristics of the subjects.

Character	Women (n=10) M ± SD	Men (n=10) M ± SD	p
Age (years)	30.0 ± 6.6	29.1 ± 5.7	0.748
Body height (cm)	169.9 ± 8.1	182.0 ± 5.1	0.001
Body weight (kg)	62.5 ± 7.2	80.7 ± 6	0.000
BMI (kg/cm ²)	21.7 ± 2.8	24.4 ± 1.5	0.019

Abbreviations: BMI – body mass index; M – mean; SD – standard deviation; p – statistical significance.

Before the study began, the participants were asked to lie on a therapy table in a supine position with their faces placed in the table's notch. A pillow was placed under the pelvis to reduce lumbar lordosis. The upper limbs were abducted to 120° and flexed at the elbows to 90°. The top of the iliac crest, the reference point for the spinous process of the fourth lumbar vertebra (L4), was used to determine the order of the spinous pro-

cesses. After locating the spinous process of L5, two points were marked on either side, 2 cm from its center. An ultrasound device was used to confirm whether these points were placed in the appropriate places. The morphometric parameters of the multifidus muscle (MFM) and thoracolumbar fascia (TLF) were examined in the resting position. Six images were taken of each side of the subject's body.

For the purpose of this study, two zones were identified: the muscular zone (MZ) and the perimuscular zone (PMZ). In the MZ, the MFM thickness was measured. The measurement was made from the apex of the target articular process to the inner edge of the upper border of the MFM. For the PMZ, the following thicknesses were measured: epimysium of the multifidus muscle (EMFM), loose connective tissue (LCT), and TLF. The EMFM thickness was measured between the

edges of the hyperechogenic region, which was located just above the area of the MFM muscle mass. The LCT thickness was determined between the borders of the hypoechogenic area, which was immediately above the EMFM. The TLF thickness was measured between the hyperechogenic borders of the area between the LCT and subcutaneous adipose tissue. The collected thickness measurements were analyzed as the average of both sides of the body (**Figs. 1 and 2**).

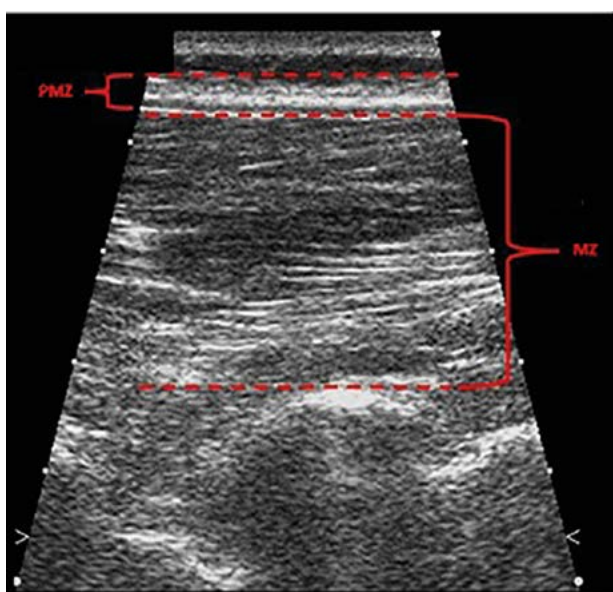


Figure 1. Ultrasound image in the sagittal plane showing the muscular (MZ) and perimuscular zones (PMZ).

Abbreviations: MZ – muscular zone; PMZ – perimuscular zone.

