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Ultrasonic Thickness of Abdominal Muscles in Patients with Non-Specific Chronic LBP based on STarT Questionnaire Subgroups

Abstract

The Multidimensional STarT Questionnaire is an index of clinical decision making and the choice of treatment type in patients with Nonspecific Chronic Low Back Pain (NSCLBP). The present study aimed to compare the ultrasonic thickness of abdominal wall muscles between NSCLBP subgroups based on the StarT Questionnaire. Seventeen male patients with NSCLBP participated in the current analytical study. Based on the STarT Questionnaire, In the mild subgroup were 10 participants placed and 7 in the moderate subgroup, and only 2 participants had severe subgroup characteristics. The ultrasonic thickness of abdominal wall muscles was measured at rest and contraction in the supine position. Kolmogorov-Smirnov tests, spatial analysis with repeated measures, and for data analysis was used paired t-tests. The $p< 0.05$ was considered statistically significant. The thickness of the transversus abdominis and internal oblique muscles in the moderate subgroup was significantly lower than that of the mild subgroup ($p=0.04$, $p=0.001$ respectively), yet no difference was found in external oblique muscle ($p=0.05$). All three muscles (internal oblique, transversus abdominis, and external oblique) in contraction were thicker than in the rest condition ($p=0.02$, $p=0.001$, $p=0.007$, respectively). Moreover, there was no significant difference between the thickness of the left and right in either of the muscles, whether in the rest of the contraction condition ($p>0.05$). Considering the difference in ultrasonic thickness of the abdominal wall muscles between the subgroups of NSCLBP patients based on the STarT Questionnaire, this questionnaire is used to determine the type of treatmen.

Keywords: *Chronic non-specific Low Back Pain ; STarT Questionnaire; Ultrasonography; lateral abdominal wall muscles*

Yoones Amiri[1], Sadegh Tavakoli[*1], Farideh Dehghan Manashadi[2], Narges Yousefi Najafabadi[4], Alireza Akbarzade Baghban[3], najme amiri[5]

1Research and Technology Office for Students, School of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran, Iran
2School of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran, Iran
3. Assoc. prof in Biostatistics, school of Rehabilitation, shahid Behshti University of Medical Science, Tehran, Iran
4. Research and Technology Office for Students, Msc in physiotherapy, school of Rehabilitation, Isfahan University of Medical Science, Isfahan, Iran
5. Research and technology Office for students, MSc in Computer, school of Computer Science, Shahid Beshhti University, Tehran, Iran
Email: Corresponding: Tavakolisadegh@yahoo.com

Introduction

Introduction and purpose:

Low Back Pain (LBP) is one of the most common musculoskeletal problems that threaten the health of communities. Its prevalence has been reported to be 10% without considering the period of infection. [1] The prevalence of chronic LBP is estimated to be up to 20%, of which 31% suffer from non-specific chronic LBP [2]. Numerous studies have been performed on the level of lumbar-pelvic muscle function in patients with chronic LBP and have reported the weakness of local stabilizers, including the transverse abdominal muscles and multifidus [3-5].

Diagnosis of LBP was difficult in the early stages of treatment. The lack of a clear biomedical model to justify pain and treatment decisions leads to patient frustration and treatment. [1, 6] here a valid treatment tool is needed for the entire range of patients with chronic nonspecific back pain that is rapid and concise. The STarT questionnaire is an available questionnaire, brief and multidimensional, and is an indicator of prognosis related to the therapists' clinical decision to choose the type of treatment in the early stages of treatment. The key objectives of this tool are to determine and identify these patients with the prognostic index obtained from their scoring and grouping into three subgroups, to determine the type of treatment before starting treatment. The low-risk group has a low negative prognosis index and responds to analgesic treatment and counseling. The high-risk group has an unfavorable prognosis and is suitable for physiotherapy. They are recommended. [7,6] Persian translation and psychometrics of the STarT questionnaire were performed by Abedi et al. [8]. However, it is necessary to evaluate the efficiency of this classification system using objective, inexpensive, and accessible evaluation methods such as ultrasonography. Numerous studies have shown that ultrasound imaging is an acceptable method for assessing abdominal muscle activity in open, standing, and walking positions. [11-9] Hodges et al. compared the electromyographic activity of the abdominal muscles with ultrasonic thickness and observed and reported a good correlation between maximal contraction in the medial oblique and transverse muscles. [12]

