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Are the Lumbar Regional Muscles' Endurance, Flexibility and Abdominal Adiposis Related to Disability in Fibromyalgia Syndrome?

Fibromiyalji Sendromunda Lumbal Bölgesel Kasların Enduransı, Esnekliği ve Abdominal Adipoz Dizabilite ile İlişkili midir?

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ABSTRACT Objective: The patients who have widespread pain around the thoracic and cervical region came to the physical therapy clinic with the diagnosis of fibromyalgia syndrome complain about symptoms reappear after a period of time. This situation revealed the idea of evaluating the lumbar region as a more central segment and applying treatment to the lumbar region. The main purpose is to examine the endurance, flexibility and abdominal fat levels of lumbar muscles in women with fibromyalgia and investigate the relationship of these parameters with disability caused by fibromyalgia. **Material and Methods:** The study included 40 female patients with fibromyalgia syndrome, aged 24-45, who met the American College of Rheumotology 2010 diagnostic criteria. functional disability of patients was evaluated with Revised Fibromyalgia Impact Questionnaire (FIQR). The endurance of the lumbar region muscles was assessed by the Biering-Sorensen Test, flexibility by the sit and reach test, spinal mobility by the Modified Schober Test. With the skinfold caliper (Accu-MeasureR) abdominal region fat mass measurement, with the tape measure waist and hip circumference measurement were recorded. **Results:** There was a positive correlation between FIQR score and waist circumference (p<0.001, r=0.568), hip circumference (p<0.001, r=0.567), waist/hip ratio (p=0.018, r=0.370), skinfold measurements (p<0.001, r=0.869). On the other hand, a negative correlation between FIQR score and endurance (p<0.001, r=-0.969) and flexibility (p<0.001, r=-0.950) were viewed. **Conclusion:** Decrease in endurance and flexibility of the lumbar extensor muscle group and the increase in abdominal adipose tissue in fibromyalgia syndrome increase the severity and disability of disease.

Keywords: Adipose tissue; endurance; fibromyalgia; pliability

ÖZET Amaç: Fibromiyalji sendromu tanısı ile torasik ve servikal bölgede yaygın ağrıları olup fizik tedavi kliniğine gelen hastalar, tedavi sonrası semptomların tekrar ortaya çıkmasından şikâyet ederler. Bu durum, lomber bölgenin daha merkezî bir segment olarak değerlendirilmesi ve bel bölgesine tedavi uygulanması fikrini ortaya çıkardı. Fibromiyaljili kadınlarda bel kaslarının dayanıklılık, esneklik ve karın yağ düzeylerini incelemek ve bu parametrelerin fibromiyaljiye bağlı sakatlıkla ilişkisini araştırmak temel amaçtır. **Gereç ve Yöntemler:** Çalışmaya, Amerikan Romatoloji Cemiyeti 2010 tanı kriterlerini karşılayan, 24-45 yaş arası fibromiyalji tanısı almış 40 kadın hasta dâhil edildi. Hastaların fonksiyonel güçsüzlüğü, Revize Fibromiyalji Etki Anketi (RFEA) ile değerlendirildi. Lumbal bölge kaslarının dayanıklılığı Biering-Sorensen Testi, esneklik Otur ve Uzan Testi, spinal hareketlilik ise Modifiye Schober Testi ile değerlendirildi. Deri kıvrımı kaliperi (Accu-MeasureR) ile karın bölgesi yağ kütlesi ölçümü, mezura ile bel ve kalça çevresi ölçümü kaydedildi. **Bulgular:** Bel çevresi (p<0,001 r=0,568), kalça çevresi (p<0,001, r=0,567), bel / kalça oranı (p=0,018, r=0,370), deri kıvrım ölçümleri (p<0,001, r=0,869) arasında RFEA skoru ile pozitif korelasyon bulundu. Öte yandan, RFEA skoru ile dayanıklılık (p<0,001, r=-0,969) ve esneklik (p<0,001, r=-0,950) arasında negatif korelasyon görüldü. **Sonuç:** Fibromiyalji sendromunda, lumbal ekstansör kas grubunun dayanıklılık ve esnekliğinin azalması ve abdominal yağ dokusunun artması, hastalığın şiddetini ve güçsüzlük oranını artırmaktadır.