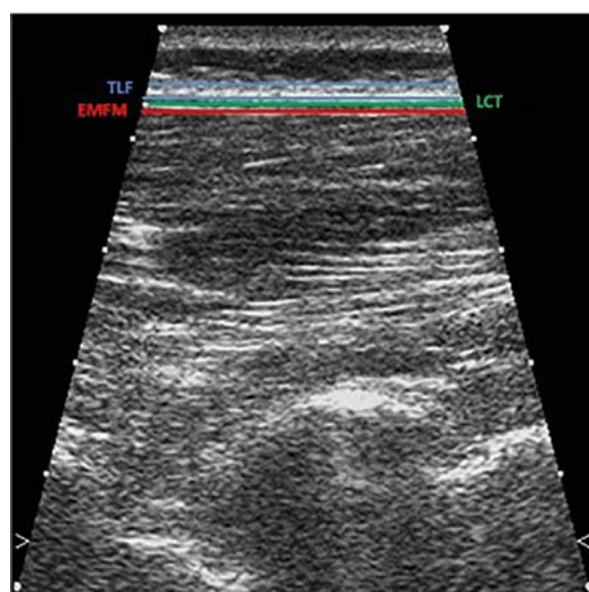


Figure 2. Ultrasound image in sagittal plane of fascial structures at the level of the L5/S1 movement segment of the spine.

Abbreviations: TLF – thoracolumbar fascia; LCT – loose connective tissue; EMFM – epimysium of the multifidus muscle.

Statistical analyses were performed using the Statistical Package for Social Sciences (SPSS) version 21. The distribution of the study variables was checked using the Shapiro-Wilk test. The Student's t-test or Mann Whitney U-test was used to compare independent variables, depending on the data distribution. The statistical significance level was set at $p = 0.05$.

Results

Statistical analysis showed significant differences in resting MFM thickness according to gender. MFM thickness was higher in men ($p = 0.019$), but there were no differences in EMFM thickness between the genders ($p = 0.384$; Fig. 3). There were no gender differences in the thickness of TLF ($p = 0.677$), LCT ($p = 0.112$), or EMFM ($p = 0.705$; Fig. 4).

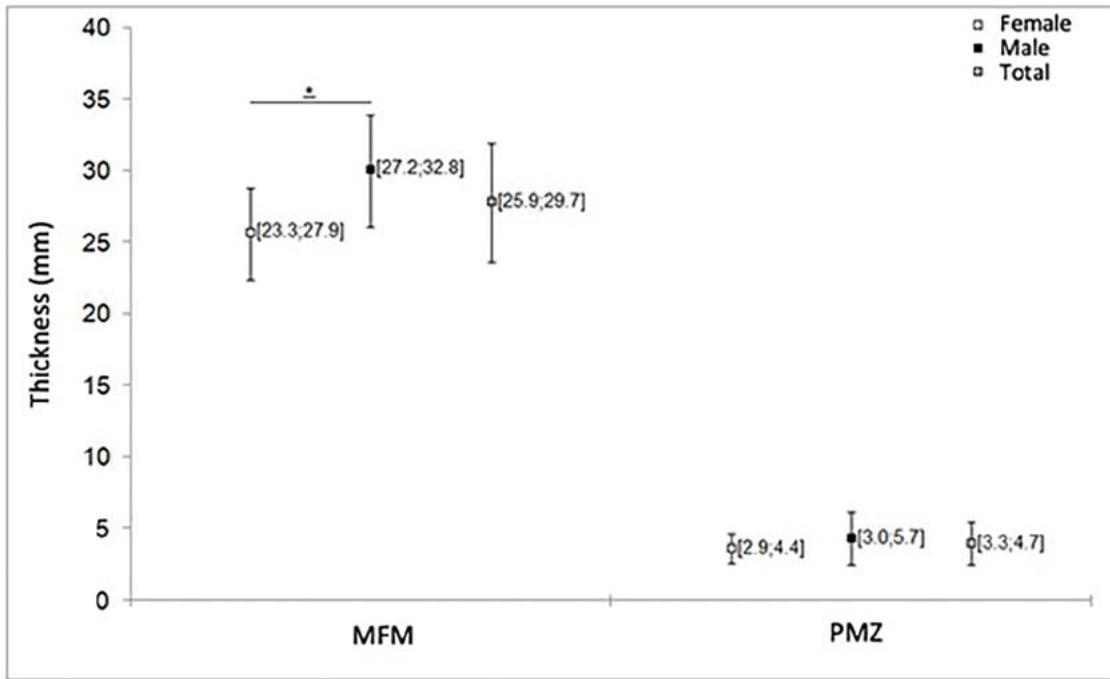


Figure 3. Results for the thickness of multifidus muscle (MFM) and perimuscular zone (PMZ) tissues for men and women.