Considering that the reduction of the thickness of the muscles of the lateral wall of the abdomen as a determining factor in their function has been suggested as one of the effective factors in the occurrence of pain in the lumbar region and its chronicity

[5, 4], STarT questionnaire is a valuable tool for grouping nonspecific back pain patients [7,8] Rehabilitation ultrasonography has been approved as a reliable, valid and non-invasive method for measuring the thickness of the lateral abdominal wall muscles in healthy individuals and patients with LBP. [13-9] The purpose of this research was to find an answer to the question of whether there is a difference in ultrasonic thickness of lateral abdominal wall muscles between different subgroups of patients with chronic nonspecific LBP according to the STarT questionnaire.

Materials and Methods:

In the present cross-sectional study, which was conducted from September 2014 to July 2015, patients who were referred to the physiotherapy department of hospitals under the auspices of Shahid Beheshti University of Medical Sciences, with the opinion of an orthopedist or neurosurgeon and a definition of chronic nonspecific LBP were included in the study. They had had LBP at least once in the past year, and this LBP had lasted more than a month each time [2: 5].

Nineteen male patients with an age range of 25-45 years were selected by the non-random sampling method. Criteria for not including people in the study were: Any history of surgery, Deformity, Bone fracture, Dislocation or malignancy of the lower limb or spine of the vulva, neuromuscular diseases, and systemic diseases such as diabetes that can affect musculoskeletal function. [13] Being an athlete, people's dissatisfaction at any stage with the implementation of the plan and also losing one of the conditions for entering the study, caused people to leave the study. People did not take muscle relaxants for 48-72 hours before the ultrasound.

A visual measurement scale was used to measure pain intensity. Persian version of the STarT questionnaire was used to group patients. Compression biofeedback made by Chatanoga Company (USA) was used to control the transverse abdominal muscle operation and Honda HS21000 Real-Time Ultrasound System - Made in Japan with Type B waves and a linear applicator with a frequency range of 5-10 MHz and a central frequency of 7.5 MHz were used for imaging.

First, each of them expressed their consent to participate in the present study by filling out a written consent form. After fully explaining the objectives and methods of surveys and experiments, demographic information including information on age, sex, height, and weight was distributed among the participants. Information was collected through face-to-face interviews. Then the pain intensity was assessed using a visual pain scale. This scale is one of the valid criteria for grading pain intensity for comparison between different periods and is in the form of a horizontal bar with a length of 10 cm, one end of which is zero painless and the other end is ten, which is the most severe pain. [17-14] The demographic characteristics of the participants are shown in Table 1.

Table 1: Mean and standard deviation of baseline indices in two subgroups of chronic LBP (number = 17)

Index / group	age	BMI	Intensity of pain (Visual scale of pain intensity)
Slight Number= 10	29.60 ±4.16	24.19 ± 2.63	3/9±1.19
Medium Number= 7	33 ±8.69	24.22 ± 3.28	7.43 ± 0.78

In the next step, people completed the Persian version of the STarT questionnaire. The STarT questionnaire is a bio-psychosocial approach questionnaire that has 9 options and divides patients with nonspecific chronic LBP into three subgroups: low, moderate, and high risk. [8-6] After completing the questionnaire, the total score of patients' responses was calculated If you agree with the said question, the score is one and if you disagree, the score is zero Based on the total scores obtained, individuals were divided into three subgroups; If their total score was three or less, they were placed in the low-risk group, If their total score was four or more, there were two situations: if the total score of questions 5 to 9 answered by the patient was three or less, they were in the middle-risk group, and if the total score of the answered questions was 9-5, number four or more, they were in the high-risk group. [8-3]. A total of 10 people were in the mild group, seven people were in the moderate group and only two people were in the severe group, which was excluded from the final analysis due to the small number. In each group, an ultrasound was performed separately to measure the thickness of the lateral abdominal wall muscles. To perform ultrasound imaging of the subject while lying on his back with straight knees and arms crossed on the shoulders was performed. To determine the location of the ultrasound probe, the axillary midline was determined (in order to record the thickness of the muscles of the lateral wall of the abdomen, including the inner, outer, and transverse inclinations). In the area between the edge of the iliac crest and the last gear, 2.5 cm came forward and this point was marked on the left and right, and in the supine position, this point of the muscles was imaged. [13,18,19] In