Anahtar Kelimeler: Yağ doku; dayanıklılık; fibromiyalji; esneklik

Fibromyalgia syndrome (FMS) is a versatile and chronic disease of unknown etiology. Clinical symptoms of the disease often disrupt the autonomy, function and independence of patients with FMS. One of the main complain of patients with FMS is widespread musculoskeletal pain which is bilateral and in-

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volves both upper and lower parts of the body. The pain may be localized commonly in the neck and back.[1]

The patients who have widespread pain around the thoracic and cervical region came to the physical therapy clinic with the diagnosis of FMS complain about symptoms reappear after a period of time. This situation revealed the idea of evaluating the lumbar region as a more central segment and applying treatment to the lumbar region.[2] If this situation repeats at regular intervals and becomes permanent, causes symptoms such as pain and functional disability in patients, having difficulty maintaining their daily work and decreasing their quality of life.[3] Waist is one of the most important reasons for the restriction of daily activities in patients diagnosed with FMS may be to experience more fatigue by reducing extra effort, that is, to decrease endurance.[4] It supports that in microscopic studies on the muscle structures of patients with FMS had a micro rupture in muscle fibrils, Type 2 muscle fiber atrophy and a 15% reduction in cell metabolism in ATP and phosphocreatinine production. This suggests that the aerobic endurance capacity has decreased.[5] At the same time, reduction in normal range of motion and shortening the length of muscle groups in these patients may cause functional limitation in daily life activities.[6] In the study conducted with female patients with FMS, when flexibility was measured in the lumbar extensor muscle group and hamstring muscles, a significant shortage of proportions appeared in healthy individuals and an increase in quality of life and a decrease in pain were observed when flexibility and stretching exercises were given to the group diagnosed with FMS.[7] The symptoms that occur in individuals with FMS limit the physical activity level of the patients, causing to experience weight gain at the same time.[8]

Although there are many studies on FMS, this study may guide clinicians to evaluate and include a more central segment in the treatment program.[9] The aim of this study is to investigate the endurance, flexibility and abdominal adipose levels of lumbar muscles of patients diagnosed with FMS and to investigate the relationship between these parameters and disability. As a hypothesis of the study, it was thought that the disability, which develops in women diagnosed with FMS will be related to the endurance, flexibility and abdominal adipose of the lumbar muscles.

MATERIAL AND METHODS

The results of physical and anthropometric measurements in female patients diagnosed with fibromyalgia have been investigated how affect the disability score by statistically analysis.

SETTING

The individuals participating in the study were informed about the test and a 'Consent form' was received from each participant. İstanbul Okan University Clinical Research Ethics Committee approval was obtained (13/09/2019/Decision No:7). The study was carried out in accordance with the rules of the Helsinki Declaration on patients diagnosed with FMS who came to Samsun VM Medicalpark Hospital Physical Therapy and Rehabilitation Outpatient Clinic. This patient group was diagnosed with FMS by Assoc. Prof. Elif Berber Menekşe and was recommended for the study. Patients with diagnosed with FMS was evaluated by physiotherapist in physical therapy unit. The written informed consent form was signed by all patients before the study, which was conducted according to the ethics guidelines and principles of the Declaration of Helsinki.

PARTICIPATIONS

Female patients between 24-45 years of age who were diagnosed with fibromyalgia according to American College Rheumotology (ACR) 2010 criteria were included in the study. A total of 55 patients were contacted between June 2019 and December 2019. Fifteen patients did not meet the inclusion criteria. Fourty patients were included in the study. Exclusion criteria are; presence of infection and fever, severe physical disability, other rheumatological diseases, neurological diseases, any problems related to the musculoskeletal system (such as fracture, deformity, sprain), pregnancy, malignancy, severe psychiatric diseases, or any exercise program in the last six months was to participate in a sportive activity.

STUDY DESIGN

Demographic information, background, family history, height and weight of the participants were

recorded. Revised Fibromyalgia Impact Questionnaire (FIQR) was applied to evaluate the disability of patients. Lumbar region muscle endurance was evaluated with Biering-Sorensen Test, flexibility with sit and reach test, spinal mobility with Modified Schober Test. Anthropometric measurements were made to determine the subcutaneous fat thickness of the lumbar region and to determine intraabdominal adipose. In these measurements; abdominal subcutaneous fat thickness was measured with skinfold caliper and waist and hip circumference were measured and recorded.[10]