Abbreviations: MFM –multifidus muscle; PMZ – perimuscular zone.

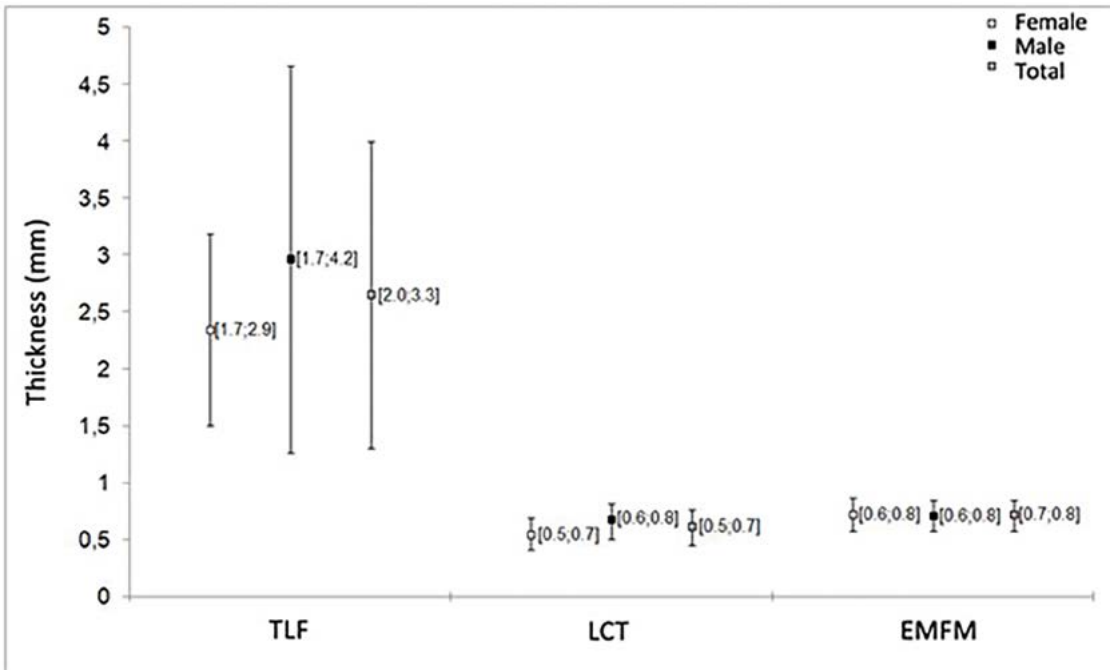


Figure 4. Results for the thickness of thoracolumbar fascia (TLF), loose connective tissue (LCT), and the epimysium of the multifidus muscle (EMFM) for men and women.

Abbreviations: TLF – thoracolumbar fascia; LCT – loose connective tissue; EMFM – epimysium of the multifidus muscle.

Discussion

The present study showed that the MFM at rest was thicker in men: on average, 27.2–32.8 mm compared to women's 23.3–27.9 mm. Unfortunately, there are few studies in the available literature on this subject.

These results are similar to those obtained by Deydre et al. [3], who reported that the resting MFM thickness was 30.6–31.7 mm for men and 26.0–27.4 mm for women. Another study showed that men also had a larger cross-sectional area of MFM [4].

The thickness of the remaining structures tested in the present study, such as TLF, EMFM, and LCT, was comparable in both genders. The average thickness of the TLF obtained in this study was 2.0–3.3 mm for both men and women.

Wilke et al. [5] studied the same TLF thickness and obtained values between 0.75 and 3.35 mm.

Schilder et al. [6] showed that the TLF thickness was 2.1 ± 0.5 mm. It should be mentioned that although the participants included those experiencing pain, the results for men and women were similar.

The limitations of this study should be noted. We had a small study group characterized by significant differences in some demographic variables. Selection of men and women with more comparable values for body weight and height would increase the representativeness of the study group of participants and strengthen the conclusions.

Conclusion

Resting MFM thickness is greater in men, whereas the resting thickness of the TLF, LCT, and EMFM is similar for both genders in the lumbosacral complex.

References

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