all imaging cases, the gel was first poured on the probe and the probe was placed vertically at the designated points then try to keep the probe in contact only with the skin and prevent the pressure of the probe. First, an ultrasound was performed in the muscle relaxation position then the patient was instructed Perform the transverse abdominal muscle by performing a tummy tuck maneuver with a focus on the lower abdomen and a reduction in waist width. At the same time, the activity of this muscle was controlled by touching its tendon in the upper anterior tibial region [19] and at the same time using compressive biofeedback; Thus, the non-change of the pressure of 40 mm Hg of compression biofeedback instrument showed the ability of the individual to act on the transverse abdominal muscle independently of other abdominal muscles. [20,21] Recording of resting thickness and contraction of lateral abdominal wall muscles at the end of exhalation, which is the maximum muscle activity, was performed bilaterally. After each imaging, if the image was sharp, the image was fixed and stored, then with the caliper of the device at the distance between the inner edge of the outer fascia and the inner fascia, the thickness of the lateral abdominal wall muscles was determined in millimeters. Imaging was repeated three times and the mean values of the three images were calculated for comparison. [18,13] It should be noted that the measurements were performed by another physiotherapist who did not know about the subgroups. Observance of ethical standards of research in this project was approved by the ethics committee in the research of Shahid Beheshti University of Medical Sciences. Descriptive statistics were used to present the values of quantitative (numerical) variables, central tendency indices, dispersion indices, and grouping of qualitative variables and calculate their absolute and relative abundance values. Due to the quantitative variables, the normal distribution based on the Shapiro-Wilk fitness test was used and repeated analysis of variance was used to evaluate the interaction between the right (right and left) and muscle position (rest and contraction) between the two groups. Pearson test was used to investigate the relationship between baseline indices and muscle thickness.

Findings:

As previously mentioned, due to the lack of several samples in the high-risk group, statistical comparisons were made only between the two groups with low and medium risk. Mean values of ultrasonic thickness of lateral abdominal wall muscles are observed in two subgroups of mild and moderate LBP based on the START questionnaire in Table 2.

Table 2: Mean values of resting thickness and contraction of lateral abdominal wall muscles in millimeters in two groups of patients with a medium to low moderate back pain

groups / muscles	low(number = 10)				medium (number =7)			
	contraction		Rest		contraction		Rest	
	left	Right	left	right	left	Right	left	right
Internal oblique muscle	9.08	9.76	7.81	8.05	11.13	10.84	8.95	9.07
External oblique muscle	5.65	6.07	5.46	5.62	6.30	6.15	5.82	5.93
Abdominal transverse muscle	4.58	5.05	2.76	3.02	5.33	5.60	3.49	3.20

There was no significant difference in the relationship between LBP and ultrasonic thickness of lateral abdominal wall muscles neither in resting thickness ($p = 0.149$, $F = 2.318$) nor the check contractile thickness ($p = 0.065$, $F = 3.965$). In the study of the relationship between group and posture (rest and contraction), in both groups, three muscles of internal inclination, transverse abdominal, and external inclination in the contraction position had a greater thickness than the resting value ($p = 0.007$, $p = 0.001$ and $p = 0.02$). In each of the examined muscles, no significant difference was observed between the thickness on the left and right sides, either in the resting position or in the contraction position ($0.05 \leq p$).

According to the Pearson test, there was no significant relationship between pain intensity with resting thickness and contraction of lateral abdominal wall muscles. Also, resting thickness and contraction of lateral abdominal wall muscles did not show a significant relationship with age and body mass index ($p \leq 1.10$).

Discussion:

This study aimed to evaluate the ultrasonic thickness of lateral abdominal wall muscles in START questionnaire subgroups. In case of observing a possible relationship, it is possible to reach a mutual understanding between the findings of a questionnaire with three biological-psychological and social components and a quantitative tool and to facilitate and accelerate the clinical decision-making process for choosing the appropriate treatment method. However, based on the findings, the mean ultrasonic thickness of the lateral abdominal wall muscles did not show a statistically significant difference between the moderate and mild subgroups. In line with the present study, Ferreira et al. In a study of 21 patients with chronic nonspecific LBP who were classified as mild to

moderate in the STarT questionnaire had no relationship between ultrasonic thicknesses of the transverse abdominal muscle. They did not observe clinical indicators such as the level of disability and subgroups of the STarT questionnaire [22]. This was while the indicators related to clinical evaluation were related to the level of disability and subgroups of the STarT questionnaire. [22] The present study of some of the findings of the Ferreira study could not show the interaction between the findings of a quantitative assessment tool, namely ultrasonography in clinical indicators and especially the factors that place people with LBP in the STarT questionnaire subgroups. The lack of correlation between ultrasonic thickness change of transverse abdominal muscle and clinical indicators such as level of disability and severe pain in patients with chronic LBP has also been shown in previous studies. [23-24].