DATA SOURCE/MEASUREMENTS

The Revised Fibromyalgia Impact Questionnaire

FIQR consists of three parts: function, general and symptoms. It is a questionnaire evaluating the limitations and functional disability in patients with fibromyalgia with a total of 21 questions. All questions were evaluated with a numerical scale between 0-10. As the score obtained from the survey increases, it shows that the disability of fibromyalgia increases. The Turkish version of the questionnaire, whose validity and reliability study was performed, was used in the study. The survey was revised by Ediz et al. which was published in 2010.[11] According to the FIQR score, the participants were divided into two groups. While the average FMS patient scores 50, the more severe affected FM patients usually score above 70.[12]

Biering- Sorensen Test

It is a test performed in the axis of isometric trunk extension, which is used to measure the lumbar endurance. This test was used for the endurance measurement of longissimus thoracis, iliocostalis lumborum and partially multifidus muscles. The patient was laid face down on the bed to be tested. From the anterior superior point of the spina iliaka, the upper body was prevented from contacting the bed. The length of the upper body in seconds, with the arms on the side, was recorded. The patient was held for a maximum of 240 seconds.[13]

Modified Schober Test

It is a test that measures spinal mobility in the lumbar region with flexion and extension movements. The patient was first placed in a sitting position and both spina iliaca posterior superior points were marked and a linear line was drawn between these two points. A second line was drawn 5 cm below this line and a third line 10 cm above. Afterwards, the patient was asked to lean forward and touch the toes, and again a measurement was made between the bottom line and the top line. If an increase of less than 5 cm is observed, the loss of flexibility, shortening or joint range of motion in the lumbar region was recorded as a sign. When the patient was tilted back (extension), the distance between the two top and bottom lines was recorded.[14]

Sit and Reach Test

It is a test to measure the flexibility of lumbar extensors, Hamstring muscle group and gastro-soleus muscle group. Since the flexibility of the isolated extensor waist muscles could not be measured in this test, patients with a visible shortness or limitation of the knee joint in the hamstring and gastro-soleus muscle groups were not included in this test. With the help of the sit and reach table, the person stretched out his feet in full contact with the box, and lay his hands on top of each other, with his palms facing the ground. The best result was recorded when he lay forward 2 times.[15]

Anthropometric Measurements

Skinfold caliper measurement

To determine the subcutaneous fat thickness of the waist region, a measurement was made with a skinfold caliper from the suprailiac region. With the skinfold caliper (Accu-Measure^{R}), a 45-degree diagonal measurement was made from the point of the line lowered down the anterior axillary line on the crystal iliac.[16] All measurements were taken on the right side of the person. The value seen in the caliper was recorded.

Waist and hip circumference measurement

Waist circumference was measured to determine the intraabdominal fat around the waist. With a garment where the tape measure can be easily applied, the arms were applied on the sides, feet were adjacent and the abdomen was in a loose position. Care was

taken that an inelastic tape measure is parallel to the ground on both sides and the tissue is not tightened. The measurement was made from the narrowest region between the subcostal region and crista iliac.[17]

In hip circumference measurement, individuals were positioned as in waist circumference measurement. The measurement was taken from the widest part of the hip.

Waist/Hip ratio

Waist to hip ratio was obtained by proportioning waist and hip circumference measurements to each other in centimeters.

All measurements were made by the same physiotherapist at the same time and in the same environment.

STUDY SIZE

Number of individuals to be included in the study according to the results of the power analysis, the standard deviation was accepted as 0.5, and 95% confidence interval and 40% for 80% power was made with G-Power program. The number of samples was determined as 40. Patients who met the ACR 2010 diagnostic criteria and participated in the study on a voluntary basis equals to 55. Fifteen patients did not meet the inclusion criteria due to their medical history. A total of 40 patients who met the study criteria were included in the study.

STATISTICAL ANALYSIS

GraphPad Prism v7.0 program was used for statistical analysis. The suitability of variables to normal distribution was examined using visual (histogram and probability graphs) and analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk tests). Descriptive analyzes were given as mean and standard deviation for normally distributed variables. Comparison of the values of the groups was done with independent sample t-test. After regression analysis between dependent variable and independent variables, multivariate regression analysis was performed to see which independent variable affects FIQR score most.

RESULTS

Demographic characteristics of the participants are shown in Table 1.

In our study, between waist circumference ($p<0.001$, $r=0.568$), hip circumference ($p<0.001$, $r=0.567$), waist/hip ratio ($p=0.018$, $r=0.370$), skinfold measurements ($p<0.001$, $r=0.869$) had positive correlation with FIQR score. On the other hand, negative correlation between FIQR score and endurance ($p<0.001$, $r= -0.969$) and flexibility ($p<0.001$, $r =-0.950$) were viewed (Table 2).

As a result of multiple regression analysis, Biering-Sorenson Endurance score ($p<0.001$) and Modified Schober test ($p<0.001$) were found to be more effective on FIQR score (Table 3). When the beta values of these two parameters were compared, it was found that the Biering-Sorensen Endurance score (Beta= -0.560) had the most negative effect on FIQR score compared to the Modified Schober Test (Beta= -0.416) (Table 3).

When two groups with an FIQR score below 70 and above 70 were examined, a statistically significant difference was found between endurance, sit and reach test, Modified Schober Test, waist circumference, hip circumference and skinfold measurements (Table 4).

TABLE 1: Demographic features of patients.

Variable	n	Minimum	Maximum	Mean	SD
Age (year)	40	24	45	35.02	6.77
Height (cm)	40	152	170	161.90	4.27
Weight (kg)	40	56	91	72.70	7.78
Waist circumference (cm)	40	70	125	100.65	15.05
Hip circumference (cm)	40	95	140	115.68	12.49
Abdominal adipose fold thickness (mm)	40	12	52	35.23	10.10

SD: Standard deviation.

TABLE 2: Relationship between the participants' revised fibromyalgia impact questionnaire score and their independent variables.

Variable		FIQR score
Waist circumference (cm)	p value	**<0.001****
	r value	0.568
Hip circumference (cm)	p value	**<0.001****
	r value	0.567
Waist/hip ratio	p value	**0.018***
	r value	0.371
Abdominal adipose fold thickness (mm)	p value	**<0.001****
	r value	0.869
Biering-Sorensen test score (sn)	p value	**<0.001****
	r value	-0.969
Sit and reach test (cm)	p value	**<0.001****
	r value	-0.937
Modified Schober test (cm)	p value	**<0.001****
	r value	-0.950

FIQR: Revised Fibromyalgia Impact Questionnaire; **p<0.001; *p<0.05; n=40;
r; Pearson correlation coefficient.

DISCUSSION

As a result of the study, it has been observed that the decrease in the endurance, flexibility and spinal mobility of the lumbar region muscles causes an increase in disability. As waist circumference, hip circumference and abdominal adipose tissue increased, patients' limitation and disability also increased.

In our study, as the FIQR score increased, the endurance of the patients' lumbar region muscles decreased. Similar to Maldonado et al., it was revealed that as the FIQR score increases, aerobic capacity, muscle strength, endurance, motor skill and flexibility test scores decrease.[18] Redondo et al. showed that in a long-term study, exercises given to improve muscle endurance and cardiovascular fitness results with a decrease in pain and fibromyalgia index questionnaire score in patients with diagnosed FMS.[19] Patients with FMS can be evaluated in terms of endurance, and by adding endurance-enhancing exercises to the treatment program, the disability of patients can be reduced. Meiworm et al. reported that they observed a decrease in painful trigger points and diffuse musculoskeletal pain by applying an endurance exercise program to patients diagnosed with FMS.[20] In recent studies, it was concluded that endurance-enhancing exercises positively affect patients' general pain and fatigue symptoms.[21,22]

Rubio et al. showed impairment in postural control and thoracic posture, loss of flexibility, decrease in spinal mobility and the presence of functional disability in patients with FMS.[23] In another study, we investigated the relationship between physical competence parameters (flexibility, strength, endurance, speed and aerobic capacity) and quality of life, and

TABLE 3: Multivariate regression analysis of independent variables with revised fibromyalgia impact questionnaire dependent variable.

Model	R	R^2	Adjusted R^2	Standard error of estimated
	0.988[a]	0.977	0.972	2.139
Anova	Sum of squares	Df	F	Sig.
Regression	6,250.911	7	195.083	**<0.001[b]**
Residual	146.479	32		
	6,397.390	39		
Dependent variable	İndependent variables	Beta	T	Sig.
The revised fibromyalgia impact questionnaire	Biering-Sorensen test (sec)	-0.560	-5.501	**<0.001***
	Sit and reach test (cm)	0.300	0.308	0.760
	Modified Schober test (cm)	-0.416	-5.719	**<0.001***
	Waist circumference (cm)	1.497	1.894	0.067
	Hip circumference (cm)	-1.114	-1.901	0.066
	Waist/hip ratio	-0.591	-1.898	0.067
	Abdominal adipose fold thickness (mm)	0.078	1.150	0.259

The symbol marked with *indicates statistical significance based on the t-test result (p<0.001).
[a]: Dependent variable-FIQR score; [b]: Independent variables-endurance, sit-access test, Modified Schober test, waist circumference, hip circumference, waist/hip ratio, skinfold.