In contrast, several studies have pointed to the logical relationship between clinical indicators and START questionnaire groups. In the study of Fritz et al., 214 patients referred to physiotherapy clinics completed the STarT questionnaire in the first session, and then the treatment was performed according to the usual routine. Finally, the researchers evaluated the treatment outcomes by various tools and suggested that the STarT questionnaire could be used as an important predictor tool in physiotherapy clinics. [25] Also, the study of Kongsted et al. On 475 patients with LBP referred to chiropractic clinics indicates that the STarT questionnaire can be used to identify and evaluate at-risk groups, especially the psychological factors involved in LBP. [26] However, a study by Toh et al. 207 patients with LBP showed that pain intensity was associated with START questionnaire subgroups. However, the authors state that out of the three bio-psychological and social components assessed by the STarT questionnaire, only changes in the psychological component are a predictor of the severity of patients' pain. [27] A study published by Medeiros et al., Which was conducted to evaluate the clinical applicability of the STarT questionnaire on 200 patients with acute LBP, showed that this questionnaire is a good predictor for clinical variables, including pain intensity. [28]

The lack of a significant relationship between the severities of the ultrasonic thickness of the lateral abdominal wall muscles in the present study is consistent with previous studies. [22] According to the bio-psycho-social perspective, it can be said that there is not much relationship between pain as a mental indicator and objective criteria such as muscle thickness. [17,22,25]

As observed in the findings section, the mean thickness of all three internal, transverse abdominal, and external oblique muscles of the abdomen was significantly different from the resting position, and the internal and transverse oblique muscles had the greatest thickness change during this maneuver. Barnett et al in comparison between abdominal flexion maneuvers and abdominal muscle strengthening movements to summon the transverse abdominal muscles and the internal inclination observed that the abdominal flexion maneuver is more effective than the supine exercise on the flexion of both muscles. [29]. Moreover, Teyhen et al. Found that of the three trunk-strengthening exercises, abdominal and quadriceps exercises, while raising the opposite arm and leg, had the greatest effect on the thickness of both transverse oblique abdominal muscles. [30] In a study by Manshadi et al., It was found that performing abdominal flexion maneuvers in both supine and standing positions increases the thickness of both the transverse abdominal muscles and the internal oblique relative to the resting position, but has no effect on the external oblique muscle thickness. [18] Ainscough et al., In the study the response of the transverse abdominal and oblique muscles to different postures of relaxation, sitting on a chair, sitting on a gymnastic ball with two legs on the ground, and sitting on two legs by lifting one leg off the ground, concluded that these two muscles become one method respond to change of state This indicates their accompaniment in different states of contraction. [31]

In the present study, no significant difference was observed between the left and right thicknesses, either at rest or in contraction. These findings are consistent with the results of previous research (10, 12). Failure to observe a significant relationship between age and ultrasonic thickness of lateral abdominal wall muscles in this study is consistent with previous studies (19,18,10,9,4) In this study, there was no observed correlation between body mass index and lateral abdominal wall muscle thickness This was probably due to the low index of the participants (less than 30 kg per square meter) The present study also had some limitations. The number of people who were placed in the severe and high-risk subgroup according to the STarT questionnaire was small, so they were not included in the final analysis. Due to the limited nature of the present study on men, it is suggested that in future studies, the relationship between the subgroups of this questionnaire be compared with other assessment methods for both sexes.

Conclusion:

Due to the lack of differences in the ultrasonic thickness of the lateral abdominal wall muscles between subgroups of patients with chronic nonspecific LBP based on the STarT questionnaire, it is better to use this questionnaire to determine the type of treatment before starting treatment, based on other

evaluation methods, especially the findings of clinical evaluations. However, due to the low number of samples in the present study, its findings should be interpreted with caution.

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References

Conflict of Interest

The authors declare no conflict of interest

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Ethics Statement

Shahid Beheshti University of Medical Sciences, Tehran, Iran

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