TABLE 4: Comparison of the values of patients with Revised Fibromyalgia Impact Questionnaire score below 70 and above 70.

Independent variables	FIQR score<70 $\bar{X}$±SD	FIQR score>70 $\bar{X}$±SD	p value
Endurance (sec)	17.15±6.05	11.52±3.95	**<0.001****
Sit and reach test (cm)	11.69±7.35	-17.63±6.55	**<0.001****
Modified Schober test (cm)	6.29±0.82	3.60±1.02	**<0.001****
Waist circumference (cm)	91.85±11.44	104.89±15.38	**0.010***
Hip circumference (cm)	108.54±8.40	119.11±13.46	**0.014***
Waist/hip ratio	0.84±0.05	0.88±0.05	0.079
Abdominal adipose fold thickness (mm)	25.46±7.04	39.93±8.17	**<0.001****

Significance test of the average difference between independent groups (t-test); FIQR: Revised fibromyalgia impact questionnaire; **: p<0.001; X: Mean; SD: Standard deviation. The symbol marked with *indicates statistical significance based on the t-test result *(p<0.05).

there was a significant relationship between flexibility score and pain severity, cognitive disorders, physical well-being and participation in social life.[24] In our study, muscle length shortening in the lumbar extensor muscle group and spinal mobility decreased in the majority of patients. The inverse relationship between spinal mobility and disability was also observed. Patients who participated in our study may have restricted daily life activities due to disability because of shortening muscle length and decreased spinal mobility in the lumbar extensor muscle group. Therefore, inclusion of flexibility exercises in the treatment program in patients diagnosed with FMS may decrease the severity of disability. In a study, a decrease in pain and disability of patients participating in the pilates exercise program with flexibility and stabilization was observed.[25] In other studies including flexibility exercises, disability was reported to decrease.[26]

Another parameter that we think is related to disability is the increase in abdominal adipose and an increase in the disability of patients. Okifuji et al. showed that a statistically significant relationship was found between the waist/hip ratio and the quality of pain, sleep quality and daily life activities.[27] In our study, the quality of daily life activity was not considered, but the disability of patients may also affect the quality of life of individuals. Correa-Rodríguez et al. showed that to investigate the relationship between FMS and obesity, it was observed that among women diagnosed with FMS, body mass index, fat mass percentage, total fat mass and visceral fat rate increased, daily activity level and sleep quality decreased, fatigue scale increased. They also reported that an increase in adipose tissue caused a higher FIQ score.[28] In another study, the relationship between total body fat ratio and body fat ratio and pain, fatigue and disability was tried to be revealed, a significant relationship was found between pain and fatigue parameters and both total body fat ratio and body fat ratio, disability and a significant ratio of body fat was found.[29] Similarly, in our study, the relationship between waist circumference, hip circumference and waist/hip ratio and anthropometric measurements such as skinfold and disability were examined, and according to the result, FIQR score increased as adipose tissue measurement increased, thus disability increased.

CONCLUSION

As a result of our study, it was observed that disability was related to endurance, flexibility and abdominal adipose tissue of lumbar muscles. It has been concluded that the reduction of endurance is more effective than other parameters in the formation of disability.

When planning treatment in FMS, the strength, durability and flexibility of the lumbar extensor muscle group should not be ignored and antagonist muscle group, the abdominal flexor and rotator muscle group, should be included in the treatment program. The treatment program to be applied to this region is important in terms of suppressing the symptoms, helping to reduce the patient's disability and stay away from daily life activities.

LIMITATIONS

Our study had the only limitation is to include only female patients in the study.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Alper Perçin;* ***Design:*** *Alper Perçin;* ***Control/Supervision:*** *Emine Atıcı;* ***Data Collection and/or Processing:*** *Alper Perçin;* ***Analysis and/or Interpretation:*** *Alper Perçin;* ***Literature Review:*** *Alper Perçin;* ***Writing the Article:*** *Alper Perçin;* ***Critical Review:*** *Emine Atıcı;* ***References and Fundings:*** *Alper Perçin;* ***Materials:*** *Alper Perçin.*